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Dakota Turbines


Patrice Lahlum

Clean Economy Rising

Wind energy propels North Dakota forward

Overview

North Dakota has become well-known for its oil and gas development, but the state also boasts abundant clean energy resources. It is a national leader in wind deployment, has a growing industrial energy efficiency sector, and possesses a large untapped potential for solar and biomass. New policies and a drive to capture these resources are propelling the state's clean energy economy forward and creating jobs. This brief examines the landscape for renewable power growth in North Dakota.

A student in the wind energy technician program at Lake Region State College in Devil's Lake.

Clean energy policies

North Dakota's clean energy sector has gained momentum from its abundant wind resources and policies that encourage deployment. In 2007, the state established a voluntary renewable portfolio standard with a goal of obtaining 10 percent of all retail electricity from renewable sources by 2015.[1]

In 2007, then-Governor John Hoeven appointed the EmPower North Dakota Commission, a 14-member panel of energy industry representatives, to develop a comprehensive energy policy. The commission has released a series of policy recommendation papers to address the state's energy needs. The goals outlined in the *Comprehensive State Energy Policy* report include increasing installed wind capacity to 5 gigawatts by 2020 and sustainably doubling energy production by 2025.[2]

North Dakota also has a net-metering policy for regulated utilities that allows customers to offset their energy costs by returning electricity to the grid from on-site distributed systems, such as solar panels. The state allows both utilities and customers to own renewable energy certificates—more commonly called credits—for generating renewable electricity. However, compared with other states, North Dakota caps eligibility at a very low limit: only renewable energy and combined heat and power projects of 100 kilowatts or less qualify, excluding benefits for larger projects that might be found in some manufacturing facilities.[3]

North Dakota has several property and sales tax reductions and exemptions for clean energy equipment and projects.[4] It also has a corporate income tax credit providing 3 percent of the capital and installation costs of a clean energy system per year for five years (for a total deduction of 15 percent). Eligible technologies include wind, solar, landfill gas, biomass, and geothermal. However, the credit expires at the end of 2014, creating uncertainty about future investment and adoption of these technologies.[5]

Key State Policies					
✓	Renewable portfolio standard	✓	Tax incentives	○	Green power purchasing
✓	Net metering	○	Loans/rebates/other financing	○	Nonutility sales of renewable electricity allowed

Source: North Carolina State University, Database of State Incentives for Renewables and Efficiency

Sources of power and economic growth

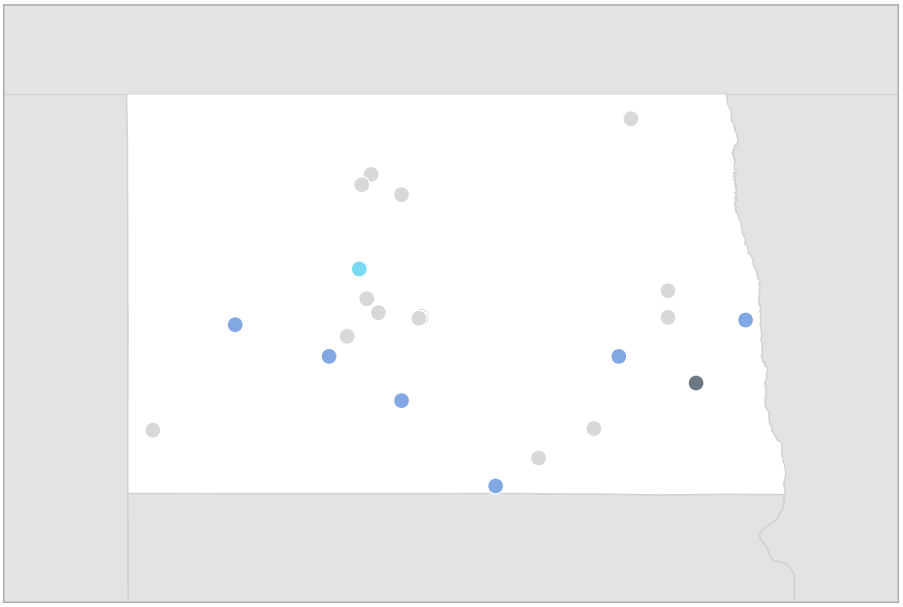
North Dakota ranks fourth in the nation in total electricity consumed per capita because long, cold winters drive up energy use. This demand, as well as the availability of shale gas and the development of renewable resources, has made North Dakota one of the top energy producing states, ranking 12th nationally.[6]

Navigant Research estimates that private investment in clean energy in the state totaled nearly $1.8 billion over the past five years (2009 to 2013) and will grow by $2.9 billion over the next decade (2014 to 2023).

When indirect economic activity, such as transportation of materials, is included, revenue associated with renewable energy totaled $4.2 billion in 2008, according to a study by the North Dakota Alliance for Renewable Energy.[7]

Wind is the state's most prevalant renewable resource and accounted for 78 percent of the 2.2 GW of clean energy installed as of 2013. Hydropower was second, with 22 percent of total clean energy capacity. Solar and biomass were relatively small contributors, but the resource potential exists for these sectors to grow in the future.

Renewable Electricity Power Plants, > 1 Megawatt Capacity



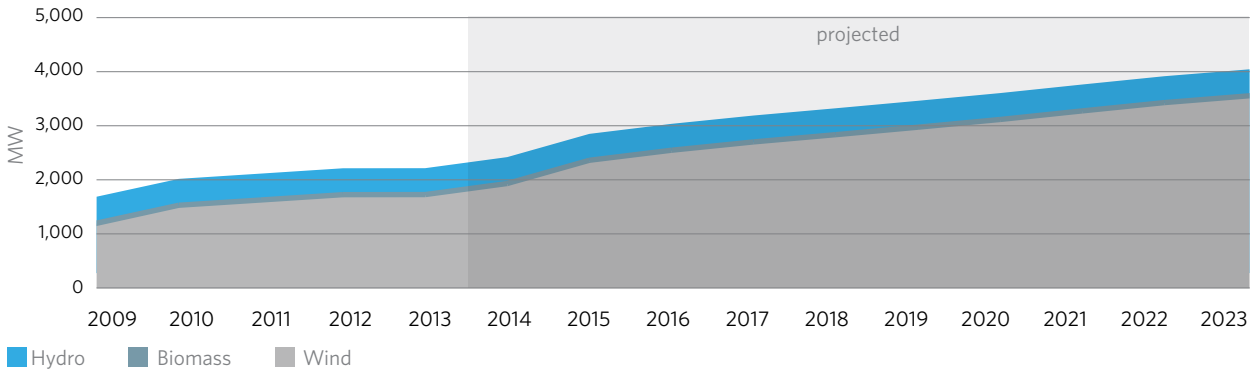
- Hydro
- Wind
- Biomass
- Combined heat and power

Source: Energy Information Administration

Snapshot: North Dakota's clean energy economy

Clean Energy Capacity, by Sector and Year

Actual (2009–13) and projected (2014–23) growth in cumulative capacity

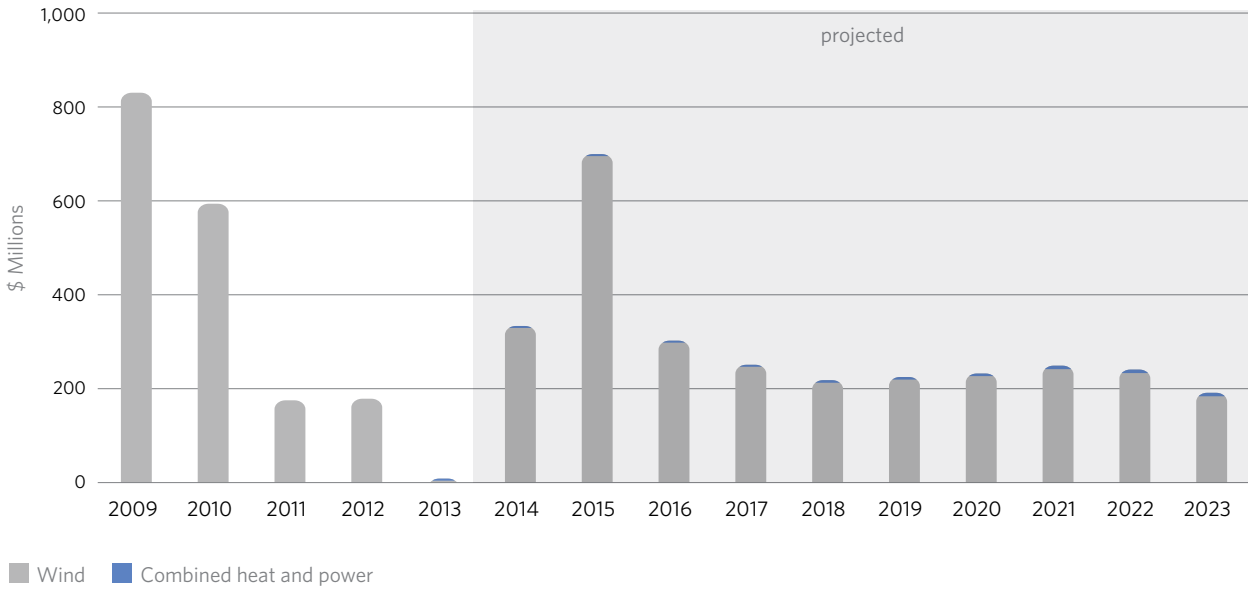


Navigant Research provided data and projections of annual capacity additions from 2009 to 2023. These figures were added to baseline 2008 cumulative capacity data from the Energy Information Administration (except for wind and solar, for which cumulative data were available from Navigant Research). Navigant Research's methodology is described at the end of this brief, and that of the Energy Information Administration is in Table 3, available at http://www.eia.gov/renewable/state/northdakota.

Sources: Navigant Research, Energy Information Administration

Clean Energy Investment, by Sector and Year

Actual (2009–13) and projected (2014–23) annual investment



Source: Navigant Research

Key Statistics

Statistics	
2 MW	in new renewable capacity installations, 2013
$4 million	in private investment, 2013
6,891	energy- and environment-related jobs, 2011

Sources: Navigant Research, Bureau of Labor Statistics

Wind industry highlights

North Dakota is a national leader in wind energy. According to a study by the U.S. Energy Department's National Renewable Energy Laboratory, the state's wind resource potential nearly matches the capacity of all U.S. fossil fuel power plants.[8] In 2013, 16 percent of the state's electricity generation came from wind.[9] Over the past five years (2009 to 2013), North Dakota installed 986 MW of wind power and invested over $1.7 billion in the sector. According to projections by Navigant Research, the state will install another 1.8 GW of wind power and attract an additional $2.9 billion in investment over the next decade (2014 to 2023).

North Dakota Wind

National rankings and statistics, 2013

Rank	
6th	in resource potential
8th	in wind-related jobs (more than 2,000)
10th	in new capacity installed (1.6 MW)
10th	in private investment ($2.9 million)
12th	in total capacity (1,681 MW across 33 projects)
500,000+	homes powered by wind

Sources: American Wind Energy Association, Navigant Research, Energy North Dakota, Energy Information Administration

North Dakota's full wind potential remains untapped. Although the state's 53 counties are suitable for wind turbines, only 26 have projects installed.[10]

The 2013 expiration of the federal production tax credit dampened investment in wind projects nationwide, and North Dakota felt the effects. According to Navigant Research, 98 MW of wind projects were added in 2012, dropping to just 1.6 MW in 2013. However, the sector is expected to continue growing, albeit at a slower rate, with an average of 181 MW projected to be installed annually in the state over the next decade.

Additional policy support—such as renewal of the production tax credit and creation of a binding state renewable portfolio standard—could encourage further growth of the industry. The EmPower North Dakota Commission has committed to supporting wind energy in the state. Its recommendations include streamlining siting of commercial-scale wind facilities, encouraging greater research and development, making permanent the sales and use tax exemptions currently set to expire in 2015, and extending the federal wind production tax credit.[11]

Project Spotlight

Google Invests in North Dakota Wind Farms

Google's first investment in utility-scale clean energy was in North Dakota. In 2010, the tech giant invested $38.8 million in two wind farms—Ashtabula II in Barnes County and Wilton Wind II in Burleigh County—after committing to deploying clean energy technologies to both power its own operations and as a separate business venture.* Google holds a 20 percent stake in the projects, which are owned and operated by NextEra Energy Resources and have a total capacity of 169.5 MW, enough to power over 55,000 homes.†

> "We're aiming to accelerate the deployment of renewable energy—in a way that makes good business sense, too."
>
> —Rick Needham, Google's green business operations manager

* Google, "Peace Garden Wind Farms: More Financing for Wind," http://www.google.com/green/energy/investments; and Google, "Renewable Energy," http://www.google.com/about/datacenters/renewable.

† Scott Morrison and Cassandra Sweet, "Google Invests in Two Wind Farms," *The Wall Street Journal*, May 3, 2010, http://online.wsj.com/news/articles/SB10001424052748704342604575222420304732394

Geographic Spotlight

Lake Ashtabula Wind Energy Center

Due to its high wind speeds, eastern North Dakota is one of several wind development hot spots in the state.* The region is home to the Ashtabula Wind Energy Center, a collection of three utility-scale projects supplying power to utilities locally and in neighboring Minnesota.

Located in Barnes, Griggs, and Steele counties, Ashtabula I, II, and III have a total of 218 wind turbines with 331 MW of capacity, enough to power 99,000 homes.† The centers are creating jobs and contributing to local and state revenue.‡

NextEra Energy Resources, an electric utility and the largest wind generator in North America, owns and operates these projects and four others in North Dakota. The utility partnered with Otter Tail Power Co. and Minnkota Power Cooperative to develop and operate the three Ashtabula wind farms.§

> "Ashtabula Wind Energy Center is a good example of how we're building a multi-resource energy industry in North Dakota. ... Projects like this are helping us to grow and diversify our economy, create jobs ... and strengthen our energy security. That benefits not only North Dakota, but also the entire nation."
>
> —then-Governor John Hoeven in 2009

Ashtabula I, the largest wind farm in North Dakota.

* American Wind Energy Association, "Wind Projects in North Dakota," updated April 10, 2014, project map, http://www.awea.org/Resources/state.aspx?ItemNumber=5191; and U.S. Department of Energy, "North Dakota 80-Meter Wind Map and Wind Resource Potential," http://apps2.eere.energy.gov/wind/windexchange/wind_resource_maps.asp?stateab=nd.

† NextEra Energy Resources, "Ashtabula I, II, & III Wind Energy Centers," http://www.nexteraenergyresources.com/content/where/portfolio/pdf/Ashtabula.pdf.

‡ U.S. Department of Energy, WINDExchange, "North Dakota 80-Meter Wind Map and Wind Resource Potential," updated June 13, 2014, http://apps2.eere.energy.gov/wind/windexchange/wind_resource_maps.asp?stateab=nd.

§ NextEra Energy Resources, "Ashtabula I, II, & III."

Source: Energy Now (2009), http://www.nexteraenergy.com/employeecentral/emp_comm/docs/ENG0709.pdf

Company Spotlight

Dakota Turbines: Developing the Next Generation of Small Wind

Dakota Turbines Inc. is a business based in Cooperstown, North Dakota, that builds compact, efficient, rugged wind turbines made almost entirely from parts manufactured in the Upper Midwest. With capital from parent company Posilock Puller Inc. and the North Dakota Industrial Commission, Dakota Turbines began developing concepts for its turbines in 2006 and completed its first commercial installation in 2011.*

The company has worked to develop innovative technologies to enhance production from wind turbines. Its unique configuration of ironless coils and magnets affixed to the turbine's rotor eliminates the need for cogs (tiny teeth that fit together) and enables the generation of electricity even at very low wind speeds. Dakota Turbines has developed a highly efficient blade design and an inverter that converts the electricity generated by the turbine into a usable form for grid connection. Its turbine design also includes fail-safe coil springs on each blade shaft that can quickly bring a turbine to a gentle stop in the event of any electrical or mechanical disruptions. The company has acquired or is working to acquire several patents for its technologies.†

A compact, efficient turbine created by Dakota Turbines in Cooperstown.

* Dakota Turbines, "A Brief Pictorial History of the Development of the Dakota Turbines Generation System," http://dakotaturbines.net/photos/development-history.

† Ibid.

Institution Spotlight

North Dakota Colleges and Universities Prepare a Skilled Wind Workforce

Colleges in North Dakota are training the next generation of energy workers to harness the state's wind resources.

Lake Region State College

Located in Devils Lake, Lake Region State College developed the first wind energy technician certificate in the state. The college began offering the one- and two-year certificate programs in 2008 in response to the rapid expansion of wind energy and the demand for skilled turbine workers. The curriculum, developed with input from industry representatives and endorsed by the American Wind Energy Association, is designed to prepare students for a position repairing and maintaining wind turbines through practical hands-on experience.*

In June 2013, the college installed a 1.6-MW wind turbine a few miles northwest of the campus in collaboration with Honeywell Building Solutions.† The project serves as a training tool for students in the technician program and is reducing energy costs for the school.‡ The campus will use 1.7 gigawatt-hours of electricity generated by the turbine, and the remaining 4.3 GWh will be sold to Otter Tail Power, the local utility, through a 15-year power-purchase agreement.§

Local utilities such as Otter Tail have provided scholarships and other support for the program.

> "This project was the missing piece to our wind energy program. We needed the turbine to turn a good program into a great one. Students feel we have a whole new program now—one where they can study theory and then enter the work environment of a commercial-grade turbine and reinforce classroom learning with hands-on experience."
>
> —Doug Darling, Ph.D., president of Lake Region State College

Bismarck State College's National Energy Center of Excellence

In 2005, the state provided funding to establish Bismarck State College's National Energy Center of Excellence, which prepares students to enter the energy workforce, offering bachelor's and associate degrees, as well as certificates in a range of sectors. The center was part of then-Gov. Hoeven's Center of Excellence program, which established research and development hubs at colleges and universities across the state to attract economic development. In 2007, the U.S. Department of

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Energy designated the Bismarck State College center as the National Power Plant Operations, Technology, and Education Center for the entire United States, recognizing its preeminence in energy industry workforce training.** Degree options in renewable energy were added in 2010.

The center continues to attract high-level interest. In August 2014, it hosted a discussion with Secretary of Energy Ernest Moniz and John Holdren, director of the White House Office of Science and Technology Policy, on energy infrastructure and workforce issues in North Dakota.††

* Lake Region State College, "Wind Energy Technician," http://www.lrsc.edu/academics/programs/wind-energy-technician.

† Kevin Bonham, "Lake Region State College to Dedicate Wind Turbine," *Prairie Business* (June 18, 2013), http://www.prairiebizmag.com/event/article/id/14984.

‡ Lake Region State College, "Wind Tower Dedicated" (June 19, 2013), http://www.lrsc.edu/lrsc-services/news/2013/june/wind-turbine-dedicated.

§ Honeywell, "Honeywell and Lake Region State College Break Ground on a Wind Turbine for Energy Production & Training" (Oct. 8, 2012), http://www.honeywellnow.com/2012/10/08/honeywell-and-lake-region-state-college-break-ground-on-a-wind-turbine-for-energy-production-training.

** Bismarck State College, "National Energy Center of Excellence: About the Center" (June 11, 2012), http://energy.bismarckstate.edu/nece/about.

†† Mike Nowatzki, "Moniz Visit: U.S. Energy Secretary Aware of Bakken Challenges," *The Jamestown Sun,* Aug. 8, 2014, http://www.jamestownsun.com/content/moniz-visit-us-energy-secretary-aware-bakken-challenges.

Industrial energy efficiency highlights

In addition to its vast wind-power resources, North Dakota has a significant opportunity to generate electricity through highly efficient technologies, such as combined heat and power and waste heat to power.

Combined heat and power technologies provide reliable electricity, mechanical power, or thermal energy by capturing heat that is wasted during electricity generation, helping power systems reach efficiencies of over 80 percent. Waste heat to power, which achieves 100 percent efficiency, captures heat released during industrial processes that convert raw materials into products. These industrial energy efficiency technologies allow businesses to reduce costs by recycling wasted heat for useful purposes and making on-site power available in the event of an electric grid power outage.

Several utilities in North Dakota use such systems, which also have been deployed in the food processing, hospitality, and chemical industries.[12] The state's strong and growing manufacturing sector—which accounts for over 6 percent of its gross product and employment—could take greater advantage of these energy- and cost-saving strategies if the right incentives were in place.[13]

Combined heat and power qualifies for North Dakota's voluntary renewable portfolio standard, but the state has done little else to encourage efficiency and has achieved almost no energy savings over the past year.[14] The EmPower North Dakota Commission has made energy efficiency a priority and recommended additional state policies, incentives, and education programs to increase deployment of these technologies.[15] Furthermore, a federal tax incentive is available for combined heat and power, but it is relatively small compared with incentives for other energy technologies and has limitations that exclude many worthy projects.[16]

Project Spotlight

Powering North Dakota Industry Efficiently

Combined heat and power and waste heat to power are being used in a variety of applications to save energy across North Dakota. Among the projects:

- American Crystal Sugar Co. uses combined heat and power to generate electricity at several of its processing plants, including a 13-MW coal-fired system in Hillsboro.*
- Basin Electric Power, a wholesale electric generation and transmission cooperative, purchases power from three 5.5-MW projects—in Manning, St. Anthony, and Zeeland—that harness wasted heat from compressor stations along the Northern Border Pipeline. The systems, developed by Oreg 2, a subsidiary of Ormat Technologies Inc., were the first waste heat to power generation projects on a natural gas pipeline in the United States.†
- Montana-Dakota Utilities owns a waste heat to power system with a capacity of 5.3 MW on a natural gas compressor station near the town of Glen Ullin.‡

Great River Energy, a nonprofit electric cooperative based in Minnesota, has built one of the largest industrial energy efficiency projects in North Dakota. Electricity from the 99-MW coal-fired combined heat and power plant near Spiritwood will be sold for commercial and residential use.§ The project created approximately 600 construction jobs and 43 direct and indirect jobs associated with the plant's operations.**

A heat recovery project in St. Anthony, North Dakota, on the Northern Border Pipeline.

Continued on next page

* U.S. Department of Energy, Combined Heat and Power Installation Database, http://www.eea-inc.com/chpdata.

† Basin Electric Power Cooperative, "Recovered Energy Generation," http://www.basinelectric.com/Electricity/Generation/Recovered_Energy_Generation/index.html.

‡ Energy ND, "Waste Heat," http://www.energynd.com/resources/waste-heat.

§ Great River Energy, "Spiritwood Station," Feb. 1, 2013, http://www.greatriverenergy.com/makingelectricity/newprojects/spiritwood_fact_sheet.pdf.

**Great River Energy, "Baseload Generation Position," January 2011, http://www.greatriverenergy.com/aboutus/pressroom/baseload_power_ps.pdf.

Emerging opportunities

In addition to abundant wind resources and demand for industrial energy efficiency, North Dakota has significant potential in other clean energy technologies, including solar, enhanced geothermal, biomass power, biogas energy, and liquid biofuels.

Due to North Dakota's long summer days and relatively dry climate, the state enjoys abundant sunshine about 60 percent of the year. As a result, solar electric potential in the state is greater than in Sun Belt locations such as Jacksonville, Florida, and Houston, Texas.[17] According to the National Renewable Energy Laboratory, rural areas of North Dakota could produce over 9.7 million GWh of utility-scale solar power, but there are very few solar installations in the state.[18]

In addition, western North Dakota has been identified by the Energy Information Administration as having good potential for deep enhanced geothermal systems: man-made reservoirs where there is sufficient heat but insufficient mobility through the rock to result in natural geothermal potential.[19] The U.S. Department of Energy has partnered with the Geothermal Laboratory at the University of North Dakota to develop and test organic Rankine cycle technology to produce energy from low-temperature geothermal sites.[20]

Finally, the state's strong agricultural sector makes it a prime location for the production of biomass power, biogas energy, and liquid biofuels.[21] North Dakota's wheat production is the highest in the nation, and the National Renewable Energy Laboratory estimates that each year the state produces 6.7 million tons of wasted crop residue, which could be converted into biomass and biogas power.[22] If harnessed, this material could produce 8.2 GWh of electricity and generate $335 million in revenue—an average of $16,000 more per year for the average wheat farm.[23]

The state's manure management systems, which produce more than 4,000 tons of methane per year, could also be tapped to generate about 14 GWh of power annually. Currently, the majority of this methane is not harnessed.[24]

In response to this untapped opportunity, North Dakota's Industrial Commission established a Biomass Incentive and Research Program in 2007 to fund research, engineering, and design of biomass projects in the state.[25] The EmPower North Dakota Commission is also working to create facilities for liquid biodiesel production and foster in- and out-of-state markets for this fuel. The commission has set a goal of replacing 5 percent of the state's annual diesel use with biodiesel by 2015.[26]

Geographic Spotlight

Solar-Powered Pasture Wells Help Farmers Deliver Water to Livestock

In the dry North Dakota summers, farmers have trouble keeping remote water wells for livestock pastures full. Instead of extending power lines, which can cost $15,000 per mile, to pump water from these remote wells, solar is often the lowest-cost solution, which is approximately $800 per project.* Verendrye Electric Cooperative is installing hundreds of solar panels to power pumping at these remote pasture wells around the Minot area. Verendrye uses high-efficiency water pumps with the solar panels, saving the farmers additional costs.†

Solar-powered pumps for stock tanks.

* FarmEnergy.org, "Verendrye Electric Cooperative," http://farmenergy.org/success-stories/rural-electric-cooperative/verendrye-electric-cooperative.

† National Resources Defense Council, "Renewable Energy for America: North Dakota," http://www.nrdc.org/energy/renewables/ndakota.asp#footnote26.

Conclusion

North Dakota's abundant energy resources, increasing demand for renewable energy and efficiency, and state and federal policies have set the stage for clean energy development. Wind energy has blossomed in the state, attracting private investment and economic development. An industrial energy efficiency sector is growing, particularly in the manufacturing and oil and gas industries. Moreover, the state's largely untapped solar and biomass potential provides significant opportunities for energy production and economic development. North Dakota's clean energy economy is ripe for continued growth, and a stronger renewable portfolio standard and more robust incentives could propel the state even further.

Endnotes

1 U.S. Department of Energy, Database of State Incentives for Renewables & Efficiency, "Renewable and Recycled Energy Objective," updated July 29, 2014, http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=ND04R&re=1&ee=0.

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4 U.S. Department of Energy, Database of State Incentives for Renewables & Efficiency, "Renewable Energy Tax Credit," updated July 29, 2014, http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=ND03F&re=1&ee=0.

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13 National Association of Manufacturers, "North Dakota Manufacturing Facts" (2012), http://www.nam.org/Data-and-Reports/State-Manufacturing-Data/2013-State-Manufacturing-Data/North-Dakota-State-Data-2013/.

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16 The Pew Charitable Trusts, "Harness the Heat to Save Money, Improve Competitiveness and Resiliency"(January 2014), http://www.pewtrusts.org/~/media/legacy/uploadedfiles/IndustrialEfficiencyFactSheetJan2014pdf.pdf.

17 U.S. Energy Information Administration, "North Dakota State Energy Profile," updated March 27, 2014, http://www.eia.gov/state/print.cfm?sid=ND; and Natural Resources Defense Council, "Renewable Energy for America: North Dakota," http://www.nrdc.org/energy/renewables/ndakota.asp.

18 National Renewable Energy Laboratory, "U.S. Renewable Energy Technical Potentials: A GIS-Based Analysis" (July 2012), http://www.nrel.gov/docs/fy12osti/51946.pdf; and Natural Resources Defense Council, "Renewable Energy for America: North Dakota."

19 U.S. Energy Information Administration, "North Dakota State Energy Profile."

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22 Ibid.

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25 North Dakota Industrial Commission, "Biomass Program," http://www.nd.gov/ndic/biomass-infopage.htm.

26 Ibid.

Acknowledgments

This policy brief is one of a collection examining state clean energy economies. The states selected have demonstrated leadership in clean energy policies, installations, and economies, or are at a crossroads in their energy futures. The brief was prepared by The Pew Charitable Trusts' clean energy initiative, with Sarah Greene as lead author. This research was funded in part by The 11th Hour Project.

Unless otherwise specified, data on capacity additions and investment were provided by Navigant Research, an energy market research firm, and include solar photovoltaics, industrial sector combined heat and power, geothermal power (excluding heat pumps), biomass power (excluding landfill-gas, anaerobic digesters, and biogas recovery), hydropower projects, permanently installed (not pilot) marine and hydrokinetic projects, and wind projects greater than 1 megawatt.

The Clean Energy Business Network

Pew's Clean Energy Business Network seeks to inform and engage clean energy business leaders in policy issues affecting the industry. For more information or to sign up for this free resource, visit pewtrusts.org/businessnetwork.

For further information, please visit:

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