Environmental Report

Pleasant Valley Wind Project

In the Matter of the Application of Pleasant Valley Wind LLC for a Certificate of Need for the 300 MW Pleasant Valley Wind Project in Dodge and Mower Counties in South Central Minnesota

PUC Docket No. IP6828/CN-09-937

Energy Facilities Permitting
85 7th Place East, Suite 500
Saint Paul, MN 55101

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Responsible Governmental Unit	Project Proposer
Minnesota Office of Energy Security	**Pleasant Valley Wind, LLC**
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Abstract

On October 27, 2009, Pleasant Valley Wind, LLC (Applicant), filed a certificate of need application with the Minnesota Public Utilities Commission (Commission) for the Pleasant Valley Wind Project (Project). The Applicant is proposing to construct a 300 megawatt (MW) large wind energy conversion system in the Minnesota counties of Dodge and Mower.

The proposed Project is a large energy facility as defined by Minnesota Statute 216B.2421. Such a facility requires a certificate of need from the Commission (Minn. Stat. § 216B.243). Additionally, the Minnesota Department of Commerce must prepare an environmental report (ER) for the Project (Minn. Rules 7849.1200).

Office of Energy Security, Energy Facility Permitting (OES EFP) staff is responsible for preparing the ER. This ER has been prepared as per Minnesota Rules 7849.1100-2100. The ER is part of the record which the Commission will consider in making a decision on a certificate of need for the Project.

Information about this Project can be found on the Commission's energy facilities permitting website: http://energyfacilities.puc.state.mn.us/Docket.html?Id=25724, or obtained by contacting Ingrid Bjorklund, Office of Energy Security, 85 7th Place East, Suite 500, St. Paul, Minnesota 55101, phone: (651) 297-7039, email: ingrid.bjorklund@state.mn.us.

Information about the Commission's certificate of need process can be obtained by contacting Bret Eknes, Minnesota Public Utilities Commission, 121 7th Place E., Suite 350, Saint Paul, MN 55101, phone: (651) 201-2236, email: bret.eknes@state.mn.us.

The record for the certificate of need for this Project can be found on the eDockets system at: https://www.eDockets.state.mn.us/EFiling/search.jsp; search on the year "**09**" and number "**937**".

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1.0 Introduction

On October 27, 2009, Pleasant Valley Wind, LLC (Applicant), filed a certificate of need application with the Minnesota Public Utilities Commission (Commission) for the Pleasant Valley Wind Project (Project). The Applicant is proposing to construct a 300 megawatt (MW) large wind energy conversion system in the Minnesota counties of Dodge and Mower.

A final decision on turbine selection and design has not be made, but the Project will consist of turbines with a rated output 1.5 or 2.3 MW in such number and combination as to yield 300 MW. Facilities associated with the Project include gravel access roads, an electrical collection system, three project substations, three transmission lines, six temporary and two permanent meteorological towers, and an operations and maintenance building.

The Project would be located northeast of the city of Austin, Minnesota, within a Project area of approximately 70,000 acres. The Project would be located in Hayfield and Vernon Township in Dodge County; Waltham, Sergeant, Pleasant Valley, Red Rock and Dexter Township in Mower County. Electricity from Project wind turbines would be collected at two Project substations and transmitted to a new 345 kV substation. The Project would connect to the electrical transmission grid via Great River Energy's Pleasant Valley substation.

In addition to a certificate of need (CN), the Project requires a site permit for the wind farm from the Commission. The site permit is being considered by the Commission in separate docket (WS-09-1197).

The proposed Project is a large energy facility as defined by Minnesota Statutes section 216B.2421. As a result, it requires the Minnesota Department of Commerce to prepare an environmental report (ER) for the Project (Minn. Rules 7849.1200). Office of Energy Security, Energy Facility Permitting (OES EFP) staff has prepared this ER to fulfill this requirement. The ER is part of the record which the Commission will consider in making a decision on a CN for the Project.

The proposed Project is intended to produce renewable energy in furtherance of Minnesota's renewable energy standard (Minn. Stat. § 216B.1691). Accordingly, alternatives examined in this ER are limited to renewable energy sources consistent with the Commission's order, dated October 8, 2009. These alternatives include: (1) a generic 300 MW wind generation Project sited elsewhere in Minnesota, (2) a 124.5 MW biomass plant, (3) a "no build" alternative, and (4) alternative renewable technologies.

Section 2 of this ER outlines the regulatory framework governing the Project. Section 3 describes the proposed Project. Section 4 describes alternatives to the Project and their feasibility and availability. Section 5 describes the potential impacts of the no build alternative. Section 6 discusses the potential human and environmental impacts of the Project and alternatives, including possible mitigations. Section 7 describes the additional permits that may be required for this Project.

Sources of Information

Information for this report is drawn from multiple sources, which are noted throughout. Primary sources include applications submitted by Pleasant Valley Wind, LLC to the Commission:

- Application for Certificate of Need, Pleasant Valley Wind, LLC, October 26, 2009.[1]
- Pleasant Valley Wind, LLC, Second Revised Application for Large Wind Energy Conversion Site Permit, February 5, 2010.[2]

Additional information has been incorporated from related Environmental Quality Board and Department of Commerce reports.

[1] Application for Certificate of Need, Pleasant Valley Wind, LLC, October 26, 2009 [hereafter CN Application], https://www.edockets.state.mn.us/EFiling/edockets/searchDocuments.do?method=showPoup&documentId={5BD289AE-48BD-44E1-BDFF-F88187776C11}&documentTitle=200910-43264-04.

[2] Pleasant Valley Wind, LLC, Second Revised Application for Large Wind Energy Conversion Site Permit, February 5, 2010, [hereafter Site Permit Application], http://energyfacilities.puc.state.mn.us/resource.html?Id=25846.

2.0 Regulatory Framework

Pleasant Valley Wind, LLC (Applicant), is proposing to construct the Pleasant Valley Wind Project (Project) in Dodge and Mower counties in Minnesota. The Project is a large wind energy conversion system as defined in the Wind Siting Act (Minn. Stat. Ch. 216F). The Project is designed to produce 300 megawatts (MW) of power and thus is a large energy facility per Minnesota Statutes section 216B.2421.

In accordance with Minnesota Statutes section 216B.243, no large energy facility may be sited or constructed in Minnesota without issuance of a certificate of need (CN) by the Minnesota Public Utilities Commission (Commission). Accordingly, on October 27, 2009, the Applicant submitted a CN application to the Commission. On December 23, 2009, the Commission issued an order accepting the application as complete and authorizing an informal review process.[3]

The informal review process includes several steps designed to develop a record upon which a CN decision can be made, including: (1) a notice and comment period, (2) analysis by Department of Commerce, Office of Energy Security, Energy Regulation and Planning (OES ERP) staff, (3) analysis by Office of Energy Security, Energy Facility Permitting (OES EFP) staff, and (4) a public hearing conducted by an administrative law judge (ALJ). Based on the ALJ's hearing report and entire record, Commission staff will make a recommendation to the Commission on issuance of the certificate of need. The Commission is the final decision-making body.

2.1 Environmental Report

Pursuant to Minnesota Rule 7849.1200, the analysis provided by OES EFP staff takes the form of an environmental report (ER). The ER provides an analysis of potential human and environmental impacts of the Project, as well as alternatives to the Project. To develop the ER, OES EFP staff is required to hold one public meeting in the proposed Project area. The purpose of the meeting is to advise the public of the Project and to solicit public input into the scope of the ER. A "scope" is a determination of what needs to be assessed in the ER in order to fully inform decision-makers and the public about the possible impacts of the Project and potential alternatives.

OES EFP staff held an afternoon and evening public meeting on February 22, 2010, in Dexter, Minnesota. Approximately 125 people attended each meeting. A public comment period followed the meetings, which closed on March 15, 2009. Twenty-six written comments were received during the comment period. Concerns raised at the public meetings and in written comments included potential impacts to property values, aesthetics, livestock, pets, horses, wildlife, native vegetation, TV reception, radio reception, internet connections, GPS interference, property damage, Austin Municipal Airport, Mayo One emergency medical helicopter service, and aerial crop applications. Impacts from noise, shadow flicker, and red strobe lights required

[3] Order Finding Application Complete and Authorizing Informal Review Process, December 23 2009, https://www.edockets.state.mn.us/EFiling/edockets/searchDocuments.do?method=showPoup&documentId={F1CCE277-F716-4EC8-952E-5ECB063CDF3D}&documentTitle=200912-45343-01.

by the Federal Aviation Administration are of particular concern to area residents. Several comments raised concerns regarding the need for wind energy and suggested other fuel types, such as solar, Bloom Box, nuclear, biomass, hydropower, and methane digesters. A number of comments expressed concerns regarding the terms of the wind easements and leases between landowners and the Applicant.

Based on the scoping comments received and the rules governing the scope of an ER (Minn. Rules 7849.1500), the Director of OES issued a scoping decision on March 25, 2009 (Appendix A). This environmental report has been developed in accordance with the scoping decision.

As noted above (and in the scoping decision), a public hearing conducted by an ALJ will be held in the Project area to further develop the record for a Commission decision. This ER will be introduced into the hearing record by OES EFP staff.

2.2 Permits

Site Permit

In addition to a certificate of need, the proposed Project requires a site permit for the wind farm (Minn. Stat. § 216F.04). This permit is issued by the Commission and is being considered by the Commission in a separate docket.[4] A site permit (authorizing the siting and constructing of the Project) may not be issued before a certificate of need has been issued for the Project (Minn. Stat. § 216B.243).

Additional Permits

In addition to approvals issued by the Commission, the Project will require permits and approvals from federal agencies, additional state agencies, and local governments. These permits are discussed in Section 7.

Public Participation

The Commission relies on public participation in its certificate of need and permitting processes. Public participation enables the development of a thorough record. Citizens can ensure notice of these processes by placing their names on the appropriate OES EFP project contact lists. Citizens can sign up for the Pleasant Valley Wind Project list on line: http://energyfacilities.puc.state.mn.us/Docket.html?Id=25724.

Citizens may also have their names placed on these project lists by contacting OES EFP State Permit Manger, Ingrid Bjorklund, phone: (651) 297-7039, email: ingrid.bjorklund@state.mn.us.

[4] The Commission docket number for the site permit is: WS-09-1197; see http://energyfacilities.puc.state.mn.us/Docket.html?Id=25724.

3.0 Description of the Proposed Project

Pleasant Valley Wind, LLC (Applicant), is proposing to construct the Pleasant Valley Wind Project (Project), a 300 MW wind farm in Dodge and Mower counties in Minnesota. Pleasant Valley Wind, LLC is a wholly owned subsidiary of Renewable Energy Systems Americas, Inc. (RES Americas). Upon construction and operation of the Project, Pleasant Valley Wind, LCC may remain as owner of the Project, or the Project may be sold to a third party.[5] The Project is intended to produce renewable energy in furtherance of Minnesota's renewable energy standard (Minn. Stat. § 216B.1691).

3.1 Project Location

The Project will be located in south central Minnesota, near the city of Austin, within a Project area of approximately 70,000 acres. The Project would be located in Hayfield and Vernon Township in Dodge County and Waltham, Sergeant, Pleasant Valley, Red Rock and Dexter Townships in Mower County (Figure 1). The Project area is predominantly in agricultural use including row crops (corn, soybeans) and livestock production (hogs, dairy, beef, turkey) (Figure 2).

The Project area topography is level to gently sloping; elevations range from 1,300 to 1,420 feet above sea level. The area includes the headwaters of three watersheds (Zumbro River, Cedar River, Root River).[6] Because of its relatively higher headwaters location, there are no major valleys, bluffs, or ridges in the area. Drainage is affected by agricultural ditches and drain tile (Figure 3).

The Project area is sparsely populated with an estimated population density of 1.2 persons per square mile.[7] The City of Sergeant (population of 74) is the only incorporated city with the Project area. Several small towns border the Project area. The nearest large city is Austin (population of 23,671), and it is located approximately six miles southwest of the Project area.

3.2 Project Description

The Pleasant Valley Wind Project will have a nameplate capacity of 300 MW. A final decision on turbine selection and design has not been made, but the Project will consist of turbines with a rated output of 1.5 or 2.3 MW in such number and combination as to produce 300 MW.[8] Characteristics of turbines currently considered for use in the Project are shown in Table 1. Turbines would be placed on towers 80 meters (262 ft) in height. Rotor diameters vary from 82.5 to 101 meters (271 to 331 ft). The total height from the ground to the tip of a fully-extended rotor blade would be 398 to 428 feet.

[5] Site Permit Application, Section 1.13.
[6] Site Permit Application, Section 6.4.1.
[7] Site Permit Application, Section 1.8. The average population density for the State of Minnesota is 61.8 persons per square mile. See Population Density, http://www.demography.state.mn.us/resource.html?Id=5238.
[8] Site Permit Application, Section 5.2.

Some site permit conditions for large wind energy conversion systems (LWECS) are based on criteria which are dependent on turbine size.[9] Turbines must be placed within the Project boundary and meet all permit conditions. Accordingly, the final siting ("micro-siting") of wind turbines for the Project will depend on, among other factors, the size of the turbines chosen for the Project. A preliminary turbine layout using General Electric 1.5 MW turbines with WindBOOST technology is shown in Figure 4A, which the Applicant submitted during the site permit process. Using WindBOOST technology with the GE 1.5 MW turbine, the turbine is essentially capable of generating 1.6 MW, and is the Applicant's preferred turbine. A preliminary layout using 1.5 MW turbines is shown in Figure 4. A preliminary layout using 2.3 MW turbines in shown in Figure 5.

Table 1. Wind Turbine Specifications[10]

Characteristic	General Electric 1.5 MW	Siemens 2.3 MW
Hub Height	80 m (262 ft)	80 m (262 ft)
Rotor Diameter	82.5 m (271 ft)	101 m (328 ft)
Total Height	121 m (398 ft)	130.5 m (428 ft)
Cut-in Wind Speed	3.5 m/s (7.8 mph)	4 m/s (8.9 mph)
Cut-out Wind Speed	25 m/s (55.9 mph)	25 m/s (55.9 mph)
Rotor Speed	9 to 18 rpm	6 to 16 rpm
Distance to 50 dB(A) Noise Level	200 m (656 ft)	320 m (1050 ft)
3 Rotor Diameters	247.5 m (812 ft)	303 m (994 ft)
5 Rotor Diameters	412.5 m (1,353 ft)	505 m (1,656 ft)

m = meters, ft = feet, m/s = meters per second, mph = miles per hour, rpm = revolutions per minute

Turbine towers will be secured by concrete foundations that vary in size and design depending on turbine size and soil and substrate conditions. A control panel inside the base of each turbine tower houses communication and electronic circuitry. Each turbine will be connected to a

[9] For example, turbine setbacks from the Project boundary and all non-participating lands are expressed in rotor diameters (RD). Rotor diameters vary with turbine size.
[10] Adapted from Site Permit Application, Section 5.2, Section 6.3.2.

supervisory control and data acquisition (SCADA) system. The SCADA system allows for real-time monitoring and control of turbine operation.

Facilities associated with the Project include gravel access roads, an electrical collection system, three Project substations, three transmission lines, meteorological towers, and an operations and maintenance building. The Project would connect to the electrical transmission grid at the existing Pleasant Valley Substation northwest of I-90 and approximately 15 miles south of Byron. The area of permanent, direct land use for the Project will be between 121 and 160 acres.[11]

Electricity generated by each turbine is stepped up by a pad-mounted transformer at the base of each turbine to a collection line voltage (34.5 kV). The collection lines and SCADA fiber optic cable will be buried. The collection lines will carry power from the turbines to two collection substations – a north substation and a south substation (Figure 6). Substations will require 2 to 4 acres of land and will include transformers, breakers, and relays.

Collection substations will transform the power to a voltage of 138 kV for transmission. Power from the collection substations will be transmitted by overhead 138 kV transmission lines to a Project substation near the Pleasant Valley Substation.[12] The length of the 138 kV line from the north collection substation to the Project substation is approximately 6.4 miles. The length of the 138 kV line from the south collection substation is approximately 7.0 miles. The Project substation will transform the power to a voltage of 345 kV for transmission to the Pleasant Valley substation, via a short (< 1,500 ft.) 345 kV line. The substations and transmission lines are being permitted by Mower County through the local review process.[13]

Gravel roads will provide access to turbine sites for construction, maintenance, and eventual decommissioning. The extent of access roads depends on the turbines used for the Project and the Project layout. The length of access roads is estimated to be between 32 and 40 miles.[14] Roads will be designed and built to accommodate heavy loads. In addition to new access roads, existing public and private roads may require temporary additions to accommodate turbine delivery.

The location of the operations and maintenance (O&M) building has not yet been determined. The O&M building will be large enough to house supervisors and crews to monitor and maintain the Project.

There are currently six meteorological towers installed on the Project site. After construction, four of these towers will be removed and two towers will be maintained permanently for the life of the Project. Meteorological towers provide real-time data to the SCADA system and allow for remote monitoring of weather conditions.

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[11] Site Permit Application, Section 6.10.2. The area of permanent land use depends on the type of number of turbines used for the Project.
[12] Site Permit Application, Section 5.3.
[13] Local Review of High Voltage Transmission Lines, http://energyfacilities.puc.state.mn.us/Docket.html?Id=3855; Pleasant Valley Wind Project, http://energyfacilities.puc.state.mn.us/Project.html?Id=27749.
[14] Site Permit Application, Section 5.4.1.

3.3 Project Cost and Schedule

The cost of developing and constructing the Pleasant Valley Wind Project is estimated to be $630 - $720 million dollars.[15] Project construction would begin once all necessary permits are obtained. The Applicant anticipates commercial operation of the Project in December 2012. The date of commercial operation depends on interconnection, permitting, and other Project development activities.

[15] Site Permit Application, Section 9.0. The applicant estimates the cost for the Project to be between $2,100 and $2,400 dollars per kilowatt of nameplate capacity. Thus, 300 MW x (1,000 kW/MW) x ($2,100/kW) = $630 million dollars. See also, CN Application, Section 3.3.6, where the applicant estimates that the cost of developing and constructing the Project is expected to exceed $600 million dollars.

4.0 Project Alternatives

This section describes alternatives to the Pleasant Valley Wind Project. Typically, alternatives to the Project would include generation facilities of all types, including plants that use coal, natural gas, fuel oil, or similar non-renewable fuels. Alternatives would also include constructing transmission facilities (to import energy) in lieu of generation. The proposed Project is intended to produce renewable energy in furtherance of Minnesota's renewable energy standard; however, the Applicant intends to offer the output from the Project into the energy markets administered by the Midwest Independent Transmission System Operator or sell the project to a third party if it cannot secure a power purchase agreement with a Minnesota utility. Consistent with the Commission's order, dated October 8, 2009, non-renewable energy sources are not under consideration as alternatives.

Alternatives to the Pleasant Valley Wind Project examined in this ER include: (1) a generic 300 MW wind generation plant (LWECS) sited elsewhere in Minnesota, (2) a 124.5 MW biomass plant, (3) a "no build" alternative, and (4) alternative renewable technologies. The generic 300 MW LWECS and 124.5 MW biomass plant are discussed further in Section 6. The "no build" alternative is discussed further in Section 5. Alternative renewable energy technologies are discussed solely in this section because none are feasible and available alternatives to the proposed Project.

4.1 300 MW LWECS

An alternative to the proposed Project, which would utilize renewable energy (i.e., wind), is a large wind energy conversion system (LWECS) sited elsewhere in Minnesota. Such a Project could, theoretically, be a 300 MW Project or a combination of smaller dispersed Projects. The analysis in this ER will attempt to describe differences in the impacts associated with a generic 300 MW wind Project sited in Minnesota and the Pleasant Valley Wind Project sited in Dodge and Mower counties.

4.2 124.5 MW Biomass Plant

A biomass alternative to the proposed Project would be a renewable energy technology. There are various possible sources of biomass fuel that could be used. St. Paul District Energy, a combined heat and power facility in downtown St. Paul, is fueled primarily by waste wood and has an electric generation capacity of 25 MW. The 55 MW Fibrominn plant in Benson burns turkey litter. The Laurentian Energy Authority operates facilities in Hibbing and Virginia with a combined capacity of 35 MW that convert wood, wood wastes, and agricultural biomass into electricity.

The biomass alternative analyzed in this ER is one that would burn a combination of hybrid willows, poplars, and corn stover, with natural gas as a backup fuel. This alternative is considered because such a plant, the NGPP Minnesota Biomass, LLC, electric generation facility, has already undergone environmental review in Minnesota, and data regarding potential

environmental impacts associated with such a plant are available. Additionally, given the potential available feedstock in the Project area, such a biomass plant is feasible.
The NGPP project was reviewed by the Environmental Quality Board (Board) in 2003 when it prepared an environmental assessment worksheet (EAW) on the proposed facility.[16] At the time it was reviewed by the Board, the NGPP project was a 38.5 MW project. The analysis that was conducted on that facility by the Board is valid for use as an alternative analysis in this ER. The Pleasant Valley Wind Project will have a capacity of 300 MW, with an estimated capacity factor of 41.5 percent. The 124.5 MW biomass alternative examined in this ER is an appropriately-sized generation alternative.[17]

4.3 No Build Alternative

The no build alternative means that no wind project is constructed. Analysis for this alternative will consider the potential benefits and drawbacks of not constructing the proposed Project (see Section 5).

4.4 Alternative Renewable Energy Technologies

Solar

Technologies for converting solar energy to electricity include thermal conversion (typically using sunlight to generate steam to turn a turbine) and photovoltaic cells (direct conversion of sunlight to electricity). Thermal systems convert sunlight into heat by concentrating sunlight with mirrors and transferring the resultant energy to a fluid medium (e.g., water, brine).[18] The energy is transferred via a heat exchanger to produce steam, and electricity is produced in steam turbine generators. Photovoltaic cells convert sunlight into electricity through semiconductor modules, typically installed in arrays.[19]

Solar technologies are more commonly employed in areas of the United States with relatively greater solar resources, i.e., the southwestern United States.[20] As an example, utility-scale thermal conversion systems (100 to 1000 MW) are being developed in California.[21] Large scale PV systems are more prevalent in Europe; however, several large PV systems (230 to 600 MW) are being developed in California.[22]

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[16] EQB Docket No. 03-67-EAW-NGP Biomass [hereafter Minnesota Biomass EAW] ; see http://energyfacilities.puc.state.mn.us/Docket.html?Id=4452

[17] 300 MW x 0.415 = 124.5 MW. The biomass alternative, because it has natural gas backup, is assumed for analysis purposes to have a capacity factor of 1.0. Scheduled and unscheduled maintenance would make the effective capacity factor slightly less than 1.0.

[18] Concentrating Solar Power, http://www1.eere.energy.gov/solar/csp_program.html.

[19] Photovoltaics, http://www1.eere.energy.gov/solar/photovoltaics.html.

[20] Concentrated Solar Power Resource Potential, http://www.eia.doe.gov/cneaf/solar.renewables/ilands/fig12.html; Solar Photovoltaic Resource Potential, http://www.eia.doe.gov/cneaf/solar.renewables/ilands/fig11.html.

[21] Large Solar Energy Projects, http://www.energy.ca.gov/siting/solar/index.html. In order to meet California's renewable portfolio standard, large solar energy Projects are being proposed in California deserts on federal Bureau of Land Management (BLM) land.

[22] List of Photovoltaic Power Stations, http://en.wikipedia.org/wiki/List_of_photovoltaic_power_stations#Large_systems_in_planning_or_under_construction.

Hydropower

Hydroelectric power plants convert the potential energy of water into electricity by passing the water through a turbine; the water turns the turbine and connected electric generator, thus producing electrical energy. The electrical generating capacity of a hydropower plant is primarily a function of two variables: (1) flow rate and (2) hydraulic head, which is the pressure created by water flowing from a higher to a lower elevation. Depending on the particular waterway being considered, project design may concentrate on either of these variables.

There are undeveloped hydropower resources in Minnesota; however, the estimated total electrical generation capacity of these resources is 136 MW.[23] The nation's first ever commercial hydrokinetic power station is scheduled to come on-line in 2009 near the city of Hastings, Minnesota.[24] The city is installing the Project at its 4.4-megawatt hydropower plant on the Army Corps of Engineers' Lock & Dam No. 2. The power generated by the two hydrokinetic units, each with a nameplate capacity of 100 kilowatts (0.1 MW), will be placed on the electric power grid through the city's existing electrical infrastructure.

Fuel Cells

A fuel cell is an electrochemical device that, without combustion, combines hydrogen and oxygen to produce water, electricity, and heat. Fuel cells require a hydrogen source for operation. This source can be pure hydrogen (hydrogen) or a hydrocarbon (e.g., methanol, natural gas). There are a number of fuel cell designs, with names derived primarily from the electrolyte used to direct electrical charges within the cell.

Fuel cell generation capacities are in the range of 100 kW to 100 MW.[25] Fuel cells are typically used as backup or additional electrical generation capacity for a specific end user. Accordingly, they are usually placed at the point of energy use, e.g., at a specific business location.[26]

Anaerobic Digestion

Anaerobic digestion is the decay of organic manner in the absence of oxygen. This decay produces hydrocarbon gases (e.g., methane) whose combustion can used to turn a turbine and electrical generator. There are two primary anaerobic digestion processes used to produce electricity: (1) anaerobic digestion of animal manures creating biogas and (2) anaerobic digestion

[23] U.S. Hydropower Resource Assessment for Minnesota, July 1996, U.S. Department of Energy (DOE), http://hydropower.inel.gov/resourceassessment/pdfs/states/mn.pdf. The DOE assessment identifies 40 potential hydropower sites in Minnesota. The electrical generation capacity of the largest single site is estimated to be 48 MW.
[24] Hastings Hydrokinetic Power Station USA, http://www.power-technology.com/Projects/hastingshydrokinetic/.
[25] Fuel Cell, http://en.wikipedia.org/wiki/Fuel_cell.
[26] Fuel Cells in Backup Power Application, http://www1.eere.energy.gov/femp/pdfs/hydrogenfc_tir.pdf; Bloom Energy Claims a New Fuel Cell Technology, New York Times, February 23, 2010, http://www.nytimes.com/2010/02/24/business/energy-environment/24bloom.html. The article indicates that Google, Bank of America, and Wal Mart are testing fuel cells at their business locations.

of municipal solid waste creating landfill gas (LFG).[27] On-farm production of biogas is typically limited to dairy farms with more than 400 cows, though small farms can utilize the technology for heating instead of electrical generation. Electrical generation capacity for biogas facilities ranges from kilowatts to over 13 MW.[28]

There are currently seven landfill gas Projects in Minnesota, generating a total of 26 MW.[29] The largest facility generates 12 MW. The estimated potential electrical generation capacity of all landfills in Minnesota is 45 MW.[30]

4.5 Feasibility and Availability of Alternatives

The feasibility and availability of alternatives to the Pleasant Valley Wind Project depend on a number of factors. In general, an alternative is feasible and available if (1) the technology is commercially available at a scale similar to the proposed Project and (2) natural resources are available in Minnesota similar to those where commercial development is taking place.

300 MW LWECS

A generic 300 MW LWECS is feasible and likely available. Wind farms are in development across the state and Minnesota's wind resources are sufficient to facilitate a 300 MW Project. Feasibility and availably are dependent on the ease of interconnection to the electrical transmission grid. In some parts of the state, the transmission grid is very near capacity and the connection of additional generating capacity is not easily achieved.

124.5 MW Biomass Plant

A 124.5 MW biomass plant is feasible and likely available. There is not currently a biomass plant of this size in Minnesota. Thus, there may be equipment, financing, logistical, or other impediments that limit the ready availability of a 124.5 MW plant.

No Build Alternative

The no build alternative is feasible and available, but would not further Minnesota's renewable energy objectives.

Solar

A solar facility is not a feasible alterative to the Pleasant Valley Wind Project. There are thermal and photovoltaic systems in development that are similar in scale to the proposed Project. However, most systems are substantially smaller. A photovoltaic system designed to replace the Pleasant Valley Wind Project would be among the largest proposed worldwide.[31] Additionally,

[27] Energy Policy and Conservation Report, 2008, Minnesota Office of Energy Security, p. 25-27, [hereafter Quad Report 2008], http://www.state.mn.us/mn/externalDocs/Commerce/Quadrennial_Report__2008_091509012935_2008-QuadReport.pdf.

[28] Id.

[29] Id.

[30] Id.

[31] Capacity factors for photovoltaic systems are in the range of 0.20 - 0.30. Thus, an appropriately-sized alternative to the proposed Project would be approximately 500 MW (300 MW x 0.415/0.25 = 498 MW). The largest proposed

these systems rely on solar resources, which are not available in Minnesota. Solar resources in Minnesota are approximately 40-60% of those of the southwestern United States.[32] Of the two solar technologies (thermal and photovoltaic), photovoltaic is likely the better long term fit for Minnesota and closer to feasibility and utility-scale application.

Hydropower

Hydropower is not feasible or available. To produce the electrical energy equivalent of the Pleasant Valley Wind Project would require developing all of Minnesota's hydropower resources (40 sites) at once and providing appropriate connections with the electrical transmission grid.

Fuel Cells

Fuel cells are commercially available but not at scale similar to the Pleasant Valley Wind Project. Additionally, fuel cells, to date, have been used solely as an electrical supply for a specific end user. They have not been used as part of utility's generation portfolio. Finally, fuel cells may or may not be an eligible energy technology such that their implementation would further Minnesota's renewable energy standard. Eligible technologies include those which produce electricity from hydrogen.[33] However, if the hydrogen source for a fuel cell is a geologic hydrocarbon (e.g., natural gas), then the fuel cell would not qualify as an eligible energy technology.[34]

Anaerobic Digestion

Anaerobic digestion is not feasible or available at a scale similar to the Pleasant Valley Wind Project. The largest biogas and LFG facilities in Minnesota are substantially smaller than the proposed Project. The estimated potential electrical generation capacity of all landfills in Minnesota is 45 MW.

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solar farm in the United States is the Rancho Cielo Solar Farm, with a Project output of 600 MW. See the List of Photovoltaic Power Stations, http://en.wikipedia.org/wiki/List_of_photovoltaic_power_stations#Large_systems_in_planning_or_under_construction.

[32] Concentrated Solar Power Resource Potential, http://www.eia.doe.gov/cneaf/solar.renewables/ilands/fig12.html; Solar Photovoltaic Resource Potential, http://www.eia.doe.gov/cneaf/solar.renewables/ilands/fig11.html.

[33] Minn. Stat. § 216B.1691, subd. 1. Eligible energy technologies include technologies that generate electricity from solar, wind, hydroelectric, hydrogen, or biomass.

[34] Id. The statute notes that hydrogen is an eligible energy technology only if the hydrogen is generated by a renewable energy source, i.e., solar, wind, hydroelectric, biomass.

5.0 The No Build Alternative

Analysis of the no build alternative involves a discussion of the environmental impacts of continuing the status quo. For example, with a proposed highway Project, the no build alternative would take into account the impacts associated with continuing to have traffic increase along existing roads and highways and for development to occur along these existing arteries. Potential impacts and benefits of the no build alternative for the Pleasant Valley Wind Project are discussed here.

5.1 Impacts

At least three categories of impacts can be identified if the Pleasant Valley Wind Project is not built: (1) a hampering of the state's ability to meet its renewable energy objectives, (2) the loss of economic benefits in the Project area, and (3) the likely negative impact of providing replacement electricity from a non-renewable energy source.

Renewable Energy Standard

Minnesota has committed to a renewable energy standard of generating 25 percent of its electricity from eligible renewable sources by the year 2025.[35] Minnesota utilities forecast the need for an additional 2,200 MW of renewable generation to meet the renewable energy standard and an additional 1,500 MW to meet other state needs by the year 2025.[36] If the Pleasant Valley Wind Project is not built, it could hinder the ability of the state to meet its renewable energy standard. There are wind resources in other parts of the state and wind farms could be placed in these areas (Figure 7). However, the wind resources of the state are finite. The wind resource in the Project area is very good, and if untapped, could hinder the state's ability to meet its renewable energy standard.

Loss of Economic Benefits

If the Pleasant Valley Wind Project is not built, there will be a loss of economic benefits in the Project area. Landowners would lose wind easement payments over the life of the Project. Local governments would lose wind energy production tax revenues. The Pleasant Valley Wind Project is expected to generate approximately 300 temporary construction jobs for local contractors and 6 to 8 permanent jobs.[37] These employment opportunities and their associated income would be lost if the Project is not built.

Replacement with a Non-Renewable Resource

If the Pleasant Valley Wind Project is not built, the electrical power it would have produced would need to be replaced, likely with a non-renewable energy resource.[38] Although the impacts

[35] Minn. Stat. § 216B.1691, subd. 2a.
[36] 2009 Minnesota Biennial Transmission Projects Report, Docket No. E999/M-09-602, https://www.edockets.state.mn.us/EFiling/edockets/searchDocuments.do?method=showPoup&documentId={00D61C53-85D2-4052-93E4-95D03AFE5532}&documentTitle=200911-43520-01.
[37] CN Application, Section 2.3.
[38] In 2008, non-renewable energy sources accounted for approximately 92 percent of Minnesota's electrical energy supply; Quad Report 2008.

associated with non-renewable sources vary, it is possible to estimate, as an example, the impact of replacing the Pleasant Valley Wind Project with coal energy. The Pleasant Valley Wind Project will produce approximately 1091 gigawatt-hours annually (GWh/yr).[39] If this energy were produced by Xcel Energy's Sherco plant (a coal-fired plant), the plant would emit pollutants, including approximately:

- 1,637 tons/yr of nitrous oxides (NO_x)
- 1,637 tons/yr of sulfur dioxide (SO_2)
- 1,303,745 tons/yr of carbon dioxide (CO_2) [40]

Nitrous oxides (NO_x) are greenhouse gases that cause ozone and related respiratory illnesses.[41] Sulfur oxides (SO_x) can cause acid rain and human respiratory illness.[42] Carbon dioxide (CO_2) is the most important greenhouse gas and is responsible for global warming and associated impacts including significant changes to world weather systems and ecosystems.[43]

5.2 Benefits

Benefits of not building the Pleasant Valley Wind Project would include avoidance of potential human and environmental impacts associated with the Project. These impacts are discussed in Section 6 of this report.

[39] 300 MW x (1 GW/1000 MW) x (0.415) x (24 hours/day) x (365 days/yr) = 1091 GWh/yr.
[40] Minnesota Energy Planning Report, 2001, http://www.state.mn.us/mn/externalDocs/Commerce/Energy_Planning_Report_121602022402_2002PlanningRpt.pdf. Emission rates per unit of electricity estimated at 0.003 lbs/kWh (NO_x, SO_2) and 2.39 lbs/kWh (CO_2).
[41] Health and Environmental Impacts of NO_x, http://www.epa.gov/air/nitrogenoxides/.
[42] Health and Environmental Impacts of SO_2, http://www.epa.gov/air/urbanair/so2/.
[43] Climate Change 2007: Synthesis Report, Summary for Policymakers, An Assessment of the Intergovernmental Panel on Climate Change (IPCC), http://www.ipcc.ch/.

6.0 Human and Environmental Impacts

This section discusses the potential human and environmental impacts of the Pleasant Valley Wind Project and Project alternatives. The alternatives include: (1) a generic 300 wind energy conversion system (LWECS) sited elsewhere in Minnesota, and (2) a 124.5 MW biomass plant. The potential impacts of alternative renewable energy technologies, addressed in Section 4, are not analyzed because these alternatives are not feasible and or available to facilitate a 300 MW facility. The potential impacts of the no build alternative are discussed in Section 5. Additionally, this section discusses mitigation strategies for potential impacts.

6.1 Air Emissions – Criteria Pollutants

Electric generation facilities have the potential to emit air pollutants during construction and operation. Minnesota Rule 7849.1500 requires this ER to examine emissions of the following pollutants: sulfur dioxide (SO_2), nitrogen oxides (NO_x), carbon dioxide (CO_2), mercury (Hg), and particulate matter (PM). These common pollutants (other than mercury) are known as criteria pollutants.[44]

Pleasant Valley Wind Project

The Pleasant Valley Wind Project will emit no criteria pollutants during operation. A minimal amount of these pollutants will be produced during construction, e.g., due to the operation of heavy machinery. Transmission lines, under certain conditions, produce limited amounts of ozone and nitrogen oxide emissions. Emissions of these pollutants will be minimal.

Generic 300 MW LWECS

A generic 300 MW LWECS would emit no criteria pollutants during operation, and would have ancillary emissions (construction, transmission line) similar to those from the Pleasant Valley Wind Project.

124.5 MW Biomass Plant

A 124.5 MW biomass plant would emit criteria pollutants (Table 2). These pollutants are based on a plant similar to the NGPP Minnesota Biomass plant (see Section 4.2). Each of these pollutants has potential to cause to human and environmental health impacts. Sulfur oxides (SO_x) cause acid rain and human respiratory illness.[45] Nitrous oxides (NO_x) are greenhouse gases that cause ozone and related respiratory illnesses.[46] Carbon dioxide (CO_2) is a greenhouse gas that is, in part, responsible for global warming and associated impacts including significant changes to world ecosystems.[47] Mercury can cause impaired neurological development in children.[48] Inhalation of particulate matter causes human respiratory illness.[49]

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[44] What Are the Six Common Air Pollutants?, http://www.epa.gov/air/urbanair/.
[45] Health and Environmental Impacts of SO_2, http://www.epa.gov/air/urbanair/so2/.
[46] Health and Environmental Impacts of NO_x, http://www.epa.gov/air/nitrogenoxides/.
[47] Climate Change 2007: Synthesis Report, Summary for Policymakers, An Assessment of the Intergovernmental Panel on Climate Change (IPCC), http://www.ipcc.ch/.
[48] Health Effects, http://www.epa.gov/mercury/effects.htm.
[49] Health and Environment, http://www.epa.gov/air/particlepollution/health.html.

Table 2. Biomass Plant Emissions, Criteria Pollutants[50]

Pollutant	lbs/kWh	tons/year
Sulfur Dioxide (SO_2)	4.06 E-04	188.6
Nitrogen Oxides (NO_x)	2.3 E-03	1080.1
Carbon Dioxide (CO_2)	3.15[51]	1.4 E06[52]
Mercury (Hg)	5.6 E-08	0.026
Particulate Matter (PM)	8.36 E-04	391.1

lbs/kWh = pounds per kilowatt-hour

Because these pollutants are diffused into a global atmosphere, regional impacts are difficult to quantify. However, impacts due to particulate matter and ground-level ozone can be localized. Particulate matter and ozone are the pollutants of most concern in Minnesota, and they are tracked regionally by the Minnesota Pollution Control Agency.[53] Because the plant is fired primarily with biomass, net impacts from carbon dioxide will be minimal. Carbon dioxide released by the plant will be incorporated into plant matter, which in time will serve as fuel for the plant. The plant will operate, to a great extent, as a closed carbon dioxide loop.[54]

Mercury exists throughout the environment; however, the primary source of mercury in air emissions is coal, i.e., the burning of coal in a coal-fired power plant. The biomass plant considered here would use biomass as a primary fuel and natural gas as a backup fuel. Thus, emissions of mercury, and related impacts, are anticipated to be minimal.

Mitigation

Emissions of some criteria air pollutants can be mitigated through control technologies. Nitrous oxides emissions could be reduced by approximately 75 percent through use of a selective non-

[50] Adapted from Minnesota Biomass EAW, http://energyfacilities.puc.state.mn.us/Docket.html?Id=4452. Boiler heat input capacity = (124.5/38.5) x 527.5 MMBtu/hr = 1,706 MMBtu/hr.
[51] AP-42, Fifth Edition, Volume 1, Chapter 1 External Combustion Sources, Section 1.6 Wood Residue Combustion in Boilers, http://www.epa.gov/ttn/chief/ap42/ch01/final/c01s06.pdf.
[52] Because the plant is fired with biomass (excepting natural gas backup) net carbon dioxide emissions from the plant would be minimal. Carbon dioxide released from the plant would be integrated into new biomass materials which, in time, would be harvested and used to fire the plant. There would be carbon dioxide emissions related to transport of biomass and plant operations.
[53] Air Quality Index for Minnesota, http://aqi.pca.state.mn.us/.
[54] Fuels used to collect and transport biomass would likely not be carbon neutral and would create carbon dioxide emissions.

catalytic reduction (SNCR) system on the biomass boiler.[55] Particulate matter emissions could be reduced by 90 percent with add-on devices such as a multi-cyclone and dust collector.[56]

In addition to the use of control equipment to mitigate pollutant impacts, a 124.5 MW biomass plant would conduct a best available control technology (BACT) analysis. The BACT analysis is a requirement of new facilities under federal new source review prevention of significant deterioration (PSD). A BACT analysis and implementation could limit emissions from the plant to less than those presented in Table 2.

6.2 Air Emissions – Hazardous Air Pollutants and Volatile Organic Compounds

Electric generation facilities have to potential to emit air pollutants during construction and operation. Minnesota Rule 7849.1500 requires this ER to examine emissions of hazardous air pollutants (HAP) and volatile organic compounds (VOC). These classes of pollutants are known or suspected of causing cancer and other serious health effects.[57]

Pleasant Valley Wind Project

The Pleasant Valley Wind Project will not emit HAPs or VOCs during operation. There are petroleum-based fluids used in the operation of wind turbines. These fluids include: gear box oil, hydraulic fluid, and gear grease. These fluids have a low vapor pressure and thus release of VOCs will be minimal. A minimal amount of HAPs and VOCs will be produced during construction, due to the use of diesel fuel in heavy machinery.

Generic 300 MW LWECS

A generic 300 MW LWECS would have HAP and VOC emissions similar to the Pleasant Valley Wind Project.

124.5 MW Biomass Plant

A 124.5 MW biomass plant would emit HAPs and VOCs (Table 3). These pollutants are based on a plant similar to the NGPP Minnesota Biomass plant (see Section 4.2). Because these pollutants are diffused into a global atmosphere, regional impacts are difficult to quantify. The only area in Minnesota with a cancer risk due to HAPs greater than 100 in a million is the Minneapolis - Saint Paul metro area.[58] The emissions from the biomass plant are, compared with other sources, relatively small.

Mitigation

It is possible to mitigate HAP and VOC emissions with control technologies. However, given the relatively small amounts of HAP and VOC emissions compared with the costs of control equipment, it is likely that control technologies will not be employed.

[55] Minnesota Biomass EAW.
[56] Id.
[57] About Air Toxics, http://www.epa.gov/ttn/atw/allabout.html;
[58] Summary of Results for the 2002 National-Scale Assessment, http://www.epa.gov/ttn/atw/nata2002/risksum.html.

Table 3. Biomass Plant Emissions, Hazardous Air Pollutants and Volatile Organic Compounds[59]

Pollutant	lbs/kWh	tons/year
Hazardous Air Pollutants (HAPs)	6.53 E-04	302.8
Volatile Organic Compounds (VOCs)	2.11 E-04	98.4

lbs/kWh = pounds per kilowatt-hour

6.3 Visibility Impairment

Wind turbines are tall towers with large, rotating blades. Consequently, they can impair visibility or otherwise impact the visible environment. This section discusses potential impacts related to visibility including shadow flicker, impacts on the viewshed, and the lighting of turbines.

Pleasant Valley Wind Project

The Pleasant Valley Wind Project would, to some degree, impair visibility and cause shadow flicker. The Project would introduce industrial wind turbines to an otherwise rural countryside. The potential impact of such an introduction depends somewhat on the aesthetic values of the observer. For some, wind turbines are an intrusion on a rural landscape. For others, wind turbines have a grace that is harmonious with a rural landscape. Dodge and Mower counties are predominantly rural with an agricultural base. Wind turbines, as gatherers of a renewable wind harvest, are in some sense compatible with a rural, agricultural heritage.

Development of an objective measure of visibility or aesthetic impairment is a difficult task. Current methods used to assess visual impacts include viewshed mapping, photographic simulations, and video animation.[60] All of these methods depend, to some extent, on assessing the current aesthetic resources of the Project area, i.e., the aesthetics of the area before construction of a wind farm. Such an assessment can be subjective; however, state and federal agencies perform assessments regularly in the development of parks that have valuable aesthetic resources. The Project area for the Pleasant Valley Wind Project does not contain state or federal parks or other aesthetic resources designated as visually valuable. This does not mean the area is not aesthetically valuable on a local level. The Project area includes one scientific and natural area (SNA) and is adjacent to another SNA, both with native tallgrass prairie.[61] Residents and visitors enjoying these areas would experience an aesthetic impact due to the proposed Pleasant Valley Wind Project.

[59] Adapted from Minnesota Biomass EAW, http://energyfacilities.puc.state.mn.us/Docket.html?Id=4452. Boiler heat input capacity = (124.5/38.5) x 527.5 MMBtu/hr = 1,706 MMBtu/hr.
[60] Visual Considerations: Public Perceptions, Regulatory Environment and Assessment Methods in the Eastern U.S., http://www.nationalwind.org/assets/blog/Allen-NWCC_2009.pdf.
[61] Site Permit Application, Section 6.7.

Wind turbines, per Federal Aviation Administration (FAA) requirements and because of their height, would be lighted.[62] In general, turbines have flashing white lights during the day and red lights during the evening.

Shadow flicker is the intermittent change in light intensity due to rotating wind turbine blades casting shadows on the ground. This change in light intensity can cause annoyance.[63] Shadow intensity, or how "light" or "dark" a shadow appears at a specific receptor, will vary with the distance from the turbine. Closer to a turbine, the turbine blades will block out a larger portion of the sun's rays and shadows will be wider and darker. Receptors located farther away from a turbine will experience thinner and less distinct shadows.

Shadow flicker varies with the angle of sun, i.e., the time of year and the time of day. Shadow flicker does not occur during cloudy days or when turbines are not rotating. Shadow flicker is reduced or eliminated when light-blocking materials, e.g., buildings, trees, shades, are located between turbines and a receptor. Because of the number of variables involved, an estimate of the potential impact of shadow flicker for a specific residence (receptor) requires modeling.

Mitigation

Mitigation of visibility impairments and shadow flicker is best accomplished by proper siting of the Project and individual wind turbines. In general, siting wind projects in rural areas minimizes human impacts. Visibility impacts can be mitigated by siting wind projects outside of areas deemed visually valuable by the state, e.g., state parks.

Setbacks from individual turbines, as embodied by Minnesota's general permit standards, mitigate visibility impacts.[64] Wind turbines must be set back from non-participating properties a distance of 5 rotor diameters (RD) on the prevailing wind direction and 3 RD on the non-prevailing wind direction. The potential setback distances for the Pleasant Valley Wind Project are shown in Table 1. The Applicant agreed to maintain 1,000 foot setbacks from residences with a goal of 1,500 feet from residences (see Figures 4 and 5).[65] Additional setbacks may be required to meet Minnesota noise standards.[66] These setbacks minimize the general visibility of the wind turbines and also shadow flicker.[67] Finally, turbines are designed to be a uniform off-white color to blend in with the horizon and reduce visibility impacts.

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[62] FAA Advisory Circular AC 70/7460-2K, HTTP://RGL.FAA.GOV/REGULATORY_AND_GUIDANCE_LIBRARY/RGADVISORYCIRCULAR.NSF/0/22990146DB0931F186256C2A00721867/$FILE/AC70-7460-2K.PDF.

[63] Public Health Impacts of Wind Turbines, Minnesota Department of Health, May 22, 2009, p. 14, [hereafter Minnesota Dept. of Health Report] http://www.health.state.mn.us/divs/eh/hazardous/topics/windturbines.pdf.

[64] Commission Order Establishing General Permit Standards, http://energyfacilities.puc.state.mn.us/documents/19302/PUC%20Order%20Standards%20and%20Setbacks.pdf.

[65] Site Permit Application, Section 6.3.

[66] Minnesota Rules Chapter 7030.

[67] There is not a Minnesota "light standard" that addresses potential impacts of shadow flicker. Ten rotor diameters has been suggested as a mitigating distance for shadow flicker; see Minnesota Dept. of Health Report, p. 14. However, shadow flicker is site and time specific and likely poorly suited for a general mitigation distance. See, e.g., Glacier Hills Wind Park Project, Volume 1, Final Environmental Impact Statement [hereafter Glacier Hills FEIS], Section 5.7.1, http://www.we-energies.com/environmental/gh_final_eis.pdf.

Lighting required by the FAA is similar to that for other tall structures in rural areas, and mitigation is not expected to be necessary.

Generic 300 MW LWECS

A generic 300 MW LWECS located elsewhere in Minnesota would have visual impacts and mitigation strategies similar to that of the Pleasant Valley Wind Project. Impacts could be mitigated by possibly locating in a more rural area of Minnesota; however, such a location would need to also have wind resources similar to those in Dodge and Mower counties.[68] Impacts could also be mitigated by utilizing wind turbines capable of generating more energy. For example, a 300 MW Project consisting of 1.5 MW turbines requires 200 turbines; a similar Project consisting of 2.3 MW turbines requires 130 turbines. The larger turbines would create a larger individual "eyeprint," but the smaller number of turbines would likely create a relatively smaller visual impact for the project.

124.5 MW Biomass Plant

A 124.5 MW biomass plant would impair visibility in the immediate area of plant, and to the extent a stack plume is visible, in the greater area. A biomass plant would not cause shadow flicker due to the lack of exterior moving parts that could cast alternating shadows.

A biomass plant would be industrial in nature with many buildings, conveyors, biomass piles, and a boiler stack. The building that houses the boiler is likely to be at least 100 feet tall. The conveyors and biomass piles could range from 30 to 50 feet in height. The plant buildings, conveyors, and piles would likely be lighted to allow for nighttime operation. Lighting would also be necessary for wood fuel loading/unloading points, truck scales, and vehicle parking areas.

The estimated height for the boiler stack is approximately 150 feet. Particulate matter control devices would capture most of the particulates from the boiler exhaust gas stream. Thus, the majority of the plume from the boiler stack would be water vapor. This transparent plume may be seen during cold weather conditions, but would likely be virtually clear during warm weather. If taller than 200 feet, the boiler stack may require FAA lighting, similar to wind turbines.

Mitigation

Mitigation of visibility impairment is best accomplished through selective location of the biomass plant. The site for the biomass plant does not need to be a rural, agricultural setting. The plant could be located in an industrial location allowing it to blend in with other industry. Thus, the plant could be located away from aesthetically valuable resources. However, the biomass plant would need to be located in an area where biomass is readily available in large quantities. Vegetative screening (trees, shrubs) could be used to partially block views of the industrial buildings, silos, conveyors, and boiler stack.

[68] Dodge and Mower County include rural and urban areas. Dodge and Mower County have population densities slightly below the Minnesota average. See http://www.demography.state.mn.us/resource.html?Id=5238.

6.4 Ozone Formation

Large electric power generating facilities, such as biomass facilities, have the potential to produce reactive organic gases, which can lead to ground-level ozone formation. Wind turbines do not produce ozone or ozone precursors. Minnesota Rules 7849.1500, subpart 2 requires that this ER address anticipated ozone formation.

Ozone can cause human health risks, and can also damage crops, trees, and other vegetation.[69]

Pleasant Valley Wind Project

The Pleasant Valley Wind Project would not produce ozone or ozone precursors. Thus, there would no human or environmental impacts due to ozone formation.

Generic 300 MW LWECS

A generic 300 MW LWECS would have ozone formation similar to the Pleasant Valley Wind Project.

124.5 MW Biomass Plant

A 124.5 MW biomass plant would produce ozone precursors (e.g., NO_x, VOC) that would lead to ozone formation. Impacts from ozone can be localized. However, the state of Minnesota is currently designated as in attainment for ozone by the Environmental Protection Agency (EPA). Given this status, ground level ozone formation and associated impacts are anticipated to be minimal.

Mitigation

Ozone formation could be mitigated by mitigating ozone precursors. See discussion in Sections 6.1 and 6.2 regarding nitrous oxides (NO_X) and volatile organic compounds (VOC) respectively.

6.5 Fuel Availability

Large electric power generating facilities require some type of fuel. This section discusses the availability of fuel for the proposed Project and alternatives.

Pleasant Valley Wind Project

The Pleasant Valley Wind Project relies on wind to generate electricity. Winds are generated by earth and solar processes; accordingly, the fuel for the Project is a very long-term renewable resource. Wind is not consumed by wind turbines. Wind that passes through a wind turbine does release energy to the turbine and turbulence is created in the wake of the turbine. Thus, to operative effectively, turbines must be set back a distance from other turbines.[70]

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[69] Ozone, http://www.epa.gov/Ozone/; Air Quality – Ozone, http://www.health.state.mn.us/divs/eh/air/ozone.htm.

[70] The distance between turbines necessary for effective operation is approximately 6 rotor diameters (RD) on the non-prevailing wind axis and 10 RD on the prevailing wind axis. Accordingly, Minnesota requires setbacks of 3 x 5 RD for each turbine. See, PUC Order Establishing General Permit Standards, http://energyfacilities.puc.state.mn.us/documents/19302/PUC%20Order%20Standards%20and%20Setbacks.pdf.

The actual availability of wind varies considerably across Minnesota, and has been analyzed by the Minnesota Department of Commerce.[71] Wind resources in Dodge and Mower counties are relatively good (Figure 7). Estimated average wind speeds for the Pleasant Valley Wind Project are 13.4 to 19.0 miles per hour (6.0 to 8.5 meters per second).[72] Power generation by the Project depends not only on how quickly the wind blows (how much energy it contains), but also how frequently it blows. Wind turbines generate power only when the wind is blowing.[73] This frequency is expressed as capacity factor, i.e., how much power the turbine is generating compared to how much it could generate if it was operating all the time. Capacity factors of 35 to 43 percent are typically achievable in Minnesota for large wind farms. The Pleasant Valley Wind Project is estimated to have a capacity factor in this range.[74]

Generic 300 MW LWECS

A generic 300 MW LWECS would utilize the same fuel as the Pleasant Valley Wind Project – wind. To be economically feasible, a 300 MW LWECS sited elsewhere in Minnesota would need to be placed in a good wind resource. The availability of good, undeveloped wind resources in Minnesota remains high. Impacts on the fuel (wind) resources would be similar to those for the Pleasant Valley Wind Project.

124.5 MW Biomass Plant

A combination of wood chips and agricultural biomass would be the main fuel sources for a 124.5 MW biomass plant. Natural gas would be used as a fuel backup. Such a plant would consume approximately 129,200 tons of biomass per month. There are currently no biomass plants of this size operating in Minnesota.[75]

It is possible that rail could be used for delivery of fuel to the plant, depending on its location. However, the most likely method of delivery for wood and agricultural biomass fuel would be by semi-trailer trucks. Trucks would likely deliver wood and agricultural biomass by loads of 20 tons or greater. The biomass facility would operate 24 hours a day, but fuel delivery times would likely be limited. The total number of daily truck trips is estimated to be approximately 210. The origin of the biomass trucks and the total trip length required for delivery would depend on the location of the biomass source relative to the biomass plant.

A back-up fuel source would be required for the biomass plant, to assist with plant start-up and to sustain the plant temporarily when the biomass fuel supplies are low. Natural gas would be used as a backup fuel. The construction of a natural gas pipeline would be required to deliver the natural gas to the biomass plant.

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[71] Wind Resource Analysis Program 2002, http://www.state.mn.us/mn/externalDocs/Commerce/WRAP_Report_110702040352_WRAP2002.pdf.
[72] Site Permit Application, Section 4.3, Figure 4.1.2. Wind speeds recorded at a height of 58 meters.
[73] See Table 1 which list includes "Cut-in Wind Speeds", i.e., the minimum wind speed necessary for the turbine to operate.
[74] Site Permit Application, Section 11.0.
[75] Xcel Energy's Bay Front power plant in Ashland, Wisconsin generates approximately 76 MW, and is moving toward becoming a 100% biomass plant, http://www.xcelenergy.com/Company/Environment/Renewable%20Energy/Pages/Biomass.aspx.

Potential impacts to the environment related to fuel for a biomass plant include possible degradation of the environment due to biomass removal (e.g., increased soil erosion due to removal of agricultural biomass; loss of wildlife habitat), air pollution due to biomass transport, and the impacts associated with building a natural gas pipeline.

Mitigation

Impacts related to fuel for a biomass plant could be mitigated by using guidelines for biomass harvest that minimize impacts and by siting the plant to minimize impacts related to biomass transportation. As an example, the Minnesota Forest Resource Council (MFRC) has developed woody biomass harvest guidelines to lessen impacts to wildlife habitat.[76] In order for mitigation to work, the biomass plant would need to require that its biomass suppliers follow biomass harvest guidelines.

6.6 Associated Transmission Facilities

Electrical generation facilities typically require construction of transmission facilities such as transmission lines and substations to connect to the transmission grid. This section discusses these associated transmission facilities and their potential impacts.

Transmission lines over 100 kilovolts and longer than 1,500 feet are defined as "high voltage transmission lines" and are subject to regulation by the Commission.[77] Wind generation facilities require construction of lower voltage electric infrastructure (typically 34.5 kV), referred to as feeder or collector lines, to collect the power generated by the wind turbines and get it to the project substation before connecting to the transmission grid.

Pleasant Valley Wind Project

The Pleasant Valley Wind Project will require three substations in the Project area and associated transmission lines. Two collection substations would gather the electrical power generated by the Project's wind turbines and transform the voltage from 34.5 kV to 138 kV. Power from the collection substations will be transmitted by overhead 138 kV lines to a Project substation. The Project substation will transform the voltage to 345 kV for transmission to the Pleasant Valley substation. The substations and transmission lines are being permitted by Mower County through the local review process.[78]

Impacts from the Project's associated transmission facilities would include impacts due to construction and impacts due to operation. Construction impacts would include impacts related to land clearing and materials transport. Operation impacts would include impacts related to electromagnetic fields (EMF), stray voltage, noise, and visibility. Power moving through a transmission line creates EMF. These fields decrease with distance from the transmission line.

[76] Forest Biomass and Biofuels Harvest, http://www.frc.state.mn.us/initiatives_policy_biofuels.html.
[77] Minn. Stat. § 216E.01, subd. 4. Under Minn. Stat. § 216E.05, high voltage transmission lines between 100 and 200 kV may be permitted by local governments.
[78] Local Review of High Voltage Transmission Lines, http://energyfacilities.puc.state.mn.us/Docket.html?Id=3855; Pleasant Valley Wind Project, http://energyfacilities.puc.state.mn.us/Project.html?Id=27749.

Stray voltage occurs with electrical distribution lines to residences and transmission lines that parallel them. Stray voltage flows through the ground.[79]

During wet weather, water can be ionized adjacent to transmission lines creating a crackling noise. Visual impacts of a transmission line depend on context. High visual impacts occur when a line is located near areas with relatively higher population densities, e.g., residential areas. Potential impacts from EMF, stray voltage, noise, and visibility are anticipated to be minimal.

Mitigation

Construction impacts can be mitigated by minimizing the amount of land clearing required. Collection lines for the Project will be routed along the shortest routes possible.[80] Operation impacts can be mitigated by placing transmission lines away from population densities. Visual impacts can be mitigated by placing collector lines underground, while aesthetic impacts from overhead collector and transmission lines can be mitigated through design and pole placement.

Generic 300 MW LWECS

A generic 300 MW LWECS would have transmission facilities similar to the Pleasant Valley Wind Project. Accordingly, potential impacts and mitigation strategies are also similar. The primary driver of potential impacts is the length and voltage of the transmission line required to interconnect the wind project with the transmission grid. A relatively longer line or higher voltage would create greater construction and operation impacts.

124.5 MW Biomass Plant

A 124.5 MW biomass plant would have transmission facilities similar to the Pleasant Valley Wind Project; however, an electrical collection system and collection substations would not be required. The plant would include a transformer to transform the voltage to transmission levels and a transmission line between the plant and a substation where the power would enter the grid.

Potential impacts and mitigation strategies would be similar to those for the Pleasant Valley Wind Project. Again, the primary driver of potential impacts is the length and voltage of the transmission line required to connect the biomass plant to the transmission grid. A relatively longer line or higher voltage would create greater construction and operation impacts.

6.7 Water Appropriations

Large electric power generating facilities may require water for operations. This section discusses potential water appropriation impacts from such facilities.

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[79] For a discussion of EMF and stray voltage, see generally, A White Paper on Electric and Magnetic Field (EMF) Policy and Mitigation Options, Minnesota State Interagency Working Group on EMF Issues, Sept. 2002, http://energyfacilities.puc.state.mn.us/documents/EMF%20White%20Paper%20-%20MN%20Workgroup%20Sep%202002.pdf; Brookings County – Hampton 345 kV Transmission Line Project, Draft Environmental Impact Statement [hereafter Brookings DEIS], Section 6.2, http://energyfacilities.puc.state.mn.us/resource.html?Id=25589.

[80] Site Permit Application, Section 7.2.4.

Pleasant Valley Wind Project

The Pleasant Valley Wind Project would require water appropriations for potable and sanitary water for the operations and maintenance facility. Water would be supplied through either rural water or a single domestic-sized well. This amount of water used would be roughly equivalent to the amount consumed by a residence or farmstead in the area, and would likely not require mitigation.

Generic 300 MW LWECS

A generic 300 MW LWECS would have water appropriations similar to the Pleasant Valley Wind Project.

124.5 MW Biomass Plant

A 124.5 MW biomass plant would require water appropriations for energy production (process water) and sanitation. Process water could come from a well; however, a municipal water source may also be required. For some aspects of the process, such as in the cooling tower, effluent water from a wastewater treatment facility could be used. Thus, the sources of water would depend on the type and availability of water sources near the facility location.

The required quantity of water would depend on plant design and water quality. Functions within the plant that require water include cooling, sanitation, washing, and separations. The average anticipated water use would be approximately 1,997 gallons per minute. If a source of effluent wastewater were available, the appropriation of well or municipal water would be relatively lower. If the plant used only well or municipal water, the water appropriation would be relatively higher. Based on anticipated water use, the plant would require a water appropriations permit from the Minnesota Department of Natural Resources (DNR).[81]

Mitigation

Mitigation of well water and municipal water use by the plant could be achieved through plant equipment choices and through the use of effluent water (water that has already been appropriated). If municipal water were used for the plant, modifications or an expansion of the municipal water treatment plant would be required to accommodate the increase in demand.

6.8 Wastewater

Large electric generation facilities have the potential to generate significant amounts of wastewater. This section discusses potential impacts from wastewater generation.

Pleasant Valley Wind Project

The Pleasant Valley Wind Project does not create wastewater during the generation of electricity. However, wastewater would be created by the operations and maintenance (O&M) building. This wastewater would likely be discharged into a septic system associated with the building. The potential impacts of this wastewater and septic system are anticipated to be minimal. Thus, mitigation of the impacts, beyond a properly functioning septic system, is not required.

[81] Water Use Permits, http://www.dnr.state.mn.us/waters/watermgmt_section/appropriations/permits.html.

Generic 300 MW LWECS

A generic 300 MW LWECS would have wastewater impacts similar to the Pleasant Valley Wind Project.

124.5 MW Biomass Plant

A 124.5 MW biomass plant would have process and sanitary wastewater discharges. The amount of wastewater discharge would depend on the water sources used for the plant (see Section 6.7). If well and municipal water are used, anticipated average wastewater discharge would be approximately 258 million gallons per year. If effluent water is also utilized, wastewater discharge would increase to approximately 782 million gallons per year.

Mitigation

Wastewater impacts could be mitigated by proper processing. The most likely scenario is transference of the wastewater to a municipal sewage system for treatment and release. Wastewater could be held or pre-treated at the biomass plant. Holding could reduce discharges through evaporation. However, holding introduces risks related to storing wastewater away from surface and ground waters.

6.9 Solid and Hazardous Wastes

Large electric generation facilities have the potential to generate solid and hazardous wastes. This section discusses potential impacts from such wastes.

Pleasant Valley Wind Project

The Pleasant Valley Wind Project would create solid and hazardous wastes. Solid wastes would be generated during construction, e.g., scrap wood, plastics, cardboard, wire. Small amounts of solid and hazardous wastes would be generated during operation, e.g., oils, grease, hydraulic fluids, solvents. Lubricants and fluids would be stored at the operations and maintenance building.

Solid and hazardous wastes, if not properly handled, can contaminate surface and ground waters. This contamination can cause human health impacts, e.g., cancer.[82]

Mitigation

Solid wastes would be disposed of according to solid waste plans in Dodge and Mower counties. Hazardous wastes would be handled appropriately. Leaks or spills would be mitigated using appropriate clean up techniques. A listing of all potentially hazardous materials related to the Project will be maintained for the Project. It is not anticipated that the Project will require a hazardous waste license. Hazardous waste generation would likely fall below the quantity required for a very small quantity generator license (220 pounds per month).[83]

[82] Volatile Organic Compounds (VOCs) in Minnesota's Ground Water, http://www.pca.state.mn.us/water/groundwater/gwmap/voc-fs.pdf.
[83] Very Small Quantity Generator Hazardous Waste Collection Program, http://www.pca.state.mn.us/publications/w-hw2-50.pdf.

Generic 300 MW LWECS

A generic 300 MW LWECS would have solid and hazardous waste impacts similar to the Pleasant Valley Wind Project.

124.5 MW Biomass Plant

A 124.5 MW biomass plant would create solid and hazardous wastes. Solid wastes would be generated during construction, e.g., scrap wood, plastics, cardboard, wire. Solid waste generated from operations would consist primarily of ash from the biomass boiler. Small amounts of hazardous wastes would be generated during operation, e.g., oils, grease, hydraulic fluids, solvents. Hazardous materials would likely be stored on site, e.g., diesel fuel.

Mitigation

Mitigation of wastes would be similar to the Pleasant Valley Wind Project. Ash generated by the plant would be held on-site in an ash holding facility or removed to an off-site disposal facility. Storage tanks would be registered and maintained in accordance with Minnesota Pollution Control Agency (MPCA) guidelines.

6.10 Noise

Large electric generation facilities have the potential to generate noise. This section discusses potential impacts from such noise.

Noise can be defined as unwanted or inappropriate sound. Sound has multiple characteristics which determine whether a sound is too loud or otherwise inappropriate. Sound travels in a wave motion and produces a sound pressure level. This sound pressure level is commonly measured in decibels (dB). Sounds also consists of frequencies, e.g., the high frequency (or pitch) of a whistle. Most sounds are not a single frequency but a mixture of frequencies. Finally, sounds can be constant or intermittent. The perceived loudness of a sound depends on all of these characteristics.

Typically a sound meter is used to measure loudness. The meter sums up the sound pressure levels for all frequencies of a sound and calculates a single loudness reading. This loudness reading is reported in decibels, with a suffix indicating the type of calculation used. For example, “dB(A)” indicates a loudness reading using an A-weighted calculation (or “scale”).

The State of Minnesota has promulgated noise standards designed to ensure public health and minimize citizen exposure to inappropriate sounds (Table 4). The rules for permissible noise vary according to land use, i.e., according to their noise area classification (NAC). In a residential setting, for example, noise restrictions are more stringent than in an industrial setting. Rural residential homes are considered NAC 1 (residential), while agricultural land and agricultural activities are classified as NAC 3 (industrial). The rules also distinguish between nighttime and daytime noise; less noise is permitted at night. The rules list the sound levels not to be exceeded for 10 percent and 50 percent of the time in a one-hour survey (L_{10} and L_{50}) for each noise area classification.

Potential human impacts due to noise include hearing loss, stress, annoyance, and sleep disturbance.[84]

Table 4. Minnesota Noise Standards[85]

Noise Area Classification[86]	Daytime		Nighttime	
	L_{50}[87]	L_{10}	L_{50}	L_{10}
1	60	65	50	55
2	65	70	65	70
3	75	80	75	80

Pleasant Valley Wind Project

The operation of wind turbines in the Pleasant Valley Wind Project would produce noise. Turbines produce mechanical noise (noise due to the gearbox and generator in the nacelle) and aerodynamic noise (noise due to wind passing over the turbine blades).[88] Perceived sound characteristics would depend on the type/size of turbine, the speed of the turbine (if turning), and the distance of the listener from the turbine.

Wind turbines produce audible, low frequency sound, and sub-audible sound (infrasound). These sounds can have a rhythmic modulation due to the spinning of the turbine blades.[89] Impacts due to these sound characteristics are subjective, i.e., human sensitivity, especially to low frequency sound, is variable. However, in general, low frequency sounds can cause annoyance and sleep disturbance.[90]

[84] Occupational and Community Noise, World Health Organization, http://www.who.int/mediacentre/factsheets/fs258/en/.
[85] Minnesota Rules 7030.0040, https://www.revisor.leg.state.mn.us/rules/?id=7030.0040. Standards expressed in dB (A).
[86] Minnesota Rules 7030.0050, https://www.revisor.leg.state.mn.us/rules/?id=7030.0050. The noise area classification is based on the land use activity at the location of the receiver (listener).
[87] Minnesota Rules 7030.0020, https://www.revisor.leg.state.mn.us/rules/?id=7030.0020. "L_{50}" means the sound level, expressed in dB(A), which is exceeded 50 percent of the time for a one hour survey. "L_{10}" means the sound level, expressed in dB(A), which is exceeded ten percent of the time for a one hour survey.
[88] Minnesota Dept. of Health Report, p. 11-14.
[89] Id.
[90] Id., Section IV.

Mitigation

The primary means of mitigating sound (noise) produced by wind turbines is proper siting. Turbines must be sited to comply with noise standards in Minnesota Rules Chapter 7030.[91] For rural residential areas in Dodge and Mower counties, this means that sound levels must meet an L_{50} standard of 50 dB(A) (Table 4). The distance that turbines are setback from residences would depend on the type and size of turbine. Setback distances to the 50 dB(A) level for turbines under consideration for this Project are shown in Table 1 – the setback distance for a 1.5 MW turbine is 656 feet; the distance for a 2.3 MW turbine is 1050 feet. The Applicant has stated that no turbines will be placed within 1,000 feet of any home; however, the Applicant proposes that a 1,500 foot setback from residences will be more typical. A setback of 1,500 feet is reflected in preliminary turbine layouts shown in Figures 4 and 5.

Cumulative noise impacts must also be considered. That is, if there are multiple turbines in the vicinity of a residence, the standards set by Minnesota Rules Chapter 7030 must still be met. This may require additional setbacks. Setback requirements are enforced by site permits issued by the Commission for wind farms. The Commission is currently reviewing public health setbacks related to wind farms to determine if they remain appropriate and reasonable.[92]

Generic 300 MW LWECS

A generic 300 MW LWECS would likely have noise impacts similar to the Pleasant Valley Wind Project. However, if the generic 300 MW LWECS were to be located in a less populated area than the Pleasant Valley Wind Project, then noise impacts may affect fewer people. In 2000, the average population density for Dodge and Mower counties was 40.4 people per square mile and 54.3 people per square mile, respectively.[93] The population density is generally greater in the southeast region of Minnesota compared to other areas in the state (Figure 10).

124.5 MW Biomass Plant

A 124.5 MW biomass plant would create noise during operation from a variety of sources including the turbine/boiler building, conveyor system, hammer mill and bale choppers, front end loaders, and idling trucks. Based on noise studies, the plant would need to be located approximately 2,100 feet from a residence to the meet the daytime L_{50} standard of 60 dB(A) and approximately 6,200 feet from a residence to meet the nighttime L_{50} standard of 50 dB(A). These are conservative estimates – they are based on maximum equipment operation and have not been adjusted for possible noise shielding.

Mitigation

Sound (noise) from the biomass plant could be mitigated by proper siting. A study would likely be required to ensure that noise standards are met for all local residents. Enclosure of heavy equipment would reduce noise impacts. Vegetative screening, planted to lessen visual impacts, would provide noise mitigation. Fuel windrows could provide noise attenuation. Hours of

[91] Minn. Rules 7030.0040, Noise Standards, https://www.revisor.leg.state.mn.us/rules/?id=7030.0040
[92] Commission Investigation into Large Wind Energy Conversion Systems Permit Conditions on Setbacks and the Minnesota Department of Health Environmental Health Division's White Paper on Public Health Impacts of Wind Turbines, CI-09-845, http://www.puc.state.mn.us/puc/energyfacilities/012254#windhealth.
[93] Site Permit Application, Section 6.2.1.

operation, e.g., for fuel delivery or heavy equipment operation, could be managed to reduce noise impacts and meet daytime and nighttime standards.

6.11 Property Values

Large electric generation facilities have the potential to impact property values. This section discusses potential property value impacts from the operation of a generation facility in the Project area.

Pleasant Valley Wind Project

The Pleasant Valley Wind Project would be located in Dodge and Mower counties in south central Minnesota. Dodge County has a population of 19,722 people.[94] The home ownership rate is approximately 84.0 percent.[95] Mower County has a population of 38,215 people.[96] The home ownership rate is approximately 78.2 percent.[97]

The impact on property values due to the Project are difficult to quantify because of the multitude of factors that influence a property's market value, including acreage, schools, parks, neighborhood characteristics, and improvements. A direct influence on property value is often the status of the housing/land market at the time of sale, i.e., a buyer's market or a seller's market.

Lawrence Berkeley National Laboratory recently completed a nationwide study on the potential impacts of wind Projects on property values.[98] Results indicate that property values near wind Projects are not negatively impacted. The study indicates that home buyers and sellers consider a property's scenic vista when determining an appropriate sales price; however, sales prices are not significantly affected by views of wind turbines. This study does not preclude the possibility of negative impacts to property values in specific situations.

Mitigation

Potential negative impacts to property values can be mitigated by siting turbines away from residences and viewsheds. Property value impacts related to annoyance (e.g., noise, shadow flicker) can be mitigated by setbacks and proper siting (see Sections 6.3 and 6.10). Property value impacts related to aesthetics and viewsheds can be mitigated by proper siting, but are relatively more difficult to mitigate due to the height of wind turbines.

[94] U.S. Census Bureau, Dodge County, Minnesota, http://quickfacts.census.gov/qfd/states/27/27039.html.
[95] Id.
[96] U.S. Census Bureau, Mower County, Minnesota, http://quickfacts.census.gov/qfd/states/27/27099.html.
[97] Id.
[98] The Impact of Wind Power Projects on Residential Property Values in the United States: A Multi-Site Hedonic Analysis, December 2009, http://www1.eere.energy.gov/windandhydro/pdfs/wind_power_Projects_residential_property_values.pdf.

Generic 300 MW LWECS

A generic 300 MW LWECS would have property value impacts similar to the Pleasant Valley Wind Project.

124.5 MW Biomass Plant

A 124.5 MW biomass plant would have the potential to negatively impact property values near the plant site and possibly along roads used to transport biomass. However, as with the Pleasant Valley Wind Project, impacts on property values due to a plant are difficult to quantify because of the multitude of factors that influence a property's market value. For example, if biomass for the plant were supplied by neighboring land parcels, these parcels might experience an increase in property value.

Mitigation

Because the plant is sited in one location (as compared to multiple turbine locations), property value impacts could be mitigated by proper siting.

6.12 Communications

Large electric generation facilities have the potential to impact electronic communications (e.g., radio, television, internet, cell phone, microwave). This section discusses potential impacts to communications from the operation of a generation facility in the Project area.

Pleasant Valley Wind Project

Wind turbines can cause interference with electronic communications by obstructing the reception of communication signals. Digital signals (e.g., digital television, internet, cell phones) are not impacted by wind turbines unless the turbines directly obstruct the signal, i.e., are in the line-of-sight.[99] Analog signals (e.g., AM and FM radio, microwaves) can be interfered with by direct obstruction and by indirect signal interference, e.g., ghosting of television pictures, signal fading.

Potential communications impacts due to the Pleasant Valley Wind Project are anticipated to be minimal. There are eight digital television facilities within the Project area.[100] Transmitters for these facilities are close to the Project are and provide strong signals.[101] There are 19 FM radio broadcast facilities and one AM radio facility operating in the Project area.[102] FM radio is not impacted by wind turbines or transmission facilities; AM radio can be impacted near transmission facilities, e.g., signal fading underneath a transmission line.

Global positioning systems (GPS) use satellite signals to determine locations on the earth's surface and are commonly used to guide agricultural operations.[103] Because GPS uses multiple

[99] Post Digital Television Transition - The Evaluation and Mitigation Methods for Off-Air Digital Television Reception in-and-around Wind Energy Facilities; http://www.comsearch.com/files/Wind_Energy_White_Paper.pdf.
[100] Site Permit Application, Section 6.5.2.
[101] Id.
[102] Id.
[103] Precision Farming Tools: Global Positioning Systems (GPS), Virginia Cooperative Extension; http://www.pubs.ext.vt.edu/442/442-503/442-503.html.

digital satellite signals, interference with the signals or subsequent uses is not anticipated. Obstruction of any one satellite signal would require direct line-of-sight obstruction due to a wind turbine. Such an obstruction would be temporary (i.e., there is concurrent GPS receiver movement, satellite movement, and wind turbine blade movement such that the obstruction would be resolved).

There are microwave beam paths in and near the Project area (Figure 8).[104] There is also a proposed microwave beam path within the Project Area (Figure 4A). Wind turbines can impact microwave communications by interfering with these beam paths (e.g., wind turbine blade slicing through a beam path). Thus, turbines need to be located within the Project area such that they do not obstruct microwave beam paths.[105]

Mitigation

Impacts to electronic communications due to the Pleasant Valley Wind Project are not anticipated. Potential impacts to microwave beam paths can be mitigated by proper wind turbine siting.

Generic 300 MW LWECS

A generic 300 MW LWECS would have communications impacts similar to the Pleasant Valley Wind Project.

124.5 MW Biomass Plant

A 124.5 MW biomass plant would have communications impacts less than the Pleasant Valley Wind Project. A biomass plant would be shorter than the Project's wind turbines and sited in one location (as opposed to multiple turbine locations). If the biomass plant location is well chosen, the plant would not impact electronic communications.

6.13 Wildlife and Domesticated Animals

Large electric generation facilities have the potential to impact the health of animals, directly and through impacts to the ecosystem. This section discusses potential impacts to wildlife and domesticated animals due to the operation of a generation facility in the Project area.

6.13.1 Wildlife

The Pleasant Valley Wind Project area consists almost exclusively of cropland (98 percent) (Figure 2).[106] Pre-settlement native prairies, wetlands, and woodlands have been converted to agricultural uses. The Project area includes the Wild Indigo Prairie Scientific and Natural Area, which includes native prairie (Figure 9).[107] Scattered patches of shrub land and forest comprise the remaining wildlife habitat.

[104] Site Permit Application, Section 6.5.2.
[105] Id.
[106] Site Permit Application, Sections 6.17, 6.18.
[107] Id.

The Project area is predominantly located in the ecological section of the Minnesota and Northeast Iowa Morainal.[108] Prior to development, prairies occupied a large area of the section. Woodland and forest were common in areas where fire was uncommon or rare.

A number of animal species are adapted to the habitat of the Project area. In such areas, crops provide seasonal cover and food, while uncultivated areas provide long-term cover, food, and water. A variety of mammals are typical in this landscape including mice, squirrel, rabbits, deer, and coyote.[109] Birds and bats are found in this landscape, but their numbers are limited due to a lack of suitable foraging and breeding habitat.[110] Additionally, the Project area is not part of a migratory flyway. The loggerhead shrike, listed as a threatened bird species by the State of Minnesota, is found in the Project area during summer months.[111]

Pleasant Valley Wind Project

The Pleasant Valley Wind Project would negatively impact select wildlife in the Project area. Impacts related to construction are likely minimal. The physical footprint of a wind turbine is relatively small. Direct land use for the Project is anticipated to be approximately 121 to 160 acres (turbines, access roads, operation and maintenance building).[112] This is less than 0.01% of the estimated Project acreage (70,000 acres). The land used for Project construction will be agricultural land, which is relatively poorer habitat for wildlife.

Impacts on ground species due to operation of the Project would be minimal. However there would be negative impacts to avian species, i.e., birds and bats. Birds can collide with spinning turbine blades. Bats can avoid turbines blades, but appear to suffer injury to their respiratory systems when they fly through low pressure wakes near turbine blades.[113]

Birds

Studies have been conducted throughout the Midwest in an attempt to quantify bird and bat mortality due to wind turbines. A study of bird mortality rates at a wind farm in Iowa resulted in estimated mortality rates between 0.3 and 0.8 birds per turbine per year.[114] This estimate is similar to results from studies in other states where mortality rates ranged between < 1 to 2.83 birds per turbine per year.[115] Studies conducted in the Buffalo Ridge region of southwestern Minnesota resulted in estimated bird mortality rates between 1.0 and 4.5 birds per turbine per year.[116] Nocturnal migrants suffered relatively more mortalities; local grassland species suffered relatively less. The studies noted that birds tend to avoid turbine towers, but utilized the surrounding habitat. A study conducted for the Bitter Root Wind Project (proposed to be located

[108] Minnesota and NE Iowa Morainal Section, http://www.dnr.state.mn.us/ecs/222M/index.html.
[109] Id.
[110] Id.
[111] Id. See also, Site Permit Application, Appendix 3, Natural Heritage Information System Results.
[112] Site Permit Application, Section 6.10.2.
[113] Extreme Pressure Changes near Blades Injures Bat Lungs, http://www.ucalgary.ca/news/aug2008/batdeaths.
[114] Bird and Bat Behavior and Mortality at a Northern Iowa Windfarm, Jain, 2005 http://www.batsandwind.org/pdf/Jain_2005.pdf.
[115] Id.
[116] Avian Monitoring Studies at the Buffalo Ridge, Minnesota Wind Resource Area: Results of a 4-Year Study, http://energyfacilities.puc.state.mn.us/documents/AvianMonitoringBuffaloRidge.pdf [hereafter Buffalo Ridge Studies].

in Yellow Medicine and Lincoln County, Minn.) found that passerines (perching songbirds) are relatively more likely to suffer mortalities due to wind turbines while waterfowl are less vulnerable to turbine collisions.[117]

Overall, studies of bird mortalities near wind farms indicate that mortalities will occur and that they will vary with bird type (e.g., passerine) and bird use (habitat). Because of the relatively poor bird habitat in the Project area and the lack of a migratory flyway, impacts to bird populations from operation of the Pleasant Valley Wind Project are anticipated to be insignificant from a population standpoint.

Bats

Bats typically utilize forests, riparian corridors, and wetlands as feeding habitat due to higher nocturnal insect densities in these areas. The Iowa wind farm study estimated bat mortality rates between 6 and 9 bats per turbine per year.[118] A Buffalo Ridge study estimated bat mortality rates at 2.2 bats per turbine per year.[119]

Due to a lack of bat feeding habitat within the Project area, bat activity is anticipated to be relatively low. Accordingly, bat mortalities from Project operation are likely not significant. This said, bat populations and movements within Minnesota are not well understood. Thus, population impacts of bat mortalities are uncertain.

Mitigation

Impacts to ground animals are expected to be minimal and mitigation is not required. Impacts to birds and bats are expected to be minimal but can be mitigated by siting. Siting away from bird habitat (grasslands, riparian areas) and bat feeding areas (forest, riparian areas) would reduce bird and bat mortalities. Birds and bats fly relatively less in windy conditions. Wind turbines operate in windy conditions and require a minimum wind speed (see Table 1). Thus, impacts to birds and bats could be mitigated by employing turbines with a relatively higher cut-in speed or by using SCADA system controls to implement a higher cut-in speed.[120]

Generic 300 MW LWECS

A generic 300 MW LWECS located elsewhere in the same ecological section of the Minnesota and Northeast Iowa Morainal would likely have wildlife impacts similar to the Pleasant Valley Wind Project. Information about local bird and bat populations within Minnesota is incomplete. The Pleasant Valley Wind Project area has relatively poor habitat for birds and bats. A generic

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[117] Wildlife Studies for the Bitter Root Wind Resource Area, Yellow Medicine and Lincoln Counties, Minnesota, April 2009, Application for a Site Permit, 138 MW Buffalo Ridge Wind Farm Project, Appendix F, http://energyfacilities.puc.state.mn.us/documents/25538/Appendix_%20F_Wildlife_Studies.pdf.
[118] Bird and Bat Behavior and Mortality at a Northern Iowa Windfarm, Jain, 2005 http://www.batsandwind.org/pdf/Jain_2005.pdf.
[119] Bat Interactions with Wind Turbines at the Buffalo Ridge, Minnesota Wind Resource Area, November 2003, http://my.epri.com/portal/server.pt?space=CommunityPage&cached=true&parentname=ObjMgr&parentid=2&control=SetCommunity&CommunityID=404&RaiseDocID=000000000001009178&RaiseDocType=Abstract_id.
[120] Effectiveness of Changing Wind Turbine Cut-In Speeds to Reduce Bat Fatalities at Wind Facilities, April 2009, http://www.batsandwind.org/pdf/curtailment_2008_final_report.pdf.

300 MW LWECS located elsewhere in Minnesota, outside of the Minnesota and Northeast Iowa Morainal, would likely be greater than that for the Pleasant Valley Wind Project.

124.5 MW Biomass Plant

A 124.5 MW biomass plant would have wildlife impacts similar to the Pleasant Valley Wind Project, except impacts to birds and bats. The plant would be constructed on an approximately 80 acre site. This acreage would be removed from use as wildlife habitat. However, the land used for the Project would be agricultural land; such land is relatively poorer habitat for wildlife. Impacts from operation of the plant are anticipated to be minimal. Emissions from the plant (e.g., hazardous air pollutants) could, through impacts to the environment, impact wildlife. The extent of this impact is uncertain.

6.13.2 Domesticated Animals

For purposes of evaluation with respect to a wind farm, domesticated animals (livestock, pets) differ from wildlife in that (1) they have limited opportunity to move away wind turbines and (2) they are more typically non-avian species. There are few aspects of animal health that can be considered outside of ecosystem health. That is, animal health depends on ecosystem health (clean water, fresh air, healthy soils, and crops). Generation facilities that impair ecosystem functioning can negatively impact animal health, e.g., emissions of hazardous air pollutants. Potential ecosystem impacts due to generation facilities are discussed elsewhere in this report (e.g., Sections 6.1 and 6.2 discussing air pollutants).

There are potential impacts to animal health that are independent of ecosystem health, i.e., impacts to health due to annoyance or stress. This stress could result from a variety of impacts related to generation facility operations, e.g., lights, noises, electrical shock. Shadow flicker is discussed in Section 6.3; noise is discussed in section 6.10.

Electrical shock could be caused by stray voltage or induced voltage.[121] Stray voltage occurs with electrical distribution lines to residences and transmission lines that parallel them. Stray voltage flows through the ground. Induced voltage occurs with ungrounded metal objects (e.g., fences) that parallel transmission lines. Induced voltage flows through the metal objects. In general, transmission lines are electrical lines with voltages of 100 kV or greater; distribution lines are electrical lines with voltages less than 100 kV.

Pleasant Valley Wind Project

Domesticated animals in the area of the Pleasant Valley Wind Project would be exposed to noise and shadow flicker created by wind turbines. Exposure would depend on the type of animal, animal husbandry practices, and the distance between animals and the turbines. Health impacts from turbine noise and shadow flicker are uncertain. Information about impacts to domesticated animals is anecdotal and indicates that animals are not impacted by turbine operations. For example, grazing animals appear to graze near, under, and up to turbine towers.

[121] See, e.g., Brookings DEIS, Section 6.2.

Studies designed to assess turbine impacts on avian wildlife have found that wildlife use areas near wind turbines (e.g., nesting, feeding), but avoid the area surrounding turbine towers.[122] It is unclear whether these species are avoiding stress due to noise or shadow flicker, or if they are avoiding potential impact with turbine blades. Studies designed to assess direct turbine impacts to non-avian wildlife (e.g., mice, squirrels, deer) and domesticated animals (e.g., cattle, horses) are scarce, presumably because impacts to these species are anticipated to be minimal.

The Pleasant Valley Wind Project does not include distribution lines to residences but does include transmission lines. The transmission lines (two 138 kV lines; one 345 kV line; see Section 6.6), depending on their location, may or may not parallel distribution lines. Thus, it's uncertain whether they would induce any stray voltage. Similarly, it's uncertain whether the transmission lines would parallel ungrounded metal objects such that they would produce an induced voltage. Due to the relatively low population density in the Project area (and associated low density of built infrastructure), health impacts to animals from stray or induced voltage are not anticipated.

Mitigation

Stray and induced voltage can be mitigated by proper grounding of facilities (e.g., buildings, fences, distribution line structures).

Generic 300 MW LWECS

A generic 300 MW LWECS located elsewhere in Minnesota would likely have impacts to domesticated animals similar to the Pleasant Valley Wind Project. However, if the generic 300 MW LWECS were to be located in an area with less population and agricultural uses than the Pleasant Valley Wind Project, then the impacts to domesticated animals may be fewer.

124.5 MW Biomass Plant

A 124.5 MW biomass plant would likely have impacts to domesticated animals less than those of the Pleasant Valley Wind Project. Biomass plant operations would create noise and lighting that could impact animal health. Additionally, the plant could have an associated transmission line that produced stray or induced voltage. However, the plant could be sited away from animals (e.g., livestock operations) to minimize health impacts. In this sense, the biomass plant represents a concentrated impact that can be moved away from animals. Wind turbines represent a diffuse impact that exists within landscapes utilized by animals.

6.14 Native Vegetation

Large electric generation facilities have the potential to impact native vegetation. This section discusses potential vegetation impacts from the operation of a generation facility in the Project area.

[122] See discussion in Application for a Site Permit, 138 MW Buffalo Ridge Wind Farm Project, Section 8.17.2, http://energyfacilities.puc.state.mn.us/documents/25538/Bitter_Root_Applictext_10-13-09.pdf. For example, studies of grassland nesting songbirds show that use of grasslands areas was reduced within 50 meters (164 ft.) of turbines, but that areas further away did not have reduced use.

Pleasant Valley Wind Project

The Pleasant Valley Wind Project area consists almost exclusively of cropland (98%) (Figure 2).[123] Pre-settlement native prairies, wetlands, and woodlands have been converted to agricultural uses. The Project area does include small patches of prairie, shrub land, and forest. These patches support several plant species of concern, e.g., Western prairie fringed orchid.[124]

Because the Project area is primarily cropland, impacts to native vegetation will be minimal.

Mitigation

Potential impacts to native vegetation can be mitigated by siting wind turbines to avoid prairies, shrub land, and forest patches that support native species, including species of concern (Figure 9).

Generic 300 MW LWECS

A generic 300 MW LWECS located elsewhere in Minnesota would have impacts to native vegetation similar to and likely greater than the Pleasant Valley Wind Project. Sites elsewhere in Minnesota may not have as extensive a conversion of native vegetation to cropland as in the Pleasant Valley Project area.

124.5 MW Biomass Plant

A 124.5 MW biomass plant would have impacts to native vegetation similar to the Pleasant Valley Wind Project. Because a biomass plant would occupy a single site, proper siting of such a plant would likely mitigate impacts to native vegetation.

6.15 Aviation

Large electric generation facilities have the potential to impact aviation. This section discusses potential impacts to aviation from the operation of a generation facility in the Project area.

Pleasant Valley Wind Project

Because of their height, wind turbines have the potential to impact aviation in and near a wind Project. Wind turbines in the Pleasant Valley Wind Project will require notice to and evaluation by the Federal Aviation Administration (FAA)[125] and the Minnesota Department of Transportation (MN DOT).[126] There are three municipal airports near the Project – the Rochester International Airport, the Austin Municipal Airport, and the Dodge Center Municipal

[123] Site Permit Application, Section 6.17.
[124] Site Permit Application, Section 6.19. Twelve species of concern were determined to be in the Project area (via Minnesota Department of Natural Resources database query). These species are state or federally listed endangered and threatened species or Minnesota special concern species.
[125] FAA Advisory Circular AC 70/7460-2K, HTTP://RGL.FAA.GOV/REGULATORY_AND_GUIDANCE_LIBRARY/RGADVISORYCIRCULAR.NSF/0/22990146DB0931F186256C2A00721867/$FILE/AC70-7460-2K.PDF
[126] Tall Towers, Minnesota Structure Height Regulations, http://www.dot.state.mn.us/aero/avoffice/talltowers.html.

Airport.[127] The Pleasant Valley Wind Project does not impact the safety zones of any of these airports.[128] Additionally, impacts to electronic airport navigation aids are not anticipated.

Wind turbines could impact local aviation, e.g., aerial crop spraying. Wind turbines would make it relatively more difficult to apply chemicals from the air. Pilots making such applications would have their attention divided between aircraft systems, spraying requirements, weather, and obstructions.[129] Additionally, operating wind turbines create turbulence wakes which would make aircraft operation difficult. However, applications by air are typically made during low wind conditions. In these conditions, wind turbines would not be turning or creating turbulence wakes.

Wind turbines could impact local helicopter navigation, e.g., emergency medical helicopters needing to land in or near the Project area. It is unclear whether the Project would significantly increase the risks of helicopter navigation. Officials at the Mayo Clinic in Rochester, Minnesota, have noted that impacts on helicopter operations due to wind projects in the area have been insignificant.[130]

Mitigation

Potential impacts to aviation can be mitigated by proper siting of the Project and adherence to FAA and MN DOT regulations. Impacts to aerial crop spraying would be difficult to mitigate.

Generic 300 MW LWECS

A generic 300 MW LWECS located elsewhere in Minnesota would likely have aviation impacts similar to the Pleasant Valley Wind Project.

124.5 MW Biomass Plant

A 124.5 MW biomass plant would have aviation impacts less than the Pleasant Valley Wind Project. A biomass plant would be relatively shorter and located on one site. Thus, its potential to disrupt aviation would be minimal.

[127] Site Permit Application, Section 6.5.2.
[128] Id. For Minnesota safety zones, see Minnesota Rules, 8800.2400, https://www.revisor.mn.gov/rules/?id=8800.2400.
[129] Aerial crop sprayers in Wisconsin adopted a resolution in 2009 refusing to provide services within wind farm Projects; Glacial Hill FEIS, Section 5.4.2.2.
[130] Mayo: Turbines do not hamper medical helicopters, Rochester Post-Bulletin, May 18, 2010, http://www.postbulletin.com/newsmanager/templates/localnews_story.asp?z=2&a=452955.

7.0 Required Permits

The Pleasant Valley Wind Project will require permits and approvals from entities other than the Minnesota Public Utilities Commission. Federal, state, and local permits or approvals that have been identified for construction and operation of the Project are listed in Table 5.

Table 5. Permits and Approvals[131]

Agency	Type of Approval
Federal	
Federal Aviation Administration	Notice of Proposed Construction or Alteration; Determination of No Hazard
U.S. Fish and Wildlife Service	Consultation and Project Review Regarding Threatened and Endangered Species
U.S. Army Corps of Engineers	Wetland (Section 404) Permit
Federal Energy Regulatory Commission	Exempt Wholesale Generator Status
State of Minnesota	
Minnesota Public Utilities Commission	Certificate of Need; LWECS Site Permit
Minnesota State Historical Preservation Office	Cultural and Historic Resources Review
Minnesota Board of Water and Soil Resources	Wetland Conservation Act Approval
Minnesota Department of Natural Resources	Pubic Water Works Permit
	License to Cross Public Lands and Waters
	Consultation and Project Review Regarding Threatened and Endangered Species
Minnesota Pollution Control Agency	NDPES Stormwater Permit for Construction
	License for Small Quantity Generator of Hazardous Waste
	State Water Quality (Section 401) Certification

[131] Potential permits and approvals required for the Pleasant Valley Wind Project. Adapted from Site Permit Application, Section 13.

Agency	Type of Approval
Minnesota Department of Health	Water Well Permit
Minnesota Department of Transportation	Driveway Permit, Utility Access Permit, Highway Access Permit, Work Within Right-of-Way Permit
	Oversize and Overweight Vehicle Permit, Single Trip Permit
	Tall Towers Permit
Local Permits	
Dodge County	Building Permits
	Moving Permit, Access Drive and Entrance Permit, Utility Permit, Work Within Right-of-Way Permit
	Wetland Permit, Septic System Permit
Mower County	Building Permits, Conditional Use Permits for Transmission lines and substations
	Moving Permit, Access Drive and Entrance Permit, Utility Permit, Right-of-Way Obstruction or Excavation Permit
	Permit to Construct Sewage Treatment System
	Wetland Permit
Townships	Township Approvals