



**Minnesota Renewable
Energy**
Year in Review
2016

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More than 22% of Minnesota’s electricity came from renewables in 2016

Wind energy generated nearly 18% of the state’s electricity

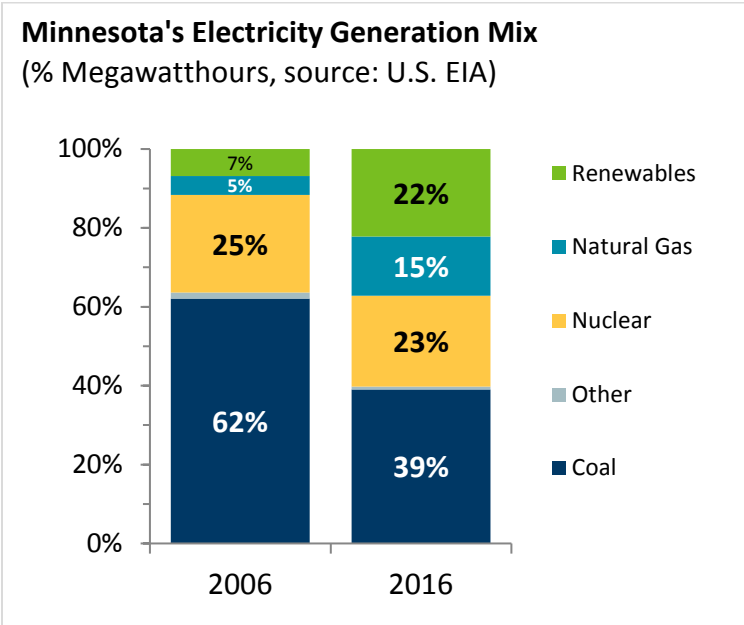
Minnesota’s commitment to renewable energy continues.

Minnesota generated more than 22% of its electricity from renewable energy sources in 2016, according to figures compiled by the Minnesota Department of Commerce and the U.S. Energy Information Administration (EIA).

From 2006 to 2016:

- Renewables tripled from 7% in 2006 to 22% 2016.
- Wind increased more than fourfold, from 4% in 2006 to 18% in 2016
- Natural gas tripled from 5% in 2006 to 15% in 2016
- Coal decreased by about one-third from 62% in 2006 to 39% in 2016

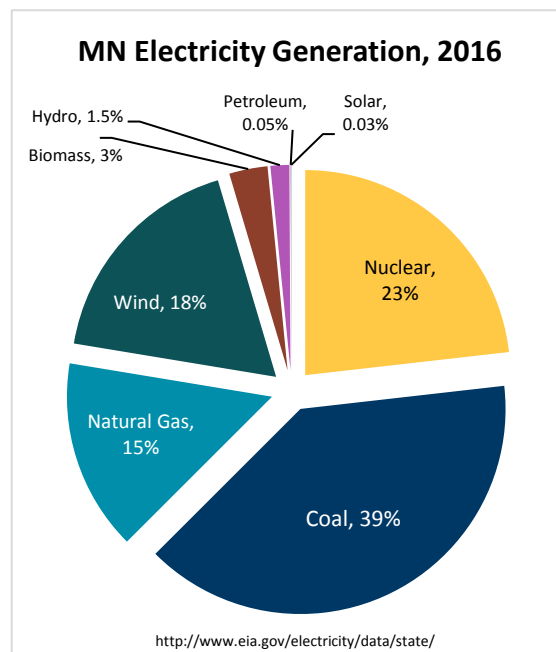
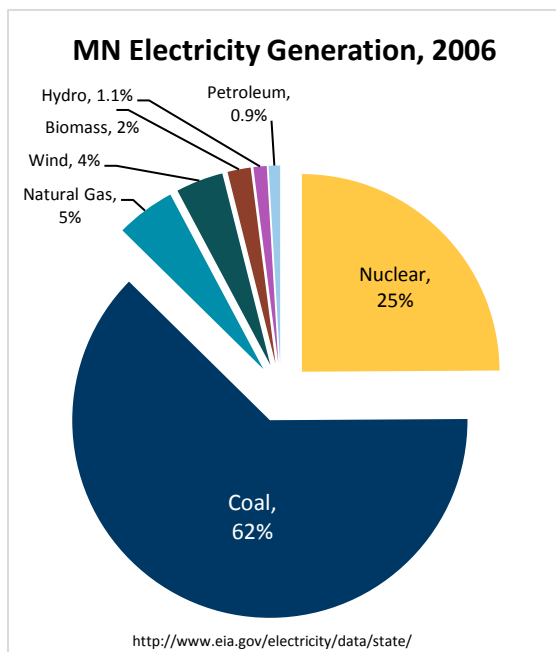
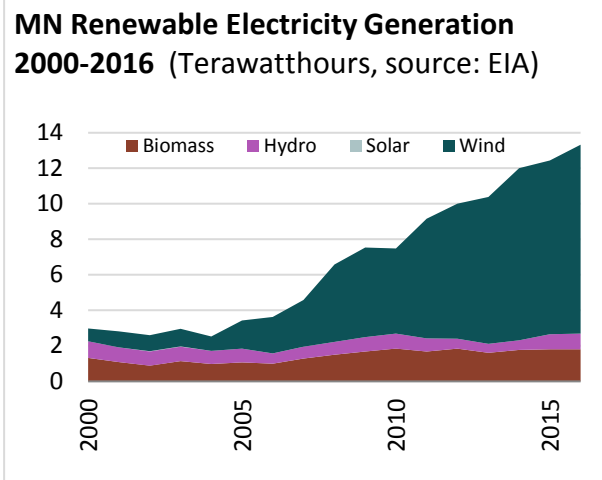
With 4,445 megawatts (MW) of electric power coming from renewables and with utility plans to add low-cost renewable energy resources for ratepayer benefit, Minnesota continues to be on pace to exceed its Renewable Electricity Standard of 25% of electric power coming from renewable sources by 2025, as set by the state’s [Next Generation Energy Act of 2007](#).



Minnesota renewable energy generation in 2016 came from these sources:

- 3,509 MW_{AC} wind^{1, 2}, contributing 17.7% of energy generated in Minnesota³
- 246 MW_{DC} solar PV¹, contributing 0.035%⁴ of energy generated in Minnesota
- 487 MW_{AC} biomass electricity production⁵, contributing 3.0% of energy generated in Minnesota³
- 203 MW_{AC} hydroelectric⁵, contributing 1.5% of energy generated in Minnesota³

AC = Alternating Current, DC = Direct Current



According to data from the U.S. Energy Information Administration (EIA), clean energy sources are taking center stage in Minnesota. For instance, wind energy generated just 3.9% of the state’s electricity in 2006 and jumped to 17.7% in 2016, while electricity from coal dropped from 62.1% in 2006 to 39.0% in 2016. Biomass increased from 1.9% to 3.0% in the same time span.

¹ Minnesota State Energy Office

² American Wind Energy Association

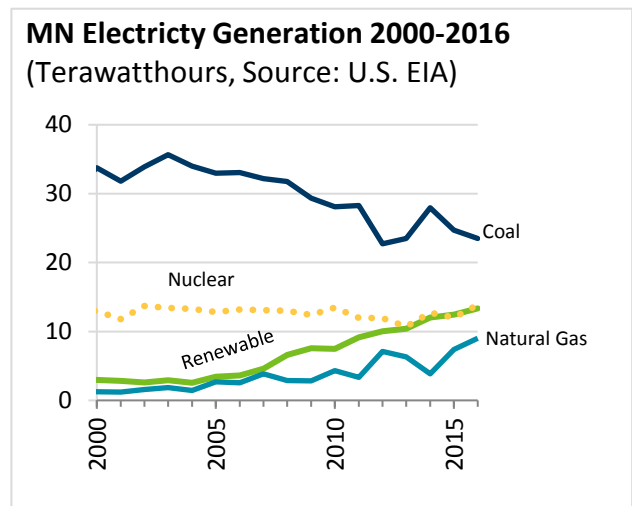
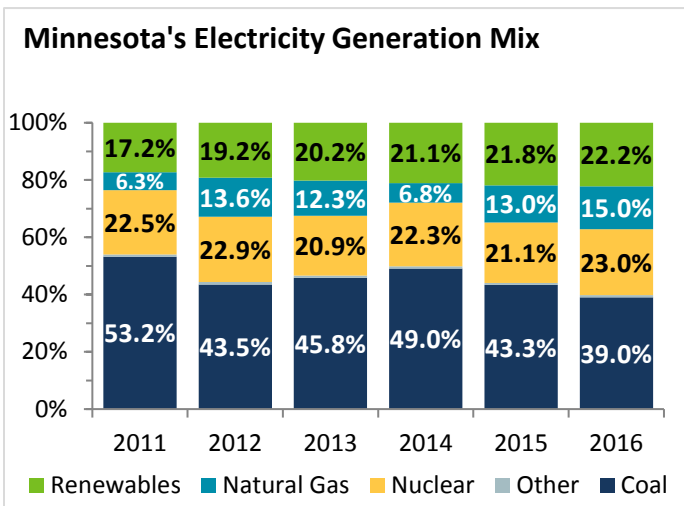
³ [Energy Information Administration](http://www.eia.gov)

⁴ Because most of the new capacity was installed in mid-December, solar produced only 0.03% of all electricity generated in Minnesota for the full year 2016 (according to EIA data). See the Solar section of this report for details.

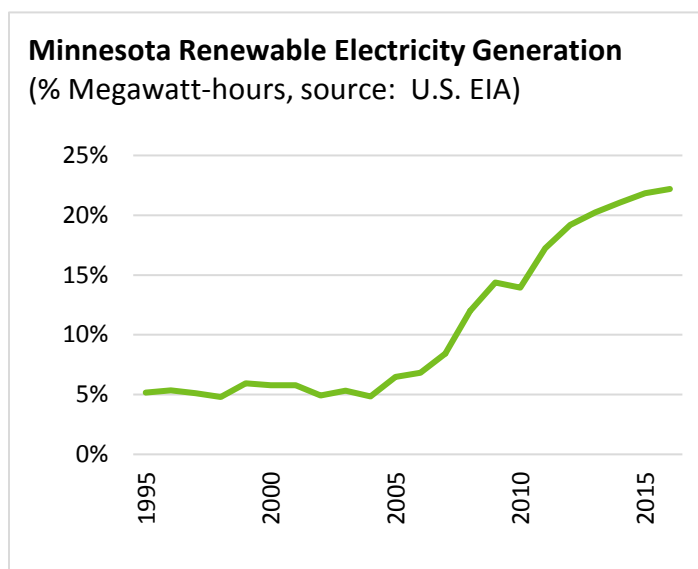
⁵ [Midwest Renewable Energy Tracking System](http://www.midwestrenewableenergy.com)

Overall, renewable energy generated 6.8% of the state’s electricity in 2006 compared to 22.2% in 2016, a more than 300% increase in the past decade. (See charts for 2006 and 2016 above to gauge renewable energy growth; EIA data is through December 2016.)

While solar energy’s contribution to the state’s electric power was relatively small in 2016 at 0.03% of in-state generation, solar capacity continues to build traction and is expected to see significant growth in the next several years. Similarly, with renewed federal tax credits for wind projects, the near future for wind also looks promising.



In each year from 2013 to 2016, renewable energy and nuclear power in Minnesota have generated nearly the same level of electricity. Note: From 2012 to 2013, coal generation decreased and natural gas increased with the outage at the Sherco 3 generator.



Planned Development from Utility Resource Plans

Minnesota's electric utilities are continuing to consider least-cost plans for their generation systems. In many cases, the least-cost plan includes significant expansion of renewable energy resources.

Minnesota Power

Minnesota Power met Minnesota's Renewable Electricity Standard a decade early. By 2015, 26 percent of Minnesota Power's retail and wholesale electric sales were from renewable energy sources. However, in June 2016, when the Public Utilities Commission voted to approve Minnesota Power's 15-year resource plan, it asked the utility to solicit proposals for additional wind and solar energy based on Department of Commerce economic analysis demonstrating that wind, solar and energy conservation savings are cost-effective for customers compared to continued operation of coal plants. In July 2016, Minnesota Power solicited proposals for up to 300 MW of wind and 300 MW of solar to maximize the benefit of the extended Federal Production Tax Credit (PTC) for wind energy and the extended Investment Tax Credit (ITC) for solar energy, and to serve as an energy-price hedge for ratepayers.⁶

The approved resource plan includes a retirement date of 2022 for 130 MW of capacity from coal-fired generator Units 1 and 2 at Boswell Energy Center. Minnesota Power's next resource plan will be due February 1, 2018.

Xcel Energy

In October 2016, when the Minnesota Public Utilities Commission met to consider Xcel Energy's Integrated Resource Plan (IRP), the Commission examined costs for Xcel Energy's system assuming no costs for carbon emissions, low-carbon emission costs and high-carbon emission costs. While the total amount of emissions and costs varied under each of these assumptions, Xcel's proposal was the least-cost approach. The Commission approved Xcel's proposal⁷, which included in the short-term:

- at least 1,000 MW of wind generation additions by 2020, plus an additional 800 MW by 2030;
- a target of 650 MW of solar generation by 2020; and an additional 750 MW by 2030;
- a retirement date of 2023 and 2026 for coal-fired units 2 and 1, respectively, totaling 1,362 MW of planned retired generation from the Sherburne County Generating Station (Sherco); and
- a February 1, 2019, filing date for Xcel's next IRP, which is to include a comprehensive study of shutting down the Monticello and Prairie Island nuclear plants, the coal-fired King plant and unit 3 of the Sherco plant.

⁶ [PUC Order Approving Minnesota Power's Resource Plan, July 18, 2016, docket E-015/RP-15-690](#)

⁷ [PUC Order Approving Xcel Energy's Resource Plan, January 11, 2017, docket E-002/RP-15-21](#)

Under the approved plan, Xcel would produce 40% of its energy from renewable resources by 2030 while reducing its carbon dioxide emissions by 60%. Xcel's planned wind additions will produce energy at a cost of 1.5 to 2.5 cents per kilowatt-hour, which is competitive with the 2.3 to 2.4 cents per kilowatt-hour costs of Xcel's Sherco coal-fired power plant.⁸

Otter Tail Power

In March 2017, the Public Utilities Commission voted to approve Otter Tail Power's (OTP) 15-year resource plan,⁹ which includes:

- 200 MW of wind additions in the 2018–2020 timeframe, and up to an additional 200 MW by 2023;
- 30 MW of solar by 2020;
- retirement of the 140 MW Hoot Lake coal-fired plant in Fergus Falls by 2021, and
- a June 3, 2019, filing date for OTP's next IRP.

This approved plan will double OTP's current wind power capacity and significantly increase solar capacity.

Great River Energy

On April 28, 2017, Great River Energy (GRE) filed its 15-year resource plan with the Public Utilities Commission¹⁰, including:

- 400 MW of wind additions by 2021, including the 300 MW Emmons-Logan wind farm in North Dakota;
- planned retirement in 2017 of the 189 MW Stanton Station coal-fired plant in North Dakota;
- redesign of GRE's Coal Creek station for more flexible operation; and
- termination of GRE's purchase obligation for 50 percent of the capacity and energy from Dairyland Power Cooperative's Genoa 3, a 379 MW coal-fired power plant in Wisconsin.

After the retirement of Stanton Station in 2017, GRE's portfolio will reflect more natural gas-fired capacity than coal-fired capacity.

⁸ [Star Tribune](#), March 16, 2017

⁹ [PUC Order Approving OtterTail Power's Resource Plan](#), April 26, 2017, docket E-017/RP-16-386

¹⁰ [Initial Filing, Great River Energy 2018-2032 Integrated Resource Plan](#), April 28, 2017, docket E-017/RP-17-286

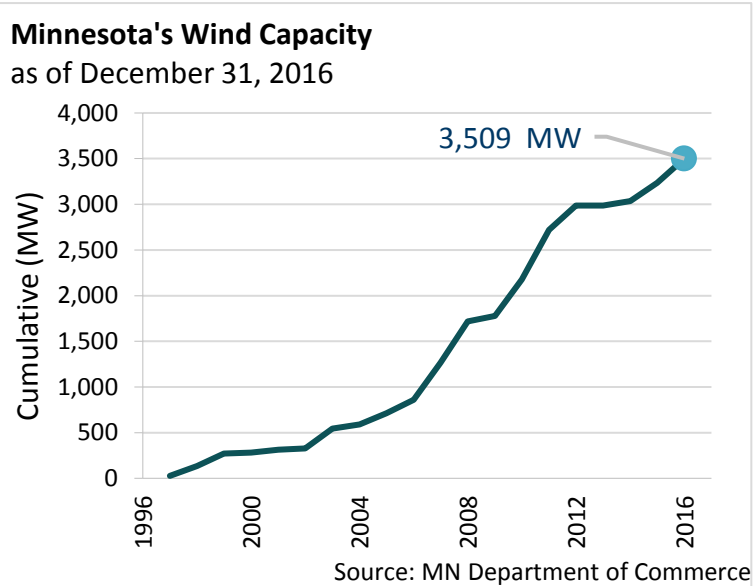
Wind Energy Update

In 2016, 17.7% of electricity generated in Minnesota came from wind power, ranking sixth in the nation for wind energy as a share of total in-state electricity generation.

Minnesota currently has 3,500 MW of installed capacity from large wind turbines (>100kW) and 8.7 MW of installed capacity from small wind turbines ≤100kW, for a total of 3,509 MW. By 2013, many utilities had procured wind energy to meet or exceed their interim Renewable Electricity Standard milestones, and overall energy consumption leveled off as energy efficiency and conservation strategies

became more widely adopted. As a result, overall development in wind slowed from 2013-2015.

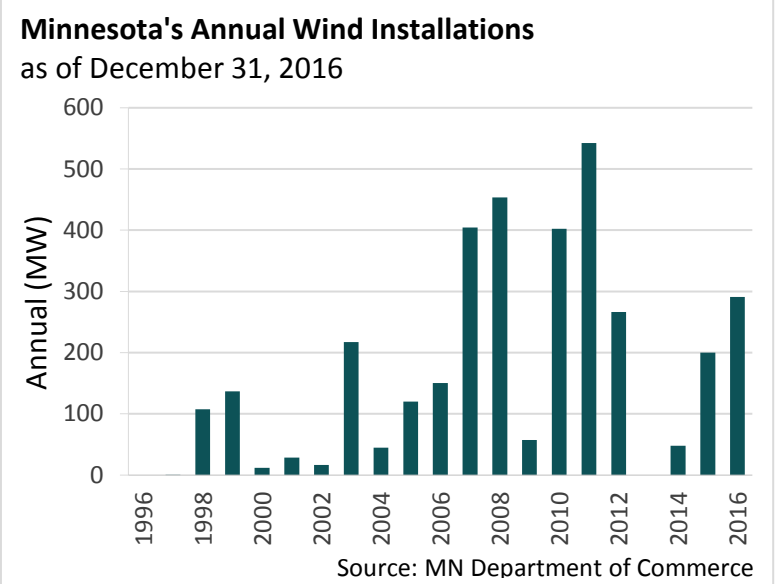
However, because of ongoing technology advancement and zero fuel costs, wind is now economically competitive with energy generation from coal and natural gas. Planned retirements of older coal plants combined with the extension of the federal Production Tax Credit are driving significant investment in new wind capacity.



2016 Wind Development

More than 291 MW of new wind was added in 2016. In addition, some of the earliest wind farms developed in the state are planned for repowering or decommissioning, creating opportunities to upgrade prime wind sites with larger and more efficient wind turbines.

Odell Wind, 200 MW_{AC} (200,000 kW) in Cottonwood, Jackson, Martin, and Watonwan Counties. Developed by Algonquin Power Co. and owned by Enel Green Power for energy sales to Xcel



Energy. In November 2014, Geronimo sold Odell to Algonquin Power Co., and Geronimo provided ongoing assistance in project development. The project achieved commercial operation in July 2016.

Black Oak & Getty, 78 MW_{AC} (78,000 kW) in Stearns County was developed by Geronimo Energy and owned by Sempra Energy for energy sales to The Minnesota Municipal Power Association. The project achieved commercial operation in November 2016.

South Fork Wind, 13.8 MW_{AC} (13,800 kW) near Worthington in Jackson County was developed by Geronimo Energy and owned by Aspenall Energy Delaware LLC for energy sales to Muscatine Power and Water in Iowa.

Decommissioning: Wind Power Partners '93 (a.k.a Buffalo Ridge Wind Farm), 26 MW_{AC} (26,280 kW), in Lincoln County, the first utility-scale wind farm to be developed in Minnesota, began commercial operation in 1994 for energy sales to Xcel Energy. The wind farm consisted of 73 Kenetech 33M-VS wind turbines rated at 360 kW each and was acquired by NextEra Energy Resources in 2003. The project stopped operating in December 2016 and is currently being decommissioned, with ongoing evaluation of the potential for repowering. This will be the first wind farm to be completely decommissioned in Minnesota.

2017-2020 Wind in Development

More than 900 MW_{AC} of new wind is in development in Minnesota over the next few years, including the following:

Bergey Wind Project, 0.5 MW_{AC} (500 kW) developed by Gone2Green for Xcel Energy and distributed among 50 sites across three counties in Xcel's service territory. (RDF funded)

Blazing Star I, 200 MW_{AC} in Lincoln County, developed by Geronimo for energy sales to Xcel Energy. Project construction is expected to begin in 2017 for completion in 2018.

Blazing Star II, 200 MW_{AC} in Lincoln County, developed by Geronimo for energy sales to Xcel Energy. Project construction is expected to begin in 2017 for completion by 2020.

Dodge County Wind, 200 MW_{AC} in Dodge County developed by Next Era. Project Construction is expected to start in 2018 for completion in 2020.

Freeborn Wind, 200 MW_{AC} in Freeborn County, Minnesota, and Worth and Mitchell Counties, Iowa, is being developed by Invenergy for sale to Xcel Energy by 2020.

Lake Benton II, 100 MW_{AC} in Pipestone County, is a planned repowering of the 102.75 MW Lake Benton II project. The project will be developed by NextEra Energy Resources for transfer to Xcel upon completion by 2020.

Palmer's Creek, 44.6 MW_{AC} in Chippewa County, developed by Fagen Engineering. Project construction is expected to start in 2017 for completion by 2018.

Red Lake Falls Hybrid Project, 4.6MW_{AC} wind and 1 MW solar in Red Lake Falls is in development by Juhl Energy. This will be the first project in the United States to use a GE integrated wind and solar plant designed to share the same converter.¹¹

Red Pine Wind, 200 MW_{AC} in Lincoln County, developed by EDF Renewable Energy for wholesale energy sales into the MISO market. Project construction is expected to begin in 2017 for completion in 2018.

Woodstock Hills, 9.2 MW_{AC} – developed by Juhl Energy for sales to Xcel Energy. If approved, this would be the first wind project in Minnesota to repower an existing 10.2 MW wind farm with new turbines. This site will also add 1 MW_{AC} of solar at the same site, increasing the capacity value of the system at the same point of interconnection.

Solar Energy Update

Minnesota was the 12th largest state solar market in 2016, and the only Midwestern state in the top 20 by either market size or installed capacity.¹²

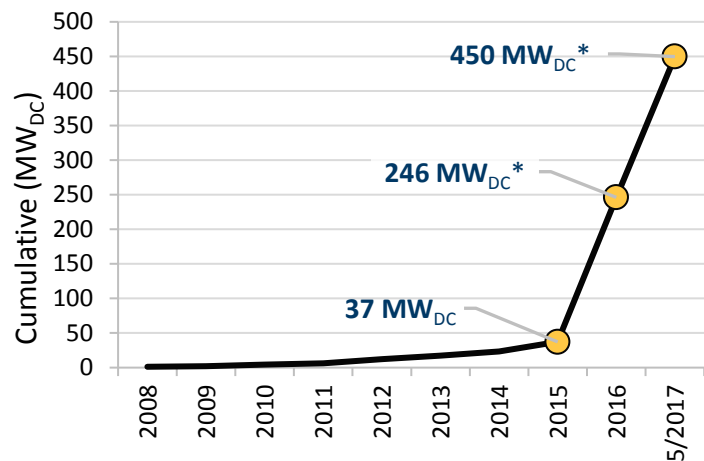
Minnesota reached a milestone of more than 246 MW_{DC}¹³ of known grid-tied PV capacity in 2016, including over 35 MW of net-metered installations <40kW. Based on utility filings, over 600 MW of large solar projects are expected to be completed in 2017, primarily from utility-scale and community solar.

In 2013, EIA started tracking solar electricity production in Minnesota.

Before 2016, most of the installed solar capacity was behind the meter, so the percent generation

Minnesota's Solar Capacity

as of May 15, 2017 (*preliminary)



Source: MN Department of Commerce

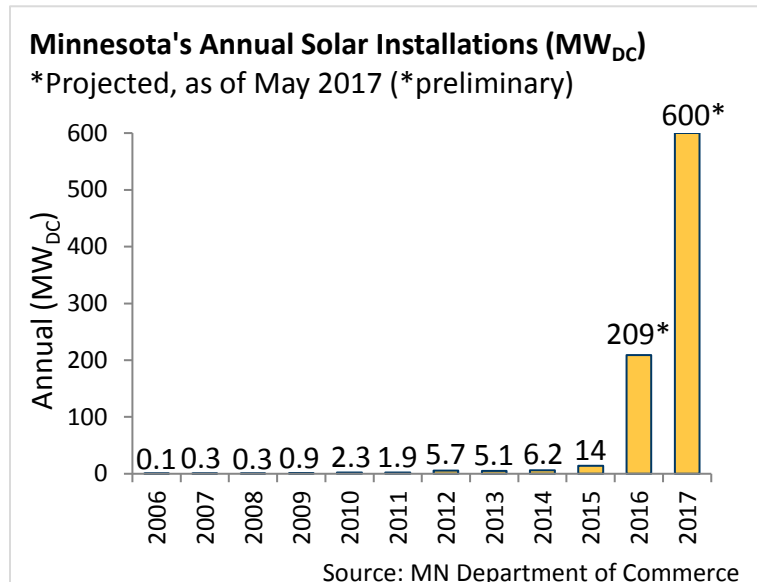
¹¹ [Midwest Energy News](#), March 2, 2017

¹² [SEIA Solar Market Insight Report 2016 Year in Review](#), March 9, 2017

¹³ The convention in the solar industry is to list capacity in direct current (DC) according to the photovoltaic module rating, which produces direct current. Other generators like wind, biomass and hydro use a spinning generator, which produces power in alternating current (AC).

shows up at less than 1%. However, with new development in 2016 and thereafter, the percent of energy from solar will grow quickly.

Statewide, with most of the capacity installed in mid-December 2016, solar PV produced 0.03% of the energy generated in Minnesota in 2016 (according to EIA data). However, with significant additions in early 2017, the percent of electricity from solar is expected to rise above 1% by the end of the year. Solar capacity increased from less than 1 MW in 2009 to 246 MW_{DC} in 2016, and present capacity will increase threefold in 2017 with projections of over 600 MW_{DC} of new capacity by year end.



Minnesota in 2013 established the [Solar Energy Standard](#) that calls for Minnesota’s investor-owned electric utilities to generate 1.5% of their electric power from solar by 2020. With state-level solar-friendly policies, extended federal tax credits and other incentive programs in place, solar is expected to exceed that standard by 2018. Meanwhile, Xcel Energy has included a target of 650 MW of solar generation by 2020; and an additional 750 MW by 2030 in its resource plan approved by the Public Utilities Commission in 2016 as a least-cost plan for the utility’s system needs.

Community Solar

Community Solar subscriptions are now available in 21 utility territories.

Cumulative community solar projects at the end of 2016 were:

- Xcel: 36.4 MW at 12 project sites*
- Other utilities: 1.72 MW at 16 utilities*

2017 outlook:

- At least 400 MW of community solar in Xcel territory*
- 1 MW from Minnesota Power at one site*
- 0.4 MW from five municipal and coop utilities

*additional project details below

2016 Large Solar Additions

North Star Solar—100MW_{AC} (100,000 kW) single-axis tracking PV in North Branch developed by Community Energy Resources LLC for Xcel Energy. The project achieved commercial operation in December 2016.

Aurora Distributed Solar Project—Approximately 6.5MW_{AC} (6,500 kW) at one site was completed in 2016. Developed by Geronimo Energy and owned by Enel Green Power for sales to Xcel Energy, the project will total 100MW_{AC} distributed between 16 sites ranging in size from 4 MW to 10 MW across 12 counties in Xcel's service territory.

Camp Ripley—Minnesota Power installed a 10MW_{AC} (10,000 kW) solar project at Camp Ripley near Little Falls to meet the utility's Solar Electricity Standard. The installation was delayed by damage from storm debris in September. Despite the setback, the project was able to achieve commercial operation in November 2016.

Black Bear Casino Resort— 1 MW_{AC} (1,000 kW) in Carleton was completed in August 2016 by Hunt Electric for the Fond du Lac Band of Lake Superior Chippewa in Minnesota Power service territory.

Dickinson Solar Project—2.25 MW_{AC} (2,250 kW) in Buffalo was completed in September 2016 by Great River Energy for wholesale supply to Wright-Hennepin Coop.

Wright-Hennepin Community Solar 3—270 kW_{DC} in Rockford was developed by Wright-Hennepin in its third round of community solar garden development.

People's Community Solar —250 kW_{DC} in the Elgin Business Park was installed by Able Energy for members of People's Energy Cooperative.

Blue Lake RDF Solar—1.25 MW_{AC}, (1,250 kW) completed in January 2016, was installed by Oak Leaf Energy Partners and SunEdison at the Blue Lake Wastewater Treatment plant in Shakopee. (RDF funded)

Target St. Paul Midway RDF project—350 kW_{AC} was completed in January 2016 at the SuperTarget Midway store in the Saint Paul Midway area within the Energy Innovation Corridor (RDF Funded).

ISD 831 Forest Lake School District—a total of 1.7 MW_{AC} (1.95 MW_{DC}) was completed by TruNorth Solar and Apex Efficiency Solutions in Xcel Energy service territory in 2016 at six schools:

- Century Jr. High—468 kW_{AC}
- Southwest Jr High—84 kW_{AC}
- Wyoming Elementary—288 kW_{AC}
- Forest Lake Elementary—84 kW_{AC}
- Forest Lake High School—368 kW_{AC}
- Forest Lake Sports Center—396 kW_{AC}

Xcel Community Solar – 2016

Xcel Reported 36.4 MW completed at 10 project sites in 2016 as a part of Xcel’s Solar*Rewards Community program.

Blue Lake Community Solar—3 MW_{AC} (3,000 kW) completed in December 2016, was installed by Oak Leaf Energy Partners, Cypress Creek Renewables and Hunt Electric at the Blue Lake Wastewater Treatment plant in Shakopee.

Empire Wastewater Treatment Community Solar—5 MW_{AC} (5,000 kW) completed in December 2016, was installed by Oak Leaf Energy Partners, Cypress Creek Renewables and Hunt Electric at the Empire Township Wastewater Treatment plant in Dakota County.

Buhl Farms Community Solar Garden — 0.204 MW_{AC} (204 kW_{AC}) in Tyler (Lincoln County) was completed in August 2016 by Novel Energy.

Faircon Community Solar Garden —0.123 MW_{AC} (123 kW_{AC}) in Saint Paul (Ramsey County) was completed in May 2016 by Novel Energy.

BentonSun Community Solar Garden—5 MW_{AC} (5,000 kW) in Norwood Young America (Carver County) was completed in December 2016 by SunShare and Mortenson Construction.

Rosemount Community Solar Gardens—5 MW_{AC} (5,000 kW) in Rosemount (Dakota County) was completed in December 2016 by Geronimo Energy.

Northfield Community Solar Gardens—5 MW_{AC} (5,000 kW) in Northfield (Dakota County) was completed in December 2016 by Geronimo Energy.

Sunrise Community Solar Gardens—5 MW_{AC} (5,000 kW) in North Branch (Chisago County) was completed in December 2016 by Geronimo Energy.

Chisago Community Solar Gardens—4 MW_{AC} (4,000 kW) in Taylor Falls (Chisago County) was completed in December 2016 by Geronimo Energy.

Paynesville Community Solar Gardens (1-4)—the first 4 MW_{AC} (4,000 kW) was completed in December 2016 in Paynesville (Stearns County) by Geronimo Energy.

2017 Solar Activity

Completed as of May 2017

Marshall Solar —62 MW (62,000 kW) solar farm in Lyon County developed by NextEra Energy Resources for Xcel Energy. This project achieved commercial operation in early January 2017.

Aurora Distributed Solar Project—approximately 66.5MW_{AC} (66,500 kW) at 12 sites were completed by May of 2017 by Enel Green Power for Xcel Energy. An additional 29MW_{AC} at three sites are expected to be completed in 2017 (see additional project details above).

Kruse Motors, 189 kW_{DC} in Marshall was completed in January 2017 by Novel Energy Solutions in Marshall Public Utilities service territory.

Xcel Community Solar – May 2017

In May 2017, Xcel reported 37.6 MW completed at 12 sites in 2017 as a part of Xcel’s Solar*Rewards Community program, with 455 MW in design & construction, and 113 with signed Interconnection Agreements.¹⁴

Paynesville Community Solar Gardens 5—the last 1 MW_{AC} (1,000 kW) was completed in January 2017 in Paynesville (Stearns County) developed by Geronimo Energy.

Ursa Community Solar Gardens—5 MW_{AC} (5,000 kW) in Farmington (Dakota County) was completed in Q1 2017 by Geronimo Energy.

Orion Community Solar Gardens—3 MW_{AC} (3,000 kW) in Saint Joseph (Stearns County) was completed in Q1 2017 by Geronimo Energy.

Lind Garden—4.86 MW_{AC} (4860 kW) in Young America (Carver County) was completed in Q1 2017 by IPS-Solar.

Eichtens CSG—3.89 MW_{AC} (3890 kW) in Center City (Chisago County) was completed in Q1 2017 by IPS-Solar.

Farmington Project—5 MW_{AC} (5000 kW) in Farmington (Dakota County) was completed in Q1 2017 by SolarStone Partners.

Pine Island project—3.9 MW_{AC} (3900 kW) in Pine Island (Goodhue County) was completed in Q1 2017 by SolarStone Partners with NRG Community Solar.

Red Wing School District—4.96 MW_{AC} (4960 kW) in Red Wing (Goodhue County) was completed in Q1 2017 by IPS-Solar.

WakeSun Community Solar—3 MW_{AC} (3000 kW) in Cold Spring (Stearns County) was completed in Q1 2017 by SunShare, Mortenson.

¹⁴ [*Xcel Monthly CSG Report, May 9, 2017, Docket E002/M-13-867*](#)

Wabasha Solar Garden—3 MW_{AC} (3000 kW) in Wabasha (Wabasha County) was completed in Q1 2017 by SolarStone Partners.

Twin Pine Farm—0.036 MW_{AC} (36 kW) in Scandia (Washington County) was completed in Q1 2017 by Novel Energy Solutions with MN Community Solar.

Solar In Development

Thomas Edison High School Green Campus Solar Project—485 kW_{DC} in Northeast Minneapolis is planned to be installed by Sundial Solar as a part of a green campus demonstration model that serves as a hands-on “classroom” to be integrated with the school’s science, math, and technology curricula. (RDF funded)

MN Renewable Energy Society Community Solar—1,000 kW_{DC} between two Community Solar Gardens, one in a rural setting and a second in an urban setting. (RDF funded)

Green Line Solar Corridor Project—967 kW_{DC} to be installed by IPS Solar at four sites along the Energy Innovation Corridor in St. Paul. (RDF funded)

Minnesota Power Community Solar Garden—1 MW_{AC} (1,000 kW) to be installed in 2017 in Wrenshall by Minneapolis-based United States Solar Corp for customer subscriptions managed by the utility