From Tragedy to Triumph—Rebuilding with Renewable Energy after Disaster

Renewable energy is generated from sources that are "green" and naturally replenished such as sunlight, wind, and geothermal heat. This energy can power, heat, and cool buildings, and can replace traditional sources of fuel (e.g., coal and natural gas) used by utilities. Most utilities are using wind power, but other types are coming to the forefront. Every day, more individuals, businesses, and communities decide to "go green" with renewable energy.

Pat Corkery / PIX15442

The Science & Technology Facility at the National Renewable Energy Laboratory in Golden, Colorado, incorporates a number of advanced energy efficiency and green building concepts. For example, the architecture makes good use of natural light wherever possible, and an automated system dims unnecessary artificial lighting to reduce electricity use.

Renewable Energy Benefits

- Generates electricity from the sun or wind
- Heats and cools quietly and naturally
- Grants tax credits to building owners
- Offers protection against rising utility bills
- Supplies reliable power after natural disasters
- Protects the environment.

Energy Efficiency First

Lower energy demand means renewable energy systems can be smaller and less expensive. Consider these basic energy efficiency strategies:

- Use efficient insulation for foundations, walls, and roofs
- Look for ENERGY STAR® doors and windows and double-paned windows with "low-e" glazing
- Seal openings and cracks to reduce cooling and heating costs

Rebuilding a community, a business, or a home after a natural disaster such as a flood, hurricane, or tornado can be daunting. Tragedy can be turned into opportunity by rebuilding with renewable energy and creating healthier and more energy-efficient communities.

- Choose high-efficiency heating, cooling, and air-conditioning (HVAC) equipment
- Use daylighting (natural light), compact fluorescent lights (CFLs), and ENERGY STAR® appliances and office equipment to reduce electricity use.

Types of Renewable Energy

Solar

Solar power technologies take advantage of a large, clean, free renewable energy source—the sun. Solar technologies are scalable—they're suitable for very small to very large applications. There are several types of solar technologies:

Solar photovoltaics (PV) convert sunlight directly to electricity and can be installed on individual rooftops or as large "fields" of solar arrays by a utility company.

Concentrating solar power (CSP) systems concentrate the sun's heat to drive a generator that produces electricity. Most CSP systems are installed by utility companies and may consist of a field of dishes, engines, parabolic troughs, or central power towers.

Solar heating technologies use collectors that absorb the sun's heat for water or space heating.

Solar lighting technologies include "clerestory" windows, skylights, and solar tubes that bring sunlight into a building where light is most needed.

Passive solar heating and daylighting strategies are integrated into designs so buildings work with the sun to operate more efficiently.

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Rebuilding Green in Greensburg

After a tornado devastated their town in May 2007, the citizens of Greensburg, Kansas, turned disaster into opportunity by rebuilding as a model "green" community. Their master plan includes goals for making residential and commercial buildings more energy efficient and developing community- and small-scale renewable energy projects.

Lynn Billman, NREL/PIX 16651

The John Deere dealership in Greensburg, Kansas, owned by BTI Equipment, uses two wind turbines to produce electricity for the building and burns waste oil for heating.

Lynn Billman, NREL/PIX 16650

The Kiowa County Courthouse in Greensburg has a geothermal heating and cooling system that uses an energy efficient ground-source heat pump to circulate air that's naturally warmed and cooled in 32 deep underground wells. This is an excellent example of green historical restoration.

Lynn Billman, NREL/PIX 16652

Greensburg's new SunChips Business Incubator building offers affordable office space for small start-up businesses. Among other green features, the solar PV panels on the roof capture the sun's energy and convert it to electricity, meeting approximately 10% of the building's total energy needs.

Community-Scale Renewable Energy Projects

The City of Greensburg, which doubles as a municipal utility, is developing large-scale renewable energy resources. One project is the Greensburg Wind Farm, a joint effort of the City of Greensburg, the Kansas Power Pool, and John Deere Renewable Energy, that will consist of ten 1.25-MW wind turbines. The wind farm is expected to be operational in 2010 and will generate enough energy to power every home, business, and municipal facility in Greensburg. Excess electricity will be sold back to the local utility.

Financing for the project was supported by Native Energy Inc., which will be the exclusive marketer of Renewable Energy Certificates (RECs) from the wind farm. RECs, also called green tags, green certificates, or tradable renewable certificates, capture the environmental attributes—typically in terms of avoided emissions—of the power produced from renewable energy. They are sold separately from the electricity that runs through the grid. Usually, 1 REC represents proof that 1 megawatt-hour of electricity has been generated from an eligible renewable energy resource. Native Energy will purchase about two-thirds of the wind farm's expected RECs over 20 years.

The city is also working with surrounding counties to explore options for using agricultural wastes to produce energy.

Small-Scale Renewable Energy Projects

Greensburg completed a study outlining the opportunities for solar PV to generate electricity on individual homes and businesses. The city also has adopted an interconnection agreement and net-metering policy that will give home and business owners credit from the local utility for excess power produced by their systems. In such distributed systems, buildings both receive and send electricity to the grid through an interconnection agreement.

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U.S. Environmental Protection Agency / PIX14837

At the EPA's Robert S. Kerr Environmental Research Center in Ada, Oklahoma, a retrofit to upgrade the building's mechanical system and incorporate renewable energy reduced the lab's annual energy consumption by 45%. The retrofit implemented a geothermal ground-source heat pump among other energy efficient systems. Because of these upgrades and "green tag" purchases from wind power, the Ada Lab became EPA's first zero emissions facility.

And net-metering policies allow the owner of a distributed system to get the most value for the electricity sent back to the grid.

Contact Information

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To see case studies about Greensburg buildings, visit:
http://greensburg.buildinggreen.com

Wind

In certain areas, the wind is another resource for producing renewable energy. Wind turbines convert the wind's kinetic energy into mechanical power, which is sent to a generator that converts the mechanical power into electricity. Wind energy can also be used for specific needs such as pumping water.

Single small turbines, rated in the 5–50 kilowatt (kW) range, can power homes, ranches, or remote buildings (zoning restrictions may apply, so check with your local zoning authority).

Turbines in the 5–100-kW range may benefit commercial buildings in appropriate locations.

Utility-scale turbines from 100 kW to several megawatts (MW) are grouped together into wind farms, often 100 MW or more in total capacity, which supply power to the electrical grid in bulk.

Geothermal

Geothermal energy is heat that resides deep within the rock and fluid of the earth's crust. This energy can be harnessed to produce electricity or direct heat, or for heating and cooling buildings.

Electrical power plants use steam from geothermal reservoirs to rotate turbines that activate generators for producing electricity.

Small-scale geothermal power plants—under 5 MW— have the potential for widespread community application where geothermal resources are abundant, possibly as "distributed energy" resources (a variety of small, modular, power-generating technologies that can be combined to improve the operation of the electrical grid).

Ground-source heat pumps typically comprise a ground heat exchanger (a system of pipes called a loop, which is buried in the shallow ground near the building), a heat pump unit, and a series of ducts through which air is delivered. A fluid—usually water or a mixture of antifreeze and water—circulates through the pipes to absorb or relinquish heat. In the winter, the heat pump removes heat from the exchanger and pumps it through the ducts. The process is reversed in the summer, when the pump moves heat from the indoor air into the heat exchanger.

Biomass

When most people think of using biomass, ethanol from corn and biodiesel from soybean oil spring to mind. Other types of biomass have the potential to contribute to our energy mix as well. Dedicated energy crops such as fast-growing trees and grasses can be grown sustainably on land that is unsuitable for food crops. Forestry or agricultural residues, such as wheat straw and the stalks, leaves, and husks of the corn plant, called "stover," are all biomass. Even the organic components of municipal and industrial wastes are usable for energy production.

Biomass is used to make **liquid fuels for transportation**, as in the cases of ethanol and biodiesel.

Most of us are familiar with **consuming biomass to generate heat**. Firewood and other biomass such as corn cobs can be burned to heat buildings. Biomass can also be "pelletized" to burn more cleanly and efficiently than firewood in heating stoves.

Utilities and major industries **consume biomass directly or convert it to a gaseous fuel to generate electricity**. Many coal-fired power plants today add biomass to their coal-burning process. This practice, called co-firing, reduces emissions while producing electricity. And industries such as pulp and paper and forest products often use biomass to co-generate heat and electricity.

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Some of these uses for biomass have been commercialized for a long time; other uses are in development and are not yet commercial. For example, the first pilot-scale ethanol plants that use biomass other than corn are just being constructed.

Financing Renewable Energy

Financial Incentives

Numerous financial incentives, such as federal and state tax credits and utility rebates, are available to help offset the cost of a renewable energy system. Many utility companies also offer net metering for grid-connected renewable energy systems, so consumers can get credit for power they produce but don't need. And the *American Recovery and Reinvestment Act*, signed into law on February 17, 2009, contains provisions that will financially benefit individuals, businesses, organizations, and the renewable energy industry as a whole.

For more information about financial incentives, visit the Database of State Incentives for Renewables and Efficiency at *www.dsireusa.org*.

Power Purchase Agreements

A power purchase agreement (PPA) is a financing mechanism created to help businesses, industrial concerns, schools and universities, and all levels of government go green with no up-front capital cost. Through these long-term contracts (about 15 years or more) a renewable energy company (PPA partner) finances, owns, and maintains the renewable energy system. The buyer agrees to purchase the electricity generated by the system from the PPA partner, which has assumed all the risks and responsibilities of ownership. At the end of the PPA term, the buyer can choose to purchase the system or extend the agreement. A PPA with predetermined electricity rates over the term of the contract helps to stabilize operating costs that were once highly variable.

Energy Efficiency and Renewable Energy Resources

Energy Savers

Basic information about energy efficiency and renewable energy from the U.S. Department of Energy (DOE)

www.energysavers.gov

ENERGY STAR®

This program of DOE and the U.S. Environmental Protection Agency (EPA) has information about energy efficiency for home and business owners as well as commercial and industrial building energy managers and operators

http://www.energystar.gov/

Own Your Power! A Consumer Guide to Solar Electricity for the Home

Information about solar energy systems, financial incentives, and warranties and insurance along with tips for success

www.nrel.gov/docs/fy09osti/43844.pdf

A Homebuilder's Guide to Going Solar

This guide helps builders assess the benefits of installing solar equipment or making houses "solar ready" to both their businesses and customers

www.solar.energy.gov/pdfs/44792.pdf

Small Wind Electric Systems: A U.S. Consumer's Guide

A consumer's guide containing information about small wind energy systems for rural areas, including maintenance and zoning issues

www.windpoweringamerica.gov/pdfs/small_wind/small_wind_guide.pdf

Geoexchange

A Web site from the Geothermal Heat Pump Consortium that presents information about geothermal heating and cooling

www.geoexchange.org

Exploring Ways to Use Biomass Energy

A DOE Web site that explains the different ways to use biomass

www.energysavers.gov/renewable_energy/biomass/index.cfm/mytopic=50001

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EERE Information Center
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This document is one in a series of documents outlining the options for and benefits of rebuilding green after a disaster. The series draws on lessons learned by teams from the U.S. Department of Energy and its National Renewable Energy Laboratory as they helped the townspeople of Greensburg, Kansas, rebuild green after a devastating tornado. To see the other documents in this series, visit www.buildings.energy.gov/greensburg/.

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