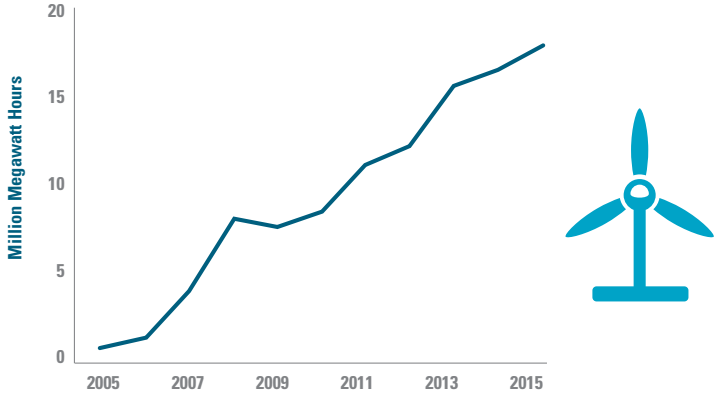
Wind Energy

Wind power on our systems has nearly doubled since 2010



Our Approach

As our most cost-effective renewable energy option, wind power is an important component of Xcel Energy's diverse energy supply. It provides clean energy that reduces emissions, and when we lock in favorable prices under long-term contracts, it can also protect customers from the rising cost of fossil fuels and environmental compliance. The American Wind Energy Association has ranked Xcel Energy the nation's No. 1 utility wind energy provider for the past 12 years. We continually work to strengthen our forecasting and other operating capabilities to improve the predictability and cost of integrating the significant wind resources on our systems.

Current Wind Additions

We announced plans in 2013 to grow our wind generation portfolio by 1,900 megawatts or nearly 40 percent through nine new, cost-effective projects. By the end of 2015, we had completed seven of the projects totaling 1,500 megawatts, with the remaining two projects set for completion in 2016. Xcel Energy owns and operates two new wind farms added last year in the Upper Midwest, Pleasant Valley and Border wind farms. We also broke ground in 2015 on the Courtenay Wind Farm that we will own and operate.

Xcel Energy's newest wind projects totaling 1,900 megawatts of added capacity include:

- 200-megawatt Limon III Wind Project, Colo. (2014)
- 250-megawatt Golden West Wind Project, Colo. (2015)
- 199-megawatt Mammoth Plains Wind Energy Center, Okla. (2014)
- 250-megawatt Palo Duro Wind Energy Center, Texas (2014)
- 250-megawatt Roosevelt Wind Ranch in Roosevelt County, N.M. (2015)
- 200-megawatt Pleasant Valley Wind Farm, Minn. (2015)
- 150-megawatt Border Wind Farm, N.D. (2015)
- 200-megawatt Odell Wind Farm, Minn. (2016)
- 200-megawatt Courtenay Wind Farm, N.D. (2016)

For the future, we have proposed adding another 1,800 megawatts of wind energy through our Upper Midwest Resource Plan. This includes capitalizing on the extension of federal tax credits by installing up to 1,500 megawatts of new wind energy by 2020 to help reduce the cost to customers.

In Colorado, as part of our comprehensive Colorado strategy for our energy future, we have proposed constructing and owning 600 megawatts of new wind generation and 90 miles of new transmission in eastern Colorado. If approved, the project will provide the lowest cost wind generation on our Colorado system and is expected to save customers more than $400 million over the next 25 years. To take advantage of federal tax credits, we have proposed to begin construction by the end of 2016 to ensure completion by the end of 2018. The all-Colorado wind project will be locally designed, manufactured, constructed and owned. Vestas will provide 300 two-megawatt wind turbines, manufactured in Brighton, Pueblo and Windsor, Colo.

Both the Upper Midwest Resource Plan and our Colorado wind proposal are before our public utilities commissions for consideration.

Wind Forecasting

Xcel Energy has used WindWX since 2009—one of the most advanced wind-production forecasting systems in the world. Through a multi-year research and development project with Global Weather Corp. (GWC), an affiliate company of the National Center for Atmospheric Research (NCAR), we helped develop this highly detailed wind-forecasting system.

Wind generation is difficult to forecast due to its variability. Most weather forecasting models are designed to generate information about winds near ground level rather than at 200 to 300 feet, where turbine hubs are typically located. Also, landscape features such as hills and trees can reshape wind speeds and directions, causing turbulence in ways that can greatly influence the amount of energy produced.

The WindWX system uses real-time, turbine-level operating data and applies sophisticated algorithms to forecast the amount of wind power that will be produced. Through ongoing work with GWC, forecasts for a 168-hour period are provided every 15 minutes across Xcel Energy's entire service territory—from the hills of western Minnesota to the plains of eastern Colorado and the flat expanses of the Texas Panhandle.

The forecasts, now available worldwide through GWC, are designed to help utilities make better commitment and dispatch decisions, including opportunities to power down less efficient power plants when sufficient winds are forecasted to help meet customer electric demands.

So far, we have improved our wind forecasting accuracy by nearly 35 percent, and better forecasting and other operations improvements have saved our customers a total of $60.6 million in fuel costs through end of 2015.

We are now finishing a third phase of our forecasting project to further enhance the sophistication of the WindWX technology. The effort seeks to improve forecasting accuracy and visualization of our renewable generation portfolio by focusing on extreme weather events, introducing probabilities into the forecasting process, and exploring solar forecasting behind the customer meter. NCAR scientists and engineers are developing systems to quantify the risk of sudden changes in wind or potentially damaging icing events and to predict the amount of energy to be produced by private solar panels on an hourly basis.

Improved Wind Integration Efforts

While wind energy prices have declined to the point where wind can compete with new natural gas-fueled generation, wind generation can be challenging to operate and integrate on the electric system. Although improved forecasting helps to manage the cost, operational costs will continue to rise as wind production increases.

Xcel Energy continues to improve processes and seek additional opportunities to lower integration costs, including:

- Cycling base-load fossil fuel units offline to accommodate more wind generation; the approach reduces fuel costs, and in 2015, helped to avoid about 278,200 tons carbon dioxide emissions.
- Using set-point controls for wind farms in combination with Automatic Generation Control of thermal units that let wind farms continue to operate at peak levels while fossil fuel production is reduced.
- Establishing a 30-minute flexibility reserve; after studying the amount of wind energy typically lost within 30 minutes, we implemented the new practice, which dramatically reduced reserve costs while maintaining system reliability.
- Adding more flexible production resources that can be ramped up and down more efficiently to work with variable wind generation, such as the new combined-cycle natural gas facility installed at Cherokee Generating Station in Colorado under our Clean Air-Clean Jobs project

Xcel Energy's Colorado system is somewhat unique in that it is small and serves a limited geographic area, which can present challenges for integrating high levels of variable wind energy. Wind generation served 19 percent of our Colorado electric load needs in 2015 and helped avoid nearly five million tons of carbon emissions. For system reliability reasons, we had to curtail about 3 percent of our total wind generation for the year. To manage the cost and overall impact of curtailments, the company has taken the following steps:

- Negotiating purchase power agreements that include free curtailment hours.
- Conducting a special screening as part of the resource planning process to account for curtailment costs as we evaluate future resources.
- Exploring opportunities to increase the flexibility of our Colorado system by developing a larger, organized market in the West; as a step in this direction, the company received approval from the Federal Energy Regulatory Commission to begin in summer 2016 the joint dispatch of its resources with the resources of other Colorado utilities to allow for more efficient and cost-effective, real-time system operations.

Wind Records

We continue to set new system records for wind generation because of our significant capacity and ongoing efforts to improve system operations through better forecasting and other measures. We have consistently achieved hourly wind generation records on our systems, but in Colorado on Oct. 2, 2015, we achieved a daily milestone when wind generation provided more than 55 percent of our customers' energy for 24 hours.

Below is an overview of our daily system wind records:

System	Percent of Load Served	Date
Colorado	55.5%	Oct. 2, 2015
Southwest	50.8%	Nov. 15, 2015
Upper Midwest	41.3%	Nov. 8, 2015
Xcel Energy Total	45.3%	April 15, 2016

Below is an overview of our hourly system wind records:

System	Percent of Load Served	Date	Time
Colorado	67.6%	April 6, 2016	12-1 a.m.
Southwest	57.6%	April 5, 2016	4-5 a.m.
Upper Midwest	55.7%	April 14, 2016	2-3 a.m.
Xcel Energy Total	55.6%	April 16, 2016	1-2 a.m.