

Non-Residential Wind Site Assessment Report



Prepared for:

XXXXXX
123456th Street
New Richmond, WI 54017

Site Visit: 04/18/11

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Client and Site Information:

<i>Client Name</i> XXXXXX		<i>Date of Site Visit</i> 04/18/11		<i>Date of Report</i> 04/19/11		
<i>Site Location</i> 123456th Street		<i>City</i> New Richmond		<i>State</i> WI	<i>Zip</i> 54017	
<i>County</i> Polk		<i>Municipality</i> Town of Farmington				
<i>Email</i>		<i>Phone</i>		<i>Cell</i>		
<i>Electric Utility</i> Polk Burnett Elec. Co-op.	<i>Phase</i> 3 Phase And Single Phase	<i>Annual Energy Usage</i> 39,500 kWh (3ph) 70,758 kWh (1ph)	<i>Energy Usage Rate</i> \$0.14/kWh (3ph) \$0.12/kWh (1ph)			
<i>Service Amperage and Location of Service Panel:</i> There are multiple meters that service this property. The farm buildings in the farm yard on the east side of 220th Street have a single phase meter and 200 amp panel. On the west side of 220th Street there is a single phase meter with 600 amp panel for the grain dryer, and 3 phase with a 400 amp panel for the irrigator. All service panels have adequate space for a wind system.						
<i>Acreage of Property</i> 504 acres	<i>Latitude:</i> 45.2294	<i>Longitude:</i> -92.6135	<i>Customer Indicated Soil Type</i> Chetek sandy loam			
<i>Distance/Direction from Airport Name</i> Approximately 6.5 miles northwest of the New Richmond Municipal Airport						
<i>Technology</i> <i>Wind</i> <i>PV</i> <i>SDHW</i>		<i>Reason for Investigating Renewables</i> <i>Reduce Cost</i> <i>Clean Energy</i> <i>Other</i>			<i>Maintenance</i> <i>Self</i> <i>Contract</i> <i>Both</i>	
<i>Installation Timeline</i> As soon as possible		<i>Wind Speed at 60m</i> 6.10 m/s 13.7 mph				

Executive Summary

This report explores a range of single and three phase small wind systems ranging from 11kW to 100kW that can be installed at Mr. XXXXXX's farm, for the purpose of offsetting the electrical consumption of the farm, curbing cost of inflation for energy consumption, and doing their part to be more self sufficient. Mr. XXXXXX feels this location is open and has a good wind resource, especially atop a small knoll on the property that will lend itself well for a favorable output from small wind system.

In order to get a better understanding of the terminology and information provided in this Wind Site Assessment Report, please read the accompanying document entitled **Wind Supplement**. The Wind Supplement will provide the background information needed to understand how the site assessor made determinations for the possible wind system locations, tower heights, wind speeds, energy outputs and costs.

Wind System Location Options:

Site 1 Location At the top of a small knoll west of the grain dryer and grain bins, at the edge of an irrigated field.			Wire run Distance 600 ft	Elevation 1060 ft
Wind Shear Factor <i>a</i> .27	Recommended Tower Height 100' up to 20kW, 120' over 20kW	Wind Speed at Hub Height 10.4 mph at 100' & 11.0 mph at 120'	Turbulence Intensity Factor 15%	
Preferred Tower Type Freestanding or Monopole Tower				

Wind System Options:

Range of Tower Heights	100' – 140'
Range of Wind Systems	11kW – 100kW
Range of Annual Output	29,500 – 136,754 kWh
Range of Costs Before Incentives	\$130,000 - \$550,000

Specific Concerns:

Airport Proximity*	The property is approximately 6.5 miles southeast of the New Richmond Municipal Airport which is greater than the 4 mile distance that typically requires an FAA application so there should be no need to file an application with the FAA.
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*An airport with a runway of at least 3200 feet within 4 miles of the client's location or an airport with a runway less than 3200 feet within 2 miles of the client's location would require an FAA application and possible height restriction for a small wind system. The client is not located within 4 miles of any public airport; therefore no FAA application is required for this location, but it would be appropriate for the client to send a letter of notification to the following airports (public and private) and landing strips:

- New Richmond Municipal Airport (public), about 6.5 miles southeast of the client
- L O Simenstad Municipal Airport (public), about 6.75 miles northwest of the client
- St. Croix Valley Airport (private), about 2.5 miles north of the client
- Danielson Landing Field (private), about 3.75 miles southeast of the client
- A landing strip 1 mile SW of Star Prairie (private), about 4 miles southeast of the client
- Irlbeck Airport (private), about 9.5 miles southwest of the client
- Amery Municipal Airfield (public), about 12 miles northeast of the client
- Flying M Ranch Airport (private), about 14.5 miles south of the client

Purpose of Site Assessments:

The purpose of this assessment is to provide site-specific information on how a wind system would perform at this location, including information on turbine options, minimum tower height, estimated energy production, estimated costs, and financial incentives. Site assessors are required to present unbiased information and may not recommend a specific contractor or product.

Project Overview:

Mr. XXXXXX has been interested in renewable energy systems for quite some time and recently saw a brochure for a small wind system that he thought may be suitable for his farm. The clients feel the incentives available at this time may offer a shorter payback for a small wind system, to make it more feasible for farm use. It is important to the clients to do their part and be self sufficient when it is reasonably possible. Mr. XXXXXX feels his location is suitable for a wind system and is hoping for favorable energy output and payback.

Electrical Load History:

There are 3 meters at the client's farm. One meter with single phase service and a 200 amp panel provides electrical service to all of the buildings on the east side of 220th Street. On the west side of 220th Street there are 2 meters; one with single phase service on a 600 amp panel for the grain dryer and storage bins while the other provides 3 phase service on a 400 amp panel to the irrigator. The client's preference is to connect the wind system to the electrical panel that provides 3 phase service to the irrigator. In 2010, the electrical consumption for the irrigator was 39,500 kWh at a rate of \$0.14/kWh. The electrical consumption for the two single phase meters totaled 70,758 kWh with a lower rate of \$0.12/kWh. The demand is higher in the autumn when the grain dryers are running. The client is involved in crop farming; the main electrical demands for this farm include: motors, fans, elevators, augers, irrigation, and lighting.



3 phase meter & elec. panel near the irrigator.



Single phase meter & elec. panel for grain dryer & bins.

Major loads and Efficiency Recommendations:

The clients mostly use fluorescent lighting throughout the property. Energy for lighting typically accounts for about 10% of the electric bill. ENERGY STAR qualified bulbs use about 75 percent less energy than standard incandescent bulbs and last up to 10 times longer. The savings for using CFLs instead of incandescent bulbs is about \$25-\$30 per bulb for the lifetime of the bulb.

The clients are involved in crop farming, grain drying and storage. Over the past few years the clients have made regular upgrades to the farm buildings. In 2010, they upgraded the electrical service to increase the efficiency of the energy used for grain drying and storage. They are considering further upgrades that include replacing an old shed with a new one twice the size, and expect the upgrades will allow them to have a bigger building without adding to the electrical demand.

The clients do not live in the house on the farm property, but Mr. XXXXXX's parents do. It is important to mention the energy efficiency of the appliances within the home because it does have a small impact on the total energy consumption on the farm. According to the Mr. XXXXXX, the stove and microwave are new, clothes washer & dryer are approximately 5 years old, the water heater is 10 years old, and the refrigerator and dishwasher are about 13 years old. Typically, appliances have a useful life of 8 to 12 years; therefore some of the appliances may be reaching the end of their useful, efficient life. The older appliances can have a significant impact on the electrical demand of the house. Replacing an old refrigerator could save as much as 75% of the electrical usage compared to a new Energy Star refrigerator. For more information on appliance energy rating go to: <http://www.energystar.gov/index.cfm?fuseaction=refrig.calculator>. Water heaters generally only last about 10 years and usually there is little warning that a water heater is going bad before it quits functioning or begins to leak. There are many options available for water heating appliances and the savings will depend on the type, fuel source, and size of unit chosen.

Regardless of the house or the farm, it is important to upgrade electrical components regularly and use Energy Star appliances. These upgrades will increase efficiency, decrease energy consumption and save the clients money on utility costs. **Every dollar invested in reducing energy consumption can save \$3 to \$5 in renewable energy system costs.**

Utility Provider:

The client's electric service provider is Polk Burnett Electric Cooperative. Check with Steve Stroshane at 800-421-0283 to discuss the grid intertie procedures and requirements, insurance issues, and to verify buy-back rates. The net metering cap is 20kW. According to the Mr. XXXXXX, Polk Burnett Electric Cooperative is willing to net meter up to 40kW, but negotiations on avoided cost rates would need to be directed to Dairyland Electric if the windy system is over 50kW.

Property Description:

- The client's property is split by 220th Street. The parcel where the wind system will be installed is approximately 160 acres of mostly open, slightly rolling farm land, on the west side of 220th Street in the Town of Farmington, in Polk County.
 - The client, along with family, owns and farms a total of 504 acres that spans both sides of 220th Street.
 - The main farm yard that includes the storage sheds and client's parent's house is located on the east side of 220th Street.
- The client is interested in installing a small wind system on a small knoll on the west side of 220th Street, west of the grain dryer and storage bins.
- There are a few trees on the property, around the buildings and at the edge of the open fields.
 - The trees common to this area are mostly Oak and Elm with approximate mature heights of 60'.
 - The closest wooded area is approximately 400' northeast of Site 1, is sparsely wooded and has a lower elevation than the knoll where the wind system will be located.
- The elevation of the client's property varies from approximately 1000' to 1080'.
 - Most of the property varies only slightly from 1020' to 1040' but small localized hills have elevations as high as 1080' and lower areas near small ponds dips down to about 1000'.
- Neighboring properties are similar to the client's, with open farm land and rolling terrain.

The following pages show aerial and topographical views of the site.

Property & Acreage:

The clients have a crop farm that spans both sides of 220th Street, in New Richmond, in Polk County. The portion of the client's property on the east side of the 220th Street is in the Township of Alden, whereas the property on the west side is in the Township of Farmington. The client, along with family, farms approximately 504 acres of mostly open, slightly rolling land. A parcel about 160 acres on the west side of 220th includes an irrigated field and a small knoll that the client feels would make a great location to install a wind system. There is 3 phase electrical service near the irrigator and single phase service near the grain dryer and storage bins. The distance from the electrical service at either location to a wind system installed on the knoll would be similar at approximately 600'. There are a few trees in sparsely wooded areas at the edge of the farm fields. Trees common to this area are mostly Oak and Elm with a mature height of approximately 65'. The trees all have a lower elevation than the wind system, if it is placed on the small knoll.

The yellow circular outline indicates a 500' radius around the proposed sites for a wind system



- ★ Indicate potential areas to install a wind system.
- ⚡ Indicates electrical connections available for possible tie-in with the wind system and the main electrical panel.

The picture below is a more detailed view of the farm yard, and a portion of the irrigated field at about the midpoint of the client's property. The client is considering the installation of a wind system on a small knoll at the edge of the irrigated field, west of the farm yard. This elevated location is one of the highest elevations on the property where a wind system would have great access to the wind resource in all directions. The farm structures are more than 500' from the wind system and that includes the electrical service that is approximately 600' from the wind system. The structures around the farm yard include: the farm house, sheds, grain dryer, grain storage bins up to 65' tall and a 50' silo. There are a few Oak and Elm trees in the same area that have mature heights around 65' tall.



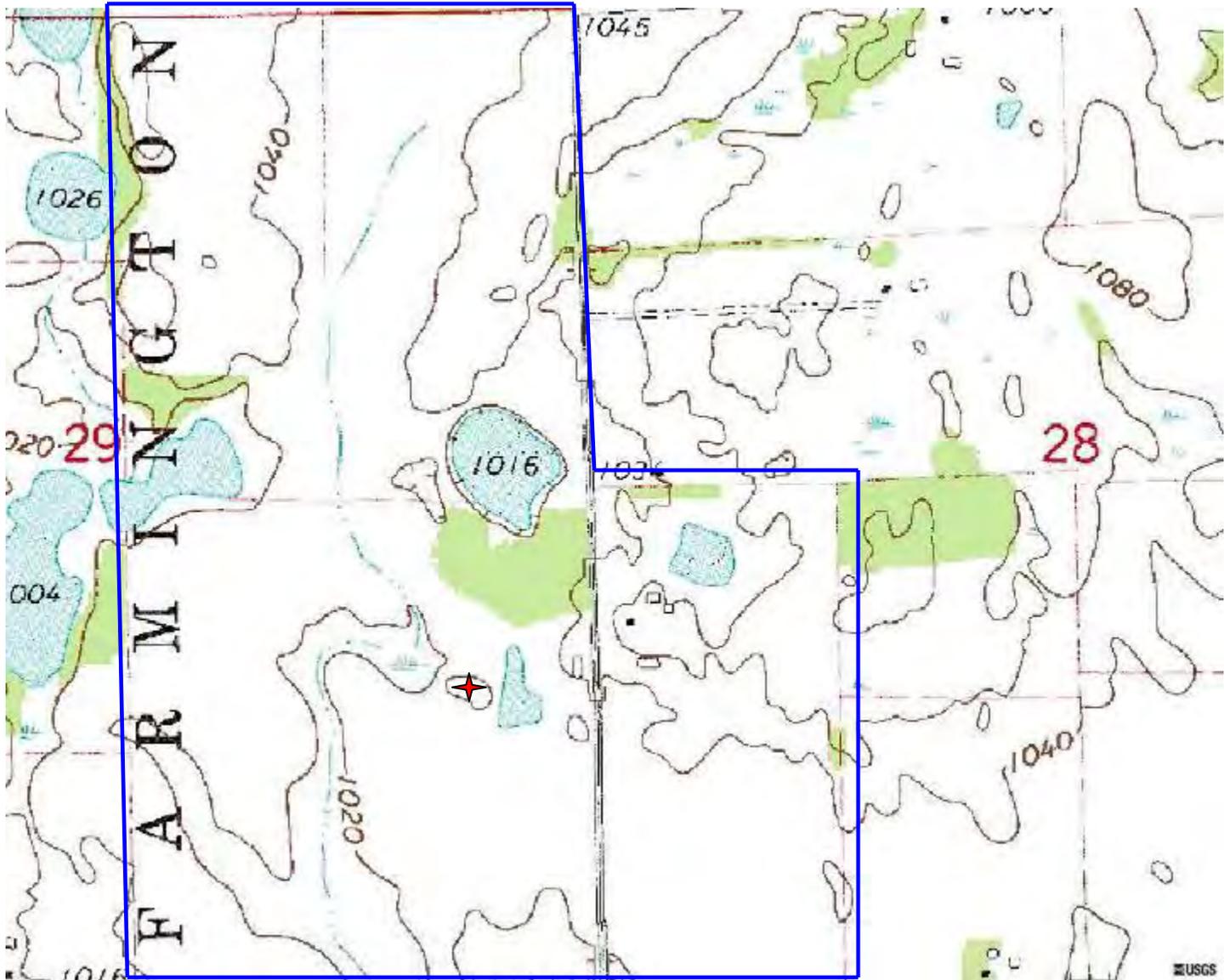
- ★ Indicates potential sites for a wind system
- ⚡ Indicates electrical connections available for possible tie-in with the wind system and the main electrical panel.

The wider view below shows this location is surrounded by open farmland with occasional buildings and trees, similar to that of the client. Many of the wooded areas follow lower elevations where the ground is too wet for cultivating. There is a sparsely wooded area about 400' northeast of the wind system site. The closest significant wooded area is a minimum of 2000' northwest of the site chosen for a wind system, thereby allowing a wind system great access to the wind resource in all directions with minimal turbulence.

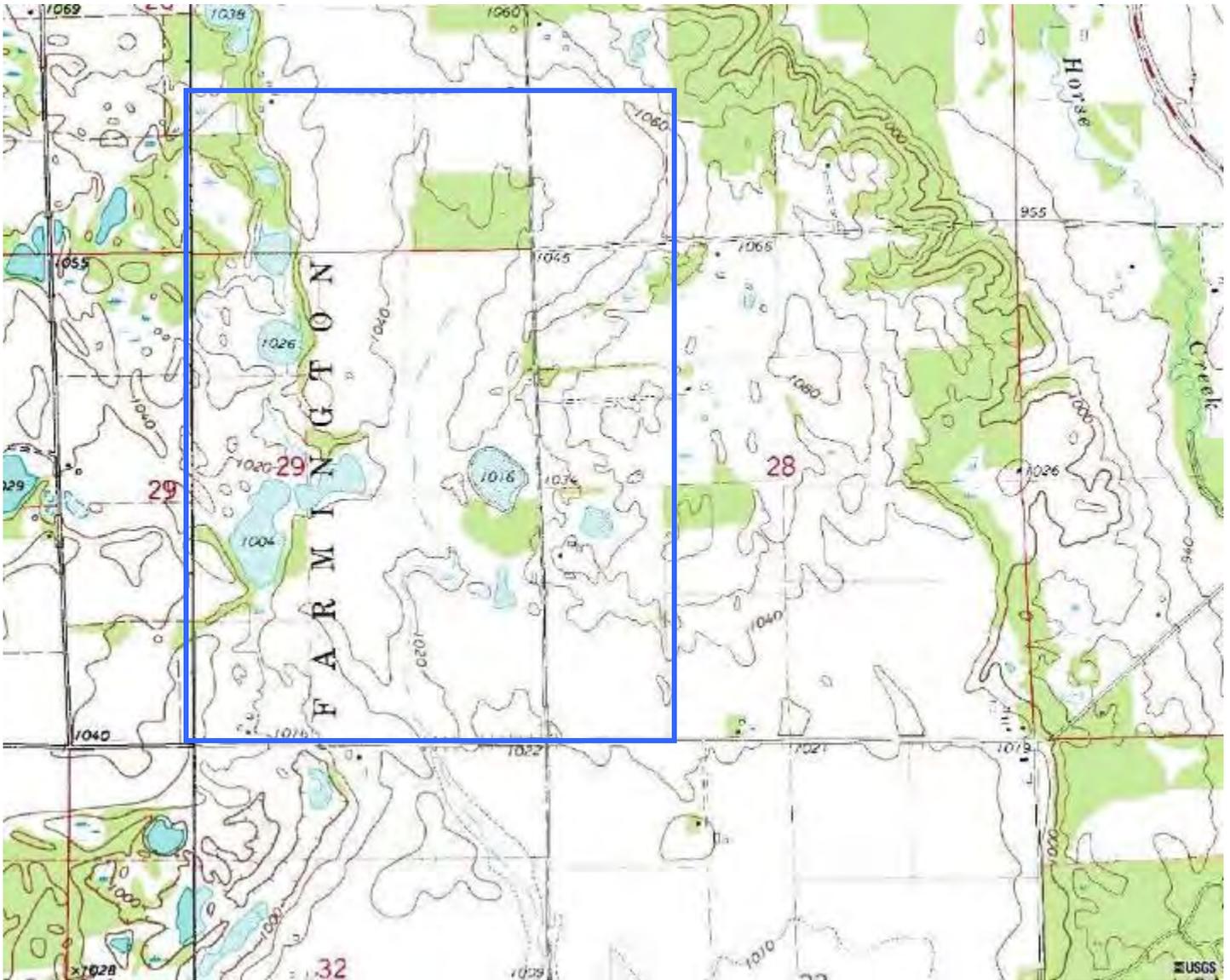


Topography:

The topographical view below indicates the client is in an area of open but rolling terrain where elevations vary from approximately 1000' to 1080'. Most of the land on the client's farm is open and used for growing crops. The site chosen for a wind system is at the edge of an open irrigated field on the west side of the property. The site is on a small knoll the measures approximately 1060'. Most of the land around the knoll is 20' to 40' lower, and dips down to about 1000' near small ponds or marshy areas.

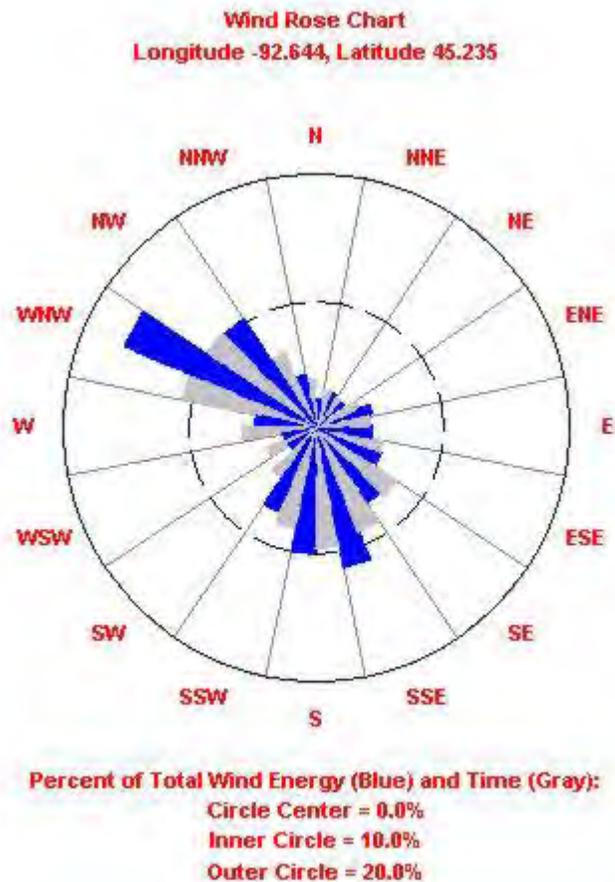


This topographical map indicates the elevation of the general area varies from 1000' to 1080' the same elevation variations found on the client's property. The terrain dips down to about 1000' along a wooded area northeast and east of the client's property and is also lower northwest and west of the client where there are several small ponds and marshy areas.



Prevailing Wind Direction:

The **wind rose** for this site is shown below and it indicates that the predominant winds in this area come from the northwest. For the best turbine performance it is best to capture the winds coming from all directions, but if there are tall obstructions at the site, the wind rose helps to determine where to position the wind system so as to be upwind of these. More information on wind roses and prevailing winds can be found in the Wind Supplement.



Wind System Sites:

Based on the considerations discussed in the Wind Supplement, the site described below would accommodate a wind system on this property. The client prefers the location of Site 1 because it is on a small knoll where the elevation is approximately 20' to 40' higher than its surroundings, thereby giving the wind system great access to the wind resource. In addition, the client would like to connect this wind system to the 3 phase electrical service provided to the irrigator on the field next to Site 1.

Sites 1 – Located on a small knoll on the west side of the client's property, west of the corn dryers and storage bins, at the edge of an irrigated field.

Advantages

- The site is open and has good access to winds from all directions.
- The site is located west of the client's buildings, on a small knoll, at the edge an irrigated farm field. This open location will allow for easy access for delivery, set up, and installation of the wind system.
- The location, at the edge of a large field, on a small knoll, will not interfere with the client's daily activities.
- Elevation at the site is approximately 1060' which is 20' to 40' higher than the land surrounding it.
- The site meets all common setback distance requirements.

Disadvantages

- The wire run is long at an approximate distance of 600'.
 - The rough costs for the wire run can range from \$7 - \$10 per foot. Although some output of a wind system is lost with a long wire run, a larger diameter wire can be used to lessen the output losses.
 - The wire run will be long (575' to 600') regardless of connecting it to the 3 phase service at the irrigator or the single phase service next to the grain dryer.

Photos of Property:



View to the North from Site 1.



View to the Northeast from Site 1.



View to the East from Site 1.



View to the Southeast from Site 1.



View to the South from Site 1.



View to the Southwest from Site 1.



View to the West from Site 1.



View to the Northwest from Site 1.

Minimum Tower Height:

As discussed in the Wind Supplement, minimum tower height is determined based on keeping the bottom of the turbine rotor 30' above the tallest obstruction within 500', or 30' above the prevailing tree height. This 30' rule is a requirement for getting an installation incentive from Focus on Energy. In fact, a minimum hub height of 100' is also a requirement for Focus on Energy funding. Below are the tallest obstructions within this radius that were considered for each site.

Site 1:

Object around Wind system site	Direction	Height of Obstruction (Mature Height if Trees) (ft)	Distance from Tower (ft)	Relative Elevation to Tower Base +/- (ft)	Relative Height of Obstruction (ft)
Grain Dryer & Storage Bins	NE, E	65' tallest	500' or more	-20'	45' tallest
Silo	E	60'	500'	-20'	40'
Scattered Oaks & Maples	N, NE, E	65' tallest	200' or more	-40' to -20'	45' tallest
Wooded areas	NW, N, NE,	65' tallest	400' or more	-40' to -20'	45' tallest

Based on these obstructions and applying the 30' rule, the minimum tower heights are shown in the table below for a variety of wind turbines. In particular, the 65' height of the mature trees less the 20' difference in elevation was used as the baseline for the minimum tower height calculation (45' effective height for the trees). The selection of wind turbines below is considered in the appropriate size range for this site based on interests expressed by the clients. Details on each of these turbines can be found in the Turbine Appendix.

Turbine	Rated Output	Blade Length (ft)	Minimum Tower Height (ft)	Commercially Available Tower Heights
Gaia	11kW	22	97	100', 120'
Endurance G3120	35 kW	31	106	120', 140'
Endurance E3120	50 kW	31	106	120', 140'
Northwind 100	100 kW	34	109	120'

Based on these tower height calculations the minimum tower height recommended for the wind systems listed in this report is a 100' tower for wind systems up to 20kW and a 120' tower for wind systems over 20kW. It is important to note that increasing the tower height increases wind speed, and increases the output of the wind system so a taller tower is recommended whenever it is possible. Also note that Focus incentive amounts are higher for taller towers.

There are several types of towers that can be used for residential and non-residential wind systems. Details of each tower type can be found in the Wind Supplement. Although the area is open, a freestanding or monopole tower is suggested due to the narrow surface area of the knoll the wind system will be installed on. If the client chooses not to install the wind system on the knoll, then it will be the client's preference if he is amiable to guyed wires anchored into the field where the wind system will be located or if he prefers a freestanding tower. An article on towers from Ian Woofenden, titled: [Wind Generator Tower Basics](#) and an article on wind systems

from Mick Sagrillo, titled: [How To Buy An Electric Wind System](#) have been included for more reference information on towers and wind systems.

Wind Speed Estimate:

How well the wind turbine performs is based on the speed and the consistency of the wind intercepted by the turbine; a continuous high-speed wind being the best condition. Once the average annual wind speed at a specific site is determined, it can be used to estimate how a variety of turbines will perform at this site.

The method used to determine the wind speed at a specific site is explained in the Wind Report Supplement. At this site the wind shear factor was estimated to be 0.27 based on the open fields that surround this site. The following image shows the wind map for this site at **60m**. Based on the wind map, the average annual wind speed at this site is estimated to be 13.7 mph at the reference height of 60m. Note that a 12.5 mph wind speed at 60m is required to qualify for Focus on Energy incentives.



Wind Map at 60m.

Hub Height	Wind Speed mph
100'	11.4
120'	12.0
140'	12.5

These wind speeds are good and should allow any wind system in this report the ability to operate at its designed efficiencies.

Energy Outputs:

The wind speed(s) calculated above are used to determine the expected power output of wind turbines at this site at various tower heights.

The estimated energy outputs are shown in the table below for the turbines appropriate for this site. Details on these turbines can be found in the Turbine Appendix. The explanation of this table and what factors are taken into account to compute these outputs can be found in the Wind Report Supplement.

The turbulence intensity has been set at 15% to account for the open fields surrounding the wind system site.

The estimated energy outputs for this location are calculated using the **7th Generation Wind Turbine Calculator v. 11.16** which is an Excel spreadsheet developed by Seventh Generation Energy Systems, and is shown in the table below.

SITE INPUTS		Project Name			
Annual Energy Use (kWh/yr) =	110,258		Wind Shear Exp. =	0.27	per site assessment
Site Wind Speed from Map (mph) =	13.7	from wind map	Weibull K =	2.35	assume k = 2
Map Wind Speed Height (60m)	60	from wind map	Turbulence Intensity =	15%	per site assessment
Recommended Tower Height (ft) =	100-140	per site assessment			
Site Altitude (ft) =	1060	from topo map			

SPECIFICATIONS					
Manufacturer	Gaia	Endurance	Endurance	Endurance	Northwind
Model		G3120	E3120	E3120	100
Nameplate Capacity (kW)	11.0	35.0	50.0	50.0	100.0
Turbine capacity at 11 m/s (kW)	13.9	35.2	50.6	55.4	80.7
Output Voltage (V)	415	240	480	480	480
Phase	3	1	1	3	3
Rotor Diameter (ft)	42.6	63.0	63.0	63.0	68.9
Tower Height (ft)	120	120	120	120	120
Total Structure Height AGL (ft)	141	151	151	151	154
Wind Speed at Hub Height (mph)	12.0	12.0	12.0	12.0	12.0
Annual Energy Output (kWh)	29,500	86,792	100,040	110,627	136,754
Monthly Energy Output (kWh)	2458	7233	8337	9219	11,396
Wind Percent of Facility Energy Use	26.8%	78.7%	90.7%	100.3%	124.0%
Excess Energy	0	0	0	369	26,496
Tower Height (ft)	n/a	140	140	140	n/a
Total Structure Height AGL (ft)		171	171	171	
Wind Speed at Hub Height (mph)		12.5	12.5	12.5	
Annual Energy Output (kWh)		93,987	109,771	121,146	
Monthly Energy Output (kWh)		7832	9148	10,096	
Wind Percent of Facility Energy Use		85.2%	99.6%	109.9%	
Excess Energy		0	0	10,888	

The wind speeds and turbine output values presented here should be taken as estimates, and should not be interpreted as a guarantee of the average wind speed or the average output of a particular wind turbine at this location.

System Costs and Incentives:

A list of the types of incentives that are available is contained in the Wind Report Supplement.

The following tables estimate the installed costs for the wind systems based on the incentives appropriate for the client. The property is suited for a freestanding tower or one with guyed wires. The tables below indicate freestanding towers, but note the cost may be slightly less if a guyed tower is used.

Currently, the client qualifies for Tier 1 incentives from Focus on Energy and may qualify for the Tier 2 incentives based on recent upgrades to the buildings and electrical components on the property. Typically a client can achieve Tier 2 incentives with qualified energy efficiency upgrades to the farm and increase the amount of incentives (up to 25% with a cap of \$100,000) the client is eligible for. It is important to note that Mr. XXXXXX has reached the cap of 25% even with the Tier 1 incentives, with the exception of the Gaia. The tables below indicate the Tier 1 incentive for the installation a wind system.

120' Freestanding Tower unless noted:

Turbine and Tower	Typical Installed Cost ¹	kWh/year	Standard (Tier 1) Focus Incentive	Typical Cost after Focus Incentive	Possible Tax Credit ² 30%	Typical Cost after Incentives	Lifetime \$/kWh ³
Gaia Monopole	\$130,000	29,500	\$13,411	\$113,236	\$39,000	\$77,589	\$0.15
Endurance G3120	\$348,000	86,792	\$87,000	\$261,000	\$104,400	\$156,600	\$0.09
Endurance E3120 single phase	\$348,000	100,040	\$87,000	\$261,000	\$104,400	\$156,600	\$0.08
Endurance E3120 3 phase	\$348,000	110.627	\$87,000	\$261,000	\$104,400	\$156,600	\$0.07
Northwind 100 Monopole	\$550,000	136,754	\$100,000	\$450,000	\$165,000	\$285,000	\$0.10

140' Freestanding Tower unless noted:

Turbine and Tower	Typical Installed Cost ¹	kWh/year	Standard (Tier 1) Focus Incentive	Typical Cost after Focus Incentive	Possible Tax Credit ² 30%	Typical Cost after Incentives	Lifetime \$/kWh ³
Endurance G3120	\$350,000	93,987	\$87,500	\$262,500	\$105,000	\$157,500	\$0.09
Endurance E3120 single phase	\$350,000	109,771	\$87,500	\$262,500	\$105,500	\$157,500	\$0.07
Endurance E3120 3 phase	\$350,000	121,146	\$87,500	\$262,500	\$105,500	\$157,500	\$0.07

1 -These costs and incentives are ball park estimates only; an installer will be able to give actual installation costs. Factors that can affect cost can be found in the Wind Report Supplement

2 -The maximum amount of the tax credit is 30% * (Installed Cost – Focus on Energy Incentive) for residential. Consult an accountant to determine to what extent able to take the full amount of this credit. For a Business, the maximum amount of the tax credit is (30% * Installed Cost), but the Focus on Energy incentive is also taxed.

3- Estimated Lifetime Cost per kWh assuming a 25 year life (Cost after Incentives + (25years * Maintenance cost/year))/ (25 * Annual kWh/yr Output)

The tables above should be used as a guide, and since this is not a financial or legal document the client should seek financial advice from an accountant and legal counsel if necessary before proceeding. In addition the incentives, from Focus on Energy, are based on the two tier incentive program that offers a Standard incentive and an Efficiency First incentive that just launched on 01/01/11. For more information about Focus on Energy incentives go to: www.focusonenergy.com.

The possible incentives available are detailed in the Wind Report Supplement. In addition to the incentives explained in the Wind Report Supplement there are incentives specific to non-residential projects that are described in the Additional Business Incentives Appendix, also included with this report.

For more information on renewable energy incentives go to the following sources:

<http://www.dsireusa.org>

www.awea.org

Summary:

The client has a large, open, and somewhat rolling farm that is mostly used for growing crops. The chosen site for a wind system is located on a small knoll, at the edge of an open irrigated field, west of the farm yard on the west side of 220th Street. There are a few trees with mature heights up to 65', but the small knoll where the wind system will be installed has at least a 20' height advantage over the mature trees. The minimum recommended tower height for this location is 100' for wind systems up to 20kW and 120' for wind systems over 20kW. A taller tower height is recommended for all wind systems, when it is available, to increase wind speed and therefore increase the output of the wind system.

The wind systems in this assessment include wind turbines rated 11kW to 100kW. The wind speed at this location is good with great access to prevailing winds, making this a good location for a wind system. The wind systems in this report generate 29,500 to 136,754 kWh annually which would offset approximately 24% to 124% of the client's total annual electrical consumption. The Endurance E3120 in the 3 phase version and the Northwind 100 both on a 120' tower will meet and exceed the client's electrical consumption, thereby supporting the client's goal of becoming self sufficient in producing enough energy to offset the annual electrical needs of the farm. The excess production of energy will also help offset future increases of energy consumption if the client expands the farming operations.

The client is eligible for incentives from Focus on Energy, possible USDA grants and loan programs, and a tax credit up to 30% of the total installed cost of the system. These incentives make it a good time to take advantage of funding opportunities for renewable energy projects.

Consult the Next Steps section in the Wind Report Supplement if interested in proceeding with a wind system installation.

Here is a checklist of things that have been addressed in the report:

Airport Proximity	Nearest airport is more than 4 miles away, the client should not need to file any applications with the FAA.
Tower Height Zoning	No limitations known for systems less than 200'.
Setback Distance from Property Lines	The site meets setback distance requirements.
Setback Distance from Utility Lines	The wind system sites are a sufficient distance from utility lines.
Soil Type	Soil is mostly sandy loam, there should be no issue with digging.
Space Availability for Mounting BOS	There is plenty of space to accommodate the BOS.
Present Electric Service Adequacy	The current electrical service is adequate for this project.
Wire Run Distance	The wire run of 600' is long; the client may need to use a larger diameter wire to compensate for the loss of energy in a long wire run.
Accessibility for Concrete Truck	The property is open with easy access for the concrete truck to reach the wind system site.
Accessibility for Crane	Parcel is open with easy access for the crane to reach the wind system site.
Interference with Underground Services	The sites should not interfere with any underground services.
Land Use	The site is open but a freestanding or monopole tower is suggested if the wind system is installed on the small knoll; otherwise the client could chose a tower with guyed wires in a more open and level area.
Aesthetics of System	A wind system should fit into the aesthetics of the location.
Proximity to Neighbors	The site allows plenty of space from the site to the neighbors.

Wind Turbine Appendix

Wind Turbines <= 20kW Name Plate Rating All are single phase unless indicated

Sky Stream 3.7

- **1.8kW** Rating at **11 m/s** (24.6mph) - Name Plate rating 2.4kW
- Southwest Windpower Flagstaff, Arizona
- Rotor Diameter 12'
- Downwind – No Tail
- 170 lbs
- Unique curved blade design.
- 5 year limited warranty
- http://www.windenergy.com/index_wind.htm

Proven 7, 11, 35

- **2.2 kW, 6.0kW, and 14.8kW** Rating at **11 m/s** (24.6mph) - Name Plate ratings are 2.5kW, 6.0kW, 15.0kW
- Proven East Kilbride Scotland, UK
- Rotor Diameter 11', 18', 30'
- Downwind Turbine – no tail
- 420lbs, 1320lbs, and 2420lbs
- Mechanical Brake
- Hinged blade design automatically adjusts to varying wind speeds (auto governing)
- 5 year limited warranty
- *The 35 model has limited availability and a long lead time; discuss with installer*
- <http://www.provenenergy.co.uk>

Endurance S-343

- **5.2kW** Rating at 11 m/s (24.6mph). Name Plate Rating 5 kW
- 343ft² swept area
- **Endurance Wind Power** - British Columbia, Canada. Engineering/Manufacturing in Spanish Fork, Utah.
- Upwind with tail
- Rotor Diameter 21'
- Use an induction generator, so the energy output is “grid-ready”; this means that no inverter is needed.
- Fault safe dual redundant braking system on rotor shaft
- Inline helical 9:1 gear box
- 660lbs
- 5 year limited warranty
- <http://www.endurancewindpower.com/>

Scirocco

- **5.7 kW** Rating at 11 m/s (24.6mph) Name Plate Rating 6 kW
- Eoltech, France
- Upwind turbine – has tail
- **2 blade** machine
- 450lbs
- Rotor Diameter 18.4'
- Centrifugal Pitch governor
- 5 years warranty
- Expensive because of the exchange rate of the Euro.
- http://www.eoltec.com/English/Main_en.htm

Aerostar 6 Meter

- **7.5 kW** Rating at 11 m/s (24.6mph) Name Plate Rating 10 kW
- Aerostar, Inc., Westport Point, Mass.
- Downwind turbine
- 2 Blade Machine
- 650 lbs.
- Rotor Diameter 22'
- Aerodynamic Tip Brakes, Failsafe Brake
- Induction Machine
- 2 years warranty standard, 5 year extended warranty option
- <http://www.aerostarwind.com>

Bergey Excel-S

- **8.0 kW** Rating at 11 m/s (24.6mph) Nameplate rating 10 KW
- **Bergey Windpower Company** Norman, Oklahoma
- Upwind system with tail
- 1200lbs
- Rotor diameter 23'
- Side facing governing/furling system
- Mechanical crank out tail shut down mechanism.
- 10 year warranty.
- <http://www.bergey.com/>

Venterra VT10

- **7.1 kW** Rating at 11m/s (24.6mph) Name plate rating 10 kW
- **VENTERA Energy Corporation** Duluth, MN
- Downwind system with no tail.
- 500 lbs
- Rotor diameter 22'
- Blade pitch governing system
- Warranty period is 5 years.
- <http://www.venteraenergy.com/index.htm>

Xzeres ARE 110 & 442

- **2.5kW and 10.3kW** Rating at 11m/s (24.6mph) Name plate rating 2.5kW and 10kW turbines
- **Xzeres Wind, Wilsonville, Oregon**
- Upwind system with tail
- 315 lbs and 1,350lbs
- Rotor diameter 11.8' and 23.6'
- Swept Area 110ft² and 442 ft²
- Side facing governing/ furling system
- Dynamic brake shut down mechanism
- *May have availability issues and long lead time, discuss with installer*
- Warranty period is 5 years.
- <http://www.xzeres.com/index.php>

Jacobs 31-20

- **17.0 kW** Rating at 11m/s (24.6mph) Name Plate Rating 20 kW
- **Wind Turbine Industries** Prior Lake, Minnesota
- Upwind turbine with tail
- 2500lbs - medium duty turbine.
- Rotor diameter 31'
- Offset Hypoid Gear Drive 1:6.1
- Blade pitch governing/ furling system.
- Mechanical disc brake shut down mechanism.
- The system requires more maintenance than turbines without a gear box.
- 1 year warranty with an extended 5 year warranty available.
- Only available with a free-standing tower from WTIC due to it's weight.
- <http://www.windturbine.net/>

Gaia 133-11 kW

- **13.9kW** Rating at 11m/s Name Plate Rating 11.0 kW
- **2 blade** machine
- **Gaia-Wind** Glasgow, United Kingdom
- **Requires 3 phase power** – not usually found at a residence
- Rotor diameter 42.6'
- Gear Box 18:1
- 1980 lbs - heavy duty residential turbine
- Uses an asynchronous generator and so the energy output is “grid-ready”; no inverter needed
- 3 level shutdown – 1:passive stall, 2 mechanical break, 3:centrifugal tip breaks
- <http://www.gaia-wind.com>

Provisional Turbines:

Renewegy VP-20

- **11.2kW** Rating at 11m/s Name plate rating 20kW
- 3 Blade upwind machine
- **Renewegy – Oshkosh, WI**
- Rotor Diameter 31' swept area 747ft²
- Gear Box - Single Planetary Ratio: 6.00:1
- 100 foot hydraulic monopole tower (the only tower option).
- **Requires 3 phase power** – not usually found at a residence
- 480 volt **three phase** induction generator
- <http://www.renewegy.com>

Turbine Photos



Sky Stream 3.7 1.8kW



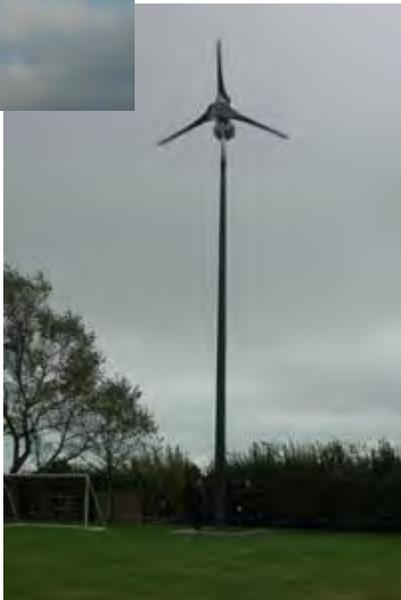
Xzeres ARE 110 2.5kW



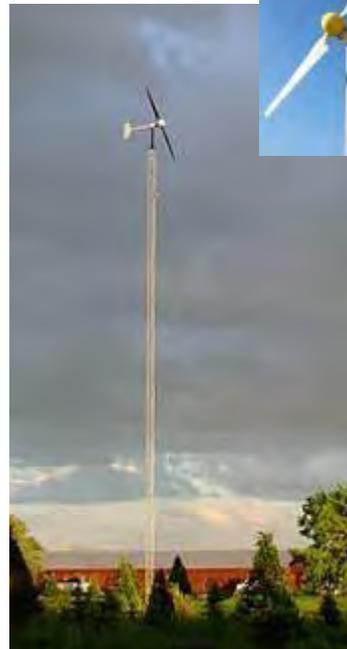
Proven 7 2.5 kW



Endurance 343 5kW



Proven 11 6kW



Eoltec Scirocco 6kW



Aerostar 6 Meter 10kW



Ventura 10kW



Bergey XL-S 10kW



Xzeres ARE 442 10kW



Proven 35 15kW



Renewegy 20kW



Jacobs 31-20 20kW



Wind Turbine Appendix

Wind Turbines over 20kW to 100kW Name Plate Rating

EMS (Vestas) V15-35

- **33.6 kW** or **35.4 kW** Rating at 11 m/s (24.6mph) for single or 3 phase respectively. Name Plate Rating 35 kW
- **Energy Maintenance Service**, LLC, South Dakota, Remanufactured Vestas turbines.
- 1/3 phase 240V/480V
- Upwind turbine
- Rotor Diameter 50'
- 13,780 lbs.
- Induction generator, so the energy output is “grid-ready”; this means that no inverter is needed.
- Offered on 110' freestanding lattice tower standard
- Preventative maintenance would need to be handled by a trained technician once a year
- 1 year limited warranty with an extended warranty available
- **Limited Availability**

<http://www.energym.com>

Halus (Vestas) V17-90

- **63.7 kW** Rating at 11 m/s (24.6mph). Name Plate Rating 90 kW
- **Halus** Power Systems in Hayward, CA. Remanufactured Vestas turbines.
- 3 phase 480V
- Upwind turbine
- Rotor Diameter 56'
- 14,065 lbs.
- Induction generator, so the energy output is “grid-ready”; this means that no inverter is needed.
- Offered on 132' freestanding lattice tower standard, although Halus has extended options.
- Preventative maintenance would need to be handled by a trained technician once a year
- 1 year limited warranty with an extended warranty available
- Offers turbines up to 500kW.

www.halus.com

Endurance G3120

- **35.2** Rating at 11 m/s (24.6mph). Name Plate Rating 35 kW
- **Endurance Wind Power** - British Columbia, Canada. Engineering/Manufacturing in Spanish Fork, Utah.
- **Single Phase only**
- Downwind turbine
- Rotor Diameter 63'
- 9,105 lbs
- Induction generator, so the energy output is “grid-ready”; this means that no inverter is needed.
- Offered on 120' and 140' freestanding lattice or monopole towers
- Preventative maintenance would need to be handled by a trained technician once a year
- 5 year limited warranty

<http://www.endurancewindpower.com/>

Endurance E3120

- **50.6kW** and **55.4kW** Rating at 11 m/s (24.6mph) on single and three phase machines respectively. Name Plate Rating on both 50 kW
- **Endurance Wind Power** - British Columbia, Canada. Engineering/Manufacturing in Spanish Fork, Utah.
- **3 phase [Single Phase may be available in future]**
- Downwind turbine
- Rotor Diameter 63'
- 9,105 lbs single phase, 8,800 lbs three phase
- Induction generator, so the energy output is “grid-ready”; this means that no inverter is needed. Single phase 240V, 3 phase 480V
- Offered on 120' and 140' freestanding lattice or monopole towers
- Preventative maintenance would need to be handled by a trained technician once a year
- 5 year limited warranty

<http://www.endurancewindpower.com/>

Northwind 100

- **80.7 kW** Rating at 11 m/s (24.6mph). Name Plate Rating 100 kW
- Northern Power in Barre, VT.
- 3 phase 480V
- Upwind
- Rotor diameter of 69'
- 16,000 lbs.
- Offered on a 121' **Monopole** tower that is climbed from the inside and comes with a fall restraint.
- Direct Drive, no gearbox
- Permanent Magnet Generator
- Preventative maintenance would need to be handled by a trained technician once a year.
- 2 years with a 5 year optional warranty.

www.northernpower.com

Turbine Photos



Endurance E3120 & G3120
photo from Endurance
Also available on monopole



Northwind 100, *photo from*
Northern Power



Vestas V-15 at LTC
Cleveland, WI
Vestas V-17 has 6'
longer blade diameter.
Photo – LTC website

Additional Business Incentives Appendix

For Business clients there are additional incentives available for small wind systems.

Summary:

1. Federal Tax Credit

- a. For Businesses the Federal Investment Tax credit is 30% of the Installed Cost of the wind system, versus 30% of (Installed Cost – Focus on Energy incentive) for residential clients. This is because businesses pay taxes on the Focus on Energy incentive.
- b. Also, businesses can apply to the US Treasury Department to get an up-front grant **instead of** the tax credit. Note that if also receiving a USDA grant, this is may not be an option [depends on timing of grants. If applied for in different years, may be possible].

2. Tax Depreciation

- a. Businesses can tax advantage of tax depreciation on the wind system to further reduce the cost of the wind system.¹

3. USDA Grant

- a. The USDA has grants available for up to 25% of the installed cost of a wind system (<= 100kW) for qualified applicants. Also, loan programs are available.

Below are the details of these incentives:

1) Federal Tax Credit

A. Investment Tax Credit (ITC)¹

The credit is equal to 30% of expenditures, with no maximum credit for small wind turbines placed in service after December 31, 2008. Eligible small wind property includes wind turbines up to 100 kW in capacity. Credits are available for eligible systems placed in service on or before December 31, 2016.

B. Coordination with Renewable Energy Grants (Section 1104):

Business taxpayers eligible for the business ITC can apply to receive a [grant](#) from the U.S. Treasury Department **instead of** taking the business ITC for new installations for property placed in service in 2009 or 2010. In some cases, if construction begins in 2009 or 2010, the grant can be claimed for energy investment credit property placed in service through 2016, and for qualified renewable energy facilities, the grant is 30 percent of the investment in the facility and the property must be placed in service before 2014 (2013 for wind facilities). Applicants interested in receiving payments under Section 1603 may submit an application on-line by going to www.treasury.gov/recovery. Applications may only be submitted after the property to which the application relates is placed in service, or is under construction. A completed application will include the signed and complete application form; supporting documentation; signed Terms and Conditions; and complete payment information. All applications must be received before the statutory deadline of October 1, 2011. Applications will be reviewed and payments made within 60 days from the later of the date of the complete application or the date the property is placed in service.

¹ http://dsireusa.org/incentives/incentive.cfm?Incentive_Code=US02F&re=1&ee=0

3) Modified Accelerated Cost-Recovery System (MACRS)

Under the federal Modified Accelerated Cost-Recovery System (MACRS), businesses may recover investments in certain property through depreciation deductions. The MACRS establishes a set of class lives for various types of property, ranging from three to 50 years, over which the property may be depreciated.²

Depreciation Schedule Options for wind equipment

1. 100% year one depreciation, using section 176 depreciation, limited to \$250,000 in 2008
2. Standard five year accelerated depreciation

Basis for Depreciation

What is the amount of the project cost that tax depreciation can be applied to?

Installed cost – ½ fed tax credit – Non-taxed Grants

Note that both the Focus on Energy grant and the USDA grant are taxable.

Determining Depreciation amount per year

Based on depreciation schedule:

Year	1	2	3	4	5	6
5 year schedule	20.00%	32.00%	19.20%	11.52%	11.52%	5.76%

Depreciation amount per year

= ((Fed. Tax Rate + State Tax Rate) * Depreciation % for Year(Y)) * Basis for Depreciation

For more information on the federal MACRS, see *IRS Publication 946, IRS Form 4562: Depreciation and Amortization*, and *Instructions for Form 4562*.

² http://dsireusa.org/incentives/incentive.cfm?Incentive_Code=US06F&re=1&ee=0

3) Rural Energy for America Program's (REAP)

REAP provides grants and loan guarantees to agricultural producers and rural small businesses to help purchase renewable energy systems, make energy efficiency improvements and perform renewable energy feasibility studies. It also funds an energy audit and technical assistance program to serve agricultural producers and rural small businesses.

A. Who is Eligible?

Eligible applicants must be either an agricultural producer or a small business. If client is an agricultural producer, then 50% or more of client's income must be from the farm. Small business can be a sole proprietor. This program excludes residential purposes. For businesses or farms applying for this grant the home must be separately metered from the farm or business and the wind system will need to be connected to the farm or business meter.

The definition of "small business" is based on the Small Business Administration's criteria based on the type of business. To determine if your business qualifies, see:

<http://www.sba.gov/services/contractingopportunities/sizestandardsttopics/indexguide/index.html>

"Rural" means a community of fewer than 50,000 people not located within a larger metropolitan area. To determine whether a potential project is in a rural area, use the [rural area determination map](#).

<http://eligibility.sc.egov.usda.gov/eligibility/welcomeAction.do>

B. How the Process Works

Incentives are awarded on a point system (see points scoring sheet handout)

Projects are then scored and ranked based on several criteria. **These are modified in 2009** and include:

1. quantity of energy replaced, produced or saved,
2. environmental benefits,
3. commercial availability of equipment or systems,
4. technical merit of project,
5. project readiness,
6. bonus points for being a small agricultural producer or very small business,
7. use of the simplified application for small projects,
8. the energy efficiency of a proposed renewable energy system (added in 2009)
9. bonus points for requesting a grant of \$20,000 or less (added in 2009)
10. receipt of previous REAP awards and
11. return on investment

See the **Rural Energy for America Program's (REAP) Details** document included with the report if applicable.

Rural Energy for America Program's (REAP) Details

1. What are the incentive options? The USDA Rural Development program offers:

o Grants.

- Grants are awarded up to 25% of the project cost up.
- The minimum grant amount is \$2,500 and the maximum grant amount is \$500,000. No person or entity can receive more than \$750,000 from multiple projects in any one year.
- The remaining 75% must come from non-federal sources including loans, investors, your own assets or any available state or local grants.
- Cannot get the federal grant in lieu of the investment tax credit as if getting the USDA grant.
- Can still take the 30% tax credit.
- The grants are competitive. Be ready to go as early as possible with t's crossed and i's dotted.
- Grants for under \$20,000 have a simplified application and have priority over larger grant requests (was new in 2009)
- Should be filled out as early as possible and will be accepted at anytime, so that as soon as the deadline arrives the application is ready to go.
- Have lowest priority (after loan only and grant/loan combos) and can only be submitted after deadline - generally in summer (this year, July 31)

o Guaranteed Loans. A guaranteed loan protects the lender against a portion of the value of a loan in the event of a default. In essence, USDA Rural Development is guaranteeing repayment of a portion of the client's loan once the client secures a loan from their bank.

- Up to 75% of eligible project cost
- The minimum guaranteed loan is \$5,000 and the maximum loan guarantee is \$25 million. A guaranteed loan can cover up to 75% of eligible project costs and up to 85% of the loan amount for loans under \$600,000, declining to 60% for loans from \$10-25 million.
- Lower interest loans get more points

▪ If the rate of the loan is below the Prime Rate (as published in the Wall Street Journal) plus 1.5 percent, award 5 points. OR
▪ If the rate of the loan below the Prime Rate (as published in the Wall Street Journal) plus 1 percent, award 10 points.

- Loan-only applications have highest priority and can be submitted immediately after Fed USDA announcement is made – generally in spring (this year May 26)
- Can be used with other federally funded incentives.

o Grant/Guaranteed Loan Combos.

- 75% of eligible project cost
- Have second highest priority (after loan only) and can be submitted immediately after Fed USDA announcement is made – generally in spring (this year May 26).

○ Feasibility Studies

- Cannot apply for a feasibility study grant and funding to implement the project, such as a REAP clean energy grant or loan guarantee, in the same year. “Acceptable” feasibility studies address economic, market, technical, financial, and management viability.
- The maximum grant amount is 25% of study cost or \$50,000.
- State feasibility study funding disqualifies an applicant from REAP feasibility study funding.
- http://www.rurdev.usda.gov/ia/rbcs_RE-EE_grants_stand_alone.html
- Elements in an acceptable feasibility study include, but are not necessarily limited to, the following elements:
 - ✓ Executive Summary
 - ✓ Economic Feasibility
 - ✓ Market Feasibility
 - ✓ Technical Feasibility (including the appropriate technical report)
 - ✓ Financial Feasibility
 - ✓ Management Feasibility
 - ✓ Qualifications

2. How to get started?

- a. <http://farmenergy.org>
- b. Most information and forms available at <http://farmenergy.org/tools/tools-and-templates>
- c. Contact Brenda Heinen
Coordinator for the Energy programs
USDA Rural Development
4949 Kirschling Court
Stevens Point, WI 54481
715-345-7615, Ext 139
brenda.heinen@wi.usda.gov

3. When start process and what are the deadlines?

- a. Start as soon as decision made to install a wind system.
- b. Encouraged to get application in early to local USDA Coordinator, Brenda Heinen, to make sure have all forms and information necessary, including environmental study, so that gaps can be addressed prior to the deadline.
- c. Local USDA office will hold onto applications until the federal announcement is made at which time grant and combo assessments can be submitted, or until the deadline at which time the grants will be submitted, so be prepared ahead of time.

4. What kind of documentation is required?

- a. Simplified application for < \$200,000 project cost – small wind(<100kw) and large wind (>100kw)
- b. Full application for >\$200,000 project cost – small (≤100kw) and large (>100kw)
- c. Most information and forms available at <http://farmenergy.org/tools/tools-and-templates>. Lots of federal forms required, many quick and can fill out on-line.
- d. If applying for a renewable energy system with project costs over \$200,000, need to have a business feasibility study performed by an independent consultant.
- e. If plan to sell power back to a utility, also need to provide an Interconnection agreement and a Power Purchase Agreement.
- f. Identify source of matching funds. If they get a 25% grant, they need the remaining 75% identified. If they get a 25% grant and a 50% guaranteed loan from our agency, then they need to identify the other 25% as match.
- g. Technical report – see Template Handout. Installer can help with this.