Frequently Asked Questions (FAQs)
Commercial-Scale Wind Turbine Generators in the OPPD Service Area

General

What is a commercial-scale wind turbine?

Large commercial-scale (utility-scale) wind turbines generally range in size from 750 kW up to 2 MW. They are typically grouped into "wind farms" with a total capacity of 50 to 100 MW. Tower heights range from 200 to 320 feet (60 meters to 100 meters). Each turbine blade is approximately 80 to 100 feet long and weighs between 8,000 and 10,000 pounds.

Are there "small" commercial-scale wind turbines?

Smaller commercial-scale wind turbines suitable for residential or farm use generally range in size from 10kW to 100 kW.

How much energy will a large commercial-scale wind turbine produce?

A 1.5-MW commercial-scale wind turbine in a moderately windy area (35% capacity factor) can produce over 4,500,000 kWh per year, or enough to power between 400 and 500 homes.

I own some land that is windy. How can I build a wind farm on it?

The first step is to find out more about just how windy the land is—its "wind resource assessment". A potential site must have minimum average wind speeds of 11 to 13 mph (at 10 meters) to even be considered as a possible site. Local weather data from airports and metrological stations can provide some insight into averages. Further steps would involve short-term monitoring with radar devices and/or long-term monitoring with anemometers. Another critical issue is to determine proximity to existing transmission lines and availability of transmission capacity on those line(s).

Who can I hire to perform a Wind Energy Assessment?

Shown below are some representative companies that perform wind energy assessments:

Global Energy Concepts www.globalenergyconcepts.com
AWS TrueWind www.awstruewind.com
Wind Logics www.windlogics.com
NRG Systems www.nrgsystems.com
VERA Wind Energy Consulting www.northeastwind.com/whatwedo/wra.html
3 Tier Environmental Forecast Group www.3tiergroup.com/windresource.htm
Second Wind www.secondwind.com/products/

What regulatory approvals are required?

Commercial-scale wind turbines may require a permit from the FAA to comply with lighting requirements. FAA requires lighting on towers exceeding 200 feet tall or within 10,000 to 20,000 feet of runways. Local ordinances and zoning restrictions should also be reviewed for each potential site.

Wind turbines will interfere with radar. If the wind project is near an airport, military airfield, or weather station, further technical investigation will be required. This may require modifications to the radar.

If the project is on federally owned lands (e.g. National Wildlife Refuge, National Forests), additional analysis under the National Environmental Policy Act (www.fws.gov/r9esnepa), Endangered Species Act (http://endangered.fws.gov) or National Wildlife Refuge System Administration Act (http://www.fws.gov/refuges/policymakers/mandates/16uscsec668dd.html) will be required.

If the wind turbines export to the electrical grid, the Nebraska Power Review Board (NPRB) must approve the installation. The applicant must show the NPRB that the "proposed electric generation facility and/or related facilities will serve the public convenience and necessity, and the applicant can most economically and feasibly supply the electric service resulting from the proposed construction or acquisition without unnecessary conflict and duplication".

The NPRB can be found at: http://www.nprb.state.ne.us/
Tim Texel is the Executive Director of the NPRB.

Who manufacturers Large Commercial-Scale Wind Turbines?

Shown below are some representative companies that manufacture large commercial-scale wind turbines:

GE Energy (US) www.gewindenergy.com
Vestas (Denmark) www.vestas.com
Suzlon (Denmark) www.suzlon.com
Bonus Energy (Denmark) www.windpower.org
Gamesa (Spain) www.gamesa.es/gamesa/index.html
EU Energy (UK) www.eunrg.com
Clipper Wind (UK) www.clipperwind.com

Who manufacturers Small Commercial-Scale Wind Turbines?

Shown below are some representative companies that manufacture small wind turbines:

Abundant Renewable Energy www.abundantre.com
Bergey WIndpower Co. www.bergey.com
Entegrity Wind Systemswww.entegritywind.com
Energy Maintenance Service www.energyms.com
Lorax Energy www.lorax-energy.com
Northern Power Systems www.northernpower.com
Solar Wind Works www.solarwindworks.com
Southwest Windpower Co, www.windenergy.com
Wind Turbine Industries Corp www.windturbine.net

Site Determination

What are the general characteristics of a good wind site?

Of course, wind speed is a very important consideration. A small increase in wind speed results in a cubic increase in power output from the turbine, so developers want to find the windiest spots. The wind speed also increases with altitude and is slowed down by surface roughness elements such as trees, rough hilly terrain, and buildings. The site must also be accessible to large cranes and other construction equipment and be near the transmission grid.

What is the "Nebraska Wind Energy Site Data Study"?

Between 1995 and 1999, wind speed data was collected at eight sites throughout Nebraska. This Study provided valuable information regarding the potential for wind energy development in Nebraska. This was a joint effort sponsored by the Nebraska Legislature's Natural Resource Committee, the Nebraska Power Association, and the Nebraska Energy Office. The final report can be found online at www.neo.ne.gov//reports/ne_wind_energy_site_data_study_1999.pdf

Where can you obtain the latest Nebraska wind energy resource maps?

The latest maps can be found online at www.neo.ne.gov/neq_online/july2005/july2005.01.htm

Does the Nebraska Energy Office (NEO) have any wind turbine information?

Yes, besides the wind energy resource maps, they have a web page that contains links to wind resource information. See www.neo.state.ne.us/renew/wind-renewables.htm

How long must wind speed measurements be made at a particular site?

Prior to building on a site, the wind speed is typically measured for one to three years to statistically quantify the wind resource.

How is wind speed measured?

A meteorological tower or mast is erected at one or more locations to continuously measure wind speed, direction, temperature, and sometimes other weather parameters. The measurements are made at multiple elevations (typically, 10, 30, and 60 meters) in order to calculate wind shear. The resulting data is analyzed to calculate average wind speeds, directions, and temperatures over annual, seasonal, monthly, and hourly time intervals.

What is a wind power class?

Wind power density (watts per square meter) is used to evaluate the wind resource potential. The wind power density indicates how much energy is available. There are seven classes of wind power as shown in the table below:

	10 meter (33 ft)			50 meter (164 ft)		
Wind Power Class	**Wind Power Density**	**Speed (m/s)**	**Speed (mph)**	**Wind Power Density**	**Speed (m/s)**	**Speed (mph)**
1	<100	<4.4	<9.8	<200	<5.6	<12.5
2	100 – 150	4.4 – 5.1	9.8–11.5	200 – 300	5.6 - 6.4	12.5-14.3

3	150 - 200	5.1 – 5.6	11.5–12.5	300 – 400	6.4 - 7.0	14.3-15.7
4	200 – 250	5.6 – 6.0	12.5–13.4	400 – 500	7.0 - 7.5	15.7-16.8
5	250 – 300	6.0 – 6.4	13.4-14.3	500 – 600	7.5 - 8.0	16.8-17.9
6	300 – 400	6.4 – 7.0	14.3-15.7	600 – 800	8.0 - 8.8	17.9-19.7
7	>400	>7.0	>15.7	>800	>8.8	>19.7

What is the wind power class of OPPD?

Extensive wind monitoring of a particular site is required to more precisely estimate the wind class. However, existing meteorological data indicates that the OPPD service area is generally in a Class 3 area. Wind speeds vary greatly across a relatively small geographical area, and there can be small pockets or "hot-spots" where the wind speeds are greater than the surrounding area.

Are wind turbines allowed near radar installations?

The federal government has stopped work on more than a dozen wind farms planned across the Midwest, saying research is needed on whether the large turbines could interfere with military radar.

Costs and Economics

How much does it cost to construct a wind turbine?

Large commercial-scale wind turbines (750 kW up to 2 MW) cost approximately $1,400 per kW (or $1.4 million per MW) of installed capacity. Smaller turbines can cost even more due to economies of scale.

How much are operation and maintenance (O&M) costs for a wind turbine?

For large commercial-scale wind turbines, O&M Costs are approximately $20/kW-yr.

How does the cost of a kWh from a wind generator compare with traditional methods of generating power?

Over the last 20 years, the cost of electricity from large commercial-scale wind turbines has dropped considerably. In the early 1980s, when the first large-scale turbines were installed, wind-generated electricity cost as much as 45 cents per kilowatt-hour. Now, wind turbine generators can generate electricity for 3 to 4 cents/kWh in many parts of the U.S.

How much would it cost to build transmission lines to a remote wind turbine site?

The best winds are often found in locations that are distant from major population areas. This is also generally true in Nebraska as well. Depending on the site, past studies indicate that transmission facilities could cost between $20 million and $100 million.

Who pays for the cost of new transmission lines?

Determining who benefits and who shares in the cost of a new transmission line is a very complex task that requires very lengthy transmission system studies.

What makes wind energy development economical?

Selection of a suitable site is crucial to the economic feasibility of wind energy. The power available from the wind is a function of the CUBE of the wind speed, which means, all other things being equal, a turbine at a site with 5-meters-per-second (m/s) (11 mph) winds will produce nearly twice as much power as a turbine at a location where the wind averages 4 m/s (9 mph). In the electric power industry, where technology options often hinge on very small economic differences, a good wind resource assessment and siting is critical.

Incentives and Policy Issues

What is the Production Tax Credit (PTC) for wind energy?

A 1.5 cent/kWh production tax credit (PTC) for wind energy was included in the Energy Policy Act of 1992. Generally, the credit is a business credit that applies to electricity generated from wind plants for sale at "wholesale" (i.e., to a utility or other electricity supplier which then sells the electricity to customers at "retail"). It applies to electricity produced during the first 10 years of a wind plant's operation. The company that owns the wind plant subtracts the value of the credit from the business taxes that it would otherwise pay.

How much is the Production Tax Credit (PTC)?

The PTC is adjusted annually for inflation, and is currently 1.9 cents/kWh.

When does the Production Tax Credit (PTC) expire?

The 2005 Energy Policy Act extended the PTC to December 31, 2007.

What is the Renewable Energy Production Incentive (REPI)?

An incentive similar to the PTC is made available to public utilities (which do not pay taxes and therefore cannot benefit from a tax credit). The incentive is called the Renewable Energy Production Incentive (REPI) and it consists of a direct payment to a public utility installing a wind plant that is equal to the PTC (1.5 cents per kilowatt-hour, adjusted for inflation). However, REPI funds are not guaranteed and are dependent upon annual appropriations by Congress. In past years this program has been under-funded. Thus, many renewable energy projects have not received any incentive payments.

What are Clean Renewable Energy Bonds (CREBs)?

The recently enacted Energy Policy Act of 2005 includes a provision granting State and local governments and cooperatives the ability to issue clean renewable energy bonds ("CREBs"). CREBs are a tax credit bond that are designed to provide the borrower with an interest free loan and the holder of the bonds with a tax credit (rather than interest) in an amount intended to provide an after tax return equal to that of a comparable taxable investment. CREBs may be issued in 2006 and 2007 to finance future expenditures. The issuer must spend 95% or more of the proceeds of the bond on a qualified project within five years from the date of issue. There is a national cap of $800 million.

What state government subsidies are available?

The Nebraska Energy Office makes available low-interest loans for residential and commercial energy efficiency projects. Only a few renewable energy projects have been funded to date.

What is a Renewable Portfolio Standard (RPS)?

An RPS requires utilities to provide a certain minimum amount of power from renewable sources. To date, 21 states and the District of Columbia have RPS requirements. Nebraska does not have any RPS requirements in place at this time, nor is there a federal RPS.

What are Renewable Energy Certificates ("Green Tags")?

Tradable renewable energy certificates (REC), or green tags, are certificates that represent the financial separation of the energy and environmental benefits from a renewable energy project. The purchaser of RECs is supporting or subsidizing the production of renewable energy without actually using that energy. They support the incremental cost of generating power with renewable technologies. This support can be either voluntary or mandatory, depending on any RPS mandates that the purchaser may be under.

What are Green Power Programs?

Green power is electric generation from renewable sources, such as wind. Some customers in Nebraska have voluntarily enrolled in green power programs and pay a monthly premium to support green power through these programs. Typically, this premium offsets the additional expense of developing renewable energy. OPPD currently offers a Green Power program.

Energy Production

How are wind energy production estimates calculated?

Energy production is a key parameter that must be estimated in order to study the economic feasibility of wind generation. Making these estimates involves adjusting the wind speed data from anemometer to wind turbine height, applying the power production performance curve of the wind turbine, factoring in various types of power production losses, and examining the timing of the energy production.

How much power does a wind turbine produce?

A 1.5-MW wind turbine in a moderately windy area (35% capacity factor) can produce over 4,500,000 kWh per year, or enough to power between 400 and 500 homes. However, wind energy production varies from month-to-month throughout the year.

What capacity factors do wind turbine generators operate at?

The currently installed utility wind turbine generators in Nebraska have operated at capacity factors of approximately 20 to 40%.

How are capacity factors related to wind classes?

Generally, a higher capacity factor, such as 40%, can only be achieved in higher wind class areas, such as a class 5 area.

What is a capacity factor and how is it related to energy production?

The capacity factor is the ratio of the electricity generated, for the time considered, to the energy that could have been generated at continuous full-power operation during the same period.

Net Capacity Factor = (Net Actual Generation/(Period Hours x Net Maximum Capacity)) x 100

Where Net actual generation (MWh) is the actual number of MWhs generated by the unit during the period being considered, less any generation (MWh) utilized for that unit's station service or auxiliaries; and Net maximum capacity is the gross maximum capacity less the unit capacity utilized for that unit's station service or auxiliaries. The gross maximum capacity is the maximum capacity a unit can sustain over a specified period when not restricted by seasonal or other deratings.

For example, if a 1.5 MW wind turbine produced 4,500 MWh per year, the annual capacity factor is as follows: 4,500 MWh/(8760 hrs x 1.5 MW)) x 100=34.2%

Wind Speeds

How much daily variation is there in wind speeds?

Generally, wind speeds decrease slightly in the early morning and evening hours. This pattern is generally the same across Nebraska.

How much seasonal variation is there in wind speeds?

In Nebraska, the wind speeds s are highest during the fall and winter, decrease during the spring, and are lowest in the summer months of July and August. This pattern is generally, the same across the state.

Interconnection and Utility Payments

What is "net metering" ("net billing") and how does it work?

Net metering or net billing is a term applied to laws and programs under which a utility allows the meter of a customer with a residential power system (such as a small wind turbine) to turn backward, thereby in effect allowing the customer to deliver any excess electricity he produces to the utility and be credited on a one-for-one basis against any electricity the utility supplies to him. OPPD does not allow net metering.

How much will OPPD pay for the output from a wind turbine generator?

OPPD will pay for the output under Rate Schedule 355, Electric Energy Purchased from Cogenerating and Small Power Production Facilities for facilities of less than 1 MW (1000 kW) of generating capability. This rate is based on OPPD's avoided costs and is available to all consumers who have qualified generation facilities and have the appropriate metering to measure the delivery of the energy to OPPD. OPPD Rate Schedule 355 can be found at: http://ww1.oppd.com/acctsvcs/rates/energypurchase/index.cfm

For facilities of 1 MW or greater, OPPD will negotiate a purchase price with the consumer based on the facility size and projected generation.

Will OPPD allow non-utility generators to connect a wind turbine generator to the OPPD system?

Yes, federal law (PURPA) requires that all utilities allow consumer-owned generations to interconnect with the grid. The consumer must enter into a written agreement with OPPD concerning the connection between OPPD's system and the consumer's facility. Please refer to Section D-8 of OPPD's Service Regulations which can be found at:
http://ww1.oppd.com/acctsvcs/rates/index.cfm

The consumer must also comply with OPPD's Distributed Generation Manual if the consumer will export to the grid (closed transition). Connections to the transmission system (69 kV and above) are also regulated by a Facility Connection Guide.

How large can a privately owned wind turbine/farm in the OPPD service area be?

There is no practical limit. As the wind turbine/farm increases in size, additional transmission investments may be necessary.

Can wind turbines be used for stand-alone of back-up generation?

Induction generators which are commonly used in wind turbines are not normally self-excited and will not operate without reactive support from an electrical connection, such as the utility grid. Therefore, it may not be possible to use them for stand-alone or back-up generation.

Who do I contact at OPPD if I want to connect a generator to OPPD's grid?

For general assistance in planning such installations, please telephone Customer Sales and Services Division at 402- 552 - 4935, or OPPD's area office.

Land Use and Environmental Issues

How many turbines can be put on a section of land?

Developers must evaluate many factors to determine how many turbines will be placed on a given section of land. In general, up to twelve 750-kW turbines or six 1.5-MW turbines can be placed on a section of land. Spacing between turbines is usually 5 to 10 rotor diameters to avoid interference with each other.

How much are landowners typically paid for each large wind turbine on their land?

Landowners are typically paid $2,000 to $3,000 per wind turbine per year.

Are wind turbines dangerous to birds?

Birds have been killed by wind turbines, as they do with other tall structures. Statistically, a sliding glass door is a greater thereat to birds than a small unlighted wind turbine. Areas that have threatened or endangered bird species should be avoided.

Are wind turbines ugly?

Given the relatively large land requirements for a large-scale wind energy facility, there is the possibility that in certain areas, some members of the public may find such a facility un-aesthetic and oppose it for that reason. The visibility impact will depend on the height, topography, and direction. Each wind turbine actually has a relatively small "footprint", they are comparable to utility poles, water towers, cellular phone towers, or satellite dishes.

Are wind turbines noisy?

Noise drops off sharply with distance. Complaints are rare. Background noise usually masks wind turbine noise. A noise reading taken 25 feet away from a turbine will drop by a factor of four at 50 feet and by a factor of 16 at 1000 feet.

Wind Energy in Nebraska

How many large commercial-scale wind turbines are in commercial operation in Nebraska?

Nebraska has a total of 48 large commercial-scale wind turbines:

LES has two turbines near Lincoln, 660 kW each, 1.32 MW total
OPPD has one turbine near Valley, 660 kW
NPPD has two turbines near Springview, 750 kW each, 1.5 MW total
MEAN has seven turbines near Kimball, 1.5 MW each, 10.5 MW total
NPPD has thirty-six turbines near Ainsworth, 1.65 MW each, 59.4 MW total

How much energy is produced by wind turbines in Nebraska?

83,942,392 kWh of wind energy were produced in Nebraska in 2005. Wind energy production varies widely by location and season. The currently installed wind turbine generators in Nebraska have operated at capacity factors of approximately 20 to 40%.

How reliable are wind turbines?

Modern wind turbines can be extremely reliable — the percentage of time many wind turbines are available to produce power is 98 percent or more. However, wind turbines can occasionally have lengthy and costly repairs. The availability of spare parts, repair personnel, and equipment determine the length of outages.

Wind Turbine Glossary

Anemometer Measures the wind speed and transmits wind speed data to the controller.

Blades Most turbines have two or three blades. Wind blowing over the blades causes them to "lift" and rotate.

Brake A disc brake that can be applied mechanically, electrically or hydraulically to stop the rotor in emergencies.

Controller Starts up the machine at wind speeds of about 8 to 16 miles per hour (mph) and shuts off the machine at about 65 mph. Turbines cannot operate at wind speeds above 65 mph because their generators could overheat.

Gear box Gears connect the low-speed shaft to the high-speed shaft and increase the rotational speeds from about 30 to 60 rotations per minute (rpm) to about 1,200 to 1,500 rpm — the rotational speed required by most generators to produce electricity. The gear box is a costly (and heavy) part of the wind turbine and engineers are exploring "direct-drive" generators that operate at lower rotational speeds and don't need gear boxes.

Generator Usually an off-the-shelf induction generator that produces 60-cycle AC electricity.

High-speed shaft Drives the generator.

Low-speed shaft The rotor turns the low-speed shaft at about 30 to 60 rotations per minute.

Nacelle The rotor attaches to the nacelle, which sits atop the tower and includes the gear box, low- and high-speed shafts, generator, controller and brake. A cover protects the components inside the nacelle. Some nacelles are large enough for a technician to stand inside while working.

Pitch Blades are turned, or pitched, out of the wind to keep the rotor from turning in winds that are too high or too low to produce electricity.

Rotor The blades and the hub together are called the rotor.

Tower Towers can be made from tubular steel or steel lattice. Because wind speed increases with height, taller towers enable turbines to capture more energy and generate more electricity.

Wind direction "Upwind" turbines are designed to operate facing into the wind. Other turbines are designed to run "downwind," facing away from the wind.

Wind vane Measures wind direction and communicates with the yaw drive to orient the turbine properly with respect to the wind.

Yaw drive Keeps the rotor of upwind turbines facing into the wind as the wind direction changes. Downwind turbines don't require a yaw drive because the wind blows the rotor downwind.

Yaw motor Powers the yaw drive.

Source: U.S. Department of Energy