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Minnesota Solar Electric Rebate Program Report 2002-2008

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Overview

Minnesota achieved a milestone of more than one megawatt of total solar photovoltaic (PV) capacity in 2008. The Minnesota Solar Electric Rebate Program offered financial assistance for most of this development, along with federal incentives (that were recently extended through December 31, 2016). The program has supported 227 solar PV installations in Minnesota, with another 46 projects in progress; the average system size is 4.6 kW.

Walewski 2.16 kW residential installation

Solar Potential in Minnesota

A common misconception is that the solar potential of a given region is related primarily to average temperature. In reality, Minnesota has a significant solar resource despite its cold climate. The Minnesota Solar Electric Rebate Program was instrumental in demonstrating that solar is a viable energy resource in Minnesota.

The PV installations completed and in progress under the program have helped lay the foundation for easier permitting, financing, interconnection, and installation of larger solar projects. Just as the wind industry is now able to capture economies of scale during installation and operation of large scale wind, the goal of the solar industry is to capture those same benefits as business, government, and other stakeholders work to reduce manufacturing costs and minimize transaction costs related to siting, financing, and managing solar projects.

Minnesota receives more solar energy in one day than the energy consumed by the state in an entire year. In fact, the resource potential of solar energy in Minnesota is sufficient to produce the equivalent amount of electricity used by the entire state in an area just 14 miles on a side.

Solar Rebate Program Results

From 2002 through 2008, the Minnesota Solar Electric Rebate Program offered direct subsidies for grid-connected, customer-sited solar electric systems. The program was delivered in two phases and funded by two installments from the Xcel Renewable Development Fund (RDF) totaling $2.15 million with an additional $200,000 from the state general fund. Rebate amounts and eligibility were determined as follows:

- The standard rebate, $2.00 per watt, was available to all Minnesota residents, businesses, and organizations, with the exception of electric utilities.
- Program guidelines specified minimum standards for installer eligibility and for appropriate siting of PV systems.
- Minimum system size was 0.5 kW (kW) while maximum system size limits were adjusted twice during the program and ranged from 2 to 40 kW. The maximum system size was changed to distribute available funds as efficiently and fairly as possible.
- An additional $0.25 per watt was made available after July 1, 2008 to those applicants who chose North American Board of Certified Energy Practitioners (NABCEP) certified installers.

The program resulted in 227 solar PV installations with another 46 projects in progress. The average system size is 4.6 kW. (See Appendix for more details.)

After the first phase of the program was initially introduced in 2002, there were few solar rebate applicants. It was not until 2006 that the $1.15 million available was fully reserved. For the most recent biennium, fiscal years 2008-09, the additional $1.2 million appropriated was fully reserved eight months prior to the end of the funding cycle.

The two phases of the Solar Electric Rebate Program from 2002-2008 leveraged approximately $4 of non-state funds for every $1 invested by the state.

Table 1: Funding Schedule for the Solar Electric Rebate Program

Funding Source	Amount	Date Available	Funds Fully Reserved
Xcel RDF	$1,150,000	2002	November 2006
Xcel RDF	$500,000	July 1, 2007	March 2008
Xcel RDF	$500,000	July 1, 2008	October 2008
General fund*	$200,000	July 1, 2008	October 2008

*$100,000 reserved for the new Minnesota Solar Hot Water Rebate Program.

PV Cost

While the price of solar PV has declined nationwide, Minnesota has not capitalized on declining costs of solar largely due to two factors: 1) the small collective size of the state's solar market and 2) the predominance of relatively small individual PV systems. According to a cost study done by Lawrence Berkeley National Laboratory (LBNL), systems completed in 2006 and 2007 that were less than two kW in size averaged $9.00 per watt nationwide, while systems larger than 750 kW averaged just $6.80 per watt.[1] However, system sizes are increasing in Minnesota; the largest known PV system is 100 kW and larger systems are in the planning stages.

Table 2: The Five Largest Solar PV Systems on Record in Minnesota

Installation	City	System Size (kW)	Year Installed	Owner Type
Merrick Corporation	Vadnais Heights	100	2008	non-profit
Hennepin County	Medina	97	2009	government
Great River Energy	Elk River	70	2008	business
Quality Bicycle Products	Bloomington	40	2007	business
Pellco Machine Inc.	Saint Michael	40	2007	business

The LBNL study also found that new construction offers cost advantages for PV systems compared to those that are retrofitted. Among small residential systems in California completed in 2006 or 2007, those systems installed in residential new construction cost 60 cents per watt less than comparably-sized retrofit applications.[2]

While the average cost of solar remains relatively high (approximately $10 per watt installed in Minnesota), the U.S. Department of Energy projects solar photovoltaic costs nationwide will reach grid parity by 2015.[3] In other words, solar PV generated electricity is expected to become cost competitive with conventional energy delivered to the grid within the next decade.

[1] Wiser , Ryan et al. Tracking the Sun: The Installed Cost of Photovoltaics in the U.S. from 1998–2007. Feb 2008. http://eetd.lbl.gov/ea/emp/reports/lbnl-1516e.pdf.
[2] Wiser , Ryan et al. Tracking the Sun: The Installed Cost of Photovoltaics in the U.S. from 1998–2007. http://eetd.lbl.gov/ea/emp/reports/lbnl-1516e.pdf. Feb. 2008.
[3] DOE Solar America Cities. http://www.solaramericacities.energy.gov/. Assumes business as usual case.

Solar Energy Production

The original program goal was to achieve a minimum solar energy production of 960 kilowatt-hours per year, per kilowatt of installed solar capacity. According to a survey of Minnesota Solar Electric Rebate Program participants completed by the Office of Energy Security (OES) in February 2009, average solar energy production among program participants was 1,170 kilowatt-hours per year per kilowatt of installed solar capacity.[4] This corresponds to a 13.4% capacity factor. Fifteen of the projects reporting were single or dual axis tracking systems and attained higher than average capacity factors. (Tracking PV systems follow the path of the sun throughout the day, thereby increasing energy production compared to a conventional fixed PV system.) See Tables 3 and 4 for details.

Table 3: Performance Table Showing Average Production for Phase I of the Program

Production Kilowatt-hours/kW/Year	Fixed or Seasonal	Single/Dual Tracking
Count	55	8
Max	1368	1603
Min	779	1195
Ave	1128	1458
Standard Deviation	148	149

Table 4: Performance Table Showing Average Production for Phase II of the Program

Production Kilowatt-Hours/kW/Year	Fixed or Seasonal	Single/Dual Tracking
Count	29	7
Max	1743	1846
Min	551	1191
Ave	1182	1593
Standard Deviation	254	231

The overall average solar production was decreased due to inverter problems. Several owners of systems reported the need to replace inverters. Inverter problems are expected to become less frequent because manufacturing improvements have been made and standard warranties have increased from two years to five-ten years. Most inverters manufactured today are expected to have a minimum ten year life.

The benefit of implementing energy efficiency improvements as part of a solar project is stressed early in the application process for the Minnesota Solar Electric Rebate Program. Using a combination of efficiency and solar energy, it is not uncommon to meet most of a building's electricity needs. The strongest solar projects are those that optimize the efficiency of a building so that every kilowatt-hour of solar production is maximized.

Northfield School of Art and Technology 1 kW system

[4] As part of the survey, OES used an upper limit for capacity factor of 20% and followed up with PV system owners reporting capacity factors of greater than 20% to verify system sizes, and the start and end dates for reported data. If the discrepancy could not be resolved, system owners with a capacity factor of 20% or greater were excluded from the analysis.

Jobs in Solar PV
During 2007 and 2008, 30 Minnesota solar installation businesses participated in the Solar Electric Rebate Program, compared to 17 businesses during 2002-2006. These companies typically employ four to ten employees. Most do not exclusively provide solar PV services, but offer other services as well. Solar installation companies typically work in partnership with electricians, general contractors, and engineers through subcontracts.

After July 1, 2008, the program was limited to professional installations by licensed contractors and professional engineers in an effort to support workforce development, offer consumer protection, and encourage better performing systems. Throughout the program, the solar installer was required to work in partnership with a licensed electrician, as required by state law.

In addition, program guidelines were revised effective July 2008 to offer additional incentives ($2.25 per watt instead of $2 per watt) to applicants who chose North American Board of Energy Practitioners (NABCEP) Solar PV Certified installer. Minnesota is one of a number of states whose programs recognize the value of NABCEP certification. NABCEP certified installers have signed a code of ethics, met specific standards of experience and training, and passed a four-hour exam. This voluntary certification helps protect consumers and enhances the solar profession by promoting training and regular continuing education. The number of certified installers in Minnesota increased from four to fourteen between 2006 and 2008. The number of installers in training to obtain certification continues to grow.


Quality Bicycle Products; 40 kW


Hermann Residence; 1.0 kW

Utility Solar Incentives in Minnesota
Two utilities, Minnesota Power and Great River Energy, offer solar electric rebates to customers in their service territories who are eligible for the state solar rebate program. These utilities match state funds for up to 2 kW of solar electric capacity or $4,000. Minnesota Power's program was first offered in 2004 and has issued 46 utility solar rebates while Great River Energy electric cooperative members have issued 55 solar rebates since program inception in 2006. These 101 installations represent nearly 45% of all PV projects completed to date under the program statewide. OES continues to review applications on behalf of these utilities, although state rebate funds are currently fully reserved.

Austin Public Utilities offers the *Solar Choice Program* which began on October 1, 2005. Rates paid to PV system owners are posted annually and can be up to $1 per kilowatt hour depending on the number of participants. The first payment was made in April 2007. As of October 2008 there were 70 purchasers participating in the program and two solar energy producers.

Information about these programs and other energy incentives can be found at the Database of State Incentives for Renewables & Efficiency at www.dsireusa.org.

Solar Industry Outlook in Minnesota

Solar electricity is one of the fastest growth industries in the nation. According to an industry report, the global solar PV market grew by 62% in 2007[5] and 110% in 2008.[6] The United States advanced to third behind Spain and Germany in terms of world demand. Industry experts expect interest in solar to continue to increase. However, financing and cost remain the primary challenges to solar deployment. Federal incentives available through 2016 will likely increase adoption of renewable energy technologies including solar PV in the U.S., particularly among those businesses that have adequate tax liability to benefit from tax credits.

Minneapolis Saint Paul: Solar America Cities

The U.S. Department of Energy (DOE) named Minneapolis Saint Paul *Solar America Cities* in 2008. OES is a partner to the Minneapolis-Saint Paul Solar America Cities project that offers both federal funding and technical assistance from national experts. The Minneapolis Saint Paul Solar Cities project is built on a unique partnership between the cities, the state, utility, industry, and non-profit organizations. All 25 Solar America Cities selected share the fundamental goal of making solar a common energy resource among residents, utilities, and within city infrastructure.

During the two-year project, the cities will engage in a strategic planning process, apply lessons learned in other Solar America Cities, and disseminate best practices regionally. This effort is intended to lay the groundwork for widespread solar deployment in the Upper Midwest as the technology becomes cost competitive.

According to Charlie Hemmeline, Deputy Director of Market Transformation for DOE, "Rather than treat solar as a novelty or demonstration, we wanted partners ready to treat solar as a serious component of their energy infrastructure - to make it mainstream. That would mean that cities would need to plan for solar in light of their various roles as customers, as policy makers, and as influencers of their residents."[7]

Conclusion

As recognized leaders in renewable energy development, Minnesotans are increasingly investing in capturing the solar resource for the benefit of Minnesota's economy, environment, and energy security. To date in Minnesota the 227 solar rebate recipients along with the 58 or more PV systems installed outside the Program have demonstrated that solar energy is a useful and viable resource in Minnesota.

We welcome the opportunity to respond to any questions you may have about the report or the Solar Electric Rebate Program. For more information please contact:

Office of Energy Security
(651) 296-5175
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[5] Solarbuzz: Annual World Solar Photovoltaic Industry Report. http://www.solarbuzz.com/Marketbuzz2008-intro.htm Mar. 2008.
[6] Solarbuzz: Annual World Solar Photovoltaic Industry Report. http://www.solarbuzz.com/Marketbuzz2009-intro.htm Mar. 2009.
[7] Interstate Renewable Energy Council newsletter, www.irec.org Dec. 2008.

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APPENDIX

Minnesota Solar Installations

as of **March 30, 2009**

Installed Capacity (kW)

	≤ 2002	2003	2004	2005	2006	2007	2008	2009	In Progress
residential	1.7	14.9	56.1	41.3	83.0	108.9	109.3	52.1	99.3
business	0.0	14.1	10.9	14.4	12.7	136.5	31.3	52.3	82.1
non-taxable	0.0	1.0	37.9	13.1	14.5	40.2	9.9	25.6	25.1
non-rebate	129.0	25.5	2.0	26.9	1.0	0.0	179.3	2.0	0.0
Total Annual	130.7	55.4	106.9	95.8	111.2	285.6	329.7	132.0	206.5
Cumulative	130.7	186.1	293.0	388.7	500.0	785.6	1115.3	1247.3	1453.8
Average	2.8	3.5	3.0	3.8	3.5	5.4	6.0	5.7	4.6
Median	2.3	1.9	1.9	2.3	2.8	2.9	2.7	3.9	3.5
Mode	2.9	1.2	1.2	2.5	2.7	2.1	2.0	2.0	2.9

Average System Cost per kW*		$8,461	$7,557	$8,707	$8,643	$9,319	$9,417	$10,312
Average Non-State Cost Share per kW*		$6,470	$5,691	$6,707	$6,643	$7,340	$7,550	$8,681
Program $ per year	$3,300	$59,560	$204,428	$137,762	$220,452	$567,988	$309,785	$215,314

*dealer installations only

Number of Installations

	≤ 2002	2003	2004	2005	2006	2007	2008	2009	In Progress
residential	1	8	29	15	26	37	37	14	28
business	0	3	3	3	2	9	10	3	10
non-taxable	0	1	3	4	3	7	5	5	7
non-rebate	45	4	1	3	1	0	3	1	0
Total MN Annual	46	16	36	25	32	53	55	23	45
MN cumulative	46	62	98	123	155	208	263	286	331

Annual kilowatt hours per kilowatt DC installed

	≤ 2002	2003	2004	2005	2006	2007	2008
fixed	1255	967	1050	1018	1226	1167	1234
seasonally adjusted			1171	1164	1175	1090	1185
single axis tracking					1603		1838
dual axis tracking			1298	1529	1597	1526	1566