

In-Depth

Photovoltaic Stations

Dig deeper into themes and topics encountered at
Cascade Meadow

Function

The Cascade Meadow center and site feature several renewable energy systems. In partnership with Rochester Public Utilities (RPU), these renewable systems support one of our major goals - to demonstrate a range of market-ready renewable energy technologies. The solar photovoltaic stations were purchased, installed and are maintained by RPU.

Renewable energy systems are generally considered appealing because they allow us to generate electricity without burning fossil fuels or emitting greenhouse gases into the atmosphere. However, in addition to these widely accepted positive impacts, each renewable energy system comes with its own challenges and barriers, each of which must be addressed when considering making the move to renewable energy. This sheet provides details for the PV stations installed at Cascade Meadow and answers some of the typical questions that arise when considering the purchase of a PV system.



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Our Photovoltaic Stations

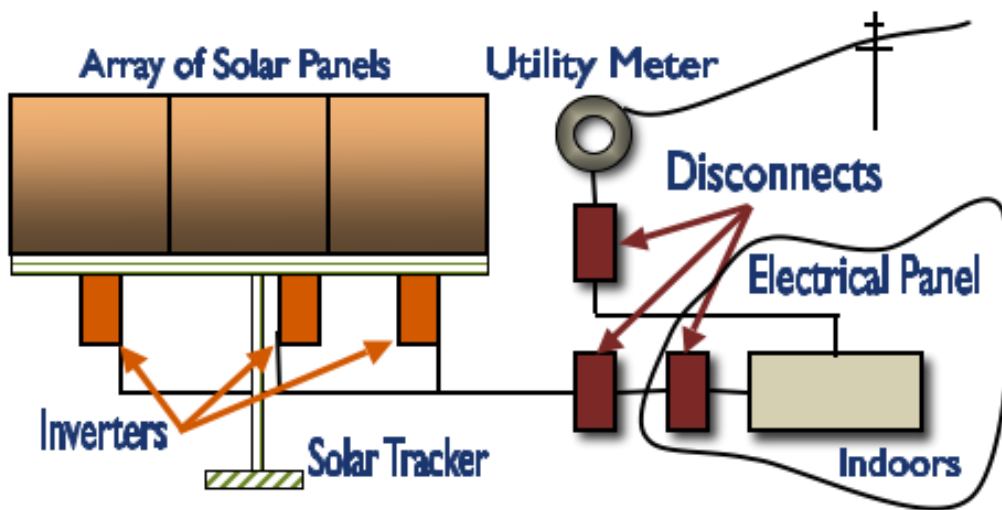
Cascade Meadow features PV arrays in three separate stations adjacent to the science center. For demonstration purposes, the stations feature several different solar cell technologies and mounting systems. [Note: several small (2"x2") solar cells are linked together to form a solar panel or module. Our PV stations or arrays are made up of multiple modules that are linked together.]

- PV Station 1 showcases "thin film" solar cell technology, and is mounted on a rack system that tracks the sun as it moves across the sky.
- PV Station 2 also tracks the sun, but uses a more common "polycrystalline" solar cell technology.
- PV Station 3 has polycrystalline solar cells like Station 2, but rather than tracking the sun, the array is mounted on a rack that will be adjusted based on the season.

Electricity generated by the three PV stations feeds directly into the electrical grid and provides clean energy for Cascade Meadow or other nearby businesses. See the chart below for more information on each of the PV stations.

	Format and Manufacturer	Power per module (Watts)	Modules in station	Total station rating	Inverters	Rack
PV Station 1	Thin Film - Sharp®	135 W	6	810 W	One PV-Powered PVP-1100 rated at 1100W	Wattsun® dual-axis tracking rack
PV Station 2	Polycrystalline - Siliken®	205 W	4	820 W	Four EnPhase Energy® micro-inverters rated at 190W each	Wattsun® dual-axis tracking rack
PV Station 3	Polycrystalline - Siliken®	205 W	3	615 W	Three EnPhase Energy® micro-inverters rated at 190W each	DPW Solar® 15°-65° adjustable

What are the Typical Components of a PV System?



Will a PV System Work For You? Conduct a Feasibility Study

PV systems are exciting for people for many different reasons. Your motivation for a solar power project will impact your selection of equipment, your installation and operation, and the overall economics of your project. PV systems won't work for everyone or every site. The process of deciding if PV will work for you is called a feasibility study. Read the details below to learn more about the process. For sites where a PV system presents too many challenges, consider purchasing renewable power from your power utility, become an advocate for large-scale renewable energy projects or look into another renewable energy system, such as solar-thermal or small wind.

- 1) Explore your motivation: Why do you want a PV system? Are there simpler or less-expensive ways to reach your energy goals?
- 2) Know your solar resource: Does your site have enough sun in a southern exposure to support a PV system? Are there other practical or physical limitations at your site (tall structures, poor security)?
- 3) Zoning/permitting: What local zoning or permitting rules (including ordinances) affect your site? Foundations and electrical components usually require inspections and permits.
- 4) Net metering: Will you tie your system to the grid? If so, what is the payment rate structure your utility will use to buy back extra power your system produces?
- 5) Choosing a solar panel, rack and other equipment: Based on the above four items, research the available solar panels and other equipment that meet your needs. Learn the differences between your choices for tracking systems, inverters and other required equipment. Know the trade-offs for mounting on the ground vs. on a roof (roof-mounting can be more secure, but involve working heights).
- 6) Choosing an installer: Contact others in your area that have used renewable installers and learn as much as you can. See more on this below.
- 7) Working with your utility: Know the applicable laws that affect you and your utility. Keep in mind that your utility has its own interests to consider.
- 8) Insurance: While often overlooked, consider protecting your investment with insurance.
- 9) Operations and maintenance: Be aware of maintenance costs for optional features like tracking systems.

A Word on Energy Efficiency/Conservation

Before you decide on the size of your renewable system, work to reduce your overall requirements by replacing lighting and appliances with energy-efficient models. According to the founder of *Home Power* magazine Richard Perez, every dollar spent on energy efficiency saves three dollars in renewable energy system costs. What he means is that if you try to size your PV system for your current needs, you'll spend a lot more than if you reduce your needs through efficiency upgrades and then size your system. Check out the Pyramid of Conservation for more information at www.mnpower.com/powerofonhome.

What are typical costs for PV arrays?

Costs can be difficult to estimate, because of the many variables and options one has in designing a PV system. Solar panels can be compared using a ration of dollars per watt. For example, a simple internet search reveals that the Sharp thin-film panels at Cascade Meadow (excluding racks, tracking, inverters, etc) cost about \$1.95/W and the Siliken panels cost about \$2.30/W. Other costs that should be considered and compared are: other equipment (such as inverters, racks, cables, safety measures), and design and installation for both the system and foundation. These can vary significantly depending on the specifics of the project and site.

Other Points to Consider

- Choose a location carefully: Location on the site affects installation costs in the length of cable required for connection into the building.
- Grid-tied or battery: Each option comes with site-specific trade-offs in cost and reliability.
- Tracking systems improve performance but usually require more space and cost more.
- Ground-mounted systems are easier to access for maintenance and usually have more space for tracking than roof-mounted but can be more easily damaged.

Additional Resources

Photovoltaic incentives and rebates:

- For Rochester Public Utilities customers: RPU has a solar electric rebate as a part of its "Conserve and Save" program. See their website below for more information. http://www.rpu.org/your_home/power_services/solar_choice/Default.htm
- For a comprehensive and up-to-date list of federal, state and local incentives and rebates, head to www.dsireusa.org.

Finding a qualified local vendors, consultants, and installer:

The Minnesota Office of Energy Security maintains a list of certified renewable energy installers. Ask a CM staff person for the list, or download the most recent list on the Office of Energy Security website at www.energy.mn.gov > renewables > publications directory > "Hiring a Renewable Energy Contractor." This document also provides a list of key questions to ask a renewable energy contractor.

MN Clean Energy Resource Teams:

www.cleanenergyresourceteams.org/technology/solar-energy

RPU is also willing to share additional information on this project. Contact Bob Freund for more information. bfreund@rpu.org

Learn More

As it becomes available, Cascade Meadow will post new information about sustainable technologies on its web site:

www.cascademeadow.org.

Watch this site for dates of upcoming workshops and events that can help answer your sustainability questions.

