Sun4Communities

The Sun4Communities project is a unique opportunity for Montana communities to promote renewable energy by hosting an on-site solar energy demonstration.

For additional information, contact:

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Section I: Project Overview

NorthWestern Energy is seeking applications from communities interested in participating in the new Sun4Communities project. Sun4Communities is an extension of the Sun4Schools project, in which 27 middle and high schools in Montana received solar electric systems and an accompanying curriculum at no cost. Sun4Communities adds libraries, city halls, and county courthouses to the list of eligible buildings. Middle and high schools are still eligible to participate.

Communities can nominate a building to participate in the project, as long as that building receives its electricity from NorthWestern Energy. Ten buildings will be chosen to participate in 2004, and will receive a 2-kW roof-mounted, utility-intertied photovoltaic (PV)—often called solar electric—system at no cost. School-installed systems will have equipment installed to monitor the performance of the solar electric system. Non-school projects will have a kilowatt-hour meter installed, which will be read by facility personnel and then forwarded to NCAT. NCAT will make the system performance results available on the montanagreenpower.com internet site. All systems will be installed by a contractor chosen by NCAT.

The primary objectives of this project are:

- to provide residents with a unique educational opportunity to learn about solar energy;
- to allow communities to generate their own "clean" electricity utilizing renewable energy resources; and
- to provide community demonstrations of PV systems at work.

Sun4Communities is funded through NorthWestern Energy's Universal Systems Benefit (USB) funds, created by Montana's 1997 utility restructuring legislation. USB funds new and existing energy conservation activities, renewable resource projects and applications, and low-income energy assistance.

The Sun4Schools project has installed PV systems on 27 Montana schools since 2000. Additional USB funds have made it possible to add PV systems on 10 additional community buildings within Montana (including schools, libraries, county courthouses, and city halls).

Each building will be included in the federal Million Solar Roofs Initiative. Announced in 1997 by the Clinton Administration, this federal effort commits to installing solar energy systems on a million buildings by the year 2010. NCAT has received a U.S. Department of Energy grant to develop a statewide implementation plan to remove barriers and strengthen local demand for solar energy technologies in Montana. The plan will result in the implementation of at least 1,000 solar energy systems in Montana by 2010, in support of the federal Million Solar Roofs Initiative.

How the Project Works

Who is Eligible to Apply

All communities served by NorthWestern Energy are eligible to apply. Interested communities must nominate a building by completing the enclosed application and submitting it to Cathy Svejkovsky at NCAT. Please read this entire application packet carefully to ensure that you fully understand the obligations of your community should it be chosen to participate.

Selection Process

An evaluation team will review all applications will review all applications and select ten winners based on the criteria outlined on pages 9-11. The decisions of the evaluation team are final.

Educational Benefits

To maximize the educational benefits of this project, a solar energy curriculum will be provided to any school chosen to participate. The school will agree to implement this curriculum in its classrooms beginning in the 2004-2005 school year as a condition of participation. This curriculum will include a variety of materials, lessons, and activities focusing on solar energy.

As an additional learning opportunity, the installed PV systems will include a performance-monitoring component that will allow community residents and students to monitor the production of electricity from the system

Community Outreach

Communities selected to participate will agree to have an Open House within six months of installation to educate the broader community about how the system works and at least one Open House per year for five years for the purpose of providing community education opportunities. These Open Houses are to be advertised in local newspapers, as well as posted on the appropriate Internet websites.

Project Financing

The basic cost of the five PV systems will be funded by this project, including installation and metering. There may be electric utility metering costs or special site-condition costs that participating communities may incur. Any additional costs will be identified prior to a final commitment by the community or school. Each participating community will accept full ownership of the system and full responsibility for system maintenance. By accepting ownership of the system, the community will receive the full warranty provided by the system supplier/installer. Additionally, the community must

commit to fully insure the system against damage for a 20-year period. There will be no additional funding available from NCAT or NorthWestern Energy after the system is installed and operational.

What is Solar Electric Energy?

Solar energy is, simply, energy from the sun. The amount of energy from sunlight that falls on the earth each day is enormous. On an average day, a square meter on Earth collects an average of about 4.2 kilowatt-hours of energy. This figure varies by location and weather patterns. Deserts receive the most sun, more than 6 kilowatt-hours per day per square meter. Northern climates, as in Montana, receive closer to 3.6 kilowatt-hours.

Photovoltaic systems convert this sunlight directly into electricity. According to the U.S. Department of Energy's Photovoltaics Program, "PV modules covering 0.3 percent of the land in the United States could supply all the electricity consumed here."

The word 'photo' means light, and 'voltaic' refers to the electrochemical process of producing electricity. When sunlight strikes a PV cell, it is changed directly into electricity without creating any air or water pollution. PV cells are made of at least two layers of semiconductor material. One layer has a positive charge, and the other has a negative charge. When light enters the cell, some of the photons from the light are absorbed by the semiconductor's atoms, freeing electrons from the cells' negative layer to flow through an external circuit and back into the positive layer. This flow of electrons produces an electric current.

Benefits of Photovoltaic Systems

Photovoltaics has proven itself over the past 20 years as an effective, quiet, reliable, and increasingly economical approach to generating pollution-free energy and reducing greenhouse gas emissions. In Montana, for example, a 2-kw PV will eliminate about 3,500 pounds of carbon dioxide and nearly a half-pound of nitrogen oxides annually.

In addition, PV systems have low operating costs, since their fuel (sunlight) is free and there are few moving parts. The systems that will be used in Sun4Communities are modular, allowing power output to be increased by adding more modules, as well as versatile, operating well in nearly any climate. They are also safe, nonflammable, UL listed, and compliant with the National Electrical Code.

Solar energy, because of its decentralized and easily distributed nature, is ideal for certain residential and commercial applications. Solar energy, for example, is well-suited to provide a portion of most homes' energy needs. Solar systems equipped by battery backup have been found to be extremely valuable in responding to the power needs of communities that have experienced hurricanes and other natural disasters. In the construction of new homes and commercial structures, "building integrated" PV systems are successfully being designed right into the façade and/or roof of these new buildings.

Today, more than 2 billion people in the world do not have electricity. Extending the utility grid to these areas is very expensive. Thus, in an increasing number of cases, solar energy is being tapped to provide less-expensive and much cleaner electricity to people in rural communities who would otherwise use noxious diesel and kerosene fuels. Several studies in the U.S. and elsewhere have cited the economic and health benefits the public can derive from the installation of PV systems, rather than building new coal- or oil-fired plants.

Photovoltaics are used to generate power for a wide variety of applications, including pocket calculators, water pumping, emergency power, sophisticated telecommunications equipment, street lighting, space satellites, lighthouses, and residential and commercial electricity.

How a Utility-Intertied Photovoltaic System Works

A utility-intertied—sometimes called grid-connected—PV system, such as those that will be installed under Sun4Communities, generate electricity that is supplemented by the energy provided by the existing utility grid. A utility-intertied PV system requires neither battery storage nor an emergency back-up system since it is connected directly to the utility grid, which is used as the storage medium. While a PV system can be designed to provide all of a building's electrical needs, most systems provide only a portion of the total electricity requirements. The systems to be installed under this project will provide only a small portion of the school's or public building's total electricity needs. An intertied system uses a specially programmed meter that is able to turn backward in case the PV system produces more energy than the building is using. The community or school will be required to sign a "net metering" agreement (see attached) with NorthWestern Energy in order to have the meter installed and as a condition of participation.

Since PV modules are only capable of producing direct current (DC) electricity, an inverter is required to convert the DC output produced by the PV array into alternating current (AC) power. AC electricity is needed to run computers, refrigerators and other appliances, and lighting. Utility interactive inverters have built-in safety features that prevent them from operating if there is an interruption in grid-supplied power. The inverter uses the prevailing line-voltage and frequency of the utility line as a control meter to ensure that the PV system's output is fully synchronized with the utility power.

The basic building block of a PV panel is the PV cell, which is a solid state, or non-mechanical, device. A solar system uses a number of PV panels, each made of silicon, plus boron and phosphorous. The output of a single cell under direct sunlight is about one watt. To increase their effectiveness, dozens of individual cells are interconnected together in a sealed, weatherproof glass package called a module. Modules come in a range of wattages, and their nature allows for great flexibility in designing systems that meet a variety of electrical needs.

Durability of Solar Systems

Solar panels are made of rugged tempered glass and will withstand nearly any natural occurrence of rain, snow, hail, or wind. When the panels are covered with snow, bright sunlight penetrates the snow and melts it from underneath. Systems can be ground-, roof, or pole-mounted.

Why Are Public Buildings a Good Choice for Solar Energy Demonstrations?

As natural centers of community activity, public buildings like schools, libraries, county courthouses, and city halls provide an excellent opportunity for the broader community to become more familiar with energy issues in general and solar energy technologies in particular. Solar energy system demonstrations can:

- provide a valuable learning experience for community residents;
- increase awareness about the benefits of solar energy;
- help protect our environment by reducing the use of fossil fuels and the subsequent harmful greenhouse gas emissions;
- save money for communities by allowing them to generate their own clean electricity from renewable energy resources; and
- help overcome current market barriers that prevent renewable energy systems from being more widely used in Montana.

Design of PV Systems for the Sun4Communities Project

Components

The PV systems installed under Sun4Communities will include the following components:

- PV modules
- Inverter to convert DC to AC energy
- For school installation, one performance-monitoring system, which will allow students to access periodic updates on the system's performance via an Internet website. For other public buildings, a kWh meter will be installed. This meter will be read by the facility personnel and the meter reading forwarded to NCAT for posting on the Internet website.
- One external, visible DC Disconnect Switch, to be located outside nears the building's main electrical entrance to allow a manual shutoff by NorthWestern Energy.
- Installation hardware
- Cabling
- Mounting hardware

The specifics of these components will be determined once an equipment supplier/ installer is selected.

System Output

A 2-kw PV system will produce about 3,000 kilowatt-hours of electricity annually. System sizes installed under Sun4Communities may vary based on project costs. Output for each system could vary somewhat according to specific site variables, local weather patterns, and other factors.

Expected Annual Maintenance Cost of the System

As PV systems are virtually maintenance-free, significant maintenance costs are not expected. System modules should last about 30 years. However, inverter life could be shorter. Common estimates for inverter life range from 15-20 years. Maintenance costs may include replacing a faulty wire and ensuring that all electrical components remain secure. NCAT recommends that a licensed electrician perform these tasks, the cost for which will be the responsibility of each individual community or school. Each selected community will be provided with an annual maintenance checklist. Buildings selected to participate will be required to commit to this annual maintenance for 20 years. **Again, the cost of system maintenance is the responsibility of each participating community or school.** Should major system components fail beyond the warranty dates, it will be the decision of the community or school whether to replace those components.

Site Installation and Technical Support

A contractor will be selected to provide and install the equipment for Sun4Communities. This contractor will be responsible for all systems engineering, site assessment, physical installation, and proper interconnection to the NorthWestern Energy utility grid. In addition, the contractor will provide a warranty on its systems, which will be transferred to the community or school when it takes ownership of the system.

Section II. Sun4CommunitiesApplication Guidelines

Selection/Eligibility Criteria

Any community served by NorthWestern Energy's electrical distribution system is eligible to apply. Awards will be granted to those six communities that make the strongest case for how a PV installation will specifically be used to educate the community as a whole about the applications and benefits of solar energy, and that also meet physical site requirements.

Communities wishing to apply must satisfy the following criteria and complete the application on pages 12-16.

A Written Narrative of no more than 500 words must accompany the application, specifically addressing the issues below. See "Hints on Completing the Written Narrative" on pages 9-10 for additional direction.

1. **"Plan of Action" for educational outreach**

   Describe the outreach efforts your community will undertake to educate its residents about the benefits of solar energy.

2. **Description of Structural Integrity of Building and Location of PV Array**

   Describe the condition of the roof and building, the proposed location of the PV array, size of roof area, roof orientation, and other physical features of the building.

   As part of your application, you must complete a sun path diagram that will assist us in estimating the impact of shading on annual system performance (see the enclosure "Picking a Solar Site" for more information). You must also include several photos of the building and its surroundings, noting where the PV array would be installed (surroundings are best captured by taking the photos from the potential location of the PV array). Indicate directions on the photos (e.g., "View of building from South").

Hints on Completing the Written Narrative

1. *"Plan of Action" for Educational Outreach*

A goal of this project is to ensure that the solar installations become an important and on-going part of each community's outreach activities. Thus, applicants will be judged heavily by their plans for education and outreach. As part of your Plan of Action, note how your community will promote the installation to the community, involve students, create interactive activities, and interact with the broader community about renewable energy issues.

Some possible outreach activities include:

- holding an annual energy fair to educate the community about solar and other renewable energy systems
- publishing articles in local newspapers about solar energy
- partnering with participating schools to incorporate renewable energy education into the classroom

When articulating your Plan of Action, describe the following points:

a. Identify a Solar Program Coordinator and the specific steps he or she will take to ensure that the entire community is made aware of the PV system.

b. Describe how the community will link with schools, residents, the business community, etc. through, for example, school-to-work programs, outside speakers, etc., to build awareness of the particular installation and solar energy in general.

c. The community must be willing to hold a 'Community Open House' or other public event within six months of the installation, as well at least one Open House per year for five years, so that the general community can learn how the system works. Explain your plans for these public-outreach events.

2. Site Requirements

Several physical requirements must be met in order for a site to be considered appropriate for a PV system. Applicants in Sun4Communities must inspect their building prior to applying to determine that the building meets the following requirements. Address the following in your Written Narrative:

a. **Orientation**: the building must have a southern exposure. For maximum daily power output, the installed PV modules must face due south (180 degrees), plus or minus 30 degrees (i.e., 150-210 degrees) and be exposed to the sun for as much of the day as possible, especially during the peak hours of 9 a.m. to 3 p.m.

b. **Shading**: Significant shading from trees, buildings, mountains, and other obstructions on the roof between 3 hours before and after solar noon during the months of April through October will reduce solar energy collection. Solar noon is the midpoint between sunrise and sunset times. The installation site should have no large roof protrusions, such as dormers and ventilation pipes, near the south, east, or west sides of the array.

c. **Roof Type and Pitch:** The building's roof should be in good condition. Preference will be given to flat roofs or those with a slope between 30 and 60 degrees.

d. **Roof Area:** The roof area required by the PV modules is approximately 100 square feet per kW installed.

e. **Roof/Electrical System Access:** Convenient access to both the roof and the building's electrical system is required to install the PV system.

f. **Electrical System:** The building must have a 120-volt, single-phase circuit. The breaker box for this current must be reasonably accessible to the PV array.

Section III: Tentative Project Schedule

1. Deadline for applications is April 23, 2004.

2. The evaluation team will review applications and select and notify winning communities by May 14, 2004.

3. Community officials must sign and return a contract outlining their obligations under the program. This contract must be signed by the appropriate official(s) by May 14, 2004, or subsequent date as determined by NCAT, if applicable, in order to continue as a participant in the project. It is your responsibility to determine, according to your local policy, who has the authority to approve participation in this project.

4. Systems will be installed by approximately October 31, 2004. Communities will assume ownership of the systems upon complete installation and final inspection and acceptance by appropriate personnel.

5. Any schools chosen to participate in the project will be provided with a copy of the curriculum developed for this project prior to the 2004-2005 school year.

Section IV: Sun4Communities Application

Please complete this application by **April 23, 2004,** and return to:

Cathy Svejkovsky
Sun4Communities
c/o NCAT
P.O. Box 3838
Butte, MT 59702

Name of Building

Address

Designated Project Coordinator _____

Project Coordinator Contact Information:
Mailing Address_____
Work Phone: _____
Fax: _____
E-mail: _____

List all NorthWestern Energy Electric Service Account Numbers for the building. Attach copies of a typical winter NorthWestern Energy bill and a typical summer NorthWestern Energy bill **for each account**. Upon notice of award, the community will be required to provide copies of all electric bills for the preceding 16 months.

_____
_____
_____
_____
_____
_____

1. Describe any energy conservation or efficiency measures the building has undergone over the past three years

_____
_____
_____

_____
_____

2. What type of electrical service does the building have?
____120/240 single-phase ____120/208 three-phase wye
____277/480 three-phase wye ____120/240/208 Delta (three-phase)
___Other (specify)_____

3. What material is the roofing made of?
___Asphalt ____Standing seam metal ___Corrugated metal
___Slate or tile ____Rubber membrane (flat roof) ___Wood shingle
___Other (specify)_____

4. What is the roof structure?
___Wood-framed ___ Steel-framed ___ Wood and steel joists
___Other (specify)_____

5. What is the structural roof sheathing?
___Wood board ___Plywood ___Steel –folded plate ___Concrete

6. Is the roof in good condition? _____

7. Which direction does the main entrance of the building face?
_____

8. Where do you think the PV array should be installed?
_____
_____
_____

9. Is the roof sloped? _____
If yes, what is the slope (in degrees)? _____

10. How many years ago was the existing roofing material installed?
____ 0-5 years ____5-10 years ____15-20 years ____20+ years

11. How many feet above the ground is the structure that will support the PV modules?
_____

12. Does the building's electrical system meet the current electric code?
_____

13. Where is the electrical service entrance and meter in relation to the proposed PV array location?
_____
_____
_____

14. Where is the 120-volt, single-phase electrical breaker box that will be use to connect the PV system to the existing electrical system in relation to the proposed PV array location?
_____
_____
_____

Written Narrative

- ❑ Attach your Written Narrative, described on page 9

Letter of Commitment

- ❑ Attach a letter of commitment signed by an appropriate official. Your specific local policy will dictate who has the authority to approve participation in this project. This letter is intended as a demonstration of the community's commitment to the project. A final agreement will be signed prior to installation.

Also attach:

- ❑ Completed Sun Path Diagram, and photos of your building, its surroundings, and the potential installation site(s). Photos of the roof and south of building are most important.

Section V: Obligations of Participating Communities

Communities selected to participate in this project must agree to fulfill the following obligations:

1. To accept full ownership of the pre-selected hardware components (as outlined in the Program Description portion of this packet) that comprise the PV system.

2. To provide assurance of the building's structural integrity.
3. To maintain full legal and financial responsibility for the system once installed.
4. To provide an analog telephone line in the location of the equipment board, which will be located as close as possible to the building's electrical breaker box (this telephone line can be an extension of an existing line).
5. To sign a NorthWestern Energy Net Metering Agreement.
6. To arrange for installation of the NorthWestern Energy net meter after the final electrical inspection of the PV system.
7. To agree to mount a permanent informational plaque (approximately 16" x 24" in size) that explains the solar energy system and net metering in detail. This plaque will be provided by NCAT.
8. To agree to insure the system against damage for 20 years.
9. To implement the solar energy curriculum provided by NCAT in its classrooms (this requirement applies to schools only).
10. To commit to an education/outreach effort that will promote solar energy within the broader community.
11. To designate an individual/team that will "champion" the project.
12. To gain approval for project participation by the appropriate decision-maker(s).
13. To hold one Open House within six months of installation, as well as at least one Open House annually for five years, to educate the general community about how the system works.

Indemnification

By applying for participation in Sun4Communities, each community hereby expressly agrees to defend, indemnify, and hold harmless both NCAT and NorthWestern Energy from any and all claims, liabilities, obligations, damages, demands, losses, causes of action, cost of expenses or whatever kind or nature, including attorney's fees in all pre-litigation and litigation issues, including trail and appellate levels and in bankruptcy or insolvency proceedings for injury to or death of any person and for damage to or destruction of any property resulting, in whole or in part, from errors, omissions, or any negligent, willful, wanton reckless, or intentional act(s) of the Building in connection with the performance of the terms and conditions of this application, to the extent caused in whole or in part by said acts, errors, or omissions of the contractor or subcontractor.

Final Application Checklist

Before submitting your application, have you:

- ***Enclosed**:*
  - Completed application form?
  - Written Narrative?
  - Copies of a typical winter NorthWestern Energy bill and a typical summer NorthWestern bill **for each account**, indicating all account numbers for the building?
  - Completed Sun Path Diagram?
  - Photos of building, surroundings, and potential installation site?
  - Letter of commitment, signed by a person authorized to approve participation in this project?

- ***Read and approved*** of your community's obligations should it be chosen to participate in this project?