

**Solar Array at the Red Lodge Wastewater Treatment Plant
Analysis of Operations (six years)**



**Katelynn Essig, Sustainability Coordinator – Energy Corps
City of Red Lodge, Montana
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I. Photovoltaic System Description

Located at Two Mile Bridge Road, the solar panel array provides electricity for the Red Lodge Wastewater Treatment Plant. This system is a 60 panel, 48.75 kW array facing and tilting south for optimal sun capture. The Red Lodge Climate Protection Group, a local group of volunteers, coordinated the planning for the installation. Resolution 3293 to approve the solar panel variable frequency drive project was passed by the Council on October 6, 2009.

II. Project Cost

The total project cost was \$510,706. This included the installation of solar panels, variable frequency drives on the blowers, and new control and monitoring units in the treatment lagoons to increase efficiencies. The City received \$265,567 (52%) from the Montana Department of Environmental Quality via the American Reinvestment and Recovery Act, Northwestern Energy, a Local Government Infrastructure Grant under Montana HB 645, and the State Revolving Fund Program. The City borrowed \$245,139 at an interest rate of .75% for 20 years. Annual payments are \$13,245.

The 48.75kW system was originally estimated to produce 6,500kWh/month. Over a 30 year projection, this system was projected to produce in excess of 2,340,000 kWh and save the City \$351,000 based on an average rate of \$.15/kWh.

III. Installation Issues

Sundance Solar Inc. installed the solar system that was operational by late August 2010. However, the initial net-meter installed by Northwestern Energy did not accurately record kWh and 40,000 kWh was credited upon installation of a new meter. In addition, the system was offline for around four months while this issue was being resolved.

IV. Net-Meter Reading – May 2016

The last inverter meter reading was completed on May 1, 2016 that showed 355,069 kWh had been produced by the system since it went live in late August 2010. Calculations have been completed to determine the array's output for the last six years.

V. Estimated kWh Produced, May - September 2016

The kWh for May to September 2016 were calculated and added to the May 2016 meter reading, given that the peak sun changes drastically between winter and summer months.

Estimated kWh produced from May to September 2016				
Average sun hours per day for summer months	Number of days May-Sept.	Hours of operation for May-Sept.	Solar array kW	Total kWh
6.12 hrs.	150 days	918 hrs.	48.75	44,752.5 kWh

Average hours of 100% sunlight for the summer months are 6.12 hours/day (industry standard) and the number of days from May 1st to September 30th is 150. This equates to 918 hours of operation. The total kWh produced is 44,752.5 (918 hours x 48.75 kW solar array output). As a result, 399,821.5 kWh (44,752.5 plus 355,069 May 1 meter reading) have been produced for the 69-month period since 2010. The number of months has been calculated as 73 operational months from September 1, 2010 through September 30, 2016 minus four months of no activity.

This calculates to an average of 5,794.5 kWh (399,821.5 / 69) produced monthly since installation.

VI. Six-Year Production Analysis

The current estimate of monthly energy produced is less than originally projected as the panels were originally estimated to produce 6,500kWh/month. The six-year average is 5,794.5 kWh/month.

The cost of electricity is not as high as originally estimated, as in 2016 the City pays an average \$.11/kWh whereas the original estimate was \$.15 /kWh. The drop in electricity costs combined with the lower than anticipated production has resulted in less financial savings than originally estimated.

At \$.11cents/kWh, the solar array has saved the city \$43,980.37 (399,821 kWh x \$.11) or about \$7,648.76 per year (\$43,980.37 / 69 months x 12). This results in an estimated payback period for the City's costs of 34.7 years (\$265,567 / \$7,648.76). The payback period is likely to decrease over time as United States Department of Energy projections depict an increase in the price of kWh over the next 20 years.

In terms of carbon emission, the solar production has saved 281 metric tons of CO₂e from the atmosphere. This is equivalent to 266 acres of forest capturing carbon for one year and offsetting 673,409 miles driven by an average passenger vehicle.

VII. Recommendations

Decreased production from original estimates can be caused from bird waste on the solar panels or from snow, creating spots on the panels where no energy is being produced. A maintenance plan should be developed to introduce power washing in the summer and to determine the financial feasibility of tilting the solar array further for better sun capture.