

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

Contract Number: RD4-2 Milestone Number: 1 Report Date: 4/6/2016

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Congressional District: (Project location) 7th District

MILESTONE REPORT

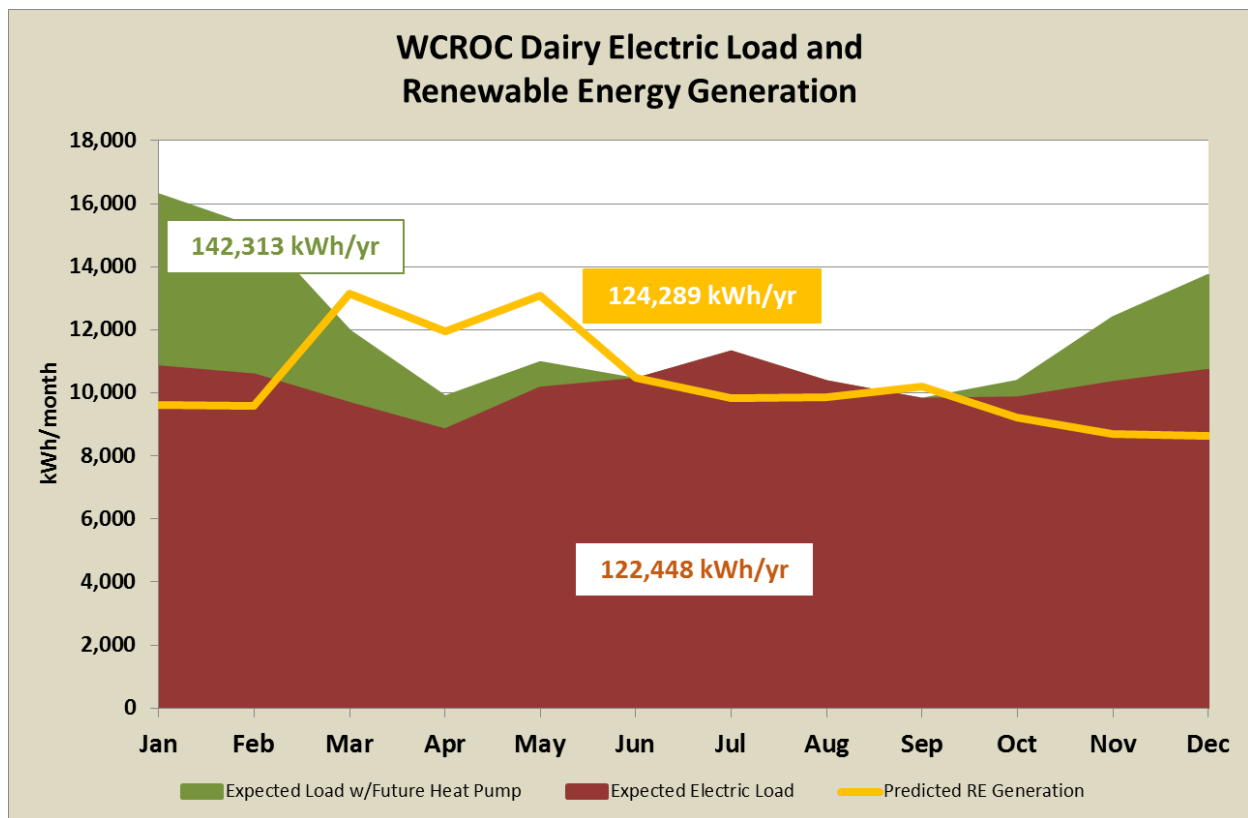
Executive Summary: Energy usage data has been collected in the WCROC dairy parlor for over one year as part of a separate sponsored project. Data compiled for calendar year 2015 shows the dairy produced 363,000 gallons of raw milk from the combined conventional and organic grazed herds. Collecting and cooling the milk as well as maintaining cow and human comfort in the parlor consumed 105,750 kWh of electricity and about 5,000 therms of natural gas.

One goal of this project is to make the dairy 'Net Zero' by converting thermal loads from natural gas to electricity, implementing energy efficiency measures, and installing renewable electricity generation. It is predicted that converting gas water heating appliances to electricity will increase the total annual electric load to about 122,000 kWh, and converting the gas furnace to an electric heat pump will bring the annual load to about 142,000 kWh.

20 kW of nameplate wind energy (two 10 kW wind turbines) and a total of 54 kW of solar PV will be installed as part of this grant to provide renewable electric generation. The predicted annual generation from these systems is about 124,000 kWh. This should be sufficient to make the barn net zero even with the new electric water heating load. Future funding will be sought to replace the gas furnace with a heat pump to completely electrify the dairy energy load, and, with modest energy efficiency measures, the planned renewable electricity sources should be able to maintain the net zero status.

Technical Progress: Details of the energy assessment in the dairy parlor and of the predicted renewable electric generation are included in the attached reports. The results of both reports are summarized in the following chart. The expected electric load (maroon region) is the electric load measured in the dairy parlor during 2015 plus the expected additional electricity needed for the tankless electric water heaters that have been installed to replace the current gas fired model. The green region in the chart represents the expected load plus the additional load that would result from replacing the existing gas furnace with an electric heat pump to heat the parlor. The heat pump is assumed to operate with a Coefficient of Performance (COP) of 2.5.

Engineered drawings for the electrical site plan, north and south wind turbines, and new dairy electrical service are attached. The plan for the ground mount solar system was included in the November monthly report with the PO to Cedar Creek Energy for the system.



Additional Milestones: Work on Milestone 2 is almost complete. The only remaining item is to secure an electrician for the wind turbine installation. Contracts for the solar PV and turbine/tower systems have already been executed.

Project Status: Installation of the solar PV system and commissioning of the new electrical and control systems in the dairy parlor are expected to start in May. Installation of the turbines will not be until August due to a long lead time for the tower which is manufactured in China.

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Appendix: Dairy Energy Report, RE Predicted Performance Report, energy system engineered drawings

Project funding provided by customers of Xcel Energy through a grant from the Renewable Development Fund.