Green Government

An initiative of the National Association of Counties

Solar Energy for County Facilities

Introduction

Solar power involves the use of the sun's energy to provide electricity, heat, or light. This energy can be harnessed for use in both large- and small-scale projects, from a home to a commercial building. According to the NACo County Green Programs Survey, which was sent to counties nationwide in June 2008, 14% of the 147 respondents generate renewable energy. Of this renewable energy, 40% is solar power.

Sunlight is made of photons, which contain energy. Several technologies have emerged to harness this energy including concentrating solar power, photovoltaics, solar heating and solar lighting, all of which will be explained in this fact sheet.

Costs and Benefits

The sun shines daily, serving as a constant free fuel. The U.S. Department of Energy (DOE) reports that even on extremely overcast days, solar energy systems can still produce 25% of maximum output, and this number increases to as much as 80% on days that are only partially cloudy. Due to this abundantly available fuel, solar power can be a cost-effective choice. Note: Regional differences (particularly weather patterns) may make another source of energy more cost effective.

Many regional utilities offer credit on energy bills for providing the utility with excess electricity from the customer's solar or other alternative energy electricity system. This "net energy metering" can lead to significant bill reductions for customers with this technology.

Environmentally, the use of solar energy benefits both land and air quality. Solar power does not create greenhouse gas emissions, nor does it release other toxins into the air. It also replaces the use of fossil fuels with a renewable resource.

Concentrating Solar Power Systems

By using mirrors or lenses to concentrate the rays of the sun, solar thermal systems can produce temperatures as high as 750 degrees Fahrenheit. DOE reports that this intense heat can produce anywhere from 10 kilowatts to 100 megawatts of electricity. Solar concentrators come in three main designs: parabolic troughs, power towers, and dish engine systems. Arrays of lenses are also occasionally used.

The parabolic trough uses a curved collector to reflect light onto a pipe running along the inside of the curved surface. This raises the temperature of a heat transfer fluid in the pipe, which then is used to run a steam generator. Often, these troughs will be combined to create a collector field, which is generally aligned on a north-south axis, in order to optimize the sun as it travels across the sky.

According to the Union of Concerned Scientists, a nonprofit organization working for a healthy world, there are currently nine solar electric generating stations in California's Mojave Desert, built from 1985 to 1991.

Power towers concentrate sunlight from a very large area on a receiver at the top of a tower. The sunlight is reflected by heliostats, large sun-tracking mirrors that all point the sunlight at the tower. Inside the tower the receiver contains a heat-transfer fluid which then generates steam power to drive turbines, producing electricity.

A dish engine system is essentially an electric generator that runs on sunlight. A dish made of glass mirrors collects direct rays of light from the sun and concentrates these rays in a receiver. The receiver converts it to heat and then transfers it to the engine, which uses it to produce electricity. This is essentially an electric generator that runs on sunlight.

Some concentrating solar systems are combined with thermal storage capacities to operate during nighttime. Others are combined with natural gas powered generators, so that power can be produced on demand if needed. In both cases, the reason is to ensure power can be produced on demand even if the sun is not shining.

Concentrating solar power systems may also use special photovoltaic cells (see the section on Photovoltaic Systems below) designed for the intense light from the concentrator. However, these types of collectors are mostly under development and not commercially available.

Boulder County, Colorado is working to identify potential sites for concentrating solar power plants, as well as finding partners to support and demonstrate these projects. The county has created a map with possible areas for these plants. The county is also encouraging a company with plants in the county, Frito Lay, to build 50 acres of solar concentrators to provide renewable fuel. This plan would reduce the plant's electricity consumption by 90% and the use of natural gas by 80%. For more information, see the Boulder County sustainability website, located at *www.bouldercounty.org/sustain/*.

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Photovoltaic Systems

Photovoltaic systems convert solar energy into electricity. The use of these systems in the U.S. is rapidly increasing. Solar Industry Magazine reports that the number of new systems in the U.S. approached 13,000 in 2007, up 24% from the previous year, bringing the cumulative number to over 48,000 locations. Methods of collecting and storing solar energy vary depending on the intended uses.

Most commercial photovoltaic "cells" (also called solar cells), are made of silicon, which is a semiconductor, allowing it to absorb some sunlight and convert it into electricity. The silicon in a solar cell is very specially formulated and manufactured so that it will allow energy to move through it, producing electricity.

Sunlight is made of photons, which contain energy. When these photons hit the photovoltaic cell, some are absorbed, and the energy from the photon is transferred to an electron in an atom in the cell. The electron uses this energy to move around freely, becoming part of the electric current. A metal backing and a grid of wires on the front collects the electricity and connects it to the power system. The photovoltaic cell is also covered with an anti-reflective coating to prevent loss of photons. Finally, a glass cover plate covers the cell to protect it from the elements.

Of course, the sun does not constantly shine in one place. One solution for this is to install deep-cycle batteries to store energy for nighttime. These batteries are charged during the day, and are able to discharge a current for a long period of time over the night or cloudy periods when more electricity is needed. Typically, however, batteries are an expensive and high-maintenance option, so are rarely used for solar electric systems except in remote locations where no utility power is available.

A more common solution is to connect the photovoltaic system to the utility power grid with equipment that outputs utility-compatible power, while protecting both the utility and photovoltaic systems in case of problems on either side. When the sun does not produce sufficient energy for the facility, electricity can come from a local power company. In addition, with the company's approval, the facility may also be able to sell excess power generated by the solar cells to the power company.

The typical amount of time that it takes for a photovoltaic system to generate the same amount of energy that it took to create the system is about 2 to 5 years. A well-designed, well-cared-for system can last for 20 or more years, creating a net energy gain.

According to the Florida Solar Energy Center, the state's energy research institute, non-tracking solar arrays (that do not follow the sun's path) located in the Northern Hemisphere should face south in order to best collect sunlight. Additionally, they should be inclined at an angle equal to 90% of their location's latitude, so as to receive as much energy as possible year-round. They should be placed away from shade. If even one of the cells in the panel is shaded, the production of power can be reduced by more than 50%. Furthermore, the panels should be designed to account for the time of year with the worst weather, so as to ensure that enough electricity can be produced year-round.

County Case Study:

Washtenaw County, Michigan
Population: 341,847
County Seat: Ann Arbor

Washtenaw County, Michigan has a photovoltaic and solar hot water heating system in two county facilities. The 10 kilowatt photovoltaic system, installed at the Washtenaw County Western Service Center, generates enough power for 3% to 5% of the facility's energy needs, saving the county $1,000 to $1,500 annually and reducing carbon dioxide emissions by 16,000 to 24,000 pounds. It was funded by a grant from the Energy Office of the State of Michigan.

The solar water heating system was installed in the county's youth center, home to 30 people. Hot water at the facility is used for 30 showers daily, laundry, and in the kitchen. The system consists of a flat-plate solar collector and a storage tank. It allows the facility to save $500 and 400 cubic feet of natural gas each year, as well as to reduce carbon dioxide emissions by 5,000 annually.

The county also educates the community about solar power. The Washtenaw County Western Service Center features a display with information about the county's solar power use, as well as a computer with real time data about energy production and the money that using solar power is saving the county.

In May 2004, Butte County, California commissioned Sun Power & Geothermal Energy in collaboration with Sharp Electronics Corporation, Pacific Gas & Electric, and the California Energy Commission, to install a solar energy system that would double the solar energy already produced in the county. Installation was completed in September 2004, with a total project cost of just over $8.4 million.

The system is comprised of four separate solar arrays, providing all power for three

county government buildings and producing approximately one peak megawatt of power. When commissioned, it was the fifth largest such system in the U.S. and the seventeenth largest in the world. Monitoring kiosks were placed in public locations for real-time viewing of solar energy production information.

Working together with Kennecott Land, Rocky Mountain Power, the Salt Lake City Corporation, and Utah Clean Energy, Salt Lake County, Utah is developing a plan to facilitate the installation of at least 10 megawatts of photovoltaic systems before 2015. These partners are identifying barriers to the use of solar energy, creating a comprehensive plan, and partnering with land developers to install solar energy in new housing developments.

Cook County, Illinois commissioned the Spire Corporation to design and build a photovoltaic array for the county's Domestic Violence Courthouse. The system produces 129,640 kilowatt-hours of electricity annually, making it the largest single system in the area. It will provide more than 5% of the building's energy needs.

The array was funded by a combination of county funds, money from the utility company, and a grant from the Illinois Clean Energy Community Foundation.

Solar Heating

According to the U.S. Environmental Protection Agency's (USEPA) ENERGY STAR program, commercial buildings across the country use almost 35% of energy for space heating. Additionally, the DOE reports that water heating comprises up to 17% of residential energy consumption and significant percentages (varying depending on industry) in commercial buildings. Solar water and space heating can reduce the use of outside energy.

Solar Water Heating

Solar water heaters require a well-insulated storage tank and a conventional water heater as back up. There are three kinds of solar collection systems used to heat water: flat plate, integral collector-storage, and evacuated tube solar collectors.

- the flat plate system: a dark absorber plate, sometimes under a glass or plastic cover, is placed in an insulated weather-proofed box on the roof in a sunny location;
- the integral collector-storage system: black tanks or tubes are placed in an insulated and glazed box through which cold water passes to be heated; or
- evacuated tube solar collector systems: rows of metal absorber tubes are surrounded by a transparent glass outer tube with the air removed, to reduce heat loss. Each metal tube has a fin whose coating absorbs solar energy.

There are two types of active solar water heating systems. Direct circulation systems pump the water directly through the collectors described above, then into the building for use. Indirect circulation, on the other hand, pumps heat-transfer fluid through the collectors, then through heat exchangers, which is used to heat the water that flows into the building.

Bexar County, Texas has installed a solar water heater in the county's Adult Detention Annex. The water heater has a 30,000 gallon capacity and is capable of heating 500,000 gallons each month to temperatures of up to 140 degrees. The system initially cost $495,000; however, operating costs are only $2,600 each year, which is $76,168 less than the annual costs of a conventional system. The county estimates that the project will have paid for itself within 4.9 years.

Solar Building Heating Systems

Solar heating requires almost no energy transformation, and therefore is an efficient use of solar power. A solar space-heating system can consist of a passive system, an active system, or a combination of both.

Passive systems are usually less costly and less complex than active systems, but both can be used to control the building temperatures. According to the DOE, it is most economical to design a system that will produce 40% to 60% of the heat for the building. Therefore, the structure should have a back-up heating system to provide the rest of the heat, as well as for cloudy days.

There are two kinds of active heating systems, liquid and air. In a liquid-based system, water or anti-freeze moves through the collector and absorbs solar heat, then travels to a storage tank or heat exchanger to transfer the heat to a distribution fluid. The collectors work the same way as described above for solar water heaters.

After the liquid is heated, it can be used to distribute heat in any of the following ways:

- radiant floor heating: the room is heated by liquid traveling through pipes in a thin concrete slab in the floor;
- hot water baseboards or radiators: fluids are distributed to appliances that heat the room; or
- central forced air system: air is passed over the heated liquid, warming it, and then returned to the room.

In an air-based collection system, the air is

heated in a collector, which can take one of the following forms:

- an airtight, insulated metal frame, with a black metal plate to absorb heat: The solar radiation heats the plate, which in turn heats the air in the collector. This air is then blown back into the room; or
- a dark metal plate with holes in it attached to the south-facing wall, leaving air space between the wall and this cover. The plate heats up, and a fan or blower draws air into the building through the holes in the collector and then through the air space, which is warmed by the hot metal plate.

Air-based heating systems produce heat at earlier and later times in the day than do liquid systems, and they also do not freeze. However, air is less efficient at transferring heat than is liquid.

Passive solar heating does not require pumps or electrical controls to transfer the heat, because the windows, walls, and floors are designed to collect, store, and then distribute it. An aperture, or collector, is a large glass window through which the sunlight enters the building. The absorber, collects the heat from the sun and stores it in the thermal mass. This thermal mass is often made of masonry, although sometimes water is used instead. During the evenings, when it becomes colder, the heat is released; in a purely passive system, this heat moves through the building by the processes of conduction, convection, and radiation; however, a fan is sometimes also used.

County Case Study:

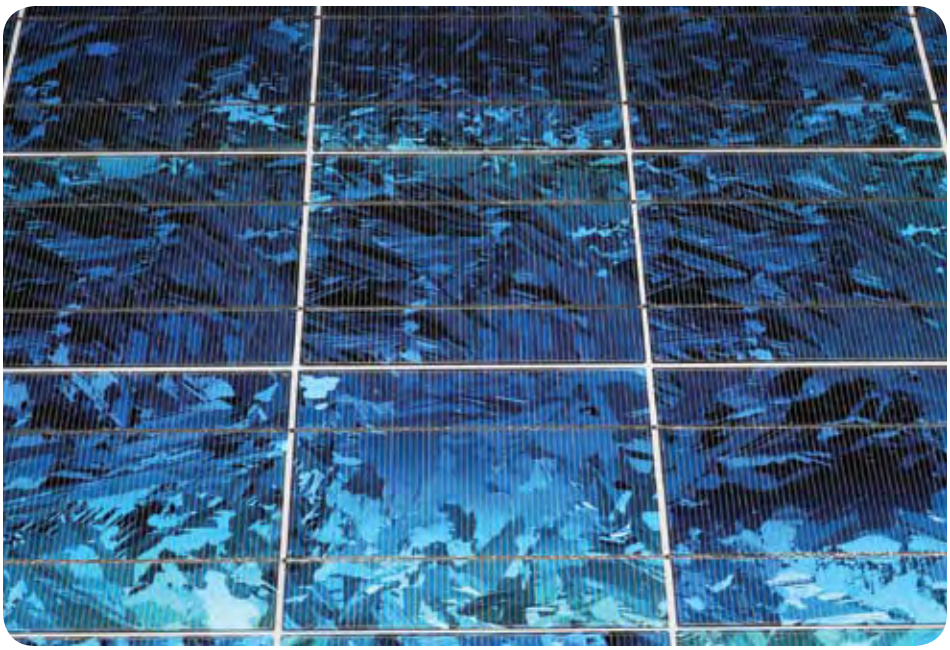
Dane County, Wisconsin
Population: 458,106
County Seat: Madison

Dane County, Wisconsin has two main photovoltaic projects: one at the Dane County Arena, the other at the Henry Vilas Zoo.

The Arena is powered by a fixed-panel, roof-mounted photovoltaic system, installed in 2000. The system consists of 16 panels, each 4 feet by 6 feet. It is capable of producing 5,612 kilowatt-hours each year, greatly reducing the energy bills for the 20,000 square foot Arena.

The Henry Vilas Zoo has a dual-axis tracking array that allows it to maximize the amount of solar energy received as the sun moves across the sky. The array, located in the flamingo pen, is capable of producing 1,950 kilowatt hours each year.

Additionally, the Dane County Justice Center was the first building to be constructed under the county's Green Building Policy. The nine-story, $44 million project incorporated daylighting concepts into its design, using the results of the county's analysis on the site to determine how to maximize natural light while minimizing heat and glare. The facility has traditional sidelight and clerestory windows, some of which have an exterior sun shade, and the building has been designed to save 50% of electricity consumption and $96,500 in annual costs.



There are three kinds of passive solar heating systems: direct gain, indirect gain, and isolated gain. A direct gain system is the simplest of the three. The sunlight first passes through south-facing windows, after which it hits masonry walls or floors. The masonry absorbs the heat and later, when the room cools, radiates it into the room.

Indirect gain systems involve an 8 to 16 inch thick masonry wall built on the south side of the building. Glass is mounted an inch in front of this wall, and the heat is stored between the window and the wall. After the heat is absorbed into the wall, it then radiates through into the living space. This is often referred to as a Trombe wall.

Isolated gain systems involve a sunspace, more commonly known as a solar room or solarium. Vertical windows are installed around the room with a masonry floor, masonry walls, or water container to absorb heat from the sun. Later, the heat is circulated to the rest of the building through ceiling and floor vents, windows, or fans.

San Mateo County, California's Office of Education demonstrated alternative building methods by constructing a building out of straw bales. The building maintains a constant inside temperature of 60 to 75 degrees Fahrenheit (despite outside temperatures of 29 to 85 degrees Fahrenheit) by incorporating elements of passive solar design. These include site orientation, double-paned windows, overhangs, and a cement slab floor which serves as the thermal mass.

Solar Lighting

According to the USEPA's ENERGY STAR program, lighting is responsible for about 13% of energy consumption in commercial buildings. Solar lighting can reduce the amount of power that facilities need to obtain from outside sources.

Outdoor Lighting

Outdoor solar lights consist of a plastic case, a solar cell, a rechargeable battery, a controller board, a light emitting diode (LED) light, and a photoresistor that is used to detect darkness. The battery is wired to the solar cells to allow the charging of the battery during the day. When it is completely charged, the battery can power the light for approximately 15 hours. At night, the photoresistor detects the absence of light and turns on the LED.

It is important to remember that operating times during the winter may be decreased because there are fewer hours of daylight for the battery to charge. Additionally, the cells need to be placed in an area where they are not shaded by trees, the surrounding landscape, or other objects.

King County, Washington has installed 102 solar-powered light emitting diode (LED) systems in bus shelters since 2004. It cost the county less to install the lights than to run wires for electricity to the shelters and there is no monthly electrical bill; additionally, the LED lights require less of the solar electricity than would incandescent bulbs, as they are more energy efficient.

In 2006 and 2007, the county also installed 150 iStops. These are bus stops that allow customers to push a button, lighting a solar-powered lamp. The county hopes that this will better allow transit operators to see passengers waiting at bus stops, preventing buses from passing riders by in the dark.

County Case Study:

Delaware County, Pennsylvania
Population: 555,648
County Seat: Media

Delaware County, Pennsylvania currently uses photovoltaic panels installed on the Veteran's Museum. These produce 5,000 kilowatt-hours each year and reduce the building's energy bill by 20%. Additionally, they prevent the emission of 12,000 pounds of carbon dioxide, 14 pounds of nitrogen oxide, and 68 pounds of sulfur dioxide.

The county is also in the process of installing solar panels on the Media Borough Public Library and Elementary School. This project is partially funded by a $94,245 grant from the Pennsylvania Energy Harvest Grant Program, and will produce 33,250 kilowatt-hours of electricity each year, saving the county at least $4,500 annually. It will also prevent 86,958 pounds of carbon dioxide emissions, 120 pounds of nitrogen oxide, and 476 pounds of sulfur oxide and mercury. The county also intends to install photovoltaic panels at the community theatre.

Indoor Lighting

Indoor lighting refers to daylighting, which is essentially the strategic positioning of apertures, or openings, to allow sunlight into the facility. This serves a dual purpose, both reducing the need for artificial light during the daytime as well as offering a view of the outside world.

When placing the apertures, consider outside obstructions that could block the path of sunlight or increase glare. Additionally, arrange the facility so that tasks which need the most light are conducted near the aperture.

The DOE reports that the window will light an area up to 1.5 times its height, but that this number can be increased by using reflectors. These reflectors can include overhangs as well as reflection from the walls, ceilings, and floor surfaces, which should be coated in high reflectance matte paint or tiles. Using light colored materials in the facility will also increase the reflection of light. Additionally, the higher the window, the more area of the room it will light.

Sometimes, daylight will provide excessive contrast or brightness. To prevent these problems, windows should be equipped with shades, blinds, or drapes. Trees, plants, window glazings, shades, and screens can also be used to diffuse light.

Types of apertures used for daylighting include the following:

- windows: apertures set at mid-level or lower in the walls;
- skylights: horizontal apertures in the roof;
- roof monitors: sections of the roof that is raised above the rest of the roof, with vertical glazing around the gap, allowing light to enter; and
- clerestories: apertures set high in the walls.

Daylighting is most effective in buildings used primarily during the day, but still requires integration with a traditional lighting system for times when there is not enough available sunlight. A daylighting system should incorporate sensors that turn off or dim artificial lights in response to the amount of natural light entering the building, so as to maintain lighting levels.

Clackamas High School in Clackamas County, Oregon, incorporates daylighting techniques into the building design. The facility was oriented to take advantage of optimal daylighting and has windows, skylights, and sunshades so that students and staff can have views and natural lighting. Approximately 90% of occupied spaces are lit using daylight, and the school saves 44% of energy through the use of this system.

Regulations for Solar Energy Systems

It should be noted that it is necessary to check local building codes and zoning laws before constructing a solar energy system. The DOE lists the following problems that those installing solar energy systems often encounter:

- exceeding roof load;
- unacceptable heat changers;
- improper wiring;
- unlawful tampering with potable water supplies;
- obstructing sideyards;
- erecting unlawful roof protrusions; and
- siting the system too close to streets or lot boundaries.

For example, Coconino County, Arizona has developed specific codes for solar installations. Any battery storage sheds for the solar energy system require a permit, and those attached to a residence must be built out of fire-resistant materials. The shed must be adequately ventilated. Additionally, metal pedestals supporting photovoltaic panels must be placed on concrete pilon footings 8 inches wide by 30 inches deep. When the panels are on the roof, the roof must be specifically designed to support this amount of weight.

Sarasota County, Florida donated more than 28,000 square feet, about half of the size of a football field, in Rothenbach Park to house the largest solar power facility in the state. The land is now covered by 1,200 photovoltaic panels mounted at ground level, capable of producing 250 kilowatt-hours of energy each year. This prevents over 654,000 pounds of carbon dioxide from entering the atmosphere annually.

The panels were installed by Florida Power and Light, which provides a voluntary solar power program to energy consumers in the area. The new array, dedicated in February 2008, is capable of powering 55 homes.

Zoning laws can also work in favor of those using solar energy. California's Civil Code, section 801.5, describes a solar easement, which is the right of receiving sunlight on land for use in a solar energy system. In order to receive a solar easement, the applicant needs to describe the dimensions of the easement in measurable quantities, such as degrees, as well as the necessary restrictions that would need to be placed on vegetation, buildings, or other objects.

If the county has sufficient access to funding and has investigated all possible legal issues, solar energy can be an excellent way to save money and the environment.

Encouraging Use of Solar Energy

Counties may to educate their residents about the benefits of solar power by distributing brochures, hosting county events, putting information in the county website, or even putting an article in the newspaper, or can provide incentives.

Montgomery County, Maryland has created a fact sheet to educate residents about solar power. This information explains how the sun provides energy, how this energy is harnessed, and the benefits of its use. Additionally, the fact sheet provides information about how to get started with solar energy.

Some counties give tours of solar and green homes. Other counties provide a series of

County Case Study:

Pima County, Arizona
Population: 924,786
County Seat: Tucson

Pima County, Arizona has joined forces with the city of Tucson to form the Tucson-Pima Metropolitan Energy Commission (MEC). The Commission, consisting entirely of volunteers, has set a goal to serve "as a catalyst for the City of Tucson and Pima County to build a more sustainable future in the region." To accomplish this, the MEC has created several programs in the region.

- The "solar village" Community of Civano: The buildings' roofs in the community are required to be built to be able to support solar equipment, and all structures in the community are required to use some application of solar energy, whether passive or active. The community was planned and built to maximize the amount of solar light each building received. All swimming pools must be heated by solar energy.
- Greater Tucson Coalition for Solar Energy: Since its start in 1997, the Coalition has raised close to $4 million for the development of solar energy, and has seen a 400% increase in the number of solar energy systems installed since 2001. Additionally, the coalition helped develop 120 new solar energy industry jobs in 2003.
- The annual Solar Energy Home Tour: The tour allows people to visit solar installations in more than 15 homes in the area. Participants are given the opportunity to speak with the owners, designers, and builders of these residences, and learn how to make their own homes more efficient and incorporate solar energy principles.

For more information on the Tucson-Pima Metropolitan Energy Commission, visit *www.tucsonmec.org/*.

educational workshops. For thirteen years, Boulder County, Colorado has been hosting the Boulder County Solar & Green Homes Expo and Evening Workshops. These teach residents and business owners how to incorporate renewable energy. A tour of over a dozen solar homes is also provided. During this tour, participants are given the opportunity to talk with owners, builders, contractors, and installers, and to learn that solar homes can be comfortable, reliable, affordable, and practical.

Arlington County, Virginia's Fresh AIRE (Arlington Initiative to Reduce Emissions) campaign has green suggestions on its website. These include information about buying solar-powered energy from local electricity providers, as well as examples of how county residents are incorporating solar and other green technology into their own lifestyles. For more information on the Arlington Fresh AIRE program, visit *www.arlingtonva.us/climate*.

Counties can also use incentives to encourage local businesses and residents to start using solar energy.

Marin County, California offers rebates to residents and local businesses in the unincorporated part of the county, as well as to county employees, regardless of the location for their residence, that have incorporated solar power. Each household/business is eligible for one rebate per solar power type. Eligible solar technology includes photovoltaic systems ($500), solar domestic water heaters ($300), and solar pool heaters ($200).

Montgomery County, Maryland also provides a Clean Energy Rewards program as an incentive to buy environmentally-friendly energy, including solar, wind, and biomass. Customers who purchase clean energy from their utility providers receive a credit on their energy bill from the program. The county reimburses the energy suppliers for the rewards that they pay to customers.

Incentives can also encourage companies to locate their solar technology in certain counties. Davidson County, North Carolina has proved $2 million in incentives to fund the construction of a photovoltaic array in the county. The array will be built by SunEdison, and Duke Energy will buy 16 megawatts of power from the new solar farm, beginning no later than 2010.

In 2005, the Miami-Dade County, Florida Board of Commissioners passed an ordinance to encourage manufacturers of solar energy equipment to relocate to the county. These companies may apply for incentives, funded through the county's Targeted Jobs Incentive Fund Program. Eligible companies are those that are planning to relocate to the county, or those already in the county planning to expand. If the company manufactures, installs, or repairs solar thermal or photovoltaic systems, it is eligible for $1,500 per new job created, up to $3,000 annually.

County Case Study:

Multnomah County, Oregon
Population: 672,906
County Seat: Portland

Multnomah County, Oregon has signed a contract with Sun Edison, LLC to install solar panels on the roofs of county buildings. Sun Edison, LLC will build, own, and operate the photovoltaic systems, with help from federal grants, for 20 years. During this time, the county will buy the solar-powered electricity from the company for 6% less than what it is paying for electricity now, a savings of $5,000 the first year, and possibly more in subsequent years as energy prices rise. At the end of the 20 years, the county will own the system.

At least five county buildings will receive solar panels, generating about a million kilowatts of solar electricity each year. This is 2% to 3% of the total county energy use. This will reduce the county's greenhouse gas emissions by 700 tons annually. Three of these solar-powered systems should be operating by the end of 2008.

Funding for Solar Energy

Solar systems do require a significant up-front cost to design and install. Funding sources to install the technology can include allocating county funds, issuing bonds, third-party financing, lease-purchase agreements, or receiving grants or loans.

Allocating County Funds

When allocating county funds from the budget, the county remains able to control the solar system and its installation completely. However, this method often will not yield as much money as would be obtained through other means.

Arlington County, Virginia allocated $1.5 million in its Fiscal Year 2008 budget for conservation efforts in county buildings. These included a multi-year program of solar-powered projects. The county is also working to educate businesses and residents about reducing greenhouse gas emissions and promoting energy conservation.

Bonds

Bonds are very similar to loans, but are more complex. A general obligation bond requires a referendum of county residents; a revenue bond system is initiated in anticipation of future savings from the project that they would finance.

In a referendum, 73% of residents San Francisco County, California voted in favor of bond measures to fund a $100 million installation of solar power, wind power, and other energy efficient technology. This will be accomplished by installing solar panels on the roofs of city and county facilities, and will provide 10 to 12 megawatts of solar power.

Performance Contracting

In performance contracting, a private business creates a contract with the county to invest in energy retrofits. The business pays for the system, and the county shares profits with the contractor. For more information on performance contracting, see the NACo Green Government fact sheet on "County Buildings: Energy Efficiency and Performance Contracting," available at *www.greencounties.org*.

Working with Siemens's Building Technologies, a 100-killowatt solar array was placed on the Health and Human Services building in Sacramento County, California. The solar energy system offsets the electricity used by the facility by nearly 50%.

Not only will this help save the county and taxpayers money on their energy bill every month, it also qualifies for than $300,000 in rebates from the Sacramento Municipal Utility District (SMUD) as part of a rebate program designed to encourage consumers and state and local agencies to invest in energy-saving technologies.

Sacramento County averages about 265 days each year that are either clear or partly cloudy, allowing the system access to the sun's rays. This can help to reduce over 800 metric tons of greenhouse gas emissions.

Lease-Purchase Agreements

A lease-purchase agreement involves the provision of solar equipment for a facility by a private business. The county makes payments on this equipment, or for the energy produced by the equipment, using the money its saves by using solar power. At the end of

the lease agreement, the county may choose to keep the equipment.

Solano County, California has signed an agreement with Honeywell, International to purchase solar power for 20 years. This will be accomplished by the installation of solar panels on bus ports near the Claybank Adult Detention Facility, which will be powered by this array. The project is projected to generate almost over a million kilowatt-hours of electricity and the save the county $1 million in energy each year. This solar power will meet almost two-thirds of the facility's energy needs and reduce carbon dioxide emissions by over 14,500 metric tons during the duration of the contract.

After the 20-year contract is completed, the county will have the option to continue buying the solar-generated electricity or to buy the solar array itself. This will be the third solar electric facility in Solano County.

Grants and Loans

Borrowing money from commercial banks, pension funds, insurance companies or other financial institutions allows the county to obtain financing for the project without allocating money from other recipients of county funds. However, interest still has to be paid on the borrowed money and the county is responsible for repaying the debt even if the savings are not as high as anticipated.

In order to fund its solar energy project in 2004, Butte County, California borrowed $3.2 million from the California Energy Commission and $1 million from the Butte County Investment Pool at a 3.95% interest rate. By making payments of $313,000 each year, this money will be repaid in 13.2 years. The cost savings from the system were about $317,000 in 2004 and it is estimated that over the course of 40 years, the net savings after the repayment of loans will be $8.5 million.

Common Solar Terms

- **Antireflection coating**- this is a thin coating that is applied to the surface of a solar cell to reduce light reflection.
- **Aperture**- the opening in the roof or wall to allow daylighting. There are two types of apertures; sidelighting (apertures on the side of the building) and toplighting (apertures on the top of the building).
- **Deep discharge battery**- a battery discharged to 20% or less of the full charge capacity.
- **Electron**- a particle in an atom with a negative electrical charge; its movement creates an electric current.
- **Incident light**- light shining onto the face of the solar cell.
- **Photon**- a light particle acting as an individual energy unit.
- **Photovoltaic array**- a collection of photovoltaic modules that function together to produce electricity.
- **Photovoltaic cell (or solar cell)**- a semiconductor element in a photovoltaic module that converts light into electrical energy.
- **Photovoltaic module**- an assembly of solar cells to generate direct current power under sunlight.
- **Photovoltaic panel**- connected photovoltaic modules.

The Santa Rita Jail in Alameda County, California, is topped by a three-acre solar array on its roof. Originally the array, installed in 2001, generated only 640 kilowatts; however, the project was so successful that the county expanded it a year later. The new array now produces 1.2 megawatts of power, and has reduced the peak summer demand of traditional electricity by 35%.

The project was funded by a combination of a low interest loan from the California Energy Commission's Emerging Renewable Buydown Program and incentives from the California Utilities Commission. The project saved the county $425,000 in the first year, and is projected to save $15 million during its life.

Additionally, programs at both the state and federal level contribute funding to assist local governments to install solar power systems. There are several of these programs in existence; examples include the California Solar Initiative (CSI) and the U.S. Department of Agriculture (USDA) Rural Energy for America Program (REAP), which are explained below.

- California Solar Initiative: As part of its Million Solar Roofs Program, the state of California has set a goal to create 3,000 megawatts of solar-powered electricity by the year 2017. To achieve this objective, the California Public Utilities Commission will provide $2.2 billion in incentives over the next decade. These incentives include $2.50 per watt for systems up to one megawatt. Additionally, California has ordered each municipal utility to offer a

solar incentive program to customers. For more information on the California Solar Initiative, visit *www.gosolarcalifornia.ca.gov/csi/*.

- USDA Rural Energy for America Program: This program provides grants and loan guarantees to purchase renewable energy systems and make improvements in energy efficiency. Several types of renewable energy are eligible for the program, including solar water heat, solar space heat, solar thermal electric, and photovoltaics. Grants offered may be up to 25% of the program's cost, while loan guarantees may be up to $25 million, as long as the combined amount of the grant and loan guarantee is not higher than 75% of the project's cost. For more information on REAP, visit *www.rurdev.usda.gov/rbs/farmbill/*.

These are only a few examples of the many programs in existence today. For a comprehensive database of state and federal energy incentives, visit *www.dsireusa.org*.

Emerging Solar Technologies

Solar power continues to change and develop as new technology emerges, and the future looks bright for the implementation of this new technology, including hybrid solar lights, solar-powered vehicles, and solar hydrogen produced from landfill gas.

Hybrid solar lighting is a combination of electrical and solar light fixtures in which a concentrator is mounted on the roof to collect sunlight, which is then funneled through optical fibers into the building. In the building, the light goes to a hybrid light fixture, which is equipped to use both sunlight and artificial light. Sensors raise and lower the necessary level of electrical light as the amount of sunlight varies throughout the day.

No energy conversion is necessary for these fixtures; the solar light is sent directly to the light fixtures. Additionally, some hybrid light fixtures also create solar-powered electricity from the invisible sun rays that cannot be used for lighting.

Several solar-powered vehicles have already been designed. Each year, the North American Solar Challenge encourages competitors to build solar-powered cars in a race from Dallas, Texas to Calgary, Alberta. At this point, many of the designers of solar-powered cars are research departments at universities.

For a solar car to function, solar cells on the car would have to collect the sunlight and turn it into electricity. Some of this electricity would be stored in a battery for use when no sunlight is available. However, the car would have to be designed very efficiently to contain enough solar cells to provide the necessary power.

Solar Hydrogen Energy Corporation (SHEC) has created a system to produce hydrogen from landfill gases, using solar power. In this system, methane and carbon dioxide, landfill gases, are fed into a reactor, heated by a concentrating solar energy system. The gases are reacted, forming hydrogen and carbon monoxide. These gases then go into a water gas shift reactor, resulting in hydrogen and carbon dioxide.

SHEC has already built one solar-hydrogen-from-landfill-gas production station in the city of Regina Saskatchewan, Canada. This plant is estimated to produce 1.2 million kilograms of renewable hydrogen annually. SHEC hopes to construct these plants in other locations, as well.

Conclusion

The use of solar technology is increasing quickly throughout the country with the use of solar lighting techniques, solar water heating, solar space heating, and solar powered electricity. Solar energy provides an economically-competitive source for energy.

Counties are tapping into the resources provided for solar energy and to great success. By facilitating solar energy use, counties can reduce cost and prevent harmful greenhouse gas emissions. As researchers continue to investigate the uses of harnessing the sun's power, new technology increases, and solar power becomes more and more a common part of daily life, benefiting both counties, taxpayers, and the environment.

Member companies of the NACo Green Government Initiative can help you with your green commercial building needs.

• Constellation Energy

Constellation Energy uses its experience in renewable technologies, including solar, biomass, and geothermal energy, to fulfill its contract for energy performance contracting in the state of Maryland. The company identifies cost-saving energy solutions that are friendly to the environment for their clients. In 2007, Constellation Energy received the 2007 Green Power Leadership award from the DOE.

• General Motors

General Motors uses solar energy to partially power two of its facilities. The company has installed photovoltaic arrays on the roofs of warehouses in Cucamonga, California, and Fontana, California, which generate up to 1.5 million kilowatts and 1.3 million kilowatts of energy each year, respectively. This powers about half the building's energy needs, and the warehouse in Fontana is estimated to create and send enough power back to the electrical grid to power 200 homes.

• Johnson Controls

Johnson Controls sells solar kits designed to help show customers how solar power can help them save money. These kits include solar batteries that have a long operating cycle, have high charge acceptance, recharge well, and require almost no maintenance.

• NORESCO

NORESCO works to bring the company's expertise into designing, building, financing, owning, managing, and operating central energy facilities, including those using photovoltaics.

• Siemens

Siemens has installed more than a megawatt of solar PV power in the last year. The company offers a full array of renewable energy solutions across the country, including landfill gas-to-energy, biomass and wastewater treatment-to-energy. Siemens also performs investment grade energy audits which identify inefficiencies and recommend energy-saving measures and retrofits.

• Wal-Mart

Wal-Mart has been piloting a program to use solar energy in its facilities. So far, 22 Wal-Mart stores, Sam's Clubs, and distribution centers in the states of Hawaii and California use solar power. Each facility's generating system can provide up to 30% of the power for the store on which it is installed, and Wal-Mart expects to reduce greenhouse gas emissions by 8,000 to 10,000 metric tons each year.

• Additional Resources

• American Solar Energy Society

www.ases.org/

The American Solar Energy Society is a nonprofit organization that works to increase the use of solar energy and other sustainable technologies across the nation. They accomplish this by public education and advocacy. The website is an up-to-date resource for information on the latest solar developments.

• Database of State Incentives for Renewables and Efficiency (DSIRE)

www.dsireusa.org

DSIRE is a comprehensive source of information on state, local, utility, and federal incentives that promote renewable energy and energy efficiency.

• Florida Solar Energy Center

www.fsec.ucf.edu/en/

The Florida Solar Energy Center was created in 1975 by the Florida Legislature to conduct research, as well as test and develop energy technology that will enhance the economy and the environment. The website has a significant amount of resources and research data.

• U.S. Department of Energy's Solar America Initiative

www1.eere.energy.gov/solar/solar_america/index.html

A program from the DOE, the Solar America Initiative strives to lower the cost of solar electricity so that it will be cost competitive across the market by 2015.

• U.S. Department of Energy's Solar Energies Technology Program

www1.eere.energy.gov/solar/

This site has some basic information about the different forms of existing solar technology, as well as newly emerging forms.

About the NACo Green Government Initiative

The NACo Green Government Initiative serves as a catalyst between local governments and the private sector to facilitate green government practices, products and policies that result in financial and environmental savings. Launched in 2007, the Initiative provides comprehensive resources for local governments on all things green, including energy, green building, air quality, transportation, water quality, land use, purchasing and recycling.

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