

Project Title: Optimizing Renewable Electric Energy Generation on Minnesota Dairy Farms

Contract Number: RD4-2 Milestone Number: 2 Report Date: 9/1/2016

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MILESTONE REPORT

Executive Summary:

This project has three primary goals: to increase the market penetration of renewable electric energy resources on Minnesota dairy farms by developing an optimized and integrated on-site electrical generation system, to support Minnesota companies through field testing and validation of their commercial, or soon to be commercial, renewable electric generation systems and components, and to reduce the carbon footprint and increase the long-term profitability of Minnesota dairy farms through on-site renewable electricity generation.

The second milestone for this project involves completing the contracts for solar PV and small-scale wind renewable energy systems. Sites have been selected for the ground-mounted solar PV array and two small scale (10kW) wind turbines, and purchase orders have been released. Finalizing the sites and contracts for these systems is an important step in the overall project because it allows construction to begin on the renewable electric systems.

Technical Progress:

Siting considerations for the solar PV array included finding a site with no shading from the south that is relatively flat and large enough (about 80' square) for the array without impinging on any road easements. It is also a good idea to have ground-mounted panels sited where they won't be in the debris path from mowers or snow blowers. The panels for this project were mounted 7 feet off the ground to allow the area under the panels to be mowed and possibly used for future studies on growing pollinator habitat under solar panels. Mounting them higher resulted in no additional installation costs.

In general, sites for wind turbines are selected for the average wind speed at the proposed tower height, lack of obstructions especially in the direction(s) of the predominate prevailing winds, and proximity to an interconnection point like a utility transformer. Additionally, each county has its own set of ordinances regulating the location of towers. Good information on average wind speeds can be obtained from the National Renewable Energy Lab (<http://www.nrel.gov/gis/wind.html>), but it is often advisable to have an on-site wind assessment

done by a qualified contractor. A good rule of thumb for obstructions is to have the lowest point of the turbine rotor at least 30 feet above any structures within 300 feet of the tower.



Fortunately, a wind assessment was done at the WCROC in preparation for a utility scale turbine installed in 2005. The assessment provided confidence in predictions of energy output from the turbines. The assessment also indicated the predominate wind directions are from the northwest and southeast so sites with fewer obstructions in those directions were preferred. In Stevens County, towers must be located at least 1.1 times the tower height away from property boundaries, one times the tower height from any road easement, and 750 feet from neighboring dwellings. After all these considerations, two sites were chosen. One near the solar array and one in a cow pasture. Both sites are well away from farm boundaries and buildings, and offer relatively little obstruction in the predominate wind directions.

Each wind turbine system consists of an 80 foot tall tower made by ARE Telecom, a 10 kW turbine made by Ventera, and an inverter to condition the generated electricity and feed it to the utility grid. There is also a disconnect switch mounted near each tower base to allow a quick shut down of the turbine in the event of an emergency. Usually, a two-way meter will be installed by the utility to measure production of the turbine for proper billing credit. The turbine located in a cow pasture will also have 4 kW or solar PV panels mounted to its base and a separate inverter and disconnect switch. This tower site was chosen for the wind/solar hybrid installation because it has much better southern sunlight exposure than the other site.

The ground-mounted solar array is comprised of Minnesota made tenKsolar panels and inverters. It is mounted on a rail system provided by the panel manufacturer which is in turn

mounted on 12 foot long helical screws that were bored directly into the ground. A concern arose about the inverters properly isolating the array from the utility grid if power is lost on only one phase. This was addressed by installing an additional phase relay that will isolate the array if power is lost to any of the three phases. The array passed the final electrical inspection and islanding test and was interconnected on October 4th.

Additional Milestones: Work continues on Milestones 3 and 4 (starting and completion of the renewable energy installations). There has been a delay in the schedule to install two 10 kW wind turbines due to longer than expected lead times for the tower monopoles and turbines.

Project Status: Project is well on track with the solar PV array, but is a little behind schedule with the wind turbines. The wind turbines are scheduled to be complete by the end of November.

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