Solar Case Study

Great River Energy

NRECA

A Touchstone Energy® Cooperative

1. Company Profile

Great River Energy (GRE) is a generation and transmission cooperative that comprises 28 distribution cooperatives in Minnesota and Wisconsin. GRE serves about 660,000 accounts or about 1.7 million people. About 57 percent of GRE's end-use members are residential consumers, and 43 percent are commercial and industrial. It has a variety of generation resources totaling more than 2,800 megawatts, the largest of which is the Coal Creek Station with 1,140 MW of coal-based generation. GRE has sufficient capacity resources through 2027, but it will need to add renewable resources by 2024 to meet the Minnesota renewable mandate of 25 percent by 2025. As part of its resource planning and as a learning experience, GRE has deployed a 272-kilowatt solar array at its campus in Maple Grove, Minnesota. The site had an existing 72-kw rooftop array and a 250-kw wind turbine. This array was sized to not exceed the average building load.

GRE has committed to installing about 20 smaller, 20-kw arrays at its member distribution cooperatives' locations.

2. Renewable Profile

The Maple Grove solar array consists of three sections, each with a different manufacturer and configuration:

1. Sharp (180 panels of 300 watts, totaling 54 kw) supported by Creotecc racking and Cantsink helical pile foundations.
2. tenKsolar (297 panels of 410 watts, totaling 121.7 kw) supported by tenKsolar rails and Chance helical pile foundations.
3. Suniva (360 panels of 265 watts totaling 95.4 kw) supported by Carport Structures parking canopies.

The total nameplate rating is 272 kw. An Advanced Energy 100-kw AC central inverter was paired with the Suniva modules. A Solectria 50-kw AC central inverter was paired with the Sharp modules, and tenKsolar 500-watt micro inverters in 6-kw inverter buses were paired with tenKsolar panels. The annual capacity factor is estimated at 15 percent.

Construction started in January 2014 and the project entered service at the end of May 2014. The array was added as part of the GRE energy renewable generation resource mix and will serve as an overall learning experience for GRE as it deploys up to 20 planned 20-kw solar projects at each distribution co-op member's location through 2015. GRE members have the option to install additional solar modules to the array for community solar on an incremental cost basis. Two of the five installations completed in 2014 have committed to doing so, one sized at 57.4 kw and the other at 45.9 kw. Three of the 14 planned installations in 2015 have committed to adding community solar and another four are still considering it. All co-op members are allowed to supply up to 5 percent of their own needs under the current all-requirements power supply contract.

The 20-kw membership initiative was started for three primary reasons:

1. To create visibility across the membership and to showcase how the GRE portfolio is evolving by providing an opportunity for each member to have an array on its distribution system.
2. To provide a real-world, hands-on experience with small-scale solar design and installation.
3. To provide an opportunity for members to start a community solar program at a favorably priced increment.

The 20-kw-size project was chosen because it is manageable from an installation and budget standpoint. There is no limitation on the size of incremental solar that a member can add.

3. Financing and Rate Design

GRE explored a number of options for financing but chose to execute a lease structure with CoBank. It provided the best value for GRE compared to alternatives and was a relatively straightforward transaction that could be executed under GRE's existing lease agreement. The lease has a 10-year term and a buyout at the end, which allowed GRE to minimize upfront expenditures by deferring any capital requirements for 10 years.

In addition to executing a lease for GRE's solar assets, GRE also offered to execute and hold a lease for any distribution member that installs incremental solar for its own needs. GRE and the member will execute a development agreement covering the development of the solar asset and the financial obligation requirements of the lease.

Here's how it works: GRE will build and finance the project through a lease with CoBank and the co-op will simply have the obligation to pay GRE for its lease costs and for the buyout at the end of 10 years. GRE encourages its member co-ops to explore all financing and development options to determine which makes the most sense.

4. Project Development

The main requirement was to locate the solar installation within GRE's Maple Grove campus so it would be visible to the public. The only calculation for yield projection was a site shade analysis. Engineering for the project was largely completed in-house for conceptual design and component selection. Dunham Associates, the original engineer for the GRE building, performed the interconnection. Components were selected based on the country and state of origin, equipment type, availability and cost, with the goal of using as many U.S.- and Minnesota-sourced components as possible, partially to take advantage of the state tax credit.

McGough Construction was the general contractor. Standard Minnesota electrical inspection and building permits were required because this project was behind the co-op meter that serves Wright-Hennepin. The only issue encountered during the electrical inspection was the need to either fence in the array or enclose all low-voltage cables in conduit. However, fencing would detract from the look of the project and add costs, so GRE proposed a compromise in which cables were routed away from any location where someone could walk up and access them, thereby keeping conduit to a minimum.

GRE, Hunt Electric (electrical construction contractor) and Wright-Hennepin Electric Cooperative (the building power supplier) commissioned the project. An anti-islanding test was important because the interconnection was behind Wright-Hennepin's meter to the building. This requirement was easily met with the equipment used because almost all inverters today have that functionality built in. Each co-op has different metering requirements for distributed generation in terms of equipment needed and communications available to the meter. GRE has been flexible in its design to meet those needs and to use different telecommunications options to communicate with meters.

5. Operations and Maintenance

Procedures, tools, checklists and a maintenance plan are still under development. The only unscheduled maintenance issue was one panel of broken glass, the cause of which is unknown. The panel was sent to the manufacturer for analysis and replaced under warranty. No operational issues such as islanding, voltage regulation or reverse flows have been noted. As this facility serves the headquarters, the only building changes required to accommodate the solar array were additional electrical panels and 480-volt switchgear. No smart grid technology is being used; however, the building already had a rather sophisticated energy management system that is also used for monitoring the array. GRE has revenue-grade meters for each of the panel/inverter combinations that it accesses through the building management system and a separate data historian. Through the data historian, GRE has access to data in one-second increments. Small voltage fluctuations in array output, based on cloud cover, were noted, but they haven't affected operations. Real-time information on the output of the tenK-solar portion of the array is made public on GRE's website using eGauge systems equipment and web portal, and a sample graph is on page 52.

6. Administrative Impacts

The Maple Grove campus project did not require adding staff members. However, successful implementation of the 20-kw membership projects required additional internal coordination between generation, business development, land rights, billing, member services and legal departments. GRE is working on programs to help its members understand the subscription costs and to market community solar. A team effort between GRE and distribution member staff ensures that solar installation meets both parties' objectives. The four GRE staffers came from the generation engineering, member services and business development departments. Also included is one person representing the installation contractor and two or three people from the distribution cooperative. Items typically discussed included interconnection, metering and communications, size of community solar, zoning and permitting, ground preparation and soil conditions and shading structures. Other items include ground finish under the array, fencing needs, construction lay-down areas, delivery/check-in of materials, site signage, and marketing and pricing of the community portion.

The need for additional skill sets at the GRE or distribution member level is evolving and will depend on how the members decide to participate in DG. GRE is still determining what the ultimate level of involvement will be as the knowledge base increases and as the pilot program ramps up.

7. Renewable Policy Development

GRE is subject to a state renewable energy standard that currently stands at 12 percent, increasing to 17 percent on Dec. 31, 2016, and to 25 percent by 2025. GRE has sufficient resources until at least 2027 with its current resource portfolio from an overall load perspective, but it plans to add additional renewables by 2024 to comply with the increased renewables mandate.

Although GRE's board of directors sets the strategic direction for renewable initiatives, the board and the membership must approve any resource additions. The board understood the need for GRE and its membership to become involved in solar development and championed this effort, passing resolutions to enable the project's development. A press release and a fact sheet are on pages 53-55.

GRE is not rate-regulated. It is, however, required to file an Integrated Resource Plan (IRP) with state regulators every other year. The IRP contains GRE's preferred plan and alternatives during a 15-year horizon while maintaining compliance with renewable energy standards and other policies.

GRE added an amendment to its most recent power supply contract with its all-requirements members allowing 5 percent self-supply, specifically to address the addition of resources such as community solar gardens. With the exception of a couple of utility-scale wind turbines, few of its members have opted for this self-supply. For many, the ability to add community solar through the GRE program will be the first generation resource that qualifies under the 5 percent option.

GRE works actively with the Minnesota Rural Electric Association in an effort to guide state energy policy. GRE has developed a DG policy and supports a consumer's choice to supply electric needs on site as long as it does not degrade safety or reliability or create a cost burden for other consumer-members. Minnesota cooperatives are currently exempt from the state's newly enacted 1.5 percent solar energy standard. GRE members are required to offer net metering for systems less than 40 kw. Minnesota has developed a state standard interconnection and contract agreement to cover DG systems up to 10 MW, and cooperative staffs were instrumental in developing the standards.

8. The Role of the G&T

GRE foresees greater penetration of DG going forward, driven by improving technology, consumer awareness and economic incentives. It is becoming another generation resource that utilities have to account for in their long-term planning and evaluate against other generation resources. GRE believes that G&Ts should lead efforts in piloting various technologies, identifying and evaluating viable business models and providing financing solutions for its members. It should further serve as a resource to members to prevent the duplication of efforts and to provide the opportunity to mitigate risks.

To support the 20-kw membership projects, GRE developed two contracts. A standard site lease agreement allowed GRE to place an array on each member site. A solar development agreement engages members wishing to develop incremental solar that could be used as a community solar resource. The additional cost for incremental solar is at the incremental cost, which allows members to realize a very competitive price on a small-scale solar project. GRE projects that the installed cost for the base 20-kw array will be about $4.40 to $5 per watt. The member's cost for the additional member kw increments will be about $2.50 to $3 per watt.

9. Consumer-Member Interest in Solar

GRE has worked closely with its member distribution cooperatives to implement its solar initiative, installing the 20-kw solar arrays at all member sites in 2015. Member feedback is very positive. GRE's 272-kw array installation initiative has been based on

1. Developing internal skills and knowledge toward DG development on member sites.
2. Creating regional visibility.
3. Assessing the technology.

GRE made a conscious effort to use U.S.-made and Minnesota-sourced panels. The G&T conducted a cost-benefit analysis, but knowledge and visibility were more important factors than economics. GRE has a special section on its website to inform the public of the solar initiatives and to show the production of the array. Future plans include establishing a member portal on GRE's Web page to view production data from the local arrays and assembling a report to capture lessons learned and establish further guidelines for future solar installations.

10. Lessons Learned

At this point, maintenance requirements will likely be relatively site-specific. GRE observed that in the solar industry, the design and technology curve is similar to laptop PCs. There is risk from supplier turnover, supplier changes in component sourcing and technical changes. Since the project started, a panel supplier changed sourcing and a rack provider stopped making the preferred rack system. Also, the marketplace is driving down the cost of panels. All of these factors can have a significant effect on the project's economics.

Managing costs and applying the appropriate development process is critical to ensuring acceptable economics on small-scale solar installations. This kind of oversight requires a slightly different skill set than we are used to across the utility industry, which has historically relied on comparatively stable suppliers and technologies.

11. Advice to G&Ts Contemplating the Move Into DG

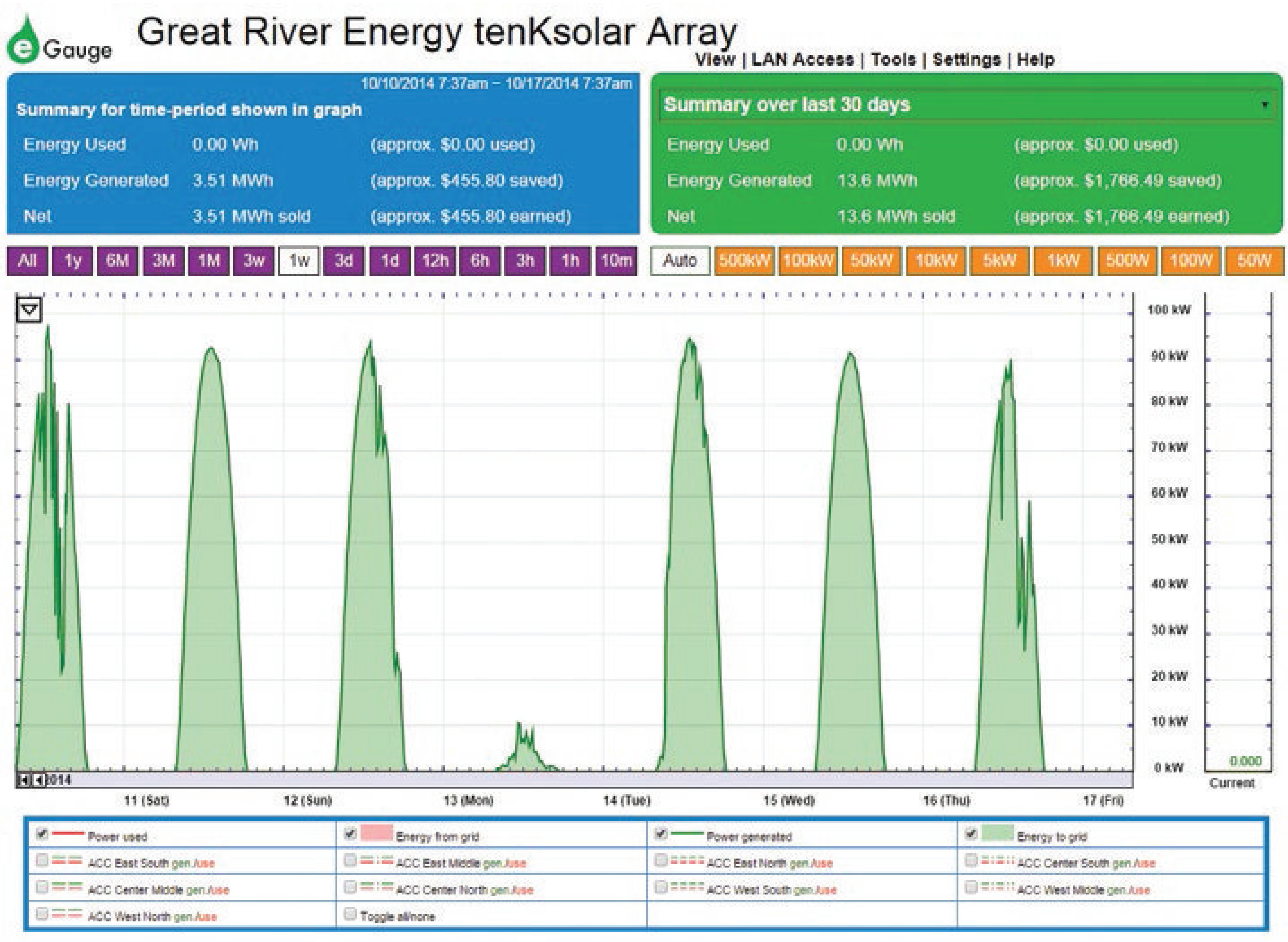
1. Work together as a membership and develop a comprehensive approach that takes into account the needs of the G&T and its distribution members.
2. Take a measured approach, limiting the financial and implementation risks.
3. Have a clear objective for the project.
4. Coordinating this activity through the G&T allows for economies of scale and socialization of costs. Most important, it allows for all of the valuable information to be shared widely throughout the membership.

For additional information, contact:

Andy Bergrud, PE
Senior Engineer PM, Great River Electric
abergrud@grenergy.com
Ph: 763-445-5809

Robert Sandberg
Manager Corporate and Business Development,
Great River Electric
bsandberg@grenergy.com
Ph: 763-445-5305

tenKsolar Array Sample Graph



Press Release

GREAT RIVER ENERGY

Home | The Cooperative Way | Making Electricity | Delivering Electricity | Saving Electricity | Learn About | About Us

Press Room

- Who We Are
- Financial
- Our LEED Buildings
- Social Responsibility
- Environmental
- Community
- Other Services
- Careers

- Press Room
- Working With Us

Great River Energy and Dakota Electric install local solar project

Dakota Electric Association's board of directors visited the new solar installation at the corner of Highway 50 and Denmark Ave. in Farmington, Minn.

Dakota Electric, along with its wholesale power supplier Great River Energy, has installed a 20-kW solar array in Farmington, Minn. Construction on the project, located at the southeast corner of Highway 50 and Denmark Avenue, is scheduled to be completed this month.

"We are happy to have this solar project installed in our service territory," CEO Greg Miller said. "Our members will benefit from the solar output as we, along with Great River Energy, learn about the performance of solar with this local project."

In addition to the Farmington solar site, Great River Energy is working with 17 other member cooperatives throughout the state to construct similar solar arrays.

In total, more than 600 kW of new solar energy installations are expected to be in service by the fall of 2015.

"These projects are teaching us and our member-cooperatives a lot about how solar performs and what it takes to plan, finance and execute a solar project," said Great River Energy senior engineering project manager Andy Bergrud. "We are learning a lot about the industry in general with this effort."

At its headquarters building in Maple Grove, Great River Energy recently completed construction on a 250-kW solar array. The project will measure the performance of different panel technologies, assess the benefits of a variety of inverters and document lessons learned while designing, permitting and installing the solar array.

"Our industry continues to evolve," said Rick Lancaster, vice president of generation at Great River Energy. "As an organization, we need to understand how these technologies may affect our business now and in the future, as well as research the impacts to our distribution system and evaluate the overall costs to integrate both large- and small-scale solar installations."

In the future, Dakota Electric will place a display on the company's webpage that will show the solar panel's actual output.

Careers | Press Room | Contact Us

12300 Elm Creek Boulevard, Maple Grove, MN 55369-4718 P: 763-445-5000 F: 763-445-5050

Privacy | Terms | Site Map

Cooperative solar projects span state

Great River Energy building distributed solar network throughout Minnesota

The electric cooperatives of Minnesota are working together to convert the sun's rays into electricity throughout every corner of the state.

In 2014 and 2015, solar arrays will be installed at sites owned by electric cooperatives. The projects are being led by Great River Energy, a wholesale electricity provider to electric cooperatives.

The local solar installations are part of a series of 18 projects, each with an electricity generating capacity of 20 kilowatts (kW). The solar projects will help Great River Energy and its member cooperatives evaluate the impact of solar energy while providing up to 500,000 kilowatt-hours (kWh) of renewable energy annually.

Although the installations will be designed, built and owned by Great River Energy, the company will work with each participating member cooperative to identify the ideal location. Additionally, Great River Energy will assist the member cooperatives with interconnection efforts and collect key information about energy production and system interaction.

Most of the solar arrays will use a packaged system design from tenKsolar. One will install panels made by Silicon Energy. Both manufacturers are Minnesota companies.

Some of the participating cooperatives are exploring plans to install additional solar arrays at sites in their service area.

Research and development

The first and largest in the series of solar installations was completed at Great River Energy's Maple Grove, Minn., headquarters site in June 2014. The 250-kW project has a research and development component that will test the performance of a variety of technologies and configurations.

The cooperative solar installations will employ solar technology from Minnesota companies tenKsolar and Silicon Energy. Energy Concepts installs and commissions the projects.

The project will enable Great River Energy and its member cooperatives to research how solar energy can work best when connected to cooperative electric systems in Minnesota and provide valuable information for future utility-scale solar projects.

Additionally, Great River Energy is working with the National Rural Electric Cooperative Association (NRECA) and Department of Energy (DOE) to analyze various business cases for distributed generation and solar installations. That work, which is funded by a joint DOE/NRECA grant and part of DOE's SunShot Initiative, will provide valuable information for cooperatives across the country.

Using a variety of solar panels and different types of electrical systems to collect and convert electricity, Great River Energy will analyze the solar energy facilities for: energy production, power quality, efficiency, durability, ideal installation conditions, reliability and finance structure.

Great River Energy's headquarters site will test a variety of solar technologies and configurations. The new 250-kW installation expands upon 72 kW of solar panels that were installed in 2008. The array includes panels made by Sharp (two rows pictured at bottom), tenKsolar (three square-shaped clusters) and Suniva (three rows closest to the building).

Great River Energy – Powering what's possible

Agralite Electric Cooperative • Arrowhead Cooperative, Inc. • BENCO Electric Cooperative • Brown County Rural Electrical Association • Connexus Energy • Cooperative Light & Power • Crow Wing Power • Dakota Electric Association • East Central Energy • Federated Rural Electric Association • Goodhue County Cooperative Electric Association • Itasca-Mantrap Cooperative Electrical Association • Kandiyohi Power Cooperative • Lake Country Power • Lake Region Electric Cooperative • McLeod Cooperative Power Association • Meeker Cooperative • Mille Lacs Energy Cooperative • Minnesota Valley Electric Cooperative • Nobles Cooperative Electric • North Itasca Electric Cooperative, Inc. • Redwood Electric Cooperative • Runestone Electric Association • South Central Electric Association • Stearns Electric Association • Steele-Waseca Cooperative Electric • Todd-Wadena Electric Cooperative • Wright-Hennepin Cooperative Electric Association.

greatriverenergy.com/solar

GREAT RIVER ENERGY®
A Touchstone Energy® Cooperative

7-30-2014

12300 Elm Creek Blvd., Maple Grove, MN 55369