

In-Depth: Photovoltaic Stations

Function

Cascade Meadow’s solar photovoltaic stations were purchased, installed, and are maintained by Rochester Public Utilities. They are just one of several systems that accomplish our goal to demonstrate a range of market-ready renewable energy technologies

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. Of course, in addition to these widely acknowledged advantages, 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 photovoltaic (PV) stations installed at Cascade Meadow and answers some of the typical questions that arise when considering the purchase of a PV system.



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.)

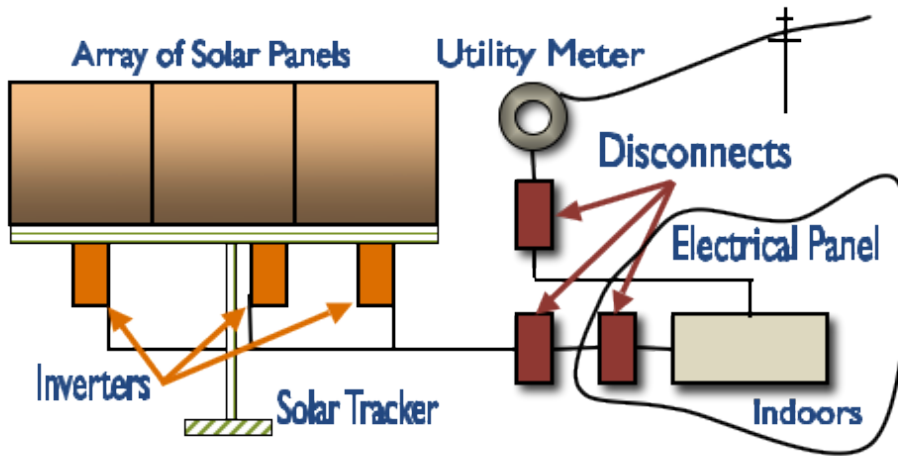
- PV Station 1 showcases “thin film” solar cell technology and is mounted on a rack system that tracks the sun as it moves across the sky.
- PV Station 2 also tracks the sun, but it uses a more common “polycrystalline” solar cell technology.
- PV Station 3 has polycrystalline solar cells like those in Station 2, but rather than tracking the sun, the array is mounted on a rack that is 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/ 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?



A Word on Energy Efficiency/Conservation

Before you decide on the size of your renewable energy 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/powerofonehome.

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, becoming an advocate for large-scale renewable energy projects, or looking 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. Research zoning/permitting: What local zoning or permitting rules (including ordinances) affect your site? Foundations and electrical components usually require inspections and permits.
4. Consider 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. Choose 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 requires a willingness to work from heights).
6. Choose an installer: Contact others in your area that have used renewable energy system installers and learn as much as you can. See more on this below.
7. Work 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. Insure your investment: This detail is often overlooked; consider protecting your investment with insurance.
9. Know the maintenance and operation costs: Be aware of maintenance costs for optional features like tracking systems.



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 ratio 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. (Note: Since their purchase in 2010, prices on these panels have dropped to \$1.05 and \$1.30 respectively.) Additional costs that one should consider and compare are those for the other necessary equipment (such as inverters, racks, cables, safety measures) and the cost for the design and installation of both the system and its foundation. These can vary significantly depending on the specifics of the project and site.

Other points to consider

- Choose your location on the site carefully. It will affect installation costs due to the length of cable required for connection into the building.
- Will your system be grid-tied or battery? Each option comes with site-specific trade-offs in cost and reliability.
- Tracking systems improve performance, but they 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 systems. On the other hand, they can be damaged more easily.

Additional resources

- To learn about 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 the website for more information: www.rpu.org/environment/solar-rebates.html.
 - Minnesota Department of Commerce rebate program that includes solar thermal: mn.gov/commerce/energy/topics/resources/energy-legislation-initiatives/made-in-minnesota.
 - For a comprehensive and up-to-date list of federal, state, and local incentives and rebates, head to www.dsireusa.org.
- To find qualified local vendors, consultants, and installers:
 - The Minnesota Department of Commerce, Energy Division maintains a list of certified renewable energy installers at mn.gov/commerce/energy/businesses/renewable-energy/solar/solar-photovoltaic/installation.
 - MN Clean Energy Resource Teams: www.cleanenergyresourceteams.org/technology/solar.
- RPU is also willing to share additional information on this project. Contact Bob Freund for more information at bfreund@rpu.org.

Learn More

Cascade Meadow’s website provides lots of additional information about various sustainability technologies. Visit www.cascademeadow.org for more details, and watch the website’s Events page to learn about upcoming workshops and events that can help answer your sustainability questions.

demonstrate • educate • participate

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