



United States Department of Agriculture
Rural Development

MAR 11 2008

Susan E. Wefald
President
Public Service Commission
600 E. Boulevard, Department 408
Bismarck, North Dakota 58505-0480

RE: Proposed PrairieWinds-ND1 115 MW Wind Turbine Generation Facility near Minot, North Dakota

Dear Ms. Wefald:

The U.S. Department of Agriculture (USDA) Rural Utilities Service (RUS) is serving as the lead Federal agency responsible for compliance with the National Environmental Policy Act (NEPA) for the proposed wind turbine generation facility referred to as the Prairie Winds - ND1 Project, to be located near Minot, North Dakota. Basin Electric Power Cooperative (BEPCO), headquartered in Bismarck, North Dakota, proposes to construct a 77-turbine, 115 megawatt (MW) facility which will tie to an existing Western Area Power Administration (WAPA) line and new substation. The Project would include seventy-seven (77) 1.5 MW wind turbine generators. Power from the facility would be supplied to Basin Electric's customers through an interconnection with the Integrated System (IS) of which WAPA is the control area operator.

A RUS funding decision must consider potential environmental impacts of the proposed project under the National Environmental Policy Act and other laws and regulations. Per RUS's NEPA implementing regulations at 7 CFR 1794.24, the BEPCO proposal requires preparation of an Environmental Assessment (EA) with scoping. RUS has agreed to be the lead agency for preparation of the EA. The Western Area Power Administration is a cooperating agency with RUS in preparation of the EA.

Enclosed for your review and comment is a copy of the Alternative Evaluation and Site Selection Study prepared for the Prairie Winds ND-1 Wind Project. We would appreciate receiving your comments within 30 days of receipt of this document.

A public scoping meeting will be held on April 3, 2008, from 4:00 PM to 7:00 PM Central Standard Time, at the North Central Research Extension Center, 5400 Highway 83 South, Minot North Dakota 58701. Representatives from RUS, WAPA, and Basin Electric will be available to discuss the planning process for the project, answer questions and take comments.

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PU-08-75 Filed: 3/17/2008 Pages: 27
Basin Electric Alternative Evaluation Analysis and
Site Selection Study

United States Department of Agriculture

USDA Rural Utilities Service

Questions should be directed to Ms. Barbara Britton, Environmental Protection Specialist, RUS, Engineering and Environmental Staff, 1400 Independence Avenue, SW, Stop 1571, Washington, D.C. 20250-1571, telephone (202) 720-1414, fax (202)720-0820, e-mail: barbara.britton@wdc.usda.gov, or Mr. Kevin Solie, Basin Electric Power Cooperative, 1717 E. Interstate Avenue, Bismarck, ND, 58503-0564, telephone 701-355-5495, fax 701-255-5144, e-mail: ksolie@bepc.com.

Sincerely,

A handwritten signature in black ink that reads "Mark S. Plank". The signature is written in a cursive style with a large, sweeping initial "M".

MARK S. PLANK
Director
Engineering and Environmental Staff
USDA, Rural Development, Utilities Programs

Enclosure



**BASIN ELECTRIC
POWER COOPERATIVE**

Your Touchstone Energy® Cooperative 

PrairieWinds-ND1 Alternative Evaluation Analysis and Site Selection Study

(February, 2008)

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1. Introduction

Basin Electric Power Cooperative (Basin Electric) is a consumer-owned, regional cooperative headquartered in Bismarck, North Dakota which services 120 member rural electric systems in nine states: Colorado, Iowa, Minnesota, Montana, Nebraska, New Mexico, North Dakota, South Dakota, and Wyoming. These member systems, in turn, distribute electricity to more than 2.5 million customers.

Public policy regarding the electric industry has increasingly focused on the carbon intensity of the resources used to generate electricity. As a result, incentives and regulation to encourage or require the generation of power from renewable or less environmentally impacting resources are being actively considered and/or implemented within the Basin Electric member service areas. At the same time, a number of proposals for national Renewable Portfolio Standards (RPS) are pending in Congress. With members in nine states, Basin Electric recognizes the need for additional renewable energy capacity to service forecasted member load growth demands and to meet state mandated RPS. A 115 Megawatt (MW) wind project is proposed as the least-cost renewable resource option to satisfy future load and RPS requirements.

Basin Electric membership passed a resolution at their 2005 annual meeting that established a goal for Basin Electric to “obtain renewable or environmentally benign resources equal to 10% of the MW capacity needed to meet its member demand by 2010”. This project would also provide opportunity for Basin Electric to meet that goal.

An Environmental Assessment (EA) is being prepared under the direction of the U.S. Department of Agriculture, Rural Utilities Service (RUS) for the proposed project. Basin Electric Power Cooperative has submitted a loan application to RUS for the proposal, and thus the EA will be developed in accordance with National Environmental Policy Act (NEPA) requirements and RUS NEPA implementing regulations.

The purpose of this report is to describe the proposal, and the technological and siting alternatives that were evaluated in its development. The report is prepared in accordance with Rural Utilities Service requirements at 7 CFR 1794.51(c). The material presented here forms in large part the basis for a more detailed assessment required for Agency compliance with the National Environmental Policy Act.

2. Project Overview

Basin Electric is proposing to construct a new 115 MW wind project in north-central North Dakota. The PrairieWinds – ND1 Project (Project) would include seventy-seven (77) 1.5 MW wind turbine generators. The wind resource assessment study conducted in the area projects a net capacity factor in the upper thirty percent range. Power from the facility would be supplied to Basin Electric’s customers through an interconnection with the Integrated System (IS), of which Western Area Power Administration (Western) is the control area operator. Western is a federal power marketing agency with the U.S. Department of Energy (DOE).

3. *Project Need and Justification*

Existing Resources

Basin Electric operates a total of 3,508 megawatts (MW) of electric generating capacity of which 953 MW is dedicated for participants in the Missouri Basin Power Project, a group of six consumer-owned utilities, including the Missouri River Energy Services and Heartland Consumers Power District. Basin Electric also has 73 MW of ownership rights in two projects which it does not operate, and has 136 MW of wind energy. Basin Electric also manages and maintains 2,424 miles of high-voltage transmission lines; 40 switchyards and substations, and 58 microwave installations used for communications and system protection.

Projected Energy Requirements

Between 1999 and 2006, Basin Electric system peak demand increased 752 MW from 1,195 to 1,947 MW or approximately 107 MW per year. Basin Electric system energy sales increased 5.3 million MWh (from 6.5 million MWh to 11.8 million MWh) or approximately 760,000 MWh per year. Basin Electric forecasts peak demand on its system to grow by 1,834 MW from 2006 through 2021 or approximately 122 MW per year. Basin Electric forecasts energy consumption on its system to grow by approximately 12 million MWh from 2006 through 2021 or approximately 800,000 MWh per year. The average expected increase in energy sales compared to the average expected increase in peak demand results in a 75% annual load factor for the forecasted load growth. Demand is forecasted to double in the next 15 years, with 1,947 MW in 2006 projected to grow 1,834 MW by 2021, and 2006 energy usage at 11.8 million MWh forecasted to grow 12 million MWh by 2021. The load growth is driven mainly by commercial sector growth which includes energy-related development in the form of coal, oil and gas development and also increased loads in the residential sector mainly located on the outskirts of larger cities within the service territory.

The difference in the load forecast plus other obligations (such as sales, losses, and reserves less Basin's system-wide load management), and existing and planned generating resources along with purchases, define the load and capability of the Basin Electric system which shows the amount of surplus capacity on the system. Figure 1 shows Basin Electric's total system summer season surplus capacity.

Basin Electric's total system deficit is 275 MW in 2008 and is forecasted to increase steadily over time. The two periods that do not produce additional deficits from one year to the next are when the Dry Fork Station in Wyoming is anticipated to go commercial in 2011 and when a long-term power supply obligation ends in early 2016.

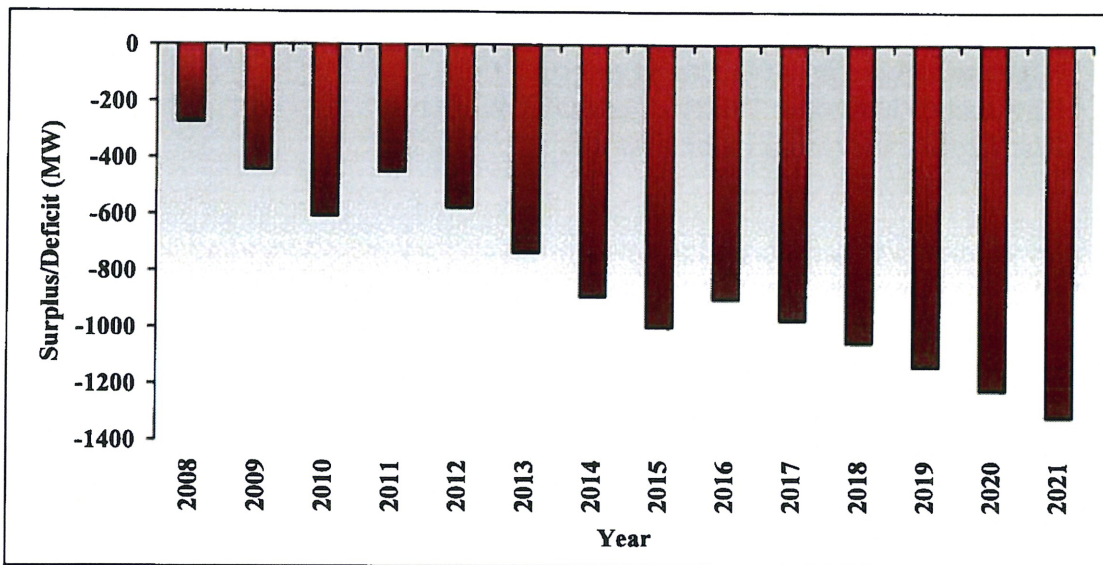


Figure 1. Total System Load and Capability

4. *Alternative Evaluation Analysis*

Overview

Basin Electric is in the process of completing a detailed power supply analysis. The draft 2007 Power Supply Analysis (PSA) provides an in depth look at Basin Electric’s current operating system, future load growth and the framework for future expansion, including both supply-side and demand-side resource expansion. Twelve resource expansion portfolios were created to meet the anticipated needs of Basin Electric and were evaluated with respect to cost, performance, and risk. All portfolios included some component of wind energy development. The twelve portfolios ranged from emphasizing nearly all baseload development to all peaking development, with various combinations in between. A number of demand-side and supply-side resource alternatives have been considered as a means of meeting the forecasted electrical need for Basin Electric. The alternatives evaluated include:

- Demand Side Management
- Renewable Energy Sources
 - Wind
 - Solar
 - Hydroelectric
 - Geothermal
 - Biomass Power
 - Biogas
 - Municipal Solid Waste
- Fossil Fuel Generation
 - Simple Cycle Combustion Turbines
 - Combined Cycle Combustion Turbines
 - Microturbines
 - Coal Facility

- Nuclear Power
- Repowering/Upgrading of Existing Generating Units
- Participation in Another Utility's Generation Project
- Purchased Power / Request for Proposals
- New Transmission Capacity

The most economical means of supplying power to a load that varies every hour on an electric power system is to have three basic types of generating assets available for use. These generation assets are commonly referred to as baseload, intermediate, and peaking capacity.

Baseload capacity runs at its full capacity continuously throughout the day and night, throughout the year. The output of baseload-type plants cannot be rapidly decreased or increased to "follow load." Baseload units are designed to optimize the balance between high capital/installation cost and low fuel cost, resulting in the lowest overall production cost under the assumption that the unit will be heavily loaded for most of its life. Typically, baseload capacity units are operated around 80 percent capacity factor or more. Coal-fired power plants, nuclear plants, and hydroelectric plants are examples of baseload generation capacity; however, hydro plants that follow load are not considered baseload units.

Intermediate capacity units are designed to be "cycled" at low load periods, such as evening and weekends. The units are loaded up and down rapidly to handle the load swings of the system while the unit is online. Typically, intermediate capacity units are operated between a 20 and 80 percent capacity factor, or between baseload and peaking. Technologies for intermediate-load plants include oil or gas-fired steam cycle plants, combined cycle plants, some hydroelectric plants, and internal combustion engine generators. While not an "on call" resource, wind facilities typically have capacity factors ranging from 30 to 40 percent, and may be classified as intermediate resources.

Peaking capacity is only operated during peak load periods and during emergencies. Very low capital/installation costs are important due to the fact these units are typically not operated very often. The production costs are relatively high due to the high cost and volatility in the price of fuel. Types of peaking capacity power plants include combustion turbines, internal combustion engine plants, and pumped-storage hydroelectric facilities. Typically, peaking resources are operated under a 20 percent capacity factor.

Of the twelve resource expansion portfolios analyzed in the PSA, the preferred portfolio included 300 MW of wind, 200 MW of peaking generation, 250 MW of intermediate generation and 600 MW of baseload coal generation. The PrairieWinds-ND1 project is proposed to meet a portion of Basin Electric's projected wind generation requirement. While baseload, intermediate, and peaking capacity units that use conventional (fossil) fuels are being contemplated for inclusion in Basin Electric's resource expansion plan, they are not addressed in this alternative evaluation analysis.

Demand Side Management

Demand Side Management (DSM) is the process of managing the consumption of energy, generally to optimize available and planned generation resources. According to the Department

of Energy, DSM refers to “actions taken on the customer’s side of the meter to change the amount or timing of energy consumption. Utility DSM programs offer a variety of measures that can reduce energy consumption and consumer energy expenses. Electricity DSM strategies have the goal of maximizing end-use efficiency to avoid or postpone the construction of new generating plants.”

DSM programs aim to achieve three broad objectives: energy conservation, energy efficiency and load management. Energy conservation can reduce the overall consumption of electricity by reducing the need for heating, lighting, cooling, cooking energy and other uses. Energy efficiency can encourage consumers to use energy more efficiently, and thus get more out of each unit of electricity produced. Load management allows generation companies to better manage the timing of their consumers’ energy use, and thus help reduce the large discrepancy between on-peak and off-peak demand.

Approximately half of the Basin Electric members are utilizing load management to manage their power purchases from Basin Electric. Basin Electric has implemented a system-wide load management program on its eastern system which enables Basin Electric to target large loads and/or generation that are not included in the members’ load management programs to be used during Basin Electric’s seasonal peak periods. Basin Electric has approximately 6-10 MW of load management available at this time.

DSM programs are capable of reducing energy demand and thus reducing the required capacity of future additional generation facilities. It is apparent, however, that energy savings through DSM are not enough to alleviate the need for the additional generating capacity fulfilled by the current proposal.

Repowering/Upgrading of Existing Generating Units

Basin Electric has committed to upgrading the high pressure and intermediate pressure (HP/IP) turbine section of the main turbine at all three units of its Laramie River Station. The Unit 2 upgrade occurred in the spring 2007 maintenance outage, unit 3 is scheduled to occur in the spring 2008 maintenance outage, and unit 1 in the spring 2009 maintenance outage. The upgrade to the HP/IP turbine is anticipated to increase the net output of each unit by 8-12 MW for a total of 24-36 MW. Basin Electric could see an additional 10-15 MW from the upgrades of these turbines, due to its 42.27% ownership share of the Missouri Basin Power Project (MBPP). The increase in net output is an efficiency increase in that there is no increase in the fuel input to the units.

Basin Electric has also evaluated the option of upgrading the HP/IP turbines at its Antelope Valley Station; however, work within the boiler would need to be done to make this a viable project. The work would require full “New Source Review” (NSR) for modification of the boiler. Basin Electric has determined that modifying the Antelope Valley Station to increase generation is not economically justifiable.

While Basin Electric has made progress in upgrading existing facilities, it is apparent that the scale of the improvements does not alleviate the need for the additional generating capacity fulfilled by the current proposal.

Participation in Another Utility's Generation Project

Basin Electric has been having discussions with some neighboring utilities about participating in a third unit at the Milton R. Young Station near Center, North Dakota. Basin Electric is looking at a 100 MW share of a 500 MW unit to be operational in the 2016-2020 time period.

This participation could help meet a portion of Basin Electric's long-term need for increased generating capacity in the region, but would not meet the purpose and need for its renewable energy requirements.

Purchased Power / Request for Proposals

Basin Electric has signed a 25-year contract with the developer of four currently operational Recovered Energy Generation (REG) power plants to purchase the output from four additional REG plants. The plants are fueled by hot exhaust from compressors on the Northern Border Pipeline. There will be one site each in Montana and Minnesota, and two sites in North Dakota. These additional four sites should have a total combined output of 22 MW and are anticipated to be operational in 2009. The generation is environmentally benign, using virtually no additional fuel and producing virtually zero emissions.

Basin Electric hired Power Systems Engineering (PSE) to develop and issue a Request for Proposals (RFP) in early 2007 for short- and long-term power supply on both its eastern and western systems. The long-term proposals were used to evaluate against Basin Electric's self-build options. The short-term proposals could be utilized to meet some of Basin Electric's need in the next couple of years. Renewable proposals were also sought.

Short-term Proposals

Basin Electric received short-term proposals from nine different entities for power products located in Basin Electric's eastern and western systems. The short-term proposals were evaluated by PSE.

Figure 2 compares Basin Electric's eastern system needed generation capacity to the magnitude of proposals received. From this information it was determined that Basin Electric could purchase the needed power from the market through 2009 but would need to develop additional resources to meet the needed obligations beyond 2009. Basin Electric elected to short-list one proposal from those received for delivery into Basin Electric's eastern system; however, since the proposals do not include renewable energy resources, they would not meet the purpose and need for the current project.

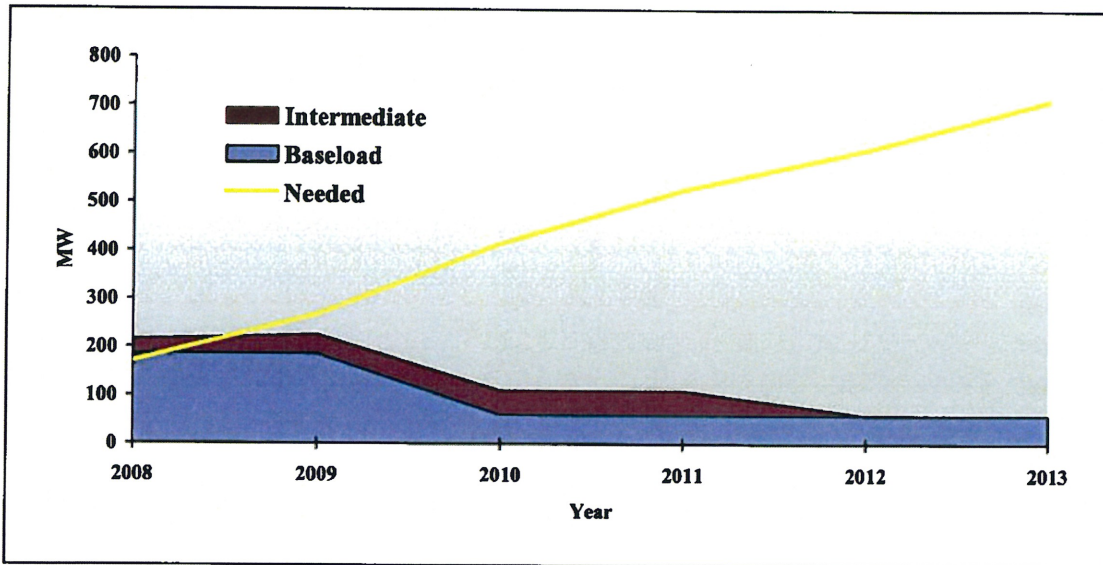


Figure 2. East System Short-Term RFP Proposals

Long-term Proposals

Basin Electric received four conventional long-term power purchase proposals from two different entities for either coal generation or a combination combined cycle and simple cycle generation. It was determined that the four long-term proposals were more costly than Basin Electric's self build options. Furthermore, they did not include renewable energy sources; as such, they do not meet the purpose and need identified for the currently proposed project.

Renewable Proposals

Basin Electric received 12 proposals from nine different entities for wind generation. These 12 wind proposals were located in North Dakota, South Dakota, Montana and Wyoming. Figure 3 shows the anticipated first-year bus bar costs of each proposal. Bus bar cost is the cost of producing one MWh of electricity, typically including the cost of capital, debt service, operation and maintenance, and fuel. The renewable proposals were evaluated by Basin Electric staff.

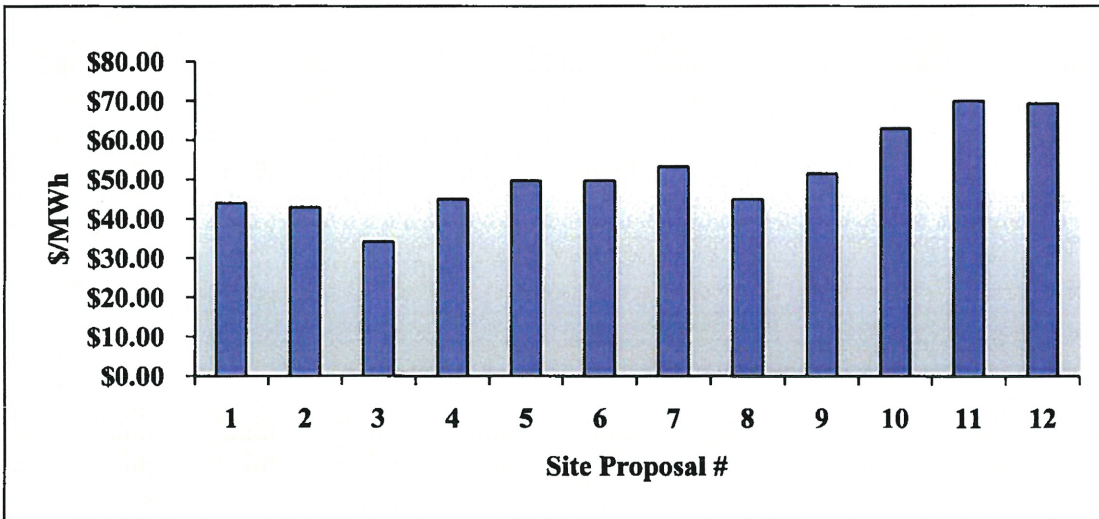


Figure 3. Renewable Proposals First-Year Bus Bar Costs

Based on the anticipated capacity factors, installation locations, bus bar costs, and durations of the proposed agreements, Basin Electric determined the self-build option for wind generation was the most economical.

New Transmission Capacity

There is limited available transmission capacity (ATC) on the transmission system to move power into the Integrated System (IS) from Nebraska Public Power District (NPPD), Mid-American Energy Company (MEC), Midwest Independent Transmission System Operator (MISO) or Saskatchewan. In order to bring in enough power to cover Basin Electric’s total need, additional transmission would need to be built and there would probably be upgrades needed to third-party transmission.

Another concern is the availability of existing generation capacity outside the region to meet Basin Electric’s need. The Request for Proposals provided few responses for power from outside the IS area during the short term; one proposal within MISO, one proposal within MEC and one proposal within NPPD. One proposal for a long-term output of a new coal plant was received that would result in either additional transmission to be built or additional wheeling expense to move the power into the IS or both. Because of these anticipated higher costs, Basin Electric feels it would be a better economic decision to build the new generation within the IS and therefore avoid some unnecessary transmission costs to provide power to the membership at the lowest reasonable cost.

Renewable Energy Resources

Overview

Renewable energy comes from sources that are essentially inexhaustible in duration but limited in the amount of energy that is available per unit of time. These energy supplies can be endless resources such as the sun, the wind, and the heat of the Earth, or they can be replaceable fuels

such as biomass, i.e. combustible plants or plant extracts, such as ethanol. The renewable energy sources evaluated include wind, solar, hydroelectric, geothermal, biomass, biogas and municipal solid waste.

In 1850, about 90 percent of energy consumed in the United States was from renewable energy resources. Now the United States is heavily reliant on non-renewable fossil fuels: coal, natural gas, and oil. Figure 3 shows that 9 percent of total electricity production was contributed from renewable energy in 2004. Non-hydro renewables made up only 2.3 percent of the total generation in the United States in 2004.

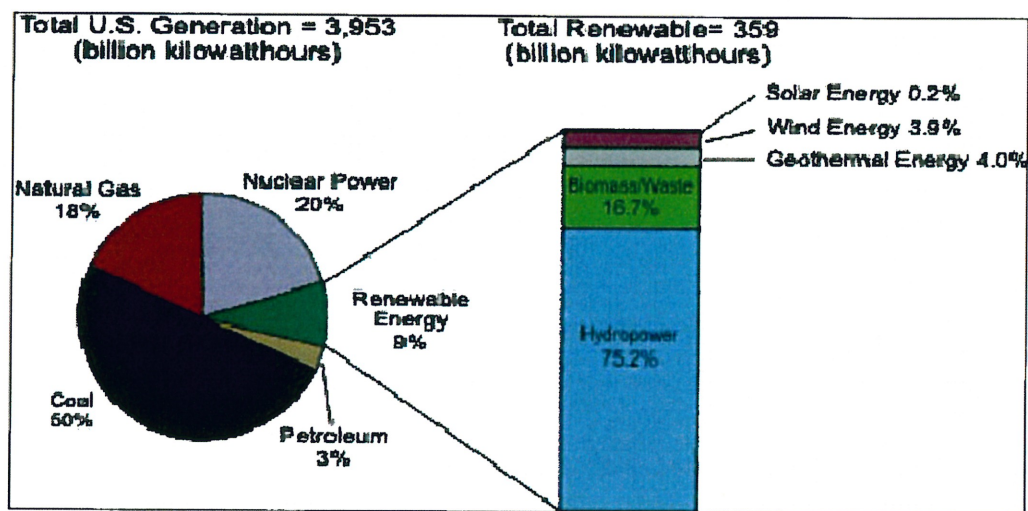


Figure 4. U.S. Electricity Generation by Energy Source, 2004¹

Solar

The sun's energy can be converted to electricity directly through photovoltaic cells (solar cells) or through thermal systems. In a thermal system, a heat transfer fluid heated in the receiver is used to generate steam, which, in turn, is used in a conventional turbine-generator to produce electricity. Thermal systems appear practical only in the southwestern United States. Solar energy varies by location and by the time of year. Solar resources are expressed in watt-hours per square meter per day ($Wh/m^2/day$), a measurement that quantifies how much energy falls on a square meter over the course of an average day.

There are two types of solar collectors, flat-plate and concentrator. Flat-plate collectors are generally fixed in a single position, but can be mounted on structures that maximize their exposure to the sun on a daily or seasonal basis. Concentrator collectors focus direct sunlight onto solar cells for conversion to electricity. These collectors are on a tracker so they always face the sun directly; since these collectors focus the sun's direct rays, they cannot utilize indirect sunlight.

¹ Source: U.S. DOE Energy Information Administration: *Renewable Energy Sources: A Consumer's Guide* (Ref. 4)

Figure 5 shows a map of the United States and the amount of solar resource capability for a flat-plate collector. Moderately useful solar resources are located throughout the Basin Electric service area.

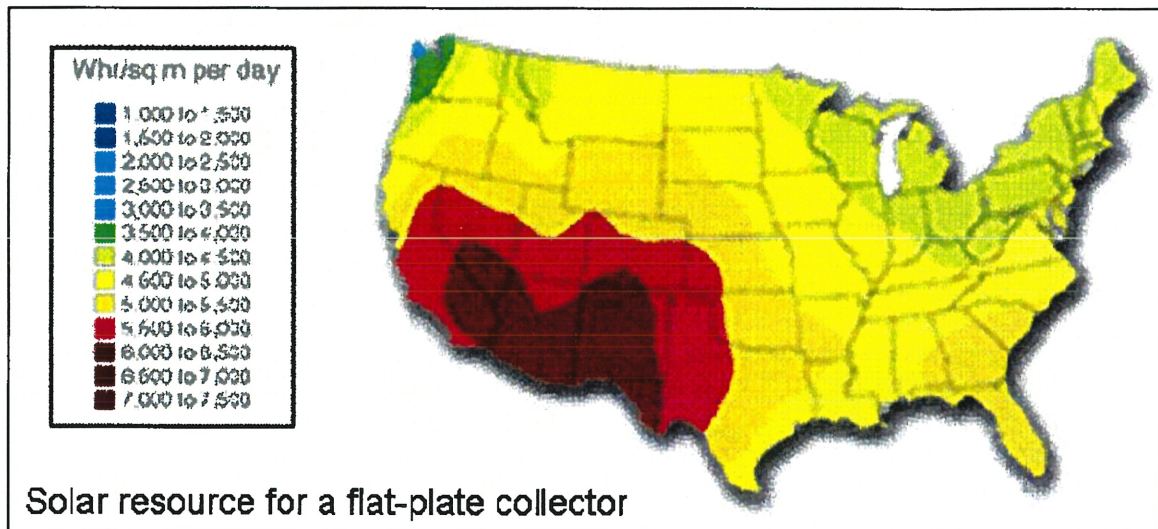


Figure 5. Solar Resources for a Flat-Plate Collector in the United States²

Figure 6 shows a map of the United States and the amount of solar resource capability for a concentrator collector.

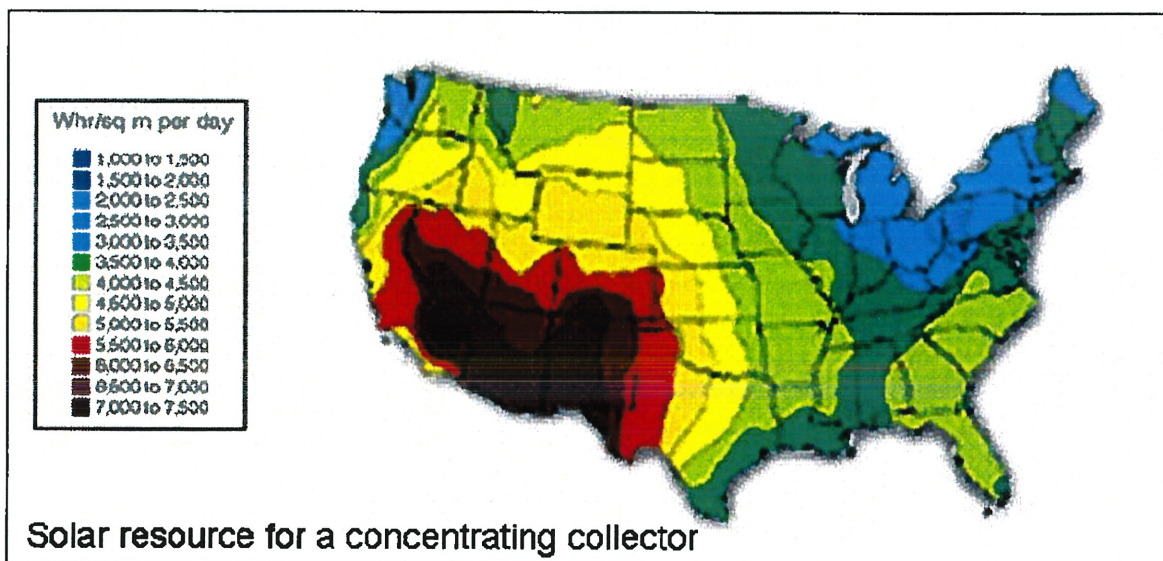


Figure 6. Solar Resources for a Concentrating Collector in the United States³

² Source: U.S. DOE EERE State Energy Alternatives website (Ref. 2)

³ Source: U.S. DOE EERE State Energy Alternatives website (Ref. 2)

Photovoltaic (PV) systems are expected to be used in the United States for residential and commercial buildings, distributed utility systems for grid support, peak power shaving, and intermediate daytime load following. With improvements in electrical storage and transmission, PV systems may be used for dispatchable electricity and for hydrogen gas (H₂) fuel production.

The main advantages of PV systems are their modularity, portability, high reliability, and low environmental impact. These systems have no (or few) moving parts, which means operating and maintenance costs are low. Another obvious benefit of PV systems is that the sun provides abundant and free fuel. Solar power, however, can be very unpredictable due to weather and other factors. It is not dispatchable in a traditional sense, meaning its output cannot be controlled and scheduled to respond to variable consumer demand for electricity. It does, however, have the advantage of providing output that has considerable coincidence with natural demand for electricity, driven largely by daytime activities – particularly in the summer when a large amount of electricity is used for air conditioning.

Fixed, investment-related charges are the largest component of solar-based electricity costs. Capital costs for PV systems range from \$5,000 to \$12,000 per kilowatt and are offset by low operating costs (no fuel). The 20-year lifecycle cost ranges from \$200/MWh to \$500/MWh.

Solar power could help fulfill the need for intermediate generation as it generally has an annual capacity factor of 20-35%; however, estimated bus bar costs are very high compared to other resources. Due to its intermittency, solar power could be integrated with on-call natural gas generation to provide a more stable product. However, the viability of a solar power resource remains limited by the relatively high bus bar cost of PV electricity and the limited availability of solar power resources within Basin Electric's eastern system.

Hydroelectric Power

Hydroelectric power (hydropower) uses the kinetic energy of flowing water. Hydropower is captured and used to power machinery or converted to electricity. Hydropower plants will typically dam a river or stream to store water in a reservoir. The water is released from the reservoir and flows through a turbine, causing it to spin and activate a generator to produce electricity. A pumped-storage hydroelectric plant has the ability to store energy by moving water from lower to higher potential energy. Energy (off-peak) is sent from the power grid to the electric generators; the generators then turn the turbines in reverse, which causes the turbines to pump water from a lower reservoir to an upper reservoir. When energy is needed, water is released from the upper reservoir back down to the lower reservoir, turning the turbines forward and generating electricity. Hydropower is the nation's leading renewable energy source, accounting for 75% of the nation's total renewable electricity generation.

Hydropower is the least expensive source of electricity in the U.S., with typical efficiencies of 85% - 92% during production. The DOE's Idaho National Laboratory (INL)⁴ reports hydropower capital costs to be \$1,700 to \$2,300/kW. Operating and maintenance costs are relatively low at about \$6 to \$7/MWh. The total levelized cost of hydropower is projected to be about \$24/MWh. A hydropower facility will typically operate longer than 50 years.

⁴ Source: Idaho National Laboratory (Ref. 5).

Hydropower production is seasonal and depends greatly on year-to-year rainfall levels. With an average annual capacity factor of 40 to 50 percent, it could meet Basin's intermediate capacity need; however, there have been several years of drought in the Upper Midwest and water is currently very limited. Further, environmental impacts associated with flooding a valley to create a reservoir may be significant, and permitting would likely be complex and time-consuming. Based on these factors, hydropower was removed from further consideration.

Geothermal

Geothermal energy is thermal energy from the Earth's interior where temperatures reach greater than 7,000°F. The heat is brought to the surface as steam or hot water and may be used to produce electricity or for space heating and industrial processes. Currently, about 8,000 MW of geothermal electricity have been developed around the world, with approximately 2,800 MW in the United States.

There are three types of geothermal energy. The first is power generation (or electric), which employs turbines using natural steam or hot water flashed to steam to produce mechanical power that is converted to electricity. The second is a direct use application where a well brings heated water to the surface and a mechanical system delivers the heat to the space or process. The third and most rapidly growing use for geothermal energy is geothermal heat pumps, which use the earth or groundwater as a heat source in winter and a heat sink in summer. A heat pump transfers heat from the soil to the house in winter and from the house to the soil in summer.

Figure 7 shows geothermal resources throughout the United States.

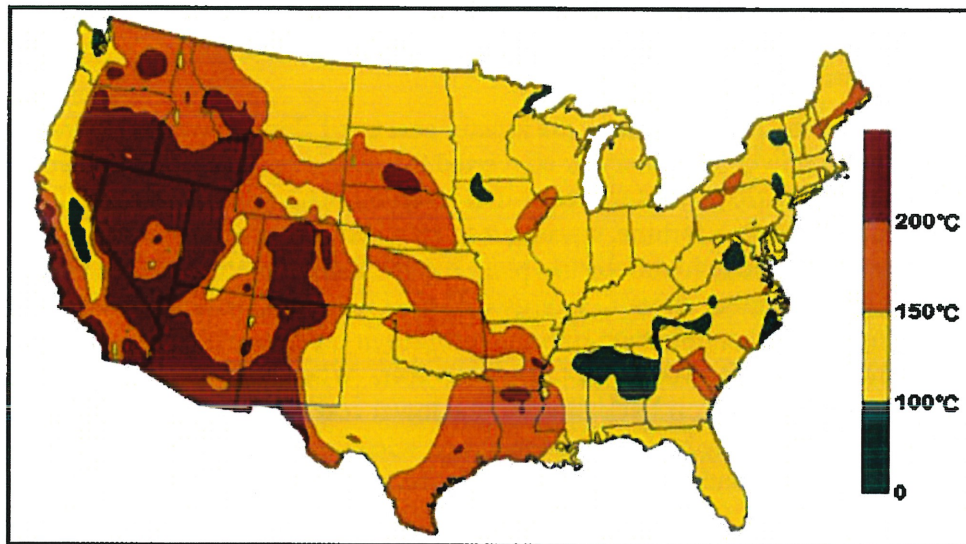


Figure 7. Geothermal Temperatures for Resources in the United States⁵

In general, geothermal resources used for electric generation should be 200°C or greater, those utilized for direct use should be between 150°C and 200°C, and those used for heat pumps should be between 100°C and 150°C. Based on Figure 7, North Dakota has low to moderate temperature resources that can be tapped for direct heat or for geothermal heat pumps. Electricity

⁵ Source: U.S. DOE EERE State Energy Alternatives website (Ref. 2)

generation is not possible with these resources. South Dakota and Montana, however, have high-temperature resources that are suitable for electricity generation as well as direct use and heat pump applications. Similar to North Dakota, Minnesota has vast low-temperature resources suitable for geothermal heat pumps but does not have sufficient resources to use the other geothermal technologies.

Geothermal power plants are very reliable when compared to conventional power plants. Geothermal power plants will typically have an availability factor of 95 percent or more and their capacity factor is highest among all types of power plants. Geothermal electric power typically ranges from \$40 to \$80/MWh, and technology improvements are lowering that range steadily.

Due to the limited geothermal resources available for power generation within Basin Electric's service territory, this alternative was not pursued further.

Biomass Power

Biomass power (biopower) is the generation of electric power from biomass resources; these resources include urban waste wood, crop and forest residues and in the future, crops grown specifically for energy production. Biomass reduces most emissions compared with fossil fuel-based electricity. Biomass results in very low net carbon dioxide (CO₂) emissions due to the absorption of CO₂ during the biomass growing cycle.

There are four primary types of biomass power systems: direct-fired, co-fired, gasification, and modular systems. Nearly all current biomass generation is based on direct-fired combustion in small, biomass-only plants with relatively low electric efficiency. Most biomass direct-fired combustion generation facilities utilize the basic Rankine cycle for electric power generation, which burns biomass fuel in a boiler to produce steam that is expanded in a Rankine Cycle turbine to produce power. Currently, co-firing is the most cost-effective technology for biomass. Co-firing substitutes biomass for coal or other fossil fuel in existing boilers.

The price of electricity depends on the type of technology used, the size of the power plant and the cost of the biomass fuel supply. Currently, the most economically attractive technology for biomass is co-firing. These projects require small capital investments per unit of power generation capacity. Co-firing systems range in size from 1 MW to 30 MW capacities. When low-cost biomass fuels are used, co-firing systems can result in payback periods as low as 2 years.

For biomass to be economical as a fuel for electricity, the source must be located near the generation site to reduce transportation costs; the most economical conditions exist when the fuel is located at the generating site itself. This condition, however, does not exist in the Basin Electric service area. Using inexpensive biomass fuels, co-firing produces power for about \$60/MWh while direct-fired generation costs are about \$90/MWh. Based on the estimated costs, it appears other renewable energy resources (such as wind) are more economical.

Biogas

Biogas power plants produce electricity through a combination of anaerobic digestion systems and associated electricity generators such as gas turbines or gas engines. The feedstock must be biodegradable in order to produce methane. Suitable feedstocks include (but are not limited to):

- Sewage treatment sludge (primary or raw sludge and/or secondary sludge)
- Slaughterhouse waste
- Food waste
- Farm waste
- Organic component of mixed municipal waste
- Biomass like maize

. An anaerobic digester is an industrial system that harnesses the natural process of anaerobic decomposition to treat waste and produce biogas that can be used to power electricity generators, provide heat and produce soil improving material. There are three stages of anaerobic digestion: hydrolysis, acidogenesis, and methanogenesis. These stages can occur in the same digestion tank or can be controlled independently and optimized according to the requirements of different bacterial processes.

Biogas is one of the principal by-products of anaerobic digestion and is a gaseous mixture composed predominantly of methane and carbon dioxide. Biogas may also contain small amounts of hydrogen and occasionally trace levels of hydrogen sulfide. Biogas can be burned to produce electricity, usually in a reciprocating engine or microturbine. The gas is often used in a cogeneration arrangement, to generate electricity and use waste heat to warm the digesters or to heat buildings. Since the gas is not released directly into the atmosphere and the carbon dioxide comes from an organic source with a short carbon cycle, biogas does not add significantly to atmospheric carbon dioxide concentrations.

The DOE Energy Information Administration⁶ projects the capital cost component of the levelized cost of biogas power to be approximately \$37/MWh in 2009. The total levelized cost of biogas power is projected to be approximately \$46/MWh.

Basin Electric currently purchases power from the Midwest Dairy biogas project (375kW) in Milbank, South Dakota. The number of cattle required to support a large project is significant, with typical estimates ranging from 1,500 to 3,000 head of cattle per MW of electricity generated. As such, Basin Electric has elected not to pursue the biogas option due to the limited opportunities for a large development in its service area.

Municipal Solid Waste

The municipal solid waste (MSW) industry includes four components: recycling, composting, landfilling and waste-to-energy via incineration. As defined by the U.S. EPA, MSW includes durable goods, non-durable goods, containers and packaging, food wastes, yard wastes, and miscellaneous inorganic wastes from residential, commercial, institutional, and industrial

⁶ Source: U.S. DOE EIA (Ref. 3)

sources. Burning MSW can generate energy while reducing the volume of waste by up to 90 percent and the weight of the waste by up to 75 percent.

MSW can be directly combusted in waste-to-energy facilities to generate electricity after the separation of recyclables. Although MSW consists mainly of renewable resources such as food, paper, and wood products, it also includes nonrenewable materials derived from fossil fuels, such as tires and plastics. There are currently 90 waste-to-energy plants in the United States, producing approximately 2,500 MW or about 0.3 percent of total national power generation. The U.S. EPA and some state governments classify MSW as renewable energy source because it is abundant and contains significant amounts of biomass.

Waste-to-energy plants work very much like coal-fired power plants but use garbage – not coal – to fire an industrial boiler. The same steps are used to make electricity in a waste-to-energy plant as in a coal-fired power plant.

1. The fuel is burned, releasing heat.
2. The heat turns water into steam.
3. The high-pressure steam turns the blades of a turbine generator to produce electricity.

Waste-to-energy plants produce air emissions when the fuel is burned, releasing chemicals and other substances found in the waste. Some chemicals can be dangerous to humans and/or the environment. The EPA requires waste-to-energy plants to use pollution control devices including scrubbers, fabric filters, and electrostatic precipitators.

Landfill disposal is generally the lowest cost method of MSW management; however, when landfills are not available near the collection area and hauling costs become excessive, waste-to-energy plants become an economical method of MSW management. The capital cost of an MSW power project is approximately \$3,500 to \$4,000/kW. The total levelized cost of MSW power is projected to be approximately \$85/MWh.

Ash disposal and air emissions are the primary environmental issues with MSW-fired plants. MSW power cannot fulfill the need for a long-term, cost-effective generation capacity due to the rural nature of Basin Electric's service territory and the lack of nearby MSW supplies.

Wind

Wind turbines convert the power in wind into electricity by utilizing a turbine to extract the kinetic energy of moving air and to produce the mechanical power used to turn an electrical generator. As a renewable resource, wind is classified according to wind power classes, which are based on typical wind speeds. These classes range from Class 1 (the lowest) to Class 7 (the highest). In general, wind power Class 4 or higher can be useful for generating wind power with large (utility-scale) turbines. Figure 8 is a map of the United States showing the general wind power classes. It indicates that the Upper Midwest has primarily a wind power Class 4 with small areas of Class 5.

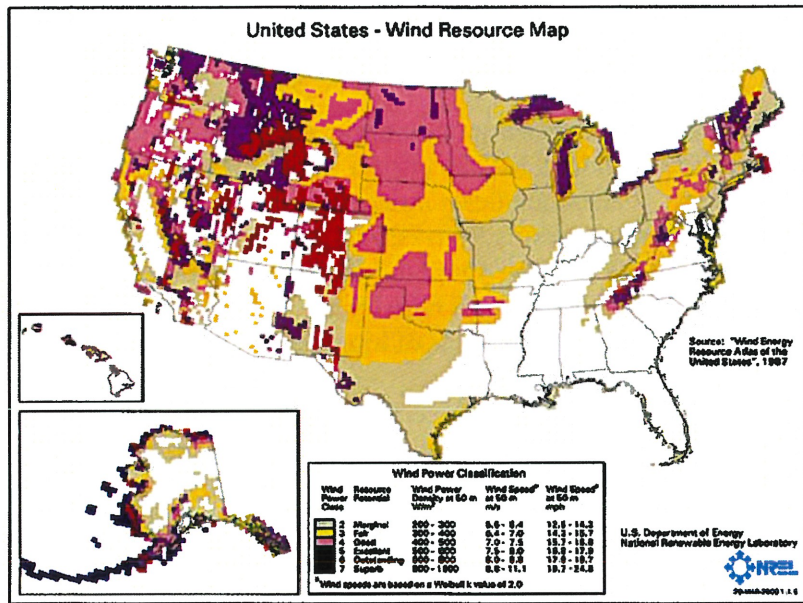


Figure 8. Classes of Wind Power in the United States⁷

Fixed, investment-related costs are the largest component of wind-based electricity costs. Improved designs with greater capacity per turbine have reduced investment costs. Wind power installations incur no fuel costs and their maintenance costs have also declined with improved designs. The U.S. Department of Energy (DOE) National Renewable Energy Laboratory⁸ projects the levelized cost of wind power to be between \$40 and \$60/MWh. However, with the rise in demand for wind generation, the capital cost of installing a wind turbine is increasing; therefore the levelized cost of wind power will also increase.

Wind is considered a fuel displacer and it can be integrated with natural gas fueled facilities to provide the energy shape required in most areas. The greatest advantage of wind power is electricity generation without emissions of any kind. Another advantage of wind power is once a wind project is built, the cost of the electricity generated remains stable because there are no fuel price increases or volatility. Acquiring wind power allows utilities to lock in a stable price for electricity for as long as 20 years or more.

Turbine Considerations

Consideration was given to the size and type of turbines to be utilized for the proposed wind installation. While larger capacity units equate to fewer towers and less disturbance for a total MW output, larger machines typically do not have the efficiencies found in some 1.5 MW turbines. Turbine selection rationale will be addressed in greater detail in the EA. Considering reliability, efficiency, constructability, and cost, Basin Electric proposes to use 1.5 MW turbines for the project.

⁷ Source: U.S. DOE NREL website (Ref. 7)

⁸ Source: Power Technologies Energy Data Book 4th edition, US DOE NREL (Ref. 6)

Conclusion

Basin Electric has established the need for additional renewable energy capacity to service forecasted member load growth demands, to meet Basin Electric's renewable energy goal set forth in 2005, and to meet state mandated RPS. Wind is the most viable renewable technology based on availability and economics. Solar resources in the region are limited and while solar economics are improving, costs are still not competitive with wind. Geothermal and bio-based resources are in some cases cost effective, but are either restricted to limited or distant locations, available in only small quantities, or present other environmental concerns. In contrast, potential wind resources in the Basin Electric member service territory are generally recognized as excellent, and limited mainly by land use and transmission. A 115 Megawatt (MW) wind project was determined to be the best available, least-cost renewable resource option to satisfy future load and RPS requirements.

5. *Site Selection Study*

Overview

Basin Electric has established the need for additional renewable energy capacity to serve forecasted member load growth demands and to meet state mandated Renewable Portfolio Standards (RPS). As such, Basin Electric is pursuing approximately 300 MW of wind development in its current resource expansion plan. Based on evaluation factors such as wind energy potential, proximity to transmission lines with available capacity, and the availability of suitable land for purchase or lease, Basin Electric is proposing to develop wind energy facilities totaling approximately 115 MW in North Dakota and 200 MW in South Dakota. This site selection study will use these evaluation factors to describe the process of identifying suitable sites for the proposed North Dakota facility.

Wind Development Potential

As a renewable resource, wind is classified according to wind power classes, which are based on typical wind speeds. These classes range from Class 1 (the lowest) to Class 7 (the highest). In general, wind power Class 4 or higher can be useful for generating wind power with large (utility-scale) turbines. Figure 9 is a map of the North Dakota showing general wind power classes. North Dakota has large areas of wind power Classes 4 and 5, indicating the potential for good to excellent wind energy resource development.

Wind Powering America⁹ within the U.S. Department of Energy National Renewable Energy Laboratory (U.S. DOE NREL) is a commitment to dramatically increase the use of wind energy in the United States. Wind Powering America indicates that North Dakota has wind resources consistent with utility-scale production, with good to excellent wind resource areas located throughout North Dakota. The American Wind Energy Association¹⁰ estimated the annual wind electricity generation potential in North Dakota to be 1,210 billion kWh.

⁹ Source: U.S. DOE NREL website (Ref. 7)

¹⁰ Source: American Wind Energy Association (Ref. 1)

As discussed in the alternatives evaluation, a wind power facility's economic feasibility strongly depends on the amount of energy it produces. Fixed, investment-related costs are the largest component of wind-based electricity costs. To ensure economic feasibility of a wind energy facility, it should be located in an area with the high potential for power production. As such, the focus for a potential site should narrow to areas of wind power Class 5 (excellent wind resource potential) within North Dakota. Areas of excellent wind resource potential are located along portions of the northwest to southeast trending Missouri Coteau, in the vicinity of the Turtle Mountains located in the extreme north-central portion of the state, and in smaller areas scattered throughout western North Dakota.

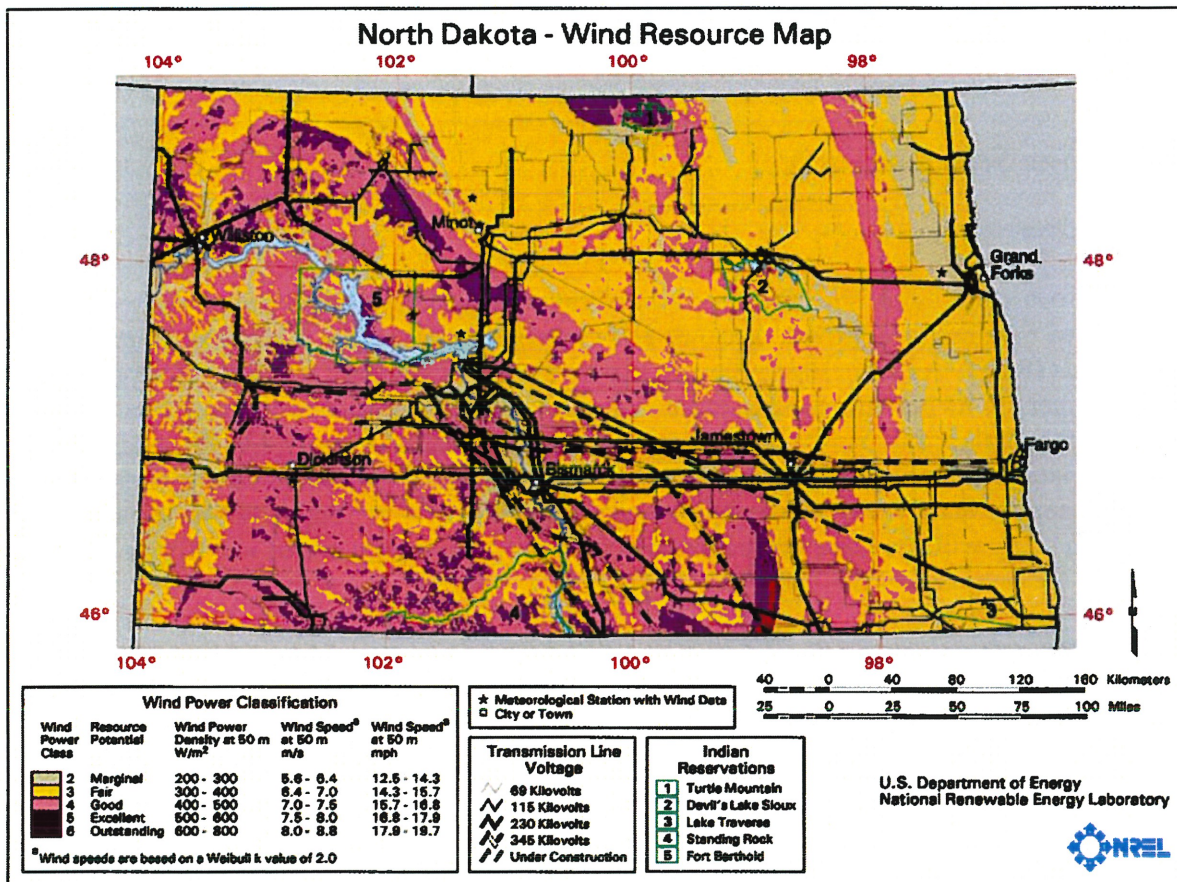


Figure 9. North Dakota Wind Resource Map¹¹

Available Transmission

In addition to wind resource potential, figure 10 also depicts the high voltage electrical transmission system in North Dakota. High voltage transmission is centered on the energy

¹¹ Source: U.S. DOE NREL website (Ref. 7)

producing region in west-central North Dakota, which is comprised of six coal fired generating plants and the Garrison Dam hydroelectric facility. The majority of the transmission lines deliver power to load centers to the east and to the south; fewer transmission lines serve loads to the north and to the west.

In order to optimize connection with the regional power grid, a wind energy facility should be located proximal to an existing transmission line with available capacity. This situation occurs both south and west of Minot, in north-central North Dakota, where both Basin Electric and Western Area Power Administration (Western) transmission lines cross relatively large areas of excellent wind resource potential. Minimizing the length of new transmission line necessary for interconnection to the grid helps reduce overall cost and minimizes impact to land based resources.

Based on initial site reconnaissance and preliminary studies of potential wind facility sites south and west of Minot, it appears Basin Electric would likely propose an interconnection to the Western 115 kV line south of Minot. Final studies are underway to confirm the Western transmission line has available capacity of at least 125 MW.

Available Land

Due to the increased interest in wind energy, many areas in North Dakota with favorable wind potential have been secured by other wind energy developers. Projects have been proposed or constructed throughout the state; Basin Electric estimates that at least 30 entities currently have interest in wind projects in North Dakota. Basin Electric right-of-way agents have contacted landowners in the proposed project area and found land is available for lease. Most landowners have been very receptive and have a favorable view of wind energy development. Potential lease payments would provide a long term supplement to farm and ranch incomes in these rural areas.

Other Considerations

Basin Electric commissioned a critical environmental issues analysis for two potential project sites in north-central North Dakota. One site (about 36,000 acres) is located approximately 10 miles west-southwest of Minot in Ward County, and the second site (about 27,000 acres) is located approximately 15 miles directly south of Minot in Ward County. Figure 10 depicts the location of the study area. Field studies were conducted in October 2007 and the report was delivered to Basin Electric in December 2007. Various resources (vegetation, water, wetlands, soils, wildlife, cultural, and community issues) were quantified to assess potential impacts. As both sites are located on the Missouri Coteau and in similar physical settings, they are virtually indistinguishable from an environmental standpoint. Both sites have potential issues (impacts to wetlands, federal wetland and grassland easements, county/township zoning, etc.) that would need to be addressed; however, based on the information collected to date, both sites appear to be viable for wind energy development.

The proposed wind energy facility would need local personnel for the routine operation and maintenance of site infrastructure. A site located near a larger rural community may be

desirable, as there are typically more opportunities and choices for commerce, employment of other family members, and schools. Basin Electric has experienced occasional difficulty in recruiting and retaining qualified individuals for positions in remote locations. Workforce availability, however, was only a minor consideration in the site selection process for this project.

The area south of Minot, ND may also be favorable since there are two currently operational Basin Electric wind turbines located near the project area. Acknowledging the relatively small scale of this facility, there does appear to be general acceptance and support for wind energy in the vicinity of the project area and throughout North Dakota.

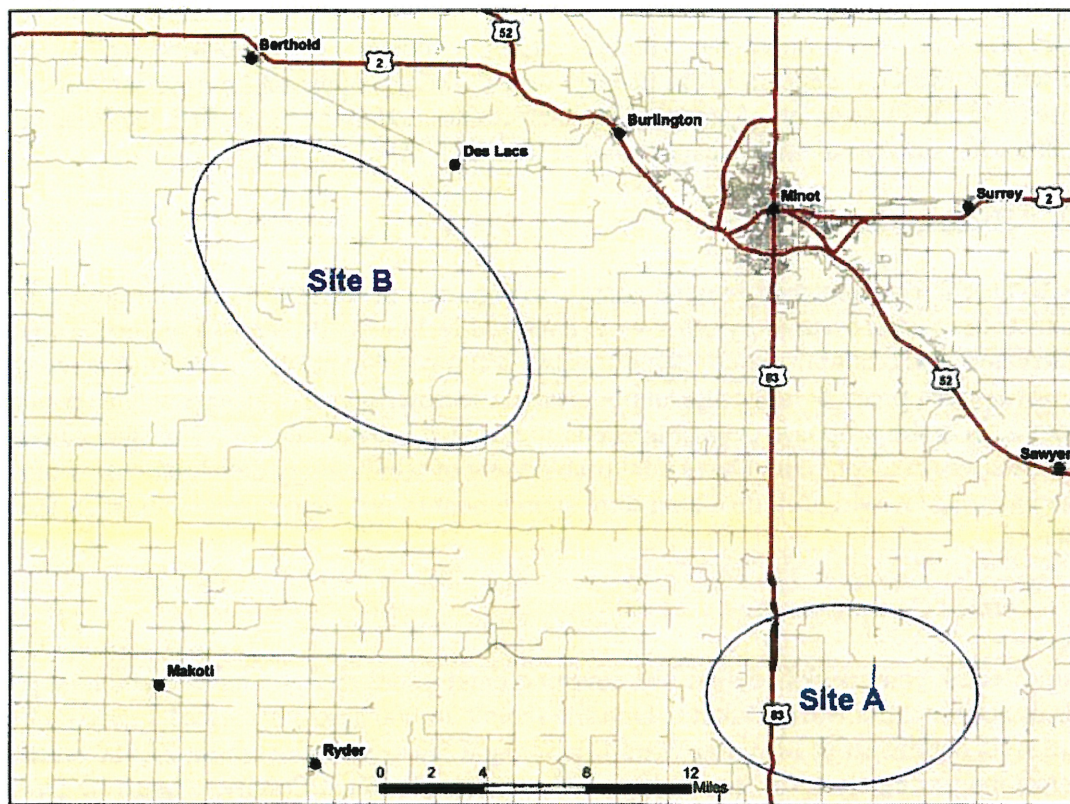


Figure 10. Project Area and Site Boundaries.

Summary

Basin Electric is proposing to construct a new 115 MW wind project in north-central North Dakota. The Project would include seventy-seven (77) wind turbine generators. The project area possesses characteristics favorable for the development of a wind energy installation, including available land, excellent wind power resource potential and nearby high voltage

transmission facilities. The wind resource assessment study conducted in the area anticipates a net capacity factor in the upper thirty percentage range.

Field studies were conducted in late 2007; various resources (vegetation, water, wetlands, soils, wildlife, cultural, and community issues) were quantified to assess potential impacts. As both sites are located in similar physiographic settings, they are virtually indistinguishable from an environmental standpoint. Both sites have potential issues that would need to be addressed; however, based on current information, both sites appear to be viable for wind energy development.

Based on information collected to date, Basin Electric proposes to carry Sites A and B forward for further evaluation through the National Environmental Policy Act (NEPA) process.

6. References

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