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energy center

Report

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A Study of Wind Energy Development in Wisconsin

A Collaborative Report

July 1, 2004

ENERGY CENTER
OF WISCONSIN
We show you how

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A Study of Wind Energy Development in Wisconsin

A Collaborative Report

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Seventh Generation Energy Systems, Inc.
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This report is available for download at www.ecw.org.

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EXECUTIVE SUMMARY

There is no question that our overall need for electricity will increase in the future. According to the Energy Information Administration, growth in electricity sales is projected to average 1.8 percent per year between 2002 and 2025.[1] Furthermore, the environmental and political implications of continuing to rely on fossil fuels to provide most of this power make it increasingly clear that alternative energy sources must be more fully developed soon. Coal-fired power plants provide nearly three-quarters of the state's electric supply. Currently, renewable resources make up only about 5 percent of net electricity generation in Wisconsin.

Beyond the established sources of hydropower, wind energy is in the forefront of renewable generation technology, and has begun to establish itself as an economic contender in the industry. At present, 53 megawatts (MW) of utility-scale wind power is on-line in Wisconsin, and several dozen small wind turbines, totaling less than 1 MW, are also connected to the grid. With over 400 MW of utility-scale wind development in the works, Wisconsin is poised to add significant amounts of new wind power and distributed generation capacity in the near future. The position of wind power as a primary new source of clean energy, however, is not unchallenged. As with any new technology, unforeseen impacts have emerged that must be evaluated and addressed.

A Study of Wind Energy Development in Wisconsin is a collaborative report that explores a variety of impacts. It is structured in three parts, with a total of five segments addressing different aspects of wind energy development. These segments include case studies of existing Wisconsin wind farms, an analysis of net metering policies, a model of wind farm layout scenarios with an accompanying economic analysis, and a report and discussion of wind turbine impacts on property values. This report attempts to go beyond the well-trodden ground of environmental impact studies into areas of economic and social impact of wind farm development on rural communities.

Part 1 begins with *Wind Power in Wisconsin: A Development Case Study,* which focuses on the development issues associated with utility-scale wind energy projects in Wisconsin. It provides a critical analysis of the five existing wind farms currently in operation. While the impetus for these projects is similar, the scale and development strategies differ, as did public acceptance of these projects.

This case study explores recent wind development efforts, both successful and unsuccessful, along with the key drivers and issues that shaped recent history. The history portion concludes with a discussion of the critical themes and issues that emerged from the evaluated projects, along with a series of recommendations to improve the siting process in the future.

Finally, the study addresses policy factors that have contributed to the development of wind power in Wisconsin. The policy discussion covers legislation in place during existing wind farm development, as well as recent policy initiatives that further work to create a positive wind development climate. The policy section concludes with recommendations for additional policy and regulatory actions that would further support the construction and operation of additional utility scale wind projects in the state.

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[1] Energy Information Administration, Annual Energy Review 2002, DOE/ EIA-0384(2002) (Washington, DC, October 2003). Projections: Tables A8 and A20.

The second section of Part 1 is *Building the Distributed Wind Generation Market in Wisconsin: The Key Role Cooperative Net Metering and Other Policy Mechanisms Could Play*. This study reviews utility policies and attitudes towards net metering in the state. It also benchmarks emerging international policy models, including new forms of aggregated and cooperative net metering.

The net metering segment concludes with an investigation of utility receptivity to customer-owned renewable energy generation, and the relative advantages and disadvantages of traditional load-based net metering compared to virtual or cooperative net metering models. It presents policy alternatives and recommendations for overcoming current barriers to building a more vigorous distributed wind generation market in Wisconsin which would utilize both residential and commercial-scale wind turbines. As the recent and looming blackouts in Eastern U.S. demonstrate, distributed generation solutions could help increase electric reliability and ease strains on transmission grids.

Part 2 presents the results of two coordinated modeling studies: *Analysis of Wind Farm Layout Schemes for Wisconsin*, and *Wisconsin Wind Plant Economic Impact Analysis.*

For the layout model, an analysis was made to determine the relative installation and maintenance costs for four different types of wind turbine configurations in the landscape. The four different layout schemes are categorized and evaluated for each of five Wisconsin counties: Dodge, Iron, Lafayette, Langlade, and Manitowoc. This selection provides a variety of terrain and conditions, from relatively flat agricultural areas to forested hilly terrain, and from the northern border to the southern border of the state This model demonstrates the cost differences of placing turbines close together versus spacing them out over a larger area.

The *Wisconsin Wind Plant Economic Impact Analysis* model takes data from the layout model and analyzes the economic impacts associated with constructing and operating 30 MW of wind generation in each of the same five Wisconsin counties. The investment and annual expenditure data from the siting analysis was used to estimate the employment, income and output (sales) impacts for both the construction period and ongoing plant operation and maintenance. The findings of the study suggest that plant location, structure of the local economy, diversity of local businesses, availability of a skilled labor force, siting configuration, and share of local spending each play a key role in determining the impacts.

The economic model concludes with projections of other benefits that might stem from the investments and ongoing operations of wind plants in Wisconsin. As the nation moves towards increasing wind generation capabilities, the prospect brightens for significant expansion of wind power equipment manufacturing within Wisconsin. The state's established industrial sector makes it a prime location for such development. The wind power industry can provide Wisconsin with a new environmentally sound industrial base and provide a significant source of jobs and income in the state.

Part 2 comprises the final segment of the report, *Examining Wind Turbine Impact on Local Property Values.* The purpose of this study was to determine whether or not residential properties near wind farms maintain their real estate value. Part of this effort included reviewing studies involving wind turbines and property values that have been done in other parts of the U.S. and abroad to explore how others had approached this and other related questions. The approach this study used to determine the impact on property values was to collect and analyze real estate sales data from before and after the installation of wind farms in Iowa and Kewaunee counties. This approach is similar to that used by the Renewable

Energy Policy Project in its 2003 study entitled The Effect of Wind Development on Local Property Values.

The attempt under this project to statistically analyze real estate sales data in the vicinity of the two Wisconsin wind developments was unsuccessful due to the scarcity of such transactions. However, the effort revealed some important methodological considerations for future attempts in this vein. First, view sheds around wind developments in Wisconsin's rolling and wooded landscape can be highly irregular. Distance to a development is not necessarily a good indicator of whether the development can be seen from a given property, and an actual visual assessment is required. Second, a substantial fraction of property transactions cannot be considered to be arms-length sales (those based exclusively on market value), which would need to be excluded from any analysis that attempts to measure whether wind developments adversely affect property sales.

CONCLUSIONS

Developing sustainable sources of energy for the future requires a broad understanding of these technologies within their working context. This does not simply mean a demonstration of their mechanical integrity, their economic feasibility, or an analysis of their impact on the natural environment, but also attention to how their presence affects existing social and economic structures. For a clean energy technology to be sustainable, it must be acceptable to the majority of people, and particularly to those who live near it.

There are many economic viewpoints involved in the average wind farm development. As indicated in Part 1 of this Study, *Wind Power in Wisconsin: A Development Case Study*, wind farm development in Wisconsin has shown that deeply rural communities, where the local economy is based in agriculture, are more receptive to wind farms because they are perceived as an economic boon. This is particularly true when local government shares in the revenues. On the other hand, for subrural residential housing developments whose economic base is primarily elsewhere, wind farms are often considered a visual blot on the bucolic landscape.

The two modeling studies in this report reveal how economic considerations are woven into wind energy development for developers, host communities, and indeed for the state as a whole. Furthermore, as some of the studies mentioned in the final section have shown, once wind farms are built they frequently become accepted as part of the landscape as do transmission lines and radio towers. As more wind farms are built and they become a familiar sight, general public perceptions may change.

This collaborative report only begins to answer questions about social and economic impacts of wind energy development in Wisconsin. A number of questions have emerged and are suggested for further study.

ECONOMIC STUDIES:

- Beginning with the method used in Part 2, Section B of this report, *Wisconsin Wind Plant Economic Impact Analysis,* study the communities where wind farms have been established to find if employment and business trends have shifted.

- Study the economic impact of wind turbine revenues from existing wind farms on turbine hosts and the local government, noting the extent of property tax relief and additional services for all local residents.
- Study trends in the value of agricultural land in areas with an established wind resource, and whether wind energy development is influencing the amount of land remaining in agriculture.
- Study the trade-off for local governments regarding tax revenues from residential development versus revenues from wind turbines.

SOCIOLOGICAL STUDIES:

- Create a model to explore whether the development of renewable energy (both wind and bioenergy) can slow the erosion of small scale farming.
- Perform more viewshed studies to verify the percentage of homes where the view is impeded, given certain aspects of terrain.
- Characterize stakeholder groups and their needs.
- Develop a database about properties that would allow economic and social trends to be followed.

Part 1

Section A: Wind Power in Wisconsin: A Development Case Study

SEVENTH GENERATION ENERGY SYSTEMS

INTRODUCTION

As early as 1991, renewable energy advocates began the call for wind energy to play an increasing and vital role in Wisconsin's energy future. Most notably, Renew Wisconsin and Wisconsin's Environmental Decade testified in Wisconsin's biennial planning process as to the benefits and feasibility of constructing over 800 MW of wind capacity by 2007.[2]

As a result of several key legislative initiatives and strong consumer demand for green power, Wisconsin today is home to five utility-scale commercial wind projects. There are currently 55 turbines in service for a total installed generation capacity of 53 MW. Moreover, plans to build an additional 314 MW of new wind capacity were announced in 2003, and there are additional projects in the development pipeline. But with 12,511 MW of total installed generation capacity in Wisconsin, wind power still accounts for less than one-half of one percent of the state's power plant inventory. While wind energy provides Wisconsin homes and business with approximately 100,000 megawatt-hours of clean energy each year, it amounts to only 0.15 per cent of all electricity used in the state.[3]

In spite of the many benefits of wind power, the siting and construction of wind turbines has proved to be a difficult and sometimes contentious issue, whether or not the proposal is for a single residential wind turbine or for a utility-scale wind farm.[4] It is reasonable to state that there are no remaining technical barriers to the widespread implementation of wind power in Wisconsin, or anywhere else for that matter.[5] However, the lack of reliable transmission access in some areas of the state remains a barrier to wind power development. This is not a technical barrier, but rather a resource allocation and infrastructure issue that impedes all new generation resources. Indeed, one of the largest impediments to the construction of new wind turbines, regardless of size, is the ability of developers to obtain the necessary local permits.

In the pages that follow, this report will focus on the development issues associated with utility-scale wind energy projects in Wisconsin by providing a critical analysis of the five existing wind farms in operation. While the impetus for these projects is similar, the scale and development strategies differ, as did public acceptance of these projects. Each turbine project is presented and evaluated from several perspectives, namely:

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[2] 1991 Public Service Commission of Wisconsin Advance Plan 6 testimony.

[3] US DOE Energy Information Administration. Data current as of 2002. http://www.eia.doe.gov/cneaf/electricity/st_profiles/wisconsin.pdf

[4] The benefits of wind power, including economic (affordable price stability), security (power supply and fuel diversity), environmental (avoided emissions), and customer satisfaction (green power) are covered in great detail in many other publications, and are beyond the scope of this document.

[5] As shown by the successful worldwide integration of over 32,000 MW of wind capacity.

- Project Description
- Development Drivers
- Development Strategies
- Stakeholder Perspectives
- Lessons Learned
- Potential Remedies

Next, this study covers recent wind development efforts, both successful and unsuccessful, along with the key drivers and issues that shaped recent history. The history portion concludes with a discussion of the critical themes and issues that emerged from the evaluated projects, along with a series of recommendations to improve the siting process in the future.

Finally, the study addresses policy factors that have contributed to the development of wind power in Wisconsin. The policy discussion covers the legislation that was in place when existing wind farms were being developed, as well as recent policy initiatives that further work to create a positive wind development climate. The policy section concludes with recommendations for additional policy and regulatory actions that would further support the construction and operation of additional utility scale wind projects in the state.

WIND DEVELOPMENT SUMMARY

The five existing wind farms in Wisconsin are summarized in Table 1 and their locations are shown on the map in Figure 1 below. Each project will be discussed in detail following the table.

TABLE 1: WIND FARMS IN WISCONSIN

WIND FARM NAME	PROJECT OWNER	NUMBER OF TURBINES	TURBINE TYPE AND RATED CAPACITY	TOTAL INSTALLED CAPACITY	IN-SERVICE DATE	LOCATION COUNTY/TOWNSHIPS
Glenmore	WPS	2	Tacke 600 CEM 600 kW	1.2 MW	Feb 1998	Brown County Town of Glenmore
Rosiere	MGE	17	Vestas V-47 660 kW	11.2 MW	June 1999	Kewaunee County Lincoln and Red River Townships
Lincoln	WPS	14	Vestas V-47 660 kW	9.2 MW	June 1999	Kewaunee County Lincoln Township
Byron	WE	2	Vestas V-47 660 kW	1.32 MW	June 1999	Fond du Lac County Town of Byron
Montfort	FPL	20	GE 1.5 1.5 MW	30 MW	June 2001	Iowa County Eden Township
Total		**55**		**52.98 MW**		

FIGURE 1: WISCONSIN WIND FARM LOCATIONS

WIND PROJECT ASSESSMENT

We performed the assessment of each of the five projects in part by reviewing publicly available information, but most of the information contained in this section is drawn from interviews with the stakeholders who participated in the development process. To the degree possible, we conducted interviews with utilities, wind developers, regulators, landowners and local government officials. Landowner interviews include those who are hosting wind turbines on their property as well as neighboring landowners. We also conducted interviews with citizens and officials who describe themselves as either proponents or opponents of wind power.

We developed interview questions for each stakeholder. The interview questions appear at the end of the case study report. Interviews were conducted in writing, in person and over the phone. Not all respondents were willing or able to answer all questions. Due to the nature of the questions and the responses, this report does not attribute specific quotes or answers to any one individual except as noted.

Interview responses provide a comprehensive overview of the wind development process in Wisconsin and allow identification of common trends and practices that have benefited or hindered the wind industry in the state. A general analysis appears at the end of this section.

GLENMORE

Project Description

The Glenmore project was the first commercial utility-scale wind project in Wisconsin. Two Tacke 600 kW turbines were built in 1997 and commissioned in February 1998 on a farm in the Town of Glenmore near Green Bay. The Tacke turbines are horizontal axis stall-regulated low-speed machines with a 46-meter rotor diameter mounted on 60-meter towers. The project was installed by a consortium of Wisconsin utilities including Wisconsin Public Service Corporation (WPS), Wisconsin Power & Light (Alliant),[6] We Energies (WE) and Madison Gas & Electric (MGE) with the support and participation of the National Renewable Energy Laboratory and the US Department of Energy (DOE) - Electric Power Research Institute (EPRI) Wind Turbine Verification Program. Turbine commissioning was accompanied by a great deal of fanfare and media coverage including a speech by then Governor Tommy Thompson.

The turbines occupy 2.4 acres of agricultural land leased from Michael and Sandra Zirbel. The turbines were installed at a cost of $2.1 million or $1,750 per kW. The site has a reported average wind speed of 13.6 mph.

Development Drivers

The PSCW order from Advance Plan 6 was the primary driver for the Glenmore project. In 1992, the Commission ordered the Eastern Wisconsin Utilities (EWU) to construct one or more state-of-the-art wind turbines, once the Wisconsin Wind Resource Assessment Program (WWRAP), a tall tower wind

[6] Wisconsin Power & Light is now Alliant Energy and will be referred to as Alliant throughout the remainder of this report.

speed monitoring study then in progress, was completed.[7] The EWU formed a consortium that included the US DOE National Renewable Energy Laboratory (NREL) and EPRI, who brought funding and expertise to the project. Their goal was to learn more about how turbines operate in Wisconsin's moderate wind resource environment. WPS has since bought out its Glenmore partners and uses the output of the turbines to supply power to NatureWise, its green power program, which currently has about 1,200 customers.

Development Strategies

The consortium had no preplanned development strategy for the Glenmore project. Rather, they selected the site based primarily on the WWRAP results. They initially considered nineteen sites around the state, later reducing this number to four. Landowners who had assisted with WRAP data collection from a tower site near their property were approached about hosting the two turbines.

WPS took the lead in getting the project permitted. They met initially with town officials without revealing who owned the selected site to protect the landowner's identity in case the town wasn't receptive to the idea. This approach appears to be helpful for avoiding divisiveness in the community in the early stages of the project.

The town of Glenmore issued a five-year conditional use permit (CUP) to WPS for the construction and operation of the turbines.[8] The CUP was renewed without incident in 2003, and will face renewal every five years for the lifetime of the project.

Stakeholder Perspectives

UTILITY

According to the conditional use permit, there is a measurable 50-db sound pressure level limit at the nearest residence. In response to a noise complaint from a nearby neighbor, WPS had noise tests performed by an outside consultant who found that WPS was complying with that permit condition.

WPS is generally pleased with the Glenmore project. The siting process went smoothly and their conditional use permit has been renewed once. The turbines are performing well despite the fact that Tacke went out of business in the middle of the project's development. At this time, WPS has no plans to add more wind capacity to its generation portfolio.

LANDOWNERS

The landowners have been very happy hosting the wind machines and state that their experience working with WPS has been very good. The landowners haven't had any issues or concerns with noise, and are

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[7] PSCW Docket 05-EP-06 Order Point 4.8 issued September 15, 1992.

[8] A local government can grant a conditional use permit to allow special land use activities which may be essential or desirable but that are not authorized under a parcel's current zoning. The CUP allows the proposed activity to occur without having to permanently rezone the parcel. Consideration of a CUP is a discretionary act and if approved, is usually subject to a number of pertinent conditions of approval. Depending on local ordinance requirements, hearings are typically held by a board of zoning, the planning commission, or a zoning administrator. The owners of property near the site are sent advance notice of the date, time, and place of the hearing.

happy with the terms of the 20-year land use lease. The turbines are located about 1,500 feet away from the nearest buildings and about 1,800 feet away from their house.

ADJACENT PROPERTY OWNERS

There is one neighbor approximately 1,000 feet away to the south from the turbines. The neighbor has complained periodically about the noise from the turbines, but the complaints have been infrequent and did not prevent WPS from getting a five-year extension on its conditional use permit.

LOCAL OFFICIALS

The local town decision makers were largely in favor of the project. WPS participated in several informational meetings at the community center, where they first explored people's reactions to the idea of having turbines in the community. Once again, WPS did not reveal the specific location. WPS approached the town board initially and the town board then solicited feedback from members of the community. Glenmore is a small town and both WPS and the town leaders acknowledged that a high level of informal dialogue about the project would occur. By the time the project came up for formal approval, it had been thoroughly discussed among the residents. Consensus emerged that "everybody felt ok about it" and "everybody had had a chance to express their opinion."

Lessons Learned

There were no major difficulties in the development of the project and therefore there were no significant lessons to learn.

Potential Remedies

One of the themes we discovered in this research is the need to pay more attention to the turbine site selection in general, and to the proximity of adjacent but non-involved landowners in particular. This will be discussed in more detail later.

Other Issues

UW Green Bay did an avian study at Glenmore and found no problems for birds at the site, but they found that there were some birds killed by the guy wires of the communications towers across the road.

The project took at least 2 ½ years from the time WPS contacted the landowners until the project was built. One of the major reasons for the delay was that Tacke, the turbine equipment company, closed during the pre-construction phase. This left WPS in the unenviable position of negotiating through at least one, and possibly two transfers of ownership responsibility for turbine manufacturing and maintenance. Enron Wind ultimately purchased Tacke and GE Wind then acquired Enron. Today, because Vestas has such a large presence in nearby Kewaunee County, they have the maintenance contract for the two Tacke machines. From WPS's perspective this has worked well. Time will tell if replacement parts will be available, and if so at what cost, as the turbines enter middle age and beyond.

As stated, WPS is operating the Glenmore project with a 5-year conditional use permit from the town. WPS has successfully renewed the CUP once, but it will need two more renewals to carry the turbines through their expected 20-year lifetimes. This represents a serious risk to the viability of the project. Should the town deny the CUP, WPS could lose five to ten years of energy from the turbines. This may be an acceptable risk factor for projects that start out as research and development endeavors, but would likely not be acceptable as commercial projects where a twenty-year power purchase contract is normally required for success.

ROSIERE

Project Description

The Rosiere wind farm is owned and operated by Madison Gas & Electric (MGE), and is located in the Townships of Lincoln and Red River, in Kewaunee County. It was built in early 1999 by MGE who acted as the developer. The project consists of seventeen 660 kW Vestas V47 turbines, with a total generating capacity of 11.22 MW. It was built at a cost of $14.5 million or $1,292 per kilowatt (kW). The facility was commissioned in June of 1999. The turbines are located on seven parcels of land which total 603 acres that belong to seven different landowners. MGE leases a total of 30.5 acres of land from these seven landowners, although the turbine foundations, transformers and access roads take up only 7.4 total acres of land. The land in the vicinity of the wind farm is mostly used for agriculture, but there is also some non-farm residential development in the area.

Development Drivers

MGE's service territory is centered in progressive-minded Madison, and many of its customers want electricity generated from renewable sources. For this reason, MGE was looking for renewable energy projects that could be used as the basis for a green-pricing program. The 1997 passage of Wisconsin Act 204 mandated MGE to acquire at least 3 MW of electrical generating capacity from renewable sources by December 31, 2000. MGE went beyond this mandate, however, when in October of 1997 it notified the PSCW of the intention to build a wind energy facility with a capacity of 11 MW. This would allow MGE to satisfy the 3 MW mandate imposed by Act 204, and to use the remaining 8 MW of generating capacity to produce power to be sold to its customers at a premium through a green-pricing program.

Development Strategies

MGE decided to act as the developer and owner/operator of their wind farm project, rather than contracting it out to an Independent Power Producer (IPP), or purchasing renewable power from elsewhere. This gave them more control over the details of project management and over their relationships with the communities involved.

MGE initially identified two possible locations for a wind farm. One was in the Township of Stockbridge, located in Calumet County, east of Lake Winnebago. The other was in the Townships of Lincoln and Red River, in Kewaunee County. In April of 1998, MGE held a number of informational meetings in these two places to discuss their wind farm plans with the local communities. These meetings featured educational materials about wind turbines and gave local residents the opportunity to ask questions of MGE personnel. At some meetings, trade-show style promotional materials were distributed and refreshments were served. Early in the process it was disclosed that Stockbridge was MGE's preferred site for the wind facility. This choice was largely due to the fact that the WWRAP study indicated that the area near Stockbridge would have the better wind resource.[9]

The Federal Production Tax Credit (PTC) for wind energy systems was due to expire in July of 1999. This meant that in order for a project to be eligible for the 1.5 cent per kilowatt-hour tax credit it needed to be operational by June 30, 1999. MGE concurrently pursued its community outreach efforts, its search for landowners willing to host turbines, and its filing of Construction Authority (CA) permit applications with the Wisconsin PSC. MGE explored the two potential wind farm sites in parallel until June of 1998, when a resolution was introduced before the Calumet County Board of Supervisors in opposition to MGE's wind development proposal. The area near Stockbridge consists of relatively small land parcels, and there is increasing residential development in the region, especially near the shore of Lake Winnebago. These factors are believed to have contributed to the level of opposition to the project. The Calumet County resolution was subsequently passed in July of 1998, and MGE abandoned its plans for development in Stockbridge. By August of 1998, MGE had signed agreements with landowners in Kewaunee County to site 17 turbines, nine in the Township of Red River and eight in the Township of Lincoln. In that same month, MGE initiated discussions with local government officials in Lincoln and Red River to seek approval to construct the wind farm.

What followed was a somewhat contentious few months in which the members of the two Townships debated the merits of MGE's proposal, largely through meetings of the respective Town Boards and Town Zoning Committees. While most of the town residents were fairly neutral or mildly supportive of the project, there were small pockets of strong support and strong opposition. Complicating matters was the fact that the WPS Lincoln wind farm (see below) was being proposed to the Town of Lincoln at the same time, and so, from the point of view of the local population, the two projects essentially became one larger project involving two different utilities.

Furthermore, there was no clearly accepted procedure in place for granting approval for the project. The two towns had adopted a zoning ordinance developed by the Bay Lakes Regional Planning Commission that did not specifically address wind turbines.[10] As a result, MGE needed a Conditional Use Permit and the Town Zoning Committee was given the authority to issue it. However, because the towns themselves had not drafted this ordinance, it was not universally understood or accepted, and debate ensued over whether the Town Board of Supervisors or the Town Zoning Committee was the proper authority to decide the fate of the project. To further complicate matters, both the Town Board and the Zoning Committee included members who were connected with the project. They were either landowners slated to host a turbine, landowners who would be an uncompensated neighbor to a turbine, or perhaps someone whose best friend strongly opposed or strongly supported the project.

On top of this difficult situation, the Federal Production Tax Credit was due to expire in July of 1999, as mentioned above. This meant that the debates taking place in the Town Board and Town Zoning Committee meetings were subject to significant time pressure as well. In the end, the townspeople in

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[9] Wisconsin Wind Resource Assessment Program Final Report, Global Energy Concepts, LLC, Kirkland, WA, January 2002.

[10] The Bay-Lake Regional Planning Commission is a public planning agency that represents local interests on state and federal planning program activities and provides assistance to the counties of Brown, Door, Florence, Kewaunee, Manitowoc, Marinette, Oconto and Sheboygan in northeastern Wisconsin.

favor of the project and MGE representatives succeeded in marshalling the support of the required majority of Zoning Committee members (3 out of 5) to move the project forward. The Conditional Use Permits were issued in November of 1998, and construction began on the Rosiere wind farm in December of 1998. By the end of June 1999, the wind farm was fully operational.

Stakeholder Perspectives

UTILITY/DEVELOPER

MGE regards the Rosiere project very favorably, as do its green power customers and shareholders. Since it was commissioned, the wind farm has met MGE's expectations in terms of power output, and MGE customers have been very pleased with the green-pricing program. The program was fully subscribed by September of 1999, and the percentage of MGE customers who have opted to voluntarily pay more to purchase wind-generated electricity is among the highest in the nation for programs of this type.

The time pressure (dictated by the Federal tax credit deadline) meant that the local permitting process, the agreements with host landowners, the permitting from the state PSC, and the community outreach efforts all had to proceed simultaneously. MGE would have liked more time for the community education and outreach aspects of the project.

In interviews, some Rosiere development participants felt that Wisconsin’s current policy giving local governments permit issuing responsibility for wind farms up to 100 MW is potentially problematic. In some cases local governments do not have an established procedure in place for making these decisions, which leads to conflicts at the local level. Wind farm developers see this as likely to lead to project delays and an increased uncertainty about the trajectory of the project. Additionally, small-town local governments are typically composed of part-time elected officials with little experience in dealing with a project on the scale of a wind farm. Also, friends and neighbors of a local government official may line up on opposite sides of the issue, placing the official in a difficult position, which in turn puts the utility or wind farm developer in a difficult position.

This underlines another common opinion expressed by some utility and development company representatives. They feel that because local governments currently have permitting authority for wind farm projects, building local support for these projects should be top priority for utilities and wind farm developers working in Wisconsin. It is important to find common ground with the local residents and their governments so the relationship between the utility or developer and the townspeople does not become an adversarial one. The way to achieve this is not always clear, but it is important for the utility or developer to provide adequate information to the town officials and residents during the process, and to be available to answer questions and address all of the town's concerns as completely as possible.

The NIMBY (not-in-my-backyard) argument is ubiquitous and needs to be anticipated and addressed somehow. MGE’s approach was to hire a land agent as the company’s representative in discussions with potential host landowners and local government officials. The land agent provided a sense of continuity and a common point of contact during the development phase. In addition, the land agent’s style and persona fit in well with the local farmers in Kewaunee County. Farmers and local residents felt like the land agent was “one of them.” MGE also recognized that the exact placement of turbines in relation to nearby residences is of vital importance. They were aware of the need to pay careful attention to these micro-siting issues so that effects such as turbine noise and blade flicker are specifically addressed during the project design phase to mitigate the potential for problems later.

According to wind developers, the primary characteristics that make a particular area desirable for wind farm development are the wind resource itself (the average wind speed in the area), access to adequately sized power lines, and the level of rural residential development. Too much residential development is seen as carrying with it a high risk of significant local opposition.

LOCAL TOWN OFFICIALS

As mentioned above, the MGE Rosiere project and the WPS Lincoln project (discussed next) became somewhat intermingled from the point of view of local government officials and local residents as well. This section applies equally to the MGE and WPS wind farms in Kewaunee County.

Interviews with local officials in Kewaunee County revealed that the amount of compensation towns receive from local wind farms is a very important issue. Most of the town officials were satisfied with the wind farm compensation their town was receiving, although there was some disagreement. The revenue is generally used to lower local property tax requirements. Some local officials, notably those who opposed the Kewaunee County wind farms, felt that in view of the compensation proposed for other recent wind farm projects such as the proposed Navitas wind farm in the Town of Marshfield, the Town of Lincoln was not getting enough compensation.[11]

Town officials involved with the MGE Rosiere and WPS Lincoln wind farms echoed the utility opinion that there was significant time pressure on the projects. The general feeling was that the Town Zoning Committee wanted more time to decide about issuing the Conditional Use Permits for the turbines, but bowed to utility pressure because of the the impending expiration of the federal PTC and the Wisconsin Act 204 mandate. Officials felt the town had received an ultimatum from the utilities to issue the Conditional Use Permits or the utilities would go back to the PSCW and seek to move the Kewaunee County projects forward by a different process. It was not exactly clear what this different process would have been, but the feeling that an ultimatum was issued by the utilities near the end of the permitting process was prevalent among town officials both supporting and opposing the project. Interestingly, this didn’t result in great ill will toward the utilities, but rather was viewed as an inevitable result of unavoidable time constraints. There is a general feeling that the utilities had been honest in their dealings with the town, that they had made a sincere attempt to be good neighbors.

LANDOWNERS

The landowners we interviewed who are hosting MGE's turbines on their land were very happy to be involved with the project. They gave MGE representatives very high marks. In their opinion, MGE lived up to its promises and was respectful of their wishes about placement of access roads and turbines, remediation of areas affected by construction, and keeping the turbines well maintained.

[11] The difference in landowner payments can be attributed primarily to turbine size. The proposed wind turbines in the Town of Marshfield (Fond du Lac County) are nearly 2.5 times larger than the machines installed in Kewaunee County.

The landowners do notice some of the characteristics others have criticized such as blade flicker (the effect caused by sunlight shining through the moving turbine blades) and turbine noise, but they are willing to live with them. They are also aware that the initial opposition to the MGE Rosiere and WPS Lincoln wind farms continues, and they expressed regret that the projects cause tensions between some people in the town.

In general, the landowners feel the compensation they are receiving from MGE for the leased land is adequate. These landowners advise other people who may be considering putting turbines on their land to proceed cautiously, do research by talking to people who already have turbines on their land or live near them, and to make sure that they will be well compensated by the utilities or developers involved.

LOCAL PROJECT OPPONENTS

Once again, many of the opponents to the MGE Rosiere project were also opponents of the WPS Lincoln project, and so much of what is expressed here applies equally to the two projects. Unless otherwise noted, the reader can assume that the views expressed in this section apply to both of the Kewaunee County wind farms.

Opposition to the two wind farms in Kewaunee County has lingered on to the present day. Town residents who were strongly in favor of the projects originally tend to remain very positive about the wind farms today, while those who were strongly opposed before are also likely to remain so. The issue of the wind farms has faded somewhat for the average resident of the area, and most of the tensions associated with the heated Town Board and Zoning Committee meetings have subsided.

The primary issues surrounding the Kewaunee County wind farm projects both before and after construction were the aesthetics of wind turbines in a rural area, residential vs. wind farm land use, concerns over the effects of turbine noise, and a fear of stray voltage. After the turbines were built and operating, the issue of turbine blade flicker arose. Flicker, also known as ”strobing,” is what occurs when a turbine blade creates a momentary shadow as it passes between the sun and the observer. No one had anticipated this phenomenon to be a potential problem while the project was being developed.[12] While project opponents suspect the utilities of understating these various effects before the wind farms were constructed, there is not necessarily a feeling that the utilities intentionally deceived the town residents in this regard. Because the MGE and WPS wind farms in Kewaunee County were the first large wind farms constructed in Wisconsin, there is a general agreement among even opponents to the projects that the utilities genuinely did not foresee the problems.

Some project opponents said they think wind turbines are unsightly and that they detract from enjoying the rural landscape. Others expressed the view that they would prefer to see more residential development in the township and thought that the wind farms would discourage people from building homes in the area. They felt that in terms of maintaining the property tax base and the livability of the area, they preferred to see residential development rather than wind farm development.[13] With regard to turbine

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[12] Strobing, or flicker, is only a possibility at certain times of the day – typically dusk and dawn – when the angle of the sun is low enough for blade shadows to be noticeable over a long distance. Further, its effect can only be observed at locations in Wisconsin to the northwest and northeast of the turbine.

[13] It is a common misperception that an increased tax base from residential development will benefit the town through lower property tax mill rates. In fact, many land use studies on this subject have shown that the increased

noise and blade flicker, the opponents expressed the view that these were very objectionable effects that had a significantly detrimental effect on their quality of life.

Another common theme voiced by the opposition to the projects in Kewaunee County is that the projects were forced on the town by powerful corporate and state government interests, and that the local opposition did not have the resources of time or money to enable them to fight back. Another common opinion among those opposed is that the wind farms are a benefit to the landowners who host the turbines, but not to the average resident of the town, and especially not to the immediate neighbors of the landowners. There was also a tendency to question utility funded studies about such issues as turbine noise and a belief that these studies were inherently biased.

There have been a number of complaints from neighbors of the MGE Rosiere wind farm in Lincoln Township since it has been up and running, although according to local officials, there have been no reported complaints about the MGE project in Red River Township. MGE has addressed the Rosiere complaints on a case-by-case basis. At least one neighbor has complained of the effect of blade flicker, which casts moving shadows on his house at certain times of day. In this case, MGE paid to plant trees between the wind turbines and the affected house to mitigate the problem. Several neighbors complained about poor TV reception, and MGE paid to replace some TV antennas, which seemed to improve the situation.

Turbine noise has caused occasional complaints from neighbors of the Rosiere project, and MGE has found that the turbine noise seems to be most objectionable to neighbors on days when the wind is blowing strong enough to spin the turbine blades, but not strongly enough to be heard itself, which covers turbine noise at higher speeds. At higher wind speeds, the ambient noise of the wind masks turbine noise. The problem seems to occur with wind speeds in the range of 9 miles-per-hour. MGE has responded to these complaints by reprogramming the turbine controllers so the turbines are not allowed to spin until the wind speed is slightly above this range. In the 9-mph wind speed range, the turbines are not producing a significant amount of power, so this change does not have a major effect on production.

LOCAL PROJECT SUPPORTERS

Once again, the views expressed in this section can be interpreted as applying to both the MGE Rosiere wind farm and the WPS Lincoln wind farm, unless otherwise noted. The most common views expressed by the supporters of the Kewaunee County wind farm projects were that the wind farms were a benefit to the townships in which they were located and to the landowners who host the turbines. Also, they felt everyone benefits because of the environmental advantages of producing energy with wind turbines rather than fossil fuel or nuclear power plants.

The benefits to the host townships include the revenue that comes to the town as a result of the project, and also the pride in setting a good example by participating in the production of clean energy. The benefit to the landowners is the economic boost they receive by leasing part of their land to the utility or developer in return for allowing the turbines and access roads to be located there. This compensation is

cost of providing municipal services to new residential development exceeds the tax revenue collected from those developments, thereby causing higher mill rates and higher taxes for everyone in the community.

regarded as a substantial benefit, particularly since wind farms are not disruptive to farming or grazing operations, which can continue to take place on the land after the wind farm is operating.

Supporters recognize the environmental benefits that come from an increase in renewable generation and a decrease in fossil fuel use. They felt in general that wind farms are an important and necessary part of the energy future, that they need to be put somewhere, and that they don't mind living near them. Supporters felt that wind farm benefits to the town and the local residents outweigh the potential problems that they can create.

Many supporters of the projects in Kewaunee County felt that opponents were complaining either out of habit, out of a feeling of anger because they were unable to stop a particular wind farm from being built, or out of resentment for not receiving the same level of compensation that the landowners who are hosting the turbines are receiving. However, supporters did acknowledge the existence of many of the same issues voiced by opponents. They do notice the sound of the turbines at times, and they occasionally have experienced blade flicker, but these issues do not loom large for them. They do not see the turbines as a threat to their quality of life.

Local supporters of the Kewaunee County wind farms generally gave high praise to MGE and its development company representatives who were involved with the projects. Supporters felt they were good people to work with and that they did a good job of answering questions and providing information over the course of the projects.

Lessons Learned

Among the lessons learned by MGE as a result of the Rosiere wind farm project would be the importance of specific turbine siting considerations, especially when residences are nearby. They recognized the need to anticipate turbine noise and blade flicker, which are much easier to deal with in the project planning stage than after construction. MGE benefited from the use of a local agent to facilitate discussions with local property owners. In addition, MGE itself designed the layout of the wind farm. Even though the scattered turbine layout may not be the most economically efficient design, MGE presumably arranged the turbines in a way to minimize local impact while maximizing capture of the wind resource.

Another lesson learned is that the people most likely to complain about a wind farm are the people who live close enough to it to experience negative effects, but who are not directly sharing in the revenue. While the landowners hosting the wind turbines notice the same effects, the financial compensation they are receiving as a result of the wind farm seems to make the effects much easier to ignore.

Potential Remedies

The obvious remedy for some of the siting problems would be to spend more time in the design phase of the project looking at the potential for problems with noise, blade flicker, and disruption of TV reception. Another possible remedy would be to increase the minimum setback distance between a wind turbine and nearby residences not receiving direct compensation from the project.

With regard to the issue of non-compensated neighbors, one suggestion is allocating revenue to residents living within a certain radius of a wind farm via an annual payment. This could be lower than the land lease payments to turbine hosts, but of an amount sufficient to recognize the neighbor’s concerns. For example, the allocation could be based on a formula where the compensation would be inversely proportional to the distance from the wind farm. Also, there could be two tiers of payments with a higher level offered to contiguous adjacent landowners and a lower level offered to non-contiguous, non-adjacent landowners. Obviously this plan would involve some arbitrary decisions but it might be better than no plan at all, at least from the point of view of the currently uncompensated neighbors. Moreover, a developer who adopted this approach would have a high degree of flexibility to design a payment plan based on the unique conditions of the project area.

LINCOLN

Project Description

The Lincoln wind farm consists of fourteen Vestas 660-kW V47 turbines, located in the Town of Lincoln, in Kewaunee County. It was built in early 1999 by WPS, which still owns and operates the project. WPS leased a total of 5 acres of land from four landowners, although they represent just two families. As with the MGE Rosiere wind farm, the surrounding land can be described as primarily agricultural. However, when compared to the MGE project in Red River Township, there is much more rural residential development in the Lincoln area.

Development Drivers

The 1997 passage of Wisconsin Act 204 mandated that WPS add 9 MW of generating capacity from renewable sources to its portfolio by December 31, 2000. This mandate seems to have set the scale of the Lincoln project because the fourteen 660 kW turbines have a total rated capacity of 9.24 MW. WPS had been considering the development of wind power facilities before the Act 204 mandate, however, and was the primary proponent of the two-turbine project at Glenmore.

While there was some demand from WPS customers for a green-pricing program, this does not seem to have been a major factor in the development of the Lincoln project since it essentially meets the Act 204 mandate. Act 204 stipulated that the power from the facilities used to satisfy the mandate couldn’t be used to supply power for a green-pricing program. As mentioned earlier, WPS uses the 1.2 MW of capacity from the two wind turbines at Glenmore, along with power produced from a biomass project to supply its NatureWise green-pricing program.

Development Strategies

Like MGE, WPS decided to act as the developer, owner and operator of its wind energy facility, rather than purchasing power from elsewhere or working through an IPP. Unlike MGE, WPS did not employ a land agent to assist with negotiations at the local level. WPS management preferred the idea of having a wind farm located in its own service territory because they felt that their customers would respond more favorably to the project if it were sited locally. Based on the data from the WWRAP study and proposals that WPS had received from IPPs for wind energy facilities, Lincoln Township was identified as a suitable location because it had a strong wind resource, mostly agricultural land use, and close proximity to transmission lines. WPS employed a consultant to recommend the wind farm layout and configuration.

As mentioned above, the WPS project in Lincoln and the MGE Rosiere project were being developed simultaneously and thus became mingled in the public mind. Much of the preceding description of the trajectory of the Rosiere project applies to the Lincoln project as well. The two wind farm proposals were debated side-by-side at many of the contentious Town Board and Town Zoning Committee meetings referred to above.

During the community outreach phase of the project, local residents were encouraged to visit the WPS Glenmore wind facility, located approximately 30 miles away. The two turbines at Glenmore are of a similar scale to the Vestas 660-kW turbines that WPS and MGE were proposing to install in Kewaunee County. According to one local resident, very few townspeople actually went to see the Glenmore turbines.

One significant difference between the Lincoln and Rosiere projects is that a different formula was used to compute the amount of annual municipal compensation from the wind farm projects. WPS pays the Town of Lincoln a flat $8,000 per year impact fee plus a portion of the state utility tax that is collected each year on the wind farm. The state utility tax decreases annually as the value of the wind farm is depreciated over its expected 30-year lifetime. This means that in the first year of the project, the Town of Lincoln received $38,000 in wind farm revenue. This amount will decrease steadily by $1,000 per year, until the 30th year of the project when the town will receive just $9,000.

In contrast, the Town of Lincoln will receive $19,000 each year from the MGE Rosiere wind farm for the entire 30-year lifetime of the project. This payment is still composed of a portion of the state utility tax plus an amount paid directly from MGE each year, but as the utility tax portion decreases over the lifetime of the project, the MGE direct contribution increases, so that the net revenue to the town remains constant.

While the WPS declining payment structure is justifiable from a pure economic perspective, MGE’s approach is preferable for obvious reasons when viewed through the community’s eyes. While an accountant may say that the value of a utility asset depreciates over time, the asset’s community presence does not depreciate.

Stakeholder Perspectives

UTILITY/DEVELOPER

Because the Lincoln and Rosiere projects followed a similar trajectory, WPS and MGE representatives shared similar experiences. WPS representatives were operating under similar time pressure in the permitting and community outreach process, and they also felt that this was detrimental to the project.

They also encountered significant local opposition, especially from landowners adjacent to those hosting the turbines. Like MGE, WPS emerged from the project convinced that gaining the support of the local community is an extremely important element of a successful wind farm project. MGE and WPS management also shared the opinion that the presence of residential development in an area being considered for a wind farm can indicate a greater potential for local opposition.

WPS management gave the Vestas company high praise for their turbines, and for the maintenance they perform. Vestas is responsible for maintaining the 14 turbines at the WPS Lincoln facility, the 17 turbines at MGE Rosiere, as well as the two turbines at Byron and the two turbines at Glenmore.

LOCAL TOWN OFFICIALS

Please refer to the perspectives of Local Town Officials described under the MGE Rosiere project.

LANDOWNERS

None of the landowners hosting turbines in the WPS Lincoln project were available to be interviewed.

LOCAL PROJECT OPPONENTS

In general, local opposition to both the Lincoln and Rosiere projects addressed similar issues. Please refer to the Rosiere section for an overview of the common perspectives. There were some different complaints about the two wind farms, however.

Some individuals opposed the WPS Lincoln project energetically from the start, and to a level not seen with the MGE Rosiere project. After the commissioning of the two wind farms, the WPS project seemed to continue to draw more criticism from local residents than did the MGE Rosiere project.

Several local residents expressed the view that the physical layout of the Lincoln wind farm may have led to problems that were not seen at the Rosiere wind farm. The Lincoln wind farm is essentially laid out in straight rows. There are three north-south running rows of turbines: two rows of five and one row of four turbines. In the Rosiere wind farm, the turbines are arranged in scattered clusters. It is possible that the linear layout of the Lincoln wind farm has oriented more turbines to cause noise and blade flicker problems for the immediate neighbors. Moreover, the higher rural residential population densities in Lincoln Township may have exacerbated the problem. WPS might have avoided this situation by learning more about local community issues or by hiring a land agent to facilitate the layout of the wind turbines in a less objectionable way.

The most extreme dissatisfaction came from a number of people living near the Lincoln wind farm. This group complained so persistently after the wind farm was built that WPS was compelled to make purchase offers on their properties so they could relocate. WPS extended offers to six nearby neighbors, and two of them accepted. The two houses in question were demolished, and future residential development on those lots is banned in order to avoid similar problems in the future. The primary complaint in these cases was noise, although poor TV reception and blade flicker were also reported to a lesser extent. It should be noted that all TV reception problems were resolved, and both MGE and WPS have committed to resolving any TV reception problems throughout the life of the wind projects.

The most controversial issue brought up in relation to the wind farm in Kewaunee County is probably “stray voltage.” The term is commonly used to refer to small voltage differences existing between different parts of a building where they normally would not occur. It can be a problem on dairy farms because cows are sensitive to small voltage differences. If a voltage difference exists between a feeding trough and the floor, the cows could feel the current and be discouraged from eating. This effect has been studied for some time in Wisconsin. It has frequently been identified as the result of faulty ground wiring practices at the site that can be corrected by making changes to the wiring of the building in question. The cause is not always discernable, however, leaving the issue of stray voltage open to controversy. In the case of the Lincoln wind farm, opponents to the project report at least one case where a nearby dairy farmer has allegedly experienced problems with stray voltage since the wind farm has been operating. This study did not investigate the validity of this claim, but merely reports it.

The issue of noticeable turbine noise at low (9 mile-per-hour) wind speeds emerged at the Lincoln wind farm, just as it did at Rosiere. WPS, like MGE reprogrammed the turbine controllers so the blades were not allowed to spin in this wind speed range. Some of the nearby neighbors also reported poor TV reception at the Lincoln facility. WPS replaced existing TV antennas with taller, higher-gain antennas and purchased a satellite TV dish for one neighbor to solve this problem.

LOCAL PROJECT SUPPORTERS

Please refer to the perspectives of Local Project Supporters described under the MGE Rosiere project.

Lessons Learned

The most obvious lessons learned from the WPS Lincoln project mirror those of the MGE Rosiere project. Of primary importance is siting turbines with careful regard for nearby rural residences. Recommended practices include scattering rather than concentrating turbines in the landscape, maintaining sensitivity to the density of rural residences, and addressing the issue of compensation for the wind farm's immediate neighbors who are not hosting a turbine.

Potential Remedies

The potential remedies to these issues would be exactly the same as outlined above for the MGE Rosiere wind farm.

The Township of Lincoln Wind Turbine Moratorium Study Committee

Within weeks after the MGE Rosiere and WPS Lincoln wind farms were commissioned, the Towns of Lincoln and Red River both adopted an ordinance drafted by the Bay Lakes Regional Planning Commission declaring an 18-month moratorium on the construction of wind turbines in the townships. The ordinance called for a period of 18 months during which no Conditional Use Permits could be granted for wind turbines or associated equipment, or facilities such as access roads or transformers. It also called for the creation of a committee to study the effects of the recently installed wind turbines, to review the conditional use permitting process, and to suggest changes and improvements to this process. In December of 1999, the Lincoln Township Board of Supervisors appointed the Township of Lincoln Wind Turbine Moratorium Study Committee. This committee consisted of five members, two alternate members, and two advisors. Members represented a mix of viewpoints including project supporters and opponents, landowners hosting turbines, and members of the Lincoln Town Board of Supervisors and the Lincoln Zoning Committee. The following items made up the agenda of the committee:

1. Study the impact of the turbines on the land in the Township

2. Study the impact of the turbines on the residents of the Township

3. Review the effectiveness of the conditions included in the Conditional Use Permits issued to WPS and MGE, and review Lincoln Township's Zoning Ordinance that was used to permit the wind farms

4. Develop standards and conditions for the siting of wind turbines in the Township

5. Make recommendations to the Board of Supervisors for amending the Township's Zoning Ordinance

Findings

Over a period of approximately two years, the committee met a total of 39 times and drew on the expertise of dozens of experts in a variety of technical and policy areas. The committee issued a final report in February of 2002. Among the most important findings were:

- Wildlife Impacts:

  Relying upon a study of wildlife impacts conducted by a representative from WPS, an independent consultant from New York, and a researcher from the University of Wisconsin-Green Bay, the committee determined that "the wind turbines have had a minimal impact on birds and bats in Lincoln Township."[14]

- Property Values:

  An informal study conducted by a Lincoln Zoning Administrator found that "location of the wind turbines has not had a negative impact on property values during the past eighteen months."[15]

- Utility offers to purchase neighboring properties:

  The committee drafted and passed a resolution condemning the WPS offers to buy six houses in the vicinity of the Lincoln wind farm, which occurred in early 2001.[16] This resolution was subsequently adopted by the Lincoln Town Board of Supervisors and passed on to WPS representatives. This matter was apparently not resolved to the satisfaction of the Moratorium Committee or the Lincoln Township Board of Supervisors, since two of the six houses in question were eventually purchased and demolished by WPS.

- Stray voltage:

  The committee "drafted and approved … an ordinance calling for a new moratorium to study the potential effects that the wind turbines may have on stray voltage and earth currents."[17] The committee recommended to the Board of Supervisors that they issue a Request for Proposals to

[14] Final Report of the Township of Lincoln Wind Turbine Moratorium Study Committee, February 2002, Township of Lincoln.
[15] Ibid.
[16] Ibid.
[17] Ibid.

study this issue. The Board never acted on this recommendation and instead let the issue of stray voltage go unanswered. This one-year stray voltage moratorium was in effect from July 6, 2001 to July 6, 2002, and applied only to wind turbines over 100 kW in capacity or over 165 feet in total height.

- The applicability of Wisconsin Statute §66.0401

  Wisconsin Statute §66.0401 restricts the ability of local governments to enact ordinances against solar and wind energy systems. The committee sought the opinion of the Wisconsin Attorney General as to the application of this statute to commercial-scale wind turbines. The Attorney General's informal opinion was that the Statute did apply to commercial-scale wind energy systems as well as residential-sized systems.

Recommendations

The Final Report of the Moratorium Study Committee also contains numerous recommendations for amendments to the Town's Zoning Ordinance regarding wind turbines and to the Town's Conditional Use Permits and Conditional Use Permitting process. Most notable was the recommendation to shift permitting authority from the Zoning Committee to the Board of Supervisors, which the latter subsequently adopted. As mentioned earlier, part of the permitting process for the Rosiere and Lincoln wind farms consisted of a tug-of-war between the Lincoln Board of Supervisors and the Lincoln Zoning Committee to determine which entity had the authority to issue Conditional Use Permits. In the end, it was the five-member Zoning Committee who issued the permits by a 3-to-2 margin over the objections of a majority of the three-member Board of Supervisors.

The Moratorium Study Committee also recommended that the Town of Lincoln's Zoning Ordinance be altered to differentiate between various sizes of wind systems. The committee recommended that wind turbines be categorized as home-sized (up to 20 kW rated capacity), farm-sized (up to 100 kW capacity), or commercial-scale (above 100 kW capacity). The committee also recommended that only projects involving commercial-scale wind turbines should be required to go through the process of obtaining a Conditional Use Permit from the Town. Projects involving smaller turbines would be subject to restrictions outlined in the recommended amendments to the Zoning Ordinance, which involved requirements such as minimum setbacks from roads and property lines, and the need to keep the turbine in good working order.

Survey of Residents

One of the most interesting sections of the Moratorium Study Committee's Final Report consists of the results of a survey conducted by the committee in collaboration with the University of Wisconsin Extension Service. Surveys were mailed to all property owners currently residing in the Township of Lincoln (approximately 310), and 223 of them took the time to respond. The surveys were anonymous and responses were grouped based on proximity to the Rosiere or Lincoln turbines in increments of distance. The survey consisted of nine questions, some multiple-part, such as:

> Are any of the following wind turbine issues currently causing problems in your household?

a. Shadows from the blades

b. TV reception

c. Blinking lights from on top of the towers

d. Noise

e. Other

The results from the responses to this question were as follows:

a. Shadows from the blades

10% yes 89% no 1% no response

b. TV reception

22% yes 74% no 4% no response

c. Blinking lights from on top of the towers

8% yes 91% no 1% no response

d. Noise

14% yes 85% no 1% no response

e. Other

[Responses included various objections to issues such as the aesthetics of the turbines, worries about stray voltage, and increased automobile traffic in the area.]

There was little statistical variation among either positive or negative opinions expressed by residents close to either wind farm. The two wind farms seemed to have had, on average, the same effect on the nearby residents.

What did emerge was a pattern showing that the most consistent indicator of whether a respondent was likely to have positive or negative feelings about the wind farms was the distance of his or her residence from the wind turbines. Respondents were grouped by distance from the turbines in the following categories: 800 feet to 1/4 mile, 1/4 mile to 1/2 mile, 1/2 mile to 1 mile, 1 mile to 2 miles, and over 2 miles. The group that had the most consistently negative feelings about the wind farms, and reported the most problems with issues such as noise and blade flicker, were those who lived between 1/4 mile and 1/2 mile away from the turbines. In fact, this group reported even more problems with these issues than did those who actually lived between 800 feet and 1/4 mile away from the turbines.

It is possible that those who live between 800 feet and 1/4 mile away would tend to be the landowners hosting the turbines, and those living between 1/4 mile and 1/2 mile away would tend to be their immediate rural residential neighbors. As mentioned in the summaries of Stakeholder Perspectives above, direct financial compensation has been shown to influence an individual's willingness to accept turbine noise, blade flicker and blinking red lights. Landowners hosting turbines do notice these effects, but they are less likely to object than are their uncompensated, immediate neighbors. Beyond one mile from the turbines, the number of negative responses generally drops off quickly.

BYRON

Project Description

The Byron project consists of two Vestas V-47 660 kW wind turbines on 65-meter towers. The turbines are located near the southeast corner of State Highway 41 and County Trunk Highway F in the Town of Byron about eight miles south of Fond du Lac. We Energies (WE) of Milwaukee announced the project in March of 1999, construction began in April, and turbines went into service on June 14, 1999. The host landowners lease the site to WE under a long-term-use agreement.

Development Drivers

The project was developed solely to provide a source of wind power for WE's green pricing program, Energy for Tomorrow (EFT). Prior to the Byron wind project, EFT was powered by existing in-state renewable facilities and out-of-state wind energy projects. Byron was WE's first in-state new EFT power supply project.

Development Strategies

WE identified the host site through the Wisconsin's Wind Resource Assessment Program. Byron is located along Wisconsin's well-known Niagara Escarpment, one of the best wind resource sites on record in the state. WE served as the project developer, owner and operator. Once a willing landowner was found, WE met informally with the Byron Town Board and found it receptive to the idea. Board members did have questions about the aesthetics, noise, and impact on birds and TV reception but WE was able to address their concerns. A conditional use permit application was prepared and submitted to the Board in early 1999. After a sparsely attended public hearing on the application, the town board granted WE the CUP. The CUP included requirements to address any problems that might arise once the project was in operation. It's worthwhile to note there were no opponents to construction of the project. Part of the reason for this is probably the small size of the project. Another likely reason is that well-publicized turbine siting problems in Lincoln Township/Kewaunee County had not yet occurred.

Stakeholder Perspectives

Byron is a true success story for all parties involved. The landowners have gone on to become strong proponents of wind and regularly host open houses for visitors to the turbines. WE is enthusiastic about the turbines' performance. The town is receiving payments from WE under the State's utility-shared revenue payment program and there was only one complaint about TV reception in the early days of the project, which has since been resolved to the complainant's satisfaction. Given the contentious nature of recent wind development projects, it is unlikely that a wind project will ever be developed again as smoothly as was Byron.

MONTFORT

Project Description

The Montfort Wind Farm is Wisconsin’s largest wind farm. It consists of 20 GE Wind (GE) 1.5 MW turbines, comprising 30 MW of total generating capacity. The turbines have a 70-meter rotor diameter and are installed on 65-meter towers. Completed in July 2001, the project was cooperatively developed by Florida-based FPL Energy (FPL) and Enron Wind. The Iowa County project site in the Town of Eden occupies three miles along U.S. Highway 18 between the villages of Cobb and Montfort, and was acquired and permitted by Enron Wind in 2000. FPL, the owner and lead developer, provided both the power sale and interconnection agreements. Enron Wind supplied, installed and commissioned Montfort’s wind turbines. FPL now owns and operates the wind farm exclusively. GE Wind has since acquired Enron Wind and is contracted to maintain the turbines.

Development Drivers

The project was developed in response to Wisconsin Act 204 to meet WE mandated renewable energy requirements. WE purchases the output from seventeen of the turbines (25.5 MW of capacity) and Alliant purchases the output of the remaining three turbines.

The Montfort site came into existence because FPL was unable to get zoning approval for a 28 MW project in the Town of Addison in Washington County in eastern Wisconsin. The Addison experience will be discussed in more detail later in this report. When FPL realized that they would not be able to develop Addison to supply power in time to meet the Act 204 requirements, they shifted their attention to Montfort. The other timing driver for Montfort was the Federal Production Tax Credit. Their project needed to be on line by December 31, 2001 in order to qualify for the PTC, which was scheduled to expire at the end of the year. Had the permitting process not gone as smoothly as it did, FPL may have bumped up against the PTC deadline.

Development Strategies

As evidenced by the quick permitting process, Montfort is a textbook example of how large wind farm development can be done right in Wisconsin. It is commonly believed that Montfort’s success is due primarily to its demographics. With some of the best soil in the county, agriculture remains strong in the township and there are no new rural subdivisions in the immediate view shed of the project. Farm sizes in Iowa County are substantially larger than in eastern Wisconsin, and population density is very low. Development pressure in the area is slight and is confined to the eastern fringe of the county and to the fringes of its two largest cities, Dodgeville and Mineral Point.

The Montfort wind farm is located along Military Ridge, which extends from its eastern terminus in Dane County west into Grant County, and running straight across Eden Township just south of U.S. Highway 18. Elevations along the Military Ridge are much lower relative to the surrounding area than along the Niagara Escarpment in eastern Wisconsin. Current wind monitoring data confirm a less energetic wind resource in this area when compared with locations on top of the Niagara Escarpment in eastern Wisconsin. However, the land along the project site is relatively flat, open, and treeless, and more accommodating to larger clusters of wind turbines than the more heavily populated east. While a strong wind resource is considered the best indicator of a project’s viability, if the development costs and timeline increase significantly due to local opposition, the overall economics of a project can be better in an environment with a lesser wind resource but a more accepting community.

The project took approximately 12 months from inception to commissioning. Major milestones of the project are shown in the timeline below:

DATE	MILESTONE
June 2000	Representatives from Enron Wind Energy Company begin reviewing sites in western Iowa County for hosting wind generators. Outreach to landowners begins.
July 2000	Enron meets with county officials to explain the project.
August 2000	Enron submits application to Iowa County for permission to build 20 1.5 MW turbines in the Township of Eden. Because two of the town's three board members are project participants, the application is taken up by the Iowa County Zoning Committee, which holds a hearing on the matter. The Committee, in consultation with the county zoning Administrator, determines that turbines are not considered a utility by ordinance, and therefore cannot be allowed on lands zoned as A-1 Agricultural. The Committee determined that the project development area land must be reclassified as M-1 Industrial.
September 2000	The Zoning Committee approves Enron's request to rezone 15.65 acres of prime agricultural land as M-1 industrial. The rezoned land consists of the turbine foundations and an access road. The Committee also approves a conditional use permit allowing installation of 20 turbines to go forward in the rezoned land. At the hearing, one Iowa County resident expressed concerns over potential impacts, but did not outright oppose the project.
October 2000	The Iowa County Board approves Enron's wind project.
December 2000	Enron sells its ownership interest in the Iowa County project to FPL Energy.
January 2001	WE agrees to purchase the output from 17 turbines (25.5 MW). Following the signing of a transmission agreement with the American Transmission Company, construction of the Iowa County wind project begins.
April 2001	Alliant agrees to purchase output from three of the project's 20 turbines (4.5 MW). The power purchase agreement clears the path for completing the project as approved.
June 2001	FPL completes construction and commissioning of all 20 turbines.

At 30 MW, the Montfort wind farm was not subject to Wisconsin's utility-shared revenue payment law, which requires financial compensation to local governments that host utility infrastructure projects. Even though there was no legal obligation to provide payments to the local government, FPL did negotiate a compensation package with the town after the necessary permits had been issued. It was wise to recognize the value and contribution of the town's support for permitting the project. Today, this gesture may be rendered moot since the 2003 passage of Wisconsin Act 31 discussed later in the policy section of this report.

Stakeholder Perspectives

LANDOWNERS

The host landowners have been very pleased with the installation of the turbines on their property and have actually requested more turbines if the project were to be expanded. There have also been requests from other nearby property owners to have turbines placed on their land. In addition, there have been no complaints of any kind from the host landowners or adjacent property owners.

LOCAL REGULATORS

Iowa County issued the project permit since the Township of Eden had previously adopted county zoning.[18] County representatives believe the interests of the county, the town and the citizens were well represented. Two public hearings were held which gave the public sufficient opportunity to state their opinions. The wind power project was strongly supported at the hearings, which the county reflected in its zoning decision. The county has not heard any criticism or backlash now that the project is built. Asked if there had been any complaints about the wind turbines since they started producing power, Town of Eden Chairman Wayne Grimm said: "Absolutely none."[19]

Initially, Enron was unaware that Iowa County ordinances require a change in zoning to take prime agricultural land out of production. The county amended its ordinances in 1995 to prohibit placement of structures on prime agricultural land as a means to protect farmland and limit non-agricultural development. There is a narrow exception (not applicable to the wind turbines in this case) allowing new structures if they're within 300 feet of an existing cluster of structures. The solution was for the county to rezone 15.65 acres from A-1 Prime Agricultural to M-1 Industrial. The wind farm service road and the tower bases occupy the rezoned land. The county expressly authorized the use of wind power facilities through the conditional use process.

Looking forward, the county would like to designate an overlay zone where wind turbines would be considered an allowable use of agricultural land. However, the issue is not currently a high priority for the county board. The county would also be receptive to considering a model zoning ordinance for wind farms.

DEVELOPER

Enron Wind acquired all permits for the project. As a result, our study was not able to draw directly upon the experience of the permitting entity. FPL, the current owner and operator of the project, was able to offer some insights into the project, however. When asked if the ease of development related to different attitudes towards wind power, FPL responded by saying it thought each case and each project is unique and that such inferences can't necessarily be generalized to a wide area.

Direct payments to the local community can help with acceptance of the project but the project must be ultimately accepted on its own merits independent of payments. Also, payments could not be discussed

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[18] In Wisconsin, Township governments can adopt county zoning ordinances rather than incur the cost of developing and managing their own zoning laws. When a township adopts county zoning, rezoning requests are determined solely by the county, although the township does provide advisory, non-binding input to the county.
[19] As reported in the Milwaukee Journal Sentinel, November 21, 2001.

until after the permits had been issued to avoid negative perceptions about the integrity of the zoning process.

From a community acceptance perspective it doesn't seem to matter that the project is being developed in response to a state mandate for renewable energy. It does seem to matter, however, where the energy will be used. A community may be more receptive to a wind farm if they know the power will used within the state or for their own green power programs. Compare this to the arguments often raised by power line and merchant power plant opponents who feel their rights are being infringed upon so that corporations can maximize their profits through interstate power sales.

Lessons Learned

The biggest lesson from the Montfort project is recognizing the importance of community acceptance to the successful and timely development of a wind farm. Enron and FPL did not make great efforts to promote community acceptance and their approach did not differ significantly from the techniques they employed in Addison or Kewaunee County. Yet, the community has embraced the project and members of the community have been vocal supporters of wind power ever since.

Montfort's success demonstrates what appears to be a clear link between wind farming and agriculture in Wisconsin. This link relates to both population density and local land use priorities. The more rural and agricultural an area is, the easier it has been to site a project. This conclusion is supported by the recent zoning approval for 99 MW of wind turbines near the Town of Darlington in Lafayette County some 25 miles to the southeast of Montfort

Other Issues

By all accounts, both the community and the host landowners consider the Montfort wind project to be a resounding success. The project is even listed on the Dodgeville Chamber of Commerce web site under the "Attractions" section.[20]

There was only one negative effect reported. One interviewee suggested that since the project was developed to serve the Act 204 mandate, the negotiated energy prices were higher than they might have been in the absence of a mandated deadline. In retrospect, lower energy prices may have been available if the required renewable energy capacity were identified through a competitive bidding process rather than from a sole source contract with one provider. The power purchase agreements between FPL and the utilities expire in 2011, or halfway through the turbines' economic life. It is reasonable to expect a new round of price negations for the Montfort energy production at that time.

RECENT DEVELOPMENT EVENTS

Over the last several years, four commercial wind projects have been proposed in Wisconsin that provide useful examples of the development process. One project proposed for the town of Addison in Washington County was, by most accounts, a nightmare for all parties involved. The developer ultimately withdrew the proposal for 28 utility-scale wind turbines. Another development proposal in Fond du Lac

[20] See http://www.dodgeville.com/vacation/attractions.html

County in northeast Wisconsin has just been permitted for 88 turbines or 160 MW of wind generation. A third project in Dodge County is now in the permitting process for 54 MW of wind capacity. The last project, near Darlington in Lafayette County in southwest Wisconsin, has received approval for up to 99 MW of new wind facilities. If all sites are developed, Wisconsin will increase its wind generation by 313 MW, or six times its existing wind capacity, marking a new era for wind power in the state. This section will provide an overview of the development issues in each of the four project areas.

ADDISON

In the summer of 1998, the Town of Addison in Washington County emerged as a leading candidate for wind development. In October of that year, FPL Energy submitted a proposal to WE and Alliant to develop a wind farm in Addison and sell them the power. The two utilities accepted FPL's proposal in February 1999 and long-term power purchase agreements were signed in April. In June 1999, FPL received approval from Addison Township to erect three meteorological towers to perform a detailed study of the wind resource.

In September of 1999 FPL submitted an application to Addison Township to construct a 29.7 MW wind power project, consisting of 33 NEG 900 kW wind generators. The submittal set in motion a series of events that would tear at the fabric of the community for years. The Addison wind farm controversy would pit neighbor against neighbor, cause resignations of local elected officials, generate multiple lawsuits and legal challenges, and terrorize the town with a bomb threat. The events that took place in Addison ultimately saw FPL abandon its plans for a wind project and in many ways would influence development strategies for all future wind projects in Wisconsin and across the country.

A full analysis of the Addison experience would be too lengthy for this study. Therefore, only an overview and assessment of the critical events is presented. Shortly after FPL submitted its CUP application, a Milwaukee Journal Sentinel article reported FPL's wind farm proposal. Soon after, another newspaper article reported complaints about turbine noise at the WPS project in Lincoln. The next month a scheduled public hearing on the CUP application in Addison was cancelled because of the overflow crowds that showed up at Addison Town Hall. Opponents were primarily concerned about the impact on property values and, to a lesser degree, turbine noise. FPL withdrew its application, determined to increase its public education and outreach. They assumed that once people learned more about wind turbines, public opposition would decrease.

Led by non-resident, project opponents organized as the Town of Addison Preservation Group[21] (TAPG). FPL responded by hosting four informational meetings on its proposed project at the Washington County Fairgrounds. The meetings addressed turbine noise and environmental impact, and included visual and aural models of the wind farm. The company also indicated it would pay $860,000 in property taxes to the county, and make additional voluntary payments that would amount to $1 million over 25 years. Judging from their comments, project opponents were unconvinced. It appeared that people were angry about seeing turbines in the landscape. It's worth mentioning that Addison and its surrounding area have grown

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[21] TAPG launched a petition drive to stop the project and created a web site where they published negative and unsubstantiated claims about the impact of wind turbines. The web site, www.misplacedwindpower.org, is still on-line but inoperable.

significantly in last decade. It's the community's easy access to Milwaukee via State Highway 41 that has resulted in the development of new and expensive subdivisions. In general, it seemed that the strongest opposition came from new residents while local farmers and long-time residents were more supportive of the project.

Meanwhile, TAPG members organized their own informational session meeting in West Bend and presented their views on the project. Turbine host landowners and other project supporters formed their own group called the Taxpayers for Addison Wind Farm.

In December 1999, TAPG initiated the first legal action against the project. They sought an order compelling the Town of Addison's Zoning Administrator to prove whether utility-scale wind generators were allowable under the local zoning ordinance. In February 2000, a Circuit Court judge issued the order, and subsequent to the hearing, the Zoning Administrator issued the requested interpretation, and the motion was dismissed. FPL resubmitted its CUP application. At the same time, TAPG requested an ethics violation investigation. The group alleged violations by town officials of the state's open meetings law, open records requests and ethics matters. In late February, the district attorney decided no action was required.

The CUP application was withdrawn again in January after FPL received notice from the Federal Aviation Administration that several of the tall towers could interfere with aircraft flight paths. Faced with additional delays, WE and Alliant terminated their power purchase agreements with FPL Energy in August 2000 citing their obligation to fulfill their Act 204 requirements by December 31, 2000.

Opponents believed that loss of the power purchase agreement would doom the project, but in October 2000, FPL submitted its third CUP application to Addison. Opponents now claimed the wind farm would be a merchant power plant and that the Town should not permit an energy facility that could sell power to out-of-state buyers. The new application called for a 25.2 MW project consisting of 28 900-kW turbines, which was five fewer turbines than in previous applications. The loss of five turbines also reduced the number of host landowners. Several of these supportive landowners now became opponents, which further increased divisiveness in the community. The CUP application provided that no turbine would be erected within 1,000 feet of a residence, and noise from the turbines would fall below 50 decibels at a distance of 450 feet beyond the tower.

TAPG again filed complaints in November of 2000 alleging violations of open records and meetings laws. Over 500 people jammed into a local high school gymnasium to attend the December hearing and more than 100 people gave testimony. At this stage, opposition arguments began to take on a new scope and tone. Opponents complained the turbines would sound "like a fleet of 747's revving for take-off." Others said the turbines would cause birds to burst into flames and fall to the ground and start wildfires. Others expressed fears about stray voltage and earth currents.[22]

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[22] Stray voltage and earth currents are not the same. Stray voltage is caused by faulty wiring, and has typically been found on the customer's side of the meter, although broken grounds on service transformers can cause similar problems. Earth currents are caused by phase imbalances on the electric distribution system and are inherent in the design. Wind turbines cannot cause stray voltage. Turbines, like any other generator, will most likely have no effect on distribution phase loading difference and hence should not affect whatever level of earth currents exist prior to their installation.

In February 2001, TAPG filed a lawsuit in Washington County seeking a judgment clarifying the Town of Addison's authority to regulate wind generation within its borders. In an unrelated but timely matter, the Wisconsin Second Court of Appeals in its *Numrich v. Mequon* ruling affirmed the statutory limitations on local governments to regulate wind energy systems. TAPG later argued this ruling wouldn't apply to commercial wind farms. This spurred the Town of Lincoln Moratorium Committee to request clarification from the State of Wisconsin Attorney General. On March 27, 2003, the Attorney General responded with an opinion that the provisions of Wisconsin Statute 66.0401 are applicable to commercial wind energy projects.

Feeling understandably overwhelmed, and on the advice of the town attorney, the Addison Plan Commission recommended hiring a consultant to review the FPL application. The Town Board hired a Green Bay-based engineering consulting firm to evaluate technical issues arising from the proposed wind farm.

In June 2001 and continuing through the fall, the town government was thrown into chaos. Board members resigned, town meetings were cancelled and recall petitions were circulated as wind farm proponents and opponents wrestled for control over the Town Board and Plan Commission. When it was over, two town chairpersons and four town attorneys had been replaced. It was not until December 2001 that the Board agreed to a procedure and timetable for reviewing and taking action on the wind farm proposal, with the final decision expected at the end of January.

Finally, in January 2002, following a review of the engineering consultant's report, the Addison Plan Commission issued a preliminary decision on FPL's application which would require a 1,000-foot setback from all roads, all property lines and all off-site residences. According to FPL, only eight of the proposed turbines would satisfy the Plan Commission's prescribed setbacks. After more than three years, and with the CUP held up for more than fifteen months, FPL Energy finally abandoned the project, claiming that the setback requirements make building a wind farm in Addison "uneconomic."

Sadly, the problems facing the community are not over. In September 2002, the town was notified that its insurer was canceling municipal coverage due to over $47,000 in claims for legal costs that were paid throughout the permitting battle. The next month, twelve landowners who would have hosted the FPL turbines filed a $7.5 million lawsuit against the Town Board claiming they lost revenue due to the Town's actions. It's likely that the wounds inflicted in Addison will take years and years to heal, which is a tragic and unintended outcome of FPL's project proposal.

There is an interesting postscript to the Addison project involving a local attorney who served as a leader of the pro-wind Taxpayers for Addison Wind Farm group. He has since formed Addison Wind Energy, LLC to purchase and install a single utility-scale turbine on his parents' property. They were among the landowners originally slated to host a FPL turbine. In July 2003 Addison Wind Energy submitted a CUP application that was approved in January 2004. The energy from the turbine will be sold to WE under a long-term power purchase agreement.

WE ENERGIES RFP

On December 18, 2002, WE issued a request for proposals for 200 MW of new wind generation to meet its internal company goal of generating five percent of its energy from renewable energy resources by

2011. Proposals were submitted on February 28, 2003 and subsequent negotiations led to the July 28, 2003 announcement that two companies were selected to provide 214 MW of wind power for 20 years from new projects located in Wisconsin. Minnesota-based developer Navitas Energy will provide 160 MW, and Chicago-based Midwest Wind Energy will develop 54 MW.

At the time of the announcement, the project locations were described only as "eastern Wisconsin" and "southeastern Wisconsin." The lack of specificity was intentional and meant to allow the developers time to initiate the permitting process without outside intervention. Looking back, this strategy may have been wise. In May 2003, Navitas announced plans for a 50 MW wind project in the Town of Maple Grove in Shawano County. Shortly thereafter, Shawano County imposed a one-year moratorium on new wind development projects. The moratorium was imposed at about the time it was reported that one of the leading Addison wind farm opponents had consulted with Shawano County landowners and government officials.[23] In July 2003, Navitas withdrew its proposal.

A brief description of the development activities for the Navitas and Midwest Wind Energy projects follows.

Fond du Lac County

On November 6, 2003, Navitas Energy received approval from the Town of Marshfield in northeastern Fond du Lac County to construct 44 Gamesa 1.8 MW wind turbines north of Highway 149. Marshfield has its own zoning laws, thereby simplifying the permitting process. In addition, utility equipment is a permitted use on land zoned for agricultural uses. The result was the creation of a joint development agreement between Navitas and the Town of Marshfield in which Navitas agreed to the setback requirements, noise limits and other conditions in exchange for authorization to construct the turbines. Under this approach the developer does not need to seek a conditional use permit for the project. In exchange for imposing a set of siting and legal requirements on Navitas and its participating landowners, the township is obligated to issue the permits required to build and operate the wind farm. Under the terms of 2003 Wisconsin Act 31, the county and town will share about $320,000 a year once the turbines are installed. One third of this amount will go to the town with two thirds allocated to the county.

Prior to formalizing the development agreement, there were several meetings held in Marshfield, attended by as many as 250 people. Residential landowners raised fears about lowered property values, noise and aesthetic disruptions. Navitas representatives answered people's questions. Also, landowners involved in the Byron turbine project were there to offer their perspective on life with wind turbines. The Marshfield Town Board subsequently voted to approve a construction agreement.

The turbines are scheduled to be on-line by the end of 2004. However after the Marshfield Town Board approved the development agreement, a small group of landowners calling themselves the Concerned Citizens of Marshfield filed suit against the Town Board on January 2, 2004. The suit alleges that the town's approval of the project was illegal and they raise a number of concerns about the potential impact of the turbines. As of the date of this report, the lawsuit remains open, although project proponents

[23] See *Milwaukee Business Journal* June 6, 2003.
http://www.bizjournals.com/milwaukee/stories/2003/06/02/story2.html?page=1

believe it will be resolved without jeopardizing the target commissioning date. According to a report in the local newspaper, both Town Attorney John St. Peter and Navitas Energy Director of Development Chris Moore said they are confident the Fond du Lac County Circuit Court would uphold the original joint development agreement signed Nov. 3, and will allow construction to continue.[24]

Just about a month after receiving approval for the Marshfield project, Navitas obtained approval on December 2, 2003 to construct a second 44-turbine project (also based on the Gamesa 1.8 MW machine) in neighboring Calumet Township. The Town Board granted its approval with a unanimous voice vote. . To date, there have been no reports of public opposition or pending lawsuits. The Navitas wind installations in Fond du Lac County total 160 MW. Navitas still needs to acquire DNR permits to cross wetland areas dispersed through both townships.

Dodge County

Midwest Wind Energy won a competitive bid to supply WE with 54 MW of wind energy. The project is still awaiting approval from Town of Herman officials in eastern Dodge County. Several public meetings have been held in the township as part of the permitting process. Like at Marshfield, the developer had representatives at the meetings to answer questions and address public concerns. There appears to be some opposition covering many of the same issues heard elsewhere, namely noise and aesthetics. While Dodge County has established a wind turbine overlay district as part of its zoning ordinance, the Township has adopted its own ordinances and has sole-decision making authority within its borders.

Darlington

In August 2002, the Milwaukee-based Business Journal ran a story announcing a 200 MW project proposed by an "unidentified developer,"[25] slated for the Darlington area in southern Lafayette County (approximately 25 miles southeast of Montfort). This report proved to be untrue and was likely based on the results of a transmission study that looked at how existing power lines could handle large amounts of wind power.

It was not until November 17, 2003 that an actual development plan was identified for the Darlington area, when the Lafayette County Planning and Zoning Committee approved a 70-turbine joint development agreement for a project on a ridge west of Darlington in the town of Seymour, near Highway 81 between Darlington and Platteville. The developer is Texas-based Zilkha Renewable Energy Company.

This project will have an installed capacity of up to 99 MW. Under current state law, generation projects 100 MW or larger require a Certificate of Public Convenience and Necessity from the PSCW which would entail a much longer, more complicated and expensive permitting process. The county handled the project zoning because the town did not have the necessary resources to comfortably manage a zoning request for a project this large. Reports in the news quote the county zoning administrator as saying, "Zilkha has been working with the county and town government over the past year after conducting

[24] *Fond du Lac Reporter*, January 22, 2004.
http://www.wisinfo.com/thereporter/news/archive/local_14281052.shtml

[25] *Business Journal*, August 26, 2002. http://www.bizjournals.com/milwaukee/stories/2002/08/19/story1.html

studies of the area where it proposes to build the towers. They do not need county approval to do this but felt they wanted the support of all the local governments."[26] As part of the zoning approval process, Zilkha conducted environmental studies of the area looking at noise impact and the flight patterns of migrating birds, as well as the impact on the land. Details of the joint development agreement are not yet available. Publicly available information does show a high level of support for the project. In testimony filed before the PSCW in an unrelated case, Zilkha states:

> "Lafayette County and the town of Darlington have been very supportive of the Project. There has been significant local press that has been positive and an enthusiastic response from landowners who quickly signed (development) options with Zilkha. In addition, we have received letters of support from the Mayor of Darlington."[27]

One interesting aspect of the Darlington project is that it is being developed without a pre-negotiated power purchase agreement from a utility, and is not being developed in response to a state mandate. It is possible that Zilkha applied for project permits in part as a hedge against a constrained transmission system in southwest Wisconsin. By securing access to both the site and available transmission capacity, Zilkha may be protecting its interests against other developers in the area. As the latest announced project in the state, it demonstrates the existence of a maturing and viable market for wind energy in Wisconsin.

WISCONSIN WIND POWER POLICY

The previous sections looked at the historical development activities of commercial wind farms currently operating in Wisconsin. This section will offer comment on two aspects of the development climate in Wisconsin. The first is current state policies and how they affect or influence wind power development. The second aspect is current wind development activity in Wisconsin surrounding projects that have been announced but are not yet in service. This section concludes with a series of policy recommendations that would provide further stimulus for increased wind power development in Wisconsin.

WIS. STAT. §70.111(18) - PROPERTY TAX EXEMPTION (1989)

In one of its earliest actions related to renewable energy, the legislature exempted wind and solar power systems from personal property taxes. This policy, in effect since 1989, prevents the increase of property taxes due to the value of qualifying wind and solar power systems. Similarly, landowners who host large wind turbines installed as part of a community-owned project or by a developer can be sure there will be no increase in property taxes due to the presence of the machines.

ACT 414 - STATE ENERGY POLICY (1994)

Wisconsin Act 414, enacted in 1994 and now codified as Wis. Stat. §1.12, established a priority hierarchy for the installation of new generation capacity with a clear preference given to non-combustible renewable energy resources. It can be argued that while Act 414 did not result in utility construction or

[26] *Wisconsin State Journal*, Page B2, November 7, 2003. http://www.madison.com/archives/read.php?ref=wsj:2003:11:07:287123:LOCAL/WISCONSIN

[27] Direct testimony of Elizabeth Hutchinson. PSCW Docket No. 05-CE-121

procurement of renewables, it did establish a knowledge base, and produce basic familiarity with the technologies that would have been otherwise absent within utility planning departments.

The pertinent language of Act 414 is presented below.

1.12 State energy policy.

(3) GOALS.

(b) *Renewable energy resources.* It is the goal of the state that, to the extent that it is cost-effective and technically feasible, all new installed capacity for electric generation in the state be based on renewable energy resources, including hydroelectric, wood, wind, solar, refuse, agricultural and biomass energy resources.

(4) PRIORITIES. In meeting energy demands, the policy of the state is that, to the extent cost-effective and technically feasible, options be considered based on the following priorities, in the order listed:

(a) Energy conservation and efficiency.

(b) Noncombustible renewable energy resources.

(c) Combustible renewable energy resources.

(d) Nonrenewable combustible energy resources, in the order listed:

1. Natural gas.

2. Oil or coal with a sulphur content of less than 1%.

3. All other carbon-based fuels.

(5) MEETING ENERGY DEMANDS. (a) In designing all new and replacement energy projects, a state agency or local governmental unit shall rely to the greatest extent feasible on energy efficiency improvements and renewable energy resources, if the energy efficiency improvements and renewable energy resources are cost-effective and technically feasible and do not have unacceptable environmental impacts.

PSCW ORDER 6690-UR-07 – NET METERING (1993)

The PSCW authorizes net metering through Order 6690-UR-107, which was issued December 29, 1992 and effective on January 1, 1993. The order applies to all utilities under the jurisdiction of PSCW. Wisconsin's net metering applies to all customer-owned electric generation facilities that are interconnected with the utility's power supply, are rated at 20 kW or less, and have entered into a parallel generation contract with the utility. If a customer wishes to be eligible for net metering but has more than one generator, the sum of all generators must be no more than 20 kW.

Under net metering, energy flowing from the customer's generation facilities into the electrical system of the utility is permitted with the utility's electric meter allowed to run backward. If the amount of energy supplied to the utility exceeds the amount of energy consumed, the customer will receive a credit on his or her monthly bill. This will be equal to the net excess kilowatt-hours of energy received by the utility, multiplied by the Energy Credit Rate, and including any applicable adjustments for cost of fuel. If a customer has more than $25 in credits due to excess energy power sales, the utility is required to send the customer a check for that credit. For customers with time-of-use rate, a second time-of-use meter must be installed and the on-peak purchases and sales will be netted separately from off-peak purchases and sales. For renewable resource generators, the energy credit rate is the customer's retail rate.

Net metering has been a significant and beneficial policy to spur the development of the residential renewable energy market for systems less than 20 kW. There is, however, a growing market demand and consumer interest in larger wind power systems ranging in size from 65 kW for small rural businesses and farms all the way up to single 1.5 MW turbines for larger farms and businesses. Without the benefit of net metering, these larger projects face economic barriers due to the low rate for any excess power generated paid by utilities. Suggested modifications to Wisconsin's net metering laws will be covered in the next section.

WIS. STAT. §66.0401 – RENEWABLE ENERGY SITING LAW (1994)

Originally written in 1981, Wisconsin Statute 66.0401 limited the ability of local governments to deny a permit for the construction of solar energy systems except for issues related to public health or public safety, or unless limits imposed by the local government did not adversely affect system cost or performance. In 1994, an amendment to the statute was included as part of Act 414 to include wind energy systems.

Wis. Stat. §66.0401 now reads in part as follows:

> **66.0401 Regulation Relating to Solar and Wind Energy Systems**.
>
> **(1)** AUTHORITY TO RESTRICT SYSTEMS LIMITED. No county, city, town, or village may place any restriction, either directly or in effect, on the installation or use of a solar energy system, as defined in s. 13.48 (2) (h) 1. g., or a wind energy system, as defined in s. 66.0403 (1) (m), unless the restriction satisfies one of the following conditions:
>
> > (a) Serves to preserve or protect the public health or safety.
> >
> > (b) Does not significantly increase the cost of the system or significantly decrease its efficiency.
> >
> > (c) Allows for an alternative system of comparable cost and efficiency.

In 2001, the intent of 66.0401 was upheld by the Wisconsin 2nd Court of Appeals in response to a legal challenge by the City of Mequon Zoning Board of Appeals. This decision was upheld and finalized when the Wisconsin State Supreme Court refused to hear Mequon's challenge to the 2nd Court of Appeals decision.

The language of 66.0401 and its intent are simple, clear and concise, and it is one of the strongest policy tools available to address local permitting of wind energy systems. Over the last several years, opponents of wind energy have tried to stop the construction of wind turbines with claims of public health and safety issues. Local government officials are often not equipped to address the myriad of concerns raised by residents or project opponents whether these concerns are legitimate or imagined. In response, they might impose artificial limits on the construction and siting of wind turbines under the rubric of public health and safety. The best examples of these actions are arbitrary limits on tower height and unduly conservative setback requirements.

ACT 204 - RENEWABLE SET-ASIDE (1998)

Reliability concerns prompted by electricity shortages in the summer of 1997 provided a legislative opportunity to incorporate renewables more firmly into the state's energy mix. Electric reliability legislation adopted in 1998 (1997 Wisconsin Act 204) contained a provision obligating the four eastern Wisconsin utilities – Wisconsin Electric Power (now We Energies), Wisconsin Public Service Corporation, Madison Gas & Electric and Alliant Energy – to build or acquire a total of 50 MW of new renewable generating capacity by December 31, 2000. This mandate, now satisfied, was a significant driver for the construction of the first wave of wind power projects in Wisconsin.

Table 2 below shows each utility's required capacity allocation and how that requirement ties into Wisconsin's operating wind farms. WE and Alliant's remaining Act 204 requirements were met with other qualified renewable energy technologies such as landfill gas and paper mill sludge.

TABLE 2: ACT 204 REQUIREMENTS FOR UTILITIES

UTILITY	ACT 204 REQUIREMENT	WIND CONTRIBUTION AND SOURCE
We Energies	27 MW	25.5 MW – Montfort
Alliant Energy	11 MW	4.5 MW – Montfort
Wisconsin Public Service	9 MW	9 MW Lincoln
Madison Gas & Electric	3 MW	3 MW Rosiere
Total	**50 MW**	

In addition to imposing a new renewable generation requirement on certain utilities, Act 204 also imposed dramatic changes to the power plant siting landscape. The law eliminated a regulatory determination of need for independently owned power plants under 100 MW. By eliminating state oversight over this category of generators, Act 204 effectively handed siting authority over to local governments. For non-utility wind power developers, only local land use permits are required for siting turbines in Wisconsin, up to a maximum of 99 MW. The combination of a renewable generation requirement and the relaxed permitting environment provided a powerful inducement for independent power producers to venture into Wisconsin in search of viable wind energy development opportunities.

ACT 9 - RELIABILITY 2000 (1999)

Eighteen months after Act 204's adoption, Wisconsin became the first state in the nation to establish a renewable portfolio standard (RPS) independent of retail competition. The state's RPS, contained in comprehensive legislation known informally as Reliability 2000 (1999 Wisconsin Act 9), went into effect at the end of 2001, and incrementally increases the contribution of renewable power sources to the state's electric energy mix, rising from 0.5% in 2001 to 2.2% in 2011. This requirement is placed on Wisconsin utilities selling retail power, and they have the option of generating the electricity themselves, purchasing the renewable electricity, or purchasing renewable energy credits from utilities that have supplies of renewable electricity in excess of their requirements.

Unlike the Act 204 capacity mandate, all Wisconsin utilities are subject to the RPS. Under the RPS, hydroelectric units placed in service before January 1998 are capped at a 0.6% maximum credit towards meeting the RPS requirement.

The other significant element of Act 9 was to create a Public Benefits program in Wisconsin wherein participating utilities would assess a public benefits surcharge on all retail customers. The collected funds would then be used to support energy efficiency, conservation and renewable energy programs, including direct support for the construction of qualified renewable energy systems. To date, one of the greatest achievements of the public benefits program has been to increase consumer awareness and support of renewable energy including small and large wind energy systems.

ACT 31 - GENERATION SITING INCENTIVES (2003)

In 2003, the Wisconsin legislature amended the Utility Shared Revenue Payments laws that provide financial compensation to local governments through shared revenue accounts for energy infrastructure in lieu of property tax assessments. Under the terms of Act 31, a wind power plant of 50 MW or larger built after 12/31/03 will, beginning in 2005, contribute a payment to the shared revenue account for the host county and municipality (or township) each year. The total financial obligation is determined by multiplying the plant capacity (number of MW) by $2,000. If the plant is located in a township, the town will receive one-third of that total and the county will receive two-thirds of that total.

Towns and counties that host projects under 50 MW would not be required to receive local aid from these projects because the generating entity is not subject to the gross receipts tax under current law. But there is nothing in state law that prevents the owner of a smaller wind farm from negotiating a similar formula with host communities. Such compensation would flow directly from the developer or owner to the town and county, and not involve the State of Wisconsin.

PSCW RULE 119 - INTERCONNECTION STANDARDS (2004)

Wisconsin has required electric utilities to interconnect non-utility and privately owned distributed generators since the early 1980's. Throughout this time, each utility has developed its own unique set of requirements and application processes. The result has been a balkanized and confusing landscape for individuals and businesses. In addition, utilities were not required to process applications in a timely manner, which created serious barriers to the economical implementation of renewable energy projects. In response, the PSCW convened a multi-year process to develop distributed generation (DG) interconnection rules, and revise outdated interconnection rules for small renewable generators. A collaborative group consisting of renewable energy advocates, utilities, insurance industry representatives, manufacturers and regulators developed the PSCW's interconnection rules (PSC 119), and accompanying Interconnection Guidelines. These rules categorize DG systems and the attendant interconnection requirements by capacity as follows:

- Category 1: 20 kW or less
- Category 2: Greater than 20 kW to 200 kW
- Category 3: Greater than 200 kW to 1 MW
- Category 4: Greater than 1 MW to 15 MW

The interconnection rules establish both a Standard Application Form and a Standard Interconnection Agreement. Insurance requirements and interconnection application fees are also based on these categories. The rules became effective February 1, 2004. While the standardized interconnection process will not affect wind projects larger than 15 MW, the rules will aid smaller wind development efforts such as community-owned turbine projects.

WISCONSIN POLICY RECOMMENDATIONS

The policies, statutes and regulatory orders previously discussed have been the primary development drivers for the existing wind capacity in Wisconsin, and have assisted in removing most of the institutional barriers impeding project construction and siting. In spite of the state's progressive attitude towards wind energy, barriers still remain, particularly in the local zoning approval arena. Also, investment decisions for generating capacity remain skewed towards conventional resources primarily due to federal subsidies for coal, gas and nuclear technologies, and failure to capture the cost of environmental and health externalities. As a result, renewable energy technologies will continue to require proactive energy policies and legislation for the foreseeable future.

In retrospect, 42 MW (or 76 percent) of the 55 MW of installed wind capacity in the state can be attributed to Wisconsin Act 204. Consumer demand, and the utilities' responsiveness to that demand, is responsible for the remainder. Clearly, mandates and market drivers were critical to Wisconsin's early wind development activities. As discussed, Wisconsin has a favorable public policy environment for the siting and development of renewable energy systems, including large and small-scale wind turbines, but there is more to be done. State leadership must remain strong if Wisconsin's economy, environment and electric system are to realize the full benefits available from wind power.

ESTABLISH RENEWABLE GENERATION TARGET

The first recommendation is that the PSCW asks Wisconsin utilities to work toward a target of 10% renewable generation by 2011. This would essentially double the amount of renewable electricity that the current Renewable Portfolio Standard (RPS) would leverage. A target, as opposed to a mandate, would allow a utility some flexibility in pricing the renewable electricity, whereas under a RPS the renewable output must be rolled into the rate base. The flexibility in pricing would encourage Wisconsin utilities to look within state borders for the renewable electricity, something the RPS is not necessarily set up to do.

UPDATE GREEN POWER PRICE STRUCTURE

Second, we recommend that Wisconsin utilities be encouraged or required to sell green power through a fixed-term rate arrangement instead of as a premium. Green pricing is designed to mobilize extra customer dollars to support renewable generation that would otherwise not be built because of higher costs. Most Wisconsin utilities have a green pricing program in place, and the vast majority of green power subscribers are residential customers. In addition, We Energies has been successfully marketing its Energy for Tomorrow program to an increasing number of commercial customers. Green power would be more attractive if the energy could be purchased through a rate based on contract prices fixed over a certain term rather than through a premium that goes up when the standard rate goes up. In other words, a fixed rate contract would offer consumers a hedge against rate increases and fuel price volatility.

CREATE SALES TAX EXEMPTION

A sales tax exemption for renewable energy systems, perhaps with a 5 MW limit, would reduce the entry level cost for people and organizations that want to invest in Wisconsin's clean energy future. The cost-effectiveness of customer owned renewable energy depends in part on system size. Economies of scale allow for unit cost reductions as system size increases. The front-loaded nature of renewable energy equipment places a premium on the number of kWh that can be produced or displaced. As a general rule, smaller renewable energy projects with higher costs per installed kilowatt have disproportionately larger requirements for reductions in the revenue stream to recover equipment costs. This puts smaller customer-sited systems at a disadvantage relative to larger, more centralized systems. Yet, there is strong interest statewide for customer owned wind projects ranging in size from several kilowatts up to two MW.

When sales or use taxes are added to the cost of customer-sited wind projects, they create another cost barrier to an investment in renewable energy. Under most circumstances, owners of small utility-scale or community owned wind systems are not able to depreciate their equipment as aggressively as larger commercial enterprises can, nor is the federal production tax credit as accessible. The fiscal impact of this would likely be small. Assuming an average installed cost of $1,500 per kilowatt, 5 MW of new wind installations per year would yield a tax revenue reduction of $412,500 annually but would result in nearly 11 million kWh of in-state clean energy production.[28]

REQUIRE STATE PROCUREMENT

The State of Wisconsin can become a driver for local production of green power through its own electricity procurement policies. State government could require purchase of at least 10 percent of its own electricity consumption from renewable resources by 2005 and 20 percent of its consumption by 2010. Such a directive could take the form of legislation or an Executive Order. State willingness to procure renewable power above state mandated minimums would depend heavily on the attractiveness of individual utility programs. Moreover, the state would benefit greatly from the recommendation that utilities provide green power through a fixed-term rate.

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[28] Assuming a 5.5% sales tax rate and a 25% effective capacity factor.

RENEWABLE ENERGY BUY BACK RATE

Currently, renewable energy systems larger than 20 kW are not eligible for net metering. An individual, small business or group of community investors who want to develop a wind project larger than 20 kW must either accept a standard tariff customer owned generation (COG) buyback rate for any excess energy production or negotiate a power purchase agreement with the local utility. Since off peak COG rates are typically in the two to three cent per kWh range, the overall economics of a project can suffer. This is especially true with wind energy systems that may produce large amounts of excess power during off-peak hours. There is an emerging market in Wisconsin for small rural businesses and farmers who could derive great benefits from mid-size wind energy systems (65kW to 660 kW) or a single large turbine up to two MW.

Buyback rates for excess energy from renewable generators ought to be raised to reflect their true value to a utility. Until recently, utilities purchasing renewable power from independent generators assumed that all the attributes of that electricity source, including its "renewable" benefits, flowed directly to them. But in a recent decision, FERC ruled that a utility is not entitled to claim the renewable attributes of a particular power source if the electricity is purchased strictly at avoided cost. If the utilities wish to apply the renewable energy they purchase to a renewable standard or target, they should pay for that benefit in the form of a higher buyback rate. Utilities also enjoy the benefit of avoided transmission costs and may see improvements in the stability of rural distribution systems.

A standard renewable energy buyback rate would resolve many of these concerns and create a better economic environment for customer owned wind systems. The rate would apply to systems greater than 20 MW connected to the customer side of the meter, where the primary intended purpose of the system is for on-site energy production and use. For new, renewable distributed generation installations, a blended rate of 6 cents/kWh is the minimum recommendation. All renewable resources as defined in Wis. Stat. 196.378 should be eligible for the 6-cent rate, with the exception of landfill gas operations greater than 500 kW. The buy back should also be indexed to the standard rate in the customer's class. In that way, future rate increases would automatically increase the renewable buyback rate as well. The buyback rate would not be available for projects larger than 2 MW that connect directly to the distribution system or transmission system, and whose primary purpose is commercial energy sales.

It is noted that Alliant currently has an experimental tariff which offers a blended 6 cent rate for certain biogas facilities and MGE has just implemented a 6.1 cent tariff for wind power, solar, biomass and biogas derived from livestock manure.

INCREASE NET METERING LIMITS

An alternative to the renewable energy standard buyback would be revising Wisconsin net metering laws to include larger systems in the purchase of excess electricity at the full retail rate. There are two options to achieve this goal. The first would be to establish a fixed capacity limit for net metering, such as 2 MW. A two-megawatt limit would provide incentives for customer-owned generation up to and including a single large utility-scale turbine. The other option would be to allow full net metering for all kilowatt-hours up to the customer's own use level. Separate meters would monitor how much energy the customer is using and how much energy is being produced from the renewable energy generator. The customer would get a one-for-one credit for all production up to his or her level of consumption. Any excess energy production above that level would be purchased by the utility either at the standard renewable energy buy-back discussed above or at some other rate that reflects the value of renewable energy.

Due to the importance of the net metering issue, a study was commissioned for this report from Heather Rhoads-Weaver of Northwest SEED. (The full Northwest SEED net metering study, "Building the Distributed Wind Generation Market in Wisconsin: The Key Role Cooperative Net Metering and Other Policy Mechanisms Could Play" appears next as Section B). Her study examines net metering policy initiatives currently in place and how they affect the market for distributed generation. It also identifies key recommendations for the future of Wisconsin's net-metering laws.

ADDRESS TRANSMISSION ACCESS CONCERNS

Larger wind projects designed for commercial power sales to the local power company or sales to non-local utilities require access to the transmission system for disposition of the energy. After permitting, gaining access to the transmission system is one of the most challenging aspects of wind project development. Currently, the American Transmission Company requires a minimum of eighteen months to construct a substation that provides the electric link between a wind farm and the interconnected transmission system. Also, there have been reports of long delays for processing interconnection requests at the Midwest Independent System Operator. More importantly, congestion on the transmission system is limiting the ability of utilities to contract for the purchase of additional green power from wind projects, in spite of growing consumer demand for more green power options.

Greater state support is necessary to help alleviate these problems. One legislative option is to enact Wires Renewable Portfolio Standard legislation. The Wires RPS is the delivery counterpart to the renewable energy generation RPS. It is logical that a requirement to generate a certain amount of energy from renewable resources be augmented by a requirement that adequate transmission capacity for this power be made available. Again, the state's ability to require a standard like this is limited but there should be a dialogue between the state and the American Transmission Company to explore all options that will reduce transmission barriers for renewable energy.

A more proactive approach would be for the Wisconsin PSC to convene a collaborative among transmission owners and operators, wind developers, wind advocates, local government representatives and environmentalists to explore how transmission project planning could be adapted to accommodate the output of wind turbines from high-probability development areas such as southwest Wisconsin. The Southwest Minnesota Transmission Line Reinforcement Project stands as a precedent for this type of collaboration with the hearings they held in 2002 and 2003. Multiple interveners and Excel Energy worked together to develop a plan that would ensure a transmission outlet for new wind generation on Buffalo Ridge.

WIND ENERGY AS PERMITTED USE

The state, working through the Department of Administration and its Smart Growth[29] comprehensive planning initiative, should evaluate its options to encourage the drafting of zoning laws that would allow wind turbines as a permitted use in agricultural-zoned land. Currently, many local zoning laws allow utility infrastructure such as power lines and substations as permitted uses on agricultural land. Extending this permission to wind turbines would mitigate many of the problems associated with the conditional-use permit process that is often required to allow non-permitted development on agricultural (or any other) land.

CONCLUSIONS

Taken in total, an examination of the successes and failures in siting and operating wind energy projects in Wisconsin leads to several ready conclusions.

IMPACT OF EXTERNAL DEADLINES

In the case of MGE's wind development, the impending expiration of the federal Production Tax Credit forced the utility to compress its outreach and education efforts. The utility simply didn't have the time to communicate informally with local community leaders, potential project participants, and their neighbors. At the sites under consideration, local residents became aware of MGE's intentions only a month before the utility filed its applications. This lack of advance communication, though understandable, caused needless consternation among local residents and started the local permitting process off on the wrong foot. In Montfort's case, the need to comply with Act 204 may have resulted in artificial upward price pressures.

As legislators consider additional actions, whether new renewable portfolio standards, renewable generation targets or state green power procurement goals, care should be taken to ensure sufficient implementation timelines to allow for competitive source procurement procedures to be followed.

CULTIVATE LOCAL CHAMPIONS

To the degree possible, developers should identify and empower a local project champion early in the process who can act as organizer and proponent for the project. MGE's need for hasty action prevented them from performing a due diligence review of the community, including past history with wind power. Opposition arose before MGE could gain any traction in the community. As for Kewaunee County, at least one of the diehard opponents, a former Lincoln Township Clerk, had revealed his anti-wind proclivities when New World Power submitted a proposal five years earlier to erect wind generators in

[29] Historically, Wisconsin towns and counties have had sole authority to adopt, or not adopt, local zoning and land use policies. The 1999-2001 Wisconsin biennial budget changed this by requiring all local governments to develop and implement comprehensive planning. The Comprehensive Planning Law or Smart Growth Law requires all communities to develop master land-use plans by January 1, 2010.

the town. If MGE had been able to investigate the landscape more thoroughly, it may have anticipated some project opposition.

In Addison, FPL clearly underestimated the skills, motivation and staying power of the opposition. It was reasonable to assume that more information and education would satisfy the concerns of the opposition. That assumption can no longer be automatic. FPL apparently suffered geographic discrimination as well. It was easy to vilify an "outsider Florida corporation." Finally, all developers need to pay attention to the first impression they make when meeting local residents. For example, an expensive suit is not necessarily the best wardrobe choice when attempting to gain the trust of farmers and rural citizens.

The turbine layout in the Iowa County project in Montfort helped forge a unified political base of support. Project participants acted as ambassadors by talking to their neighbors and elected officials about the project before Enron filed its CUP application. The landowners were so effective in securing support within the community, that outreach from the project developer was hardly needed.

When project opponents get the jump on participating landowners, the latter have a tendency to become reticent in public discussions, and refrain from championing their own interests for fear of dividing the community further. Intimidation can also be a factor. This puts the developer in the unenviable position of serving as the primary promoter. In Kewaunee County, MGE believed it had to play this role, as did FPL in Addison. It took a while before participating landowners in Red River, with the assistance of the MGE land agent, found their voices and asserted their interests in public forums and before local decision-makers. Had there been enough time for the landowners to communicate with their neighbors prior to the formal permitting process, it is likely MGE's road to project approval would have been a less bumpy one.

Finally, developers need to empower their official representatives or agents to make decisions and offer solutions to citizen concerns during public hearings or other meetings. Lincoln Township residents reported a high level of frustration with WPS representatives who deferred requests for action until they had management approval. On the other hand, it was reported that MGE representatives were able to respond immediately to resident concerns and requests.

RESPECT GROWTH AND SUBURBAN DEVELOPMENT

The risk of encountering or provoking opposition increases in areas experiencing significant (more than one percent per year) population growth and/or new housing starts. In a rural area that otherwise appears attractive for wind generation, suburban-style residential growth complicates the siting and permitting process in several ways. As the number of houses within a half-mile radius around the project site increases, the number of households likely to object to the project increases proportionally.

Residential development of farmland near metropolitan areas is a growing trend in Wisconsin and elsewhere. A number of concerns about this trend are emerging, many of which concern clashes of urban and rural cultures. The newest arrivals in these areas were presumably attracted to its pastoral nature, which for many of them does not include wind turbines on the horizon. Because they most likely commute to work, residents of these suburban developments do not have an economic interest in their land as do the farmers in the area who derive some portion of their earnings from working the land they own. Commuter households tend to be unsympathetic to the economic hardships encountered by resident farmers. In fact, the farmers are frequently viewed as a dying breed whose land will eventually be sold for development.

Suburban development pressure may not be a fatal problem if the remaining farmers still control the local political bodies. In both Kewaunee County and Addison, however, neither the old-line farm families nor the newcomers hold a distinct political advantage, which explains why the matter of future wind development is still unresolved in these towns and suggests that nothing short of a court decision, or new legislation, will likely settle this issue.

PROVIDE TOOLS FOR LOCAL GOVERNMENT

More resources are needed to help local governments work their way through the permitting process. The sudden emergence of big wind power in 1999 surprised the first group of towns approached by wind developers. Their zoning ordinances are silent on siting utility-scale wind generators. In the wake of the Kewaunee County siting battle, several counties have passed ordinances specific to wind development, some more restrictive than others and all of questionable legality under Wis. Stat. 66.0401.[30]

The state would benefit from a consistent set of zoning parameters for wind energy projects. Also, it is very difficult for project developers in Wisconsin to gain a variance from an existing ordinance unless they can demonstrate hardship. Until the state establishes a way to help local governments establish a procedure for reviewing wind power development proposals, conflicts at the local level are likely to be the rule, not the exception, especially for larger projects.

As previously noted, local governments are frequently without the expertise to address either the technical issues or the sometimes emotionally charged concerns about wind turbines. One solution to this conflict would be for the state to develop and promulgate a model wind zoning ordinance that would streamline the siting process, define technical requirements and standards for designating zoning districts such as agriculture, rural residential and commercial and allow non-commercial wind turbines as a permitted use. The model ordinance, if objective and inclusive, could be relied upon to guide the permitting process. Another option would be to create a planning tool kit that can be distributed to local and county governments that would provide objective, concise and useful information for local planners.

TURBINE PLACEMENT

The first generation of wind power projects in Wisconsin (particularly in Kewaunee County) showed that unless developers pay attention to the placement of turbines, noise and blade flicker could become significant issues for nearby residences. The importance of turbine placement and wind farm design cannot be overemphasized. Developers need to make use of visual rendering tools to ensure their project explicitly evaluates the potential effect of noise levels and blade flicker on host landowners and adjacent property owners.

[30] Examples include Door, Dodge and Green Counties.

ADJACENT PROPERTY OWNER CONCERNS

Developers should place a higher priority on finding ways to placate non-host neighbors. Some of the loudest opponents to the Addison project were farmers in the project area who, for one reason or another, were not hosting wind turbines. Rancor among neighboring farm households can play into the hands of opposition leaders, who can exploit these divisions to undermine political support for wind power. If the farmer's nonparticipation is a result of a physical consideration (low lying land, setback problems, etc.), developers ought to consider compensating these individuals in some fashion, especially if they are in a position to influence the outcome of the permitting process.

As previously discussed, developers may want to consider developing a payment plan to compensate adjacent, contiguous non-turbine host landowners and perhaps non-contiguous landowners within a defined radius of the project. Developers should also seriously consider making payments to the local government according to the formula established by Wisconsin Act 31, even if the project is less then 50 MW and therefore not subject to its provisions. This would relieve concerns that non-host landowners and other nearby residents aren't receiving benefits from the project. Presumably, increased revenue to the local government from a turbine project should result in slowing the rise in property tax rates, which is a strong argument in any Wisconsin community.

LOCATION LOCATION LOCATION

Experience suggests it's easier to situate large clusters of wind turbines in western Wisconsin than in eastern Wisconsin. Even though the wind resource is more energetic along the Niagara Escarpment in the eastern half of the state, siting turbines is a more delicate process there due to smaller farm sizes and higher population densities. Furthermore, in western Wisconsin local governments tend to be more receptive to farming constituency priorities than in the east, owing in large part to agriculture's importance to the western Wisconsin economy. There is also a higher proportion of farmers serving on local and county boards in that part of the state. Developers would be well advised to consider the tradeoffs between the costs of a simpler permitting process in lower wind resource regions, and the expense of development in a higher wind area with a more difficult, time-consuming and expensive permitting process.

USE APPROPRIATE DEVELOPMENT STRATEGIES

When the research for this report was first started, we assumed the best development strategy is to be as open as possible. This included holding multiple informational meetings, reaching out to people and sharing as much data as possible. Today, our conclusion is very different. FPL tried the first strategy in Addison and it failed. Conversations with other developers confirm that while they initially shared the belief that reaching as many people as possible during the early stages of a project would make the process easier, experience has taught them otherwise. One developer stated that each piece of information presented to the public was twisted and then used against them, and their project was held up for years.

Current wisdom suggests that developers need to identify willing landowners and discussing permitting concerns with local government officials before making a public announcement. This approach allows conversations to develop naturally and calmly and facilitates an orderly exchange of information. In this way, developers can directly address the concerns of landowners and town officials, free from the pressure of potentially emotional public gatherings where non-resident opponents of wind energy may arrive purposely for a confrontation. When developers work quietly to identify local concerns and permitting requirements, the process is greatly improved and the subsequent pubic hearings can be conducted from a position of knowledge rather than as defense of wind power.

LIST OF ABBREVIATIONS

ABBREVIATION	EXPLANATION
COG	Customer Owned Generation
CUP	Conditional Use Permit
EFT	Energy for Tomorrow
FPL	Florida Power and Light Energy
kW	Kilowatt
kWh	Kilowatt-hour
IPP	Independent Power Producer
MGE	Madison Gas & Electric
MW	Megawatt
PSCW	Public Service Commission of Wisconsin
PTC	Production Tax Credit
WE	We Energies
WPS	Wisconsin Public Service Corporation
WWRAP	Wisconsin Wind Resource Assessment Program

QUESTIONS USED FOR INTERVIEWS WITH UTILITIES AND WIND DEVELOPERS

1. Do you expect your utility to pursue another wind power project within two years? Five years?

Choosing a Developer

2. (Question for utilities) Considering that these were the first utility-scale wind projects in Wisconsin, were there any challenges in finding a wind developer?

3. (Question for Wind Developer) Considering that these were the first utility-scale wind projects in Wisconsin, did being first present you with any challenges?

Choosing a Site—Technical Considerations

4. To what extent has transmission interconnection driven the location of the turbines?

5. Was information available that made it easier to choose a site for a wind farm? If yes, what was the information? If no, what information would have been helpful?

6. Was wind monitoring conducted to assess the wind potential of the site? If yes, how long were measurements taken, and how many monitoring stations?

7. Would you use the site plans and engineering specifications at previous wind farms as a template for planning future projects, or would you make some changes based on your operating experience?

8. Based on your experience, do you believe that you can avoid siting disputes in the future?

9. If so, what are the factors to look for in evaluating a candidate site for future wind development?

10. Is project siting easier to accomplish in southwestern Wisconsin than in eastern Wisconsin?

11. Under current law, utilities must share revenues from wind power projects with host counties and towns, but that requirement does not apply to independent power producers. Is that situation complicating the siting process in Wisconsin?

12. Would you consider pursuing project development opportunities in areas characterized by substantial population growth and the emergence of bedroom communities?

13. How does Wisconsin's siting laws compare with those in other states?

14. Did you have alternative sites in mind in case the primary spot proved problematic?

15. Did having a fallback location work against the primary site?

Working with Landowners

16. What types of arrangements were made with landowners to acquire the land needed for the wind machines and access roads?

17. In rough terms, how much will landowners receive per turbine per year?

18. What was the reaction of landowners toward the project?

19. Did any landowners refuse to allow the turbines to be installed on their land? If yes, why?

20. Are your landowner participants pleased with the way things worked out?

21. What would landowner participants say to prospective landowners wondering whether to host utility-scale turbines on their properties?

Working with the Utility

22. Did utility interconnection rules and requirements make it easy or difficult to connect to the grid?

23. Was new or rebuilt transmission lines, substations, or distributions line required? If yes, who paid for them?

24. Do you know of any rules or procedures issued by the host utility or MAPP, MAIN, MISO, etc. that made it easier or more difficult for connecting to the grid, arranging for transmission service, scheduling the energy with the control area, or dealing with control area imbalance penalties?

25. Has the creation of the American Transmission Company created any special concerns with respect to connecting to the grid, arranging for transmission service, scheduling energy deliveries with the control area, or dealing with control area imbalance penalties?

Working with Local Communities

26. How did you notify the public about your project?

    a. Meetings?

    b. How many meetings were held, where were they held, and who sponsored them?

    c. Were they well attended?

    d. What were the outcomes of the meetings?

    e. Advertisements?

    f. Which media?

27. Was there opposition to the project?

28. What were the concerns of those opposed?

29. Was the opposition widespread?

30. Was the opposition well coordinated?

31. How was the opposition dealt with? Meetings? Settlement?

32. What could have been done to reduce opposition to the project?

33. Was the opposition in Wisconsin different or similar to opposition in other parts of the country?

34. Were any lawsuits filed against the project?

35. Did you have to file, or threaten to file, any lawsuits to keep the project alive?

36. What happened to the lawsuits?

37. Who paid the legal costs associated with these lawsuits?

38. What was the opinion/attitude of your company's senior management toward this project? Did your company's attitude influence the community and/or the success of the project?

39. Did opposition of other projects in Wisconsin influence or affect your project?

40. Were other successful projects helpful in persuading members of the public, potential landowners, and local government officials?

41. Would you do anything differently the next time around to bring local decision-makers up to speed on wind power?

42. How helpful were resident project supporters in the siting process?

43. Nonresident project supporters?

44. Were the education materials you circulated to educate the local community adequate?

45. If not, in what way were they inadequate?

46. Have you upgraded your education materials since the project started operating?

47. Are they accessible and complete enough to support another wind power siting effort?

48. Was the credibility of your utility an issue during the siting process?

49. Do you think the public considers your utility as a credible, reliable information source on wind power?

50. Do you think it makes a difference to the host community what the rationale behind the project is, that is, whether the project is intended to serve a particular utility or to operate as a merchant plant?

51. Given what you now know about opponents to the project, would it have been possible to head off conflict or was it inevitable and unavoidable?

52. In the future, what steps should a developer take to determine if there is someone strongly opposed to a potential development site?

Obtaining Permits

53. Which agencies or boards were formally involved in the project (local, county, state)?

54. Did local or county ordinances (zoning or siting) create any barriers for the development of the wind project?

55. Were local government officials adequately prepared for the decisions they had to make?

56. How long did it take to get the needed permits?

57. For each agency involved, did the agency understand its role, or was there a learning curve?

58. Did agencies work together, or were there turf battles, lack of coordination, or needless duplication?

59. Was it necessary to perform specific impact studies (e.g., environmental, noise, others)?

60. How could the siting/permitting process be improved?

61. Are there any aspects of the permits regulating your project that you regard as being unnecessary or unduly restrictive?

Obtaining Financing

62. How was the project financed? Local, state, or regional banks? Internally (that is, no or little outside funds)? Partnerships? Did Wisconsin present any challenges for project financing?

63. Did the availability of financing (or lack thereof) hinder or advance the project?

64. Did the project rely on a long-term sales agreement in order to move forward? How long was the contract?

65. Does the wind project have to pay local or state taxes?

66. Does the wind project qualify for state or federal tax incentives?

67. Did state or federal tax policies hurt or advance the project?

68. Did the project rely on selling the green portion of the wind electricity separately from the energy?

69. Do you believe that being able to sell and trade the green attributes of wind power is important and/or necessary to support wind power development?

Constructing the Wind Farm

70. Was it hard to acquire the wind machines? Were there long lead times?

71. Were the turbines well suited for the winds in Wisconsin?

72. Was it necessary to build new roads or bridges, or other infrastructure, in order to move forward with the project? If yes, who paid for infrastructure improvements?

73. Did the wind project damage any roads, bridges, or other infrastructure?

74. Were there any complaints about construction noise, construction dust, storm runoff, traffic congestion, etc.?

75. Was it hard to find qualified people or firms to perform the steps needed to obtain permits, to prepare the site, or to install the wind machines?

76. Were these people available locally, or did they need to be brought in from out-of-state?

Operating the Wind Farm

77. Were any full time jobs created as a result of the project? Part time? What are the average wages? Are these jobs short term or long term? Union or non-union?

78. Has there been any vandalism?

79. Since your project started operating, has there been any change in the attitude of local government officials to your turbines? Neighboring landowners?

80. After the wind machines were installed and were operating, did anyone complain about signal interference, blade flicker, and other physical impacts?

81. From a production standpoint, how have the wind generators performed since their installation?

82. Do they present any extra difficulties to the local grid?

QUESTIONS USED FOR INTERVIEWING LOCAL GOVERNMENT AND PERMITTING OFFICIALS

83. When did you first become aware of the wind developer's intention to site a wind power project in your area?

84. Were you aware of either Act 204 (mandating wind development by utilities) or 66.031/66.032 (state statutes regarding siting of wind machines) when wind power became an issue?

85. What authorization was needed in your town/county in order to build a wind farm?

86. Were any special permits, variances, or agreements needed in order to proceed with the project?

87. Were local government officials adequately prepared for the decisions they had to make?

88. How long did it take to get the needed permits?

89. Was it necessary to perform specific impact studies (e.g., environmental, noise, others)?

90. Would you be receptive to a model siting ordinance serving as a template for local governments to adopt?

91. Would the regional planning commission in your area be receptive to this effort?

92. Do you believe that the town's/county's interests were represented fairly in the way the siting process unfolded?

93. Do you think your concerns were adequately addressed in the process of approving the project?

94. How could the siting/permitting process be improved?

95. Based on your experience, do you believe that siting disputes can be avoided in the future?

96. Do you think it makes a difference to the host community what the rationale behind the project is, that is, whether the project is intended to serve a particular utility or to operate as a merchant plant?

97. Given what you now know about opponents to the project, would it have been possible to head off conflict or was it inevitable and unavoidable?

98. Did opposition of other projects in Wisconsin influence or affect your opinion of wind development?

99. What has been the local reaction to the wind project?

100. Did the wind developer/utility provide accurate information about the benefits, costs, and impacts (especially construction and operation) of the wind farm?

101. Was it necessary to build new roads or bridges, or other infrastructure, in order to move forward with the project? If yes, who paid for infrastructure improvements?

102. Did the wind project damage any roads, bridges, or other infrastructure?

103. Were there any complaints about construction noise, construction dust, storm runoff, traffic congestion, etc.?

104. After the wind machines were installed and were operating, did you have any trouble about noise, TV/radio interference, blade flicker, and other physical impacts?

105. What would you say to prospective landowners wondering whether to host utility-scale turbines on their properties?

QUESTIONS USED FOR INTERVIEWING LANDOWNERS

106. How did you hear about the wind project?

107. What types of arrangements were made with landowners to acquire the land needed for the wind machines and access roads?

108. In rough terms, how much will landowners receive per turbine per year?

109. Are you satisfied with these arrangements?

110. Did any landowners refuse to allow the turbines to be installed on their land? If yes, why?

111. Did the wind developer/utility provide accurate information about the benefits, costs, and impacts (especially construction and operation) of the wind farm?

112. Did you have any complaints about construction noise, construction dust, storm runoff, traffic congestion, etc.? Were your complaints dealt with in a timely manner?

113. After the wind machines were installed and were operating, did you have any trouble about noise, TV/radio interference, blade flicker, and other physical impacts?

114. What would you say to prospective landowners wondering whether to host utility-scale turbines on their properties?

115. How could the siting/permitting process be improved?

QUESTIONS USED FOR INTERVIEWING THE GENERAL PUBLIC

116. How did you hear about the project?

117. Did the wind developer/utility provide accurate information about the benefits, costs, and impacts (especially construction and operation) of the wind farm?

118. Did the wind developer/utility provide enough information?

119. Were there any complaints about construction noise, construction dust, storm runoff, traffic congestion, etc.?

120. After the wind machines were installed and were operating, did anyone complain about noise, TV/radio interference, blade flicker, and other physical impacts?

121. Do you think your concerns were adequately addressed in the process of approving the project?

122. Based on your experience, do you believe that siting disputes can be avoided in the future?

123. How could the siting/permitting process be improved?

124. Did opposition of other projects in Wisconsin influence or affect your opinion of wind development?

125. Were other successful projects helpful in forming your opinion of wind development?

126. Were the education materials you received from the utility, developer, or government agencies adequate?

127. Do you think it makes a difference to the host community what the rationale behind the project is, that is, whether the project is intended to serve a particular utility or to operate as a merchant plant?

128. Given what you now know about opponents to the project, would it have been possible to head off conflict or was it inevitable and unavoidable?

Part 1

Section B: Building the Distributed Wind Generation Market in Wisconsin: The Key Role Cooperative Net Metering and Other Policy Mechanisms Could Play

NORTHWEST SEED

INTRODUCTION

INTEREST IN WIND DEVELOPMENT GROWS AMONG FARMERS

A recent national survey sponsored by the American Corn Growers Foundation[31] found a surprisingly strong level of support by corn farmers for wind energy. Over 82% of farmers surveyed agree that rural electric cooperatives should help support and promote wind energy. More than half reported that they would be willing to invest their own money in wind power projects. Almost 38% believe that the best way for farmers to financially benefit from wind development is leasing land to wind developers. Nearly a third of those polled – 31% percent – favor farmer-owned wind co-ops as the best way for farmers to realize financial rewards from wind energy. Only 13% percent feel that purchasing a small wind turbine for individual use is the optimal choice. However, installing a small scale wind project may currently be the most viable option for many Wisconsin farmers, because few own sufficient land to host a commercial-scale wind farm and opportunities to join community wind cooperatives are still scarce in the U.S.

Small farm operators recognize wind as a financially useful tool, and they see wind energy cooperatives as vehicles to help them succeed and prosper. Demand for widespread farmer-owned wind development is increasing, yet current Wisconsin policies may not be adequate to accommodate the potential growth. Awareness is particularly lacking about how rural electric co-ops and municipal utilities can encourage widespread use of small-scale, net-metered wind systems to help meet regional power supply needs.

VARIATIONS OF NET METERING

"Net metering" is a key policy intended to promote customer investment in renewable distributed generation (DG) energy sources. Small-scale wind turbines, ranging in size from 400 watts to 20 kilowatts, qualify as a DG technology in Wisconsin and are eligible for net metering capacity credits.[32] Net metering generally refers to the ability of distributed generators to receive compensation from their utilities for the electricity they generate but do not consume on site. Consumers who have installed grid-connected small wind turbines can watch their electricity meter spin backwards when they send surplus power to the grid for consumption by other grid-connected customers.

Traditionally, net metering has been developed under what has been described as a "load-based" model. Wind turbines are installed at sites where the electricity generated by the turbines is intended primarily for on-site consumption. There are three basic variations on the load-based net metering model currently being used in United States: net billing, net purchase and sale, and simultaneous purchase and sale.

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[31] McGuire, Dan. "National Survey Shows Corn Producers Overwhelmingly Support Wind Energy—Energy Title, State Incentives and Production Tax Credits Have Strong Backing," American Corn Growers Foundation. http://www.acgf.org/programs/nr/2003%20Wind%20Producers%20Survey.asp

[32] Other states have set higher capacity limits for qualifying DG technologies, e.g. California allows net metering up to 1 MW; Iowa and Ohio have no size limits for net metering systems; and Minnesota provides production incentives for wind facilities up to 2 MW.

Load-Based Net Metering:

"Net billing" is the most common and traditional form of net metering. The owner of the small wind turbine offsets his or her own electricity demand during a monthly billing period. Any excess power is banked on the utility grid for use at another time when the wind is not blowing. The customer is then billed only for the net amount of energy consumed each month. Some policies allow for "annualized time offset," a model used in more than a dozen states[33] in which excess energy can be banked annually instead of monthly.

"Net purchase and sale" allows customers to use the sale of their own wind generation to offset energy purchased from their host distribution utility. Any electricity needed above what is generated on-site is bought from their utility at the retail price. Any excess wind generated is sold to the utility at a fixed or negotiated buy back rate. This version of net metering requires more accounting for utilities and may be considered more appropriate for large-scale facilities where on-site energy consumption is minimal relative to the amount of electricity generated.

"Simultaneous purchase and sale" prohibits customers from offsetting their own electricity demand. Any power they produce from DG equipment is sold directly to the utility at a fixed buy back rate. They purchase all electricity they consume from the utility at retail rates.[34] This scheme is not technically net metering.

In addition to the three load-based net metering models just described, new models are emerging that are considered virtual or cooperative net metering. Organizations, communities, and companies are currently developing and implementing innovative approaches for integrating consumer-owned energy generation systems that are not primarily for on-site use. These models include aggregated net metering, the multiple owners model, and donated bill credits as methods of exporting electricity produced by wind turbines beyond the site of generation. While state polices are not yet in place to facilitate widespread adoption of these promising forms of cooperative net metering, a few pioneering projects in the U.S. are paving the way for others to follow. In some cases, wind turbine owners may be able to negotiate project-specific power purchase agreements with utilities to establish new forms of net metering similar to these examples.

Cooperative Net Metering:

"Aggregated net metering" allows for power produced by more than one wind turbine to be aggregated even when two or more turbines are physically separated. The output from the aggregated turbines is treated by the host utility as one single on-site generator.[35] Additionally, a utility could allow electrical loads of multiple consumers to aggregate and offset by a turbine or aggregated source even when the producers and consumers are separated physically (as proposed recently in Vermont and Idaho). This

[33] States with net metering policies which allow net generation to carry over month-to-month include: California, Kentucky, Maine, Montana, New Jersey, New York, Rhode Island, Vermont, Virginia, Washington and Wyoming.
[34] State of Iowa Department of Commerce, Iowa Utilities Board, Docket No. RMU-97-12, January 6, 1998; IN RE: Net Billing. http://www.awea.org/policy/iowanb.html
[35] Wells Rural Electric in Nevada has adopted a policy allowing aggregated net metering for multiple sites serviced for the same customer, such as a telecommunications company with multiple sites; however this policy has not yet been exercised.

model could prove attractive for a condominium complex or other close-knit community investing in wind turbines off site.

The "multiple owners model" is currently practiced in Europe, Canada and Minnesota. Consumers invest in a generator and either consume the electricity or receive dividends derived from the sale of the electricity generated. Typical turbine owners include community groups, schools, or local governments. Schools, community organizations, cities, counties, developers and non-profits typically instigate these projects, which are extremely beneficial because they are highly visible for outreach, education and the environment. Spirit Lake Community School District in Iowa uses the multiple-owner model for two wind turbines that are used as primary energy sources for the operations in the district. Surpluses have been generated that have made a profit for the elementary school.[36]

In Washington State, representatives from community action agencies are seeking "donated bill credits" through an innovative project to benefit low-income customers. They are working to allocate electricity credits from wind turbine generation to offset utility bills for low-income households, thereby supplementing federal energy assistance program funding.[37]

UTILITY AND CUSTOMER PERSPECTIVES ON VALUING DG SYSTEMS

Net metering encourages on-site generation, which can mitigate the need for expensive distribution line upgrades and in some cases may relieve transmission congestion. Net metering provides economic incentives to encourage private investment of renewable energy technologies without major outlays of public funds. By allowing customer-generators to receive a utility's retail value for electricity generated on-site, net metering can lower the economic burden associated with installing new small renewable energy facilities.[38] As net metering becomes more common, utilities are discovering new rationales for adopting progressive net metering policies.

Some utilities are even helping overcome typical concerns:

- While utilities generally oppose any policies they consider to be mandates imposed on them, an increasing number of utilities and cooperatives are recognizing the benefits of distributed wind energy in promoting their voluntary green power programs and the importance of policy incentives to promote the relatively nascent customer-owned wind turbine market.

- Rather than viewing net metering as a revenue loss based on retail rates credited for customer-generated electricity, some utilities consider net metering as an inexpensive, administratively simple way to capture benefits of small wind turbines funded by the capital of individual generators on behalf of all customers.

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[36]Case Study: Spirit Lake, Iowa: Wind Power for On-site Power Generation http://www.greenpowergovs.org/wind/Spirit%20Lake%20case%20study.html

[37] Updates will be reported at www.awish.net

[38] Small Wind Toolbox: http://www.awea.org/smallwind/toolbox/IMPROVE/utilities.asp

- Some utilities have voluntarily offered premium rates for net metering customers, while others continue to interpret federal regulations as requiring utilities to purchase power at no more than the wholesale avoided cost. The Federal Energy Regulatory Commission (FERC) has recently confirmed that net metering policies are allowable.[39]

- Forward-looking utilities maintain that DG systems can save all ratepayers money by reducing the most costly utility line extensions and upgrades. This position is in response to those who describe net metering as a subsidy to DG generators who must be funded by customers who have not installed and do not operate their own electricity generators.

- Some utilities are working to develop low-cost, automated metering systems to prevent loss of actual generation and customer load information. This is of concern if a sufficiently large number of customers enroll in net metering, resulting in meter readings no longer accurately representing the real load of a given area.

- Interconnection guidelines, testing, and certification processes have decreased concerns about the safety of emerging wind technologies and their posing a possible threat to utility line workers. UL 1741 ensures safe operation on an electricity grid, including during utility outages and maintenance.[40]

Wind energy advocates maintain that net metering promotes distributed generation, which, in turn, offers many compelling benefits for our current aging electricity infrastructure, the environment, the utilities, and their customers:

- DG connects to the grid at decentralized distribution points, which enhances national security, while large-scale centralized power plants represent prime terrorist targets.

- Small wind turbines can either be connected to an AC grid or stand alone as DC power systems, which makes them versatile components of any smart electricity infrastructure plan.

- Distributed wind systems are natural investments for farmers. It makes sense to them because of the history of harnessing natural resources for economic use. Given that many of the best wind resources in this country tend to be in rural areas, farmers and ranchers are logical candidates for investing in these clean electricity generators.

- Local financing for small-scale wind projects is gaining momentum in the United States making wind turbines even more attractive to members of the agricultural community and other rural residents.[41]

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[39] See FERC's recent ruling on *Swecker v. Midland Power*.
[40] Consumer Energy Information: EREC Reference Brief: http://www.eere.energy.gov/consumerinfo/refbriefs/ja7.html
[41] Cohen, Joseph & Tom Wind. "Distributed Wind Power Assessment" National Wind Coordinating Committee, February 2001. http://www.nationalwind.org/pubs/distributed/distributed_wind.pdf

- Manufacturing of wind turbines, towers, inverters and other components, along with wind turbine installation, operation and maintenance represent considerable potential for economic development, particularly in economically depressed rural areas.

From a customer's point of view, many factors impact the economics of connecting a DG wind energy system to the grid, including:

- The variability of the wind resource and its value related to on-site generation or as recognized by the utility.
- Costs of purchasing, installing, and connecting the system to a utility.
- Costs of operating the system.
- Cost of purchasing electricity from the host utility when the customer-owned DG system is not generating electricity.
- Value of any net electricity production sold to the utility.
- Interconnection and transaction costs charged to the DG owner by the utility.
- Variability levels of wind as a energy resource.

The latter costs depend on state policy, utility tariffs and rules, and/or the results of negotiations with the utility.

From the utility perspective, a variety of methods are used for evaluating the cost and value of the electricity generated by a DG wind energy system:

- Some utilities use the discounted cash-flow technique to determine net present value and return on investment rate.
- Others calculate the equalized life cycle cost per kWh of DG production (which is the cost of the system over the life of the system, divided by the total output of the system), and then compare this cost to the rate at which they buy and sell DG power. Utilities already use this method to calculate their rates, so it is not too much of a stretch to do a similar analysis for a DG system. Still, considerable leeway is evident in such a DG system cost assessment.
- Some, including the Bonneville Power Administration, are beginning to determine the value of DG in helping avoid utility line upgrades and even relieving transmission congestion.

Utilities should consider that DG systems produce excess generation, which could cost less than spot prices, and offer some protection from volatile energy markets. Excess energy could be stored and then distributed to the grid during peak periods of demand.

The Bonneville Power Administration is working diligently to create strategies for non-wire solutions to high transmission loads in the Pacific Northwest. A working group determined that non-wire technologies are emerging and have high potential to electronically manage overall power exchange, and consumption.[42]

NET METERING POLICY ANALYSIS

WISCONSIN'S NET BILLING ORDER

The PSCW issued Order 6690-UR-107 in December 1992, updating the state's net metering law first placed on the books in the late 1980s. All utilities under PSCW jurisdiction (all investor owned utilities operating in the state) are required to comply with the net metering provisions, which apply to all customer classes connected to the utility grid. The sum of all generation by a single DG system may not exceed 20 kW. Most residential-scale wind turbines easily fall under the 20 kW threshold. However, turbines above 100 kW may be more appropriate for agricultural, commercial and industrial customers wishing to offset a substantial portion of their load. Other states including California, Iowa and Ohio allow net metering for systems as large as 1 MW.

Wisconsin has completed the process of developing state interconnection standards, which will tailor standards specifically for the state. The standards, known as PSCW Rule 119 came into effect on February 1, 2004. The rules established a much needed standard application form and agreement, which will facilitate the process for the DG customer. Insurance requirements are specified with a tiered interconnection system with varying application fees.[43]

Wisconsin's net metering policy is a net purchase and sale, load-based model that allows for two-way electric meters to measure the flow of power to and from the electrical grid. If the amount of electricity generated by the DG customer exceeds the amount consumed during a month, the customer receives a credit on his or her monthly bill equal to the excess kWh received by the utility, multiplied by the Energy Credit Rate (ECR). The ECR for renewable sources is the retail rate; the ECR for non-renewable DG is the utilities' avoided cost wholesale rate. For Wisconsin commercial and industrial customers that qualify for time-of-use rates, a second meter is installed for high peak generation, which is netted separately from off-peak generation.[44] Some Wisconsin utilities issue checks to customers instead of a bill credit if the value of net generation exceeds $25.

U.S. FEDERAL POLICIES

Without state net metering, small customer-owned generators are usually treated by electric utilities as qualifying facilities (QFs) under the Public Utility Regulatory Policies Act of 1978 (PURPA) and subsequent implementation rules by the Federal Energy Regulatory Commission (FERC).

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[42] NW Energy Coalition Report, available at www.nwenergy.org/publications/report/03_jan/rp_0301_10b.html
[43] Rules for Interconnecting Customer Owned Distributed Generation Facilities. Available at www.dsireusa.org/library/docs/additionaldocs/WIPSC119DraftIntrRules80602.pdf
[44] Energy Efficiency and Renewable Energy Laboratory Green Power Network: http://www.eere.energy.gov/greenpower

Under PURPA, regulated investor-owned utilities and independent power producers (IPP's) pay their avoided cost rate to DG facilities for providing electricity. PURPA is the regulatory framework developed in the 1980's, when power markets were first opened up to competition in response to cost overruns associated with utility nuclear power plants and other ratepayer-supported utility electricity generation facilities.

While some utilities have interpreted PURPA as preventing net metering when purchasing power from DG sources (at a price higher than avoided cost), many states have ruled that net metering falls under state regulatory jurisdiction on utility pricing practices, not federal laws governing independent power producers.[45]

In December 2003, an important and influential FERC ruling required two power co-ops in Iowa, (Midland Power Cooperative and Central Iowa Power Cooperative), to allow net metering for customers, even though Iowa's state law does not require co-ops to offer the service.[46] In one case FERC rejected a proposal to waive the PURPA requirement stated above. FERC decisively stated that Midland had acted wrongly by blocking an individual generator's interconnection attempts.[47] This has implications for all state net-metering policies, especially those that only include investor owned utilities or certain utilities in the state.

In August 2003 the Institute for Electrical and Electronics Engineers (IEEE) published a federal interconnection standard, IEEE P1547, which applies to grid connection of DG systems. This document lays a foundation for technical interconnection, which will facilitate the process considerably. Currently, PURPA requires utilities to make standard purchase contracts. Yet utilities often make it very expensive and difficult for interconnection within these contracts. Basic interconnection requirements include:

- Power meets utility determined acceptable quality.
- Power has fault and voltage protection.
- The system automatically disconnects from the grid in the event of a grid power outage.
- The system uses a two-way meter or two meters to record both power used from the grid and power delivered to the grid (some states require the utility to cover the costs of the metering equipment)
- A liability insurance policy covering the system

Proposed federal net metering provisions provide amendments to PURPA but do not alter the current regulatory framework in which each state determines what specific requirements they ultimately adopt, such as net metering buy-back rates. Each utility is directed to make net metering service available to any customer who requests it, up to 10 kilowatts for residential customers and 500 kW for commercial

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[45] Yih-huei Wan, "Net Metering Programs," NREL/SP-460-21651, December 1996, http://www.eere.energy.gov/greenpower/netmetering.html
[46] Windletter: December 2003 Newsletter of the American Wind Energy Association
[47] Iowa – FERC Orders Electric Cooperative to Provide Net Metering, Tuesday, December 9, 2003: http://irecusa.org/articles/static/1/1070946226_987096450.html

customers. Each state regulatory commission is instructed to make a determination concerning whether it is appropriate to implement net metering in its service territories.

However, language included in proposed Energy Policy Act of 2004 is encouraging for net metering advocates:

> "An electric utility shall charge the owner or operator of an on-site generating facility rates and charges that are identical to those that would be charged other electric consumers of the electric utility in the same rate class; and shall not charge the owner or operator of an on-site generating facility any additional standby, capacity, interconnection, or other rate or charge."

Additional language included in this federal legislation implies that utilities should adopt annualized accounting of any excess generation from a DG system, a public policy that makes net metering more attractive to many potential small wind turbine owners.

STATE NET METERING MODEL

California's net metering law is a benchmark for other states. The annualized accounting requirement for excess electricity generation from renewable DG systems up to 1 MW is the most useful one for consumers. Under this model, excess generation in one month is carried over to the next as a credit, allowing all electricity generated by customers to be applied to offset their own consumption within the annual period. If electricity generation from a DG system exceeds consumption of grid power over the course of a single year, the net excess electricity generation is delivered to the grid by the DG system without any compensation. Annualized accounting creates incentives for customers to size their DG system to match their own load but does not encourage generation of surplus electricity that can be used by other customers.

WISCONSIN UTILITY ANALYSIS

Interviews with utilities, co-ops and municipalities throughout Wisconsin highlighted successes and barriers to distributed wind generation, and revealed a wide range of attitudes and policies. The number of DG customers varies widely, as do the available resources. Some small municipalities are not yet familiar with net metering as a policy. Some in the power industry do not feel that renewable energy generation is feasible in their area. The interviews also exposed strong resistance by some utility leaders to the idea of distributed generation.

Some utility representatives expressed support for DG, yet they perceive many barriers to widespread development:

- Cost is cited as one of the largest barriers to DG development. State financial incentives have not had a major impact and have not done much to promote DG in Wisconsin.
- Lack of public awareness is also slowing the growth of DG development. There is a need for utility-sponsored educational materials for customers interested in DG to help explain the economics of renewable energy systems.

- Some utilities feel that net metering tariffs should be assessed on an individual basis to determine whether economics that favor the individual customer place an economic burden on other customers who would subsidize the program through utility prices.
- Low prices of electricity dissuade customers from being interested in net metering.

Utilities view green pricing programs as the best available outlet for promoting renewable energy generation. Some utilities are looking into renewable DG for local demonstration projects to promote customer interest in their green pricing programs.

ALTERNATIVE POLICIES AND MODELS

When assessing adoption of alternative policies for Wisconsin that would encourage increased rates of renewable DG, a minimum criterion for all alternatives is promoting a healthier environment. The following criteria also need to be considered:

- Effectiveness: Increasing the number of customers and the amount of generation they produce from their own energy from renewable DG sources.
- Cost: Net metering is widely accepted as a low cost option to promote the purchase of renewable DG).
- Level of customer cross subsidy: The possible economic impact on the utilities and the ratepayers of net metering policies.
- Level of revenue generation for DG owners.

The following alternatives emerged.

POWER PURCHASE CONTRACTS

Existing net metering laws in some states do not require the host distribution utility to purchase excess generation from a customer owned DG system. PURPA and FERC have established net metering guidelines, yet these steps are not enough to stimulate a robust market for DG.

It is often more costly for a utility to generate and distribute electricity during high or peak demand times, depending on weather conditions and time-of-day electricity demand. Typically utilities charge a higher rate for electricity during peak demand times. This is called “time of use” or “real time” pricing.

It can be argued that when a customer-owned DG system generates excess electricity during peak times, this generation is undervalued unless the DG system owner is paid the peak price. This is the case for net metering customers in California, provided they also install a time-of-use meter. DG system owners may also negotiate a higher price, or a capacity credit, for producing power during peak power demand. Such power purchase contracts could raise the administrative costs for the utilities, yet they may still be the most cost-effective option to capture the full value of net-metered power generators.

COMMUNITY WIND COOPERATIVES

Three unique and innovative wind power cooperatives are demonstrating new models for expanding the concept of cooperative net metering and establishing mechanisms to provide returns to wind generation investors.

Toronto WindShare

Toronto Hydro Energy Services (THES), an electric utility that serves retail customers in the Toronto area, and WindShare have partnered to install wind turbines on the Toronto waterfront. This will be the first commercial-scale wind development in an urban area in North America.[48] Anyone who is interested in supporting non-polluting sources of electricity can buy shares of a wind turbine to earn financial dividends from power sales or rely upon wind power to serve their own electricity needs.

Five years in development, a group of Toronto residents launched this project out of concern that the government and utilities were not doing enough to reduce air pollution and prevent global climate change. Until they accumulated sufficient funds from co-op members, they financed the project with community funds, seed money, federal government grants, and Climate Change Action Coalition funding aggregated by the Toronto Atmospheric FundWindShare members can purchase co-op shares for one dollar each, a level of investment that secures participants voting privileges. A minimum of five and a maximum of fifty "preference" shares can be purchased for $100 each, which entitle investors either to proceeds of WindShare sales or to shares of the electricity generated. At present, a cap of 16,000 "preference" shares has been established for the two wind turbines. An 8% return on investment is projected for "preference" investors. The co-op has collected sufficient funds to cover the development costs of the first turbine, which has been generating electricity since January 2003 and has produced 1,000,000 kWh of power. So far, co-op share sales are continuing to cover the costs of the second turbine.

WindShare has a contract with THES to buy the wind-generated electricity for the first three years of operation. After this phase ends, WindShare has several options to choose from. They can renew the contract with THES, sell power to a different electricity retailer, or market the electricity directly to WindShare members.

The WindShare model transforms participants into investor-owners of a clean electricity generation facility. WindShare is lobbying for net metering standards and a Renewable Portfolio Standard in the Canadian provinces. The long-term goal of WindShare is to establish a cooperative net metering program for all the turbines developed by shareholders. WindShare demonstrates that voluntary investment cooperatives can play a role in developing new wind energy systems. Cooperatives can also foster support for new kinds of net metering that allow urban residents to play a role in supporting renewable DG systems.

Our Wind Co-op

Another cooperative model is specifically designed to support small-scale wind installations on farms and ranches throughout the Northwestern U.S. Its name is Our Wind Co-op, a program initiated through a

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[48] Windshare web site: www.windshare.ca

cooperative business model to install ten 10 kW wind turbines. Our Wind Co-op is helping to create low-risk opportunities to demonstrate that locally owned small DG wind energy systems are feasible and cost-effective. The co-op has a goal of installing at least 1 MW of DG wind energy by 2005. The environmental attributes of this energy are aggregated, marketed and sold as value-added Green Tags, providing an ongoing revenue stream to help repay initial installation costs and ongoing operation and maintenance expenses. The systems are installed in various utility service areas, with most employing annualized net metering.[49]

A collaborative of Northwest non-profits launched Our Wind Coop (OWC) to increase self-sufficiency and secure long-term fixed price energy sources. They financed capital costs with upfront Green Tags investments and leveraged multiple funding sources. With initial support from the U.S. Department of Energy's National Renewable Energy Laboratory, the Bonneville Environmental Foundation (BEF), and a U.S. Department of Agriculture (USDA) Value-Added Development Grant, Northwest Sustainable Energy for Economic Development (SEED) partnered with the Last Mile Electric Cooperative, Northwest Cooperative Development Center, and Climate Solutions to help farmers, ranchers, and rural businesses develop community-based wind projects. To date Our Wind Co-op has successfully installed five 10 kW systems in Washington and Montana, with another five turbines planned by mid-2004.

The Bonneville Environmental Foundation (BEF) provided an initial Green Tags down payment of $600 per kW for OWC's initial 100 kW (a total of $60,000), representing estimated production for 10 years at 3.5¢/kWh. OWC was awarded one of the first USDA Renewable Energy Systems grants, which meant a 25% rebate on installation costs through a joint application under Section 9006. Co-op members and the public will be able to monitor OWC turbines' energy production on the www.ourwind.org website. The environmental attributes of this energy will be aggregated, marketed and sold as Value-Added Green Tags at 6-10¢/kWh, recouping the front-loaded BEF contribution and providing an additional ongoing revenue stream to help cover O&M and remaining financing costs. This is particularly important because of low retail electric rates in the Northwest.

OWC's use of Green Tags investments was an innovative way to finance capital costs and expand DG development. This strategy brought in many public and private partners, reducing financial barriers for potential wind turbine owners, both rural and urban, who might be discouraged by the front-end costs. Currently, each site is net metered separately. However, OWC is seeking ways to aggregate excess generation and allocate at least a portion to local community action agencies.

Corn-er Stone Co-op

Corn-er Stone Co-op has the objective of generating new income for farmers, thereby spreading economic benefits within the local community. The project is farmer-owned but employs local businesses and contractors. The co-op formed two liability companies to maximize the project's use of tax credits and wind energy incentives. Eighty-five percent of the 66 investors are farmers. The two companies maintain an open and voluntary membership, and a democratic structure. Capital from sold shares has financed two 1.9 MW wind projects. This co-op model leads to economic development of the whole region and a return

[49] Northwestern Energy customers were allowed to strike out the default section of the utility's standard interconnection agreement granting the utility rights to net metered systems' Green Tags.

of farmer's investment.[50] The biggest barrier for this project was not the financing or permitting, but rather was negotiating the power purchase agreement.

Under cooperative models, several individuals contribute to, and benefit from renewable DG systems. The success of OWC, WindShare and other wind co-op efforts could build support for a wide range of alternative approaches to supporting renewable DG systems.

ALTERNATIVE INTERNATIONAL POLICIES

Europe has long been a leader in developing public policies that support renewable energy technologies, including DG small wind energy systems. The first private wind turbine cooperative was created in Denmark in 1980. The only ownership requirement governing installations of DG small wind energy was quite simple: the residence of a wind turbine owner could be no farther than 3 kilometers from the turbine. This ensured that those who bore the costs associated were the ones who would financially benefit from the wind turbines.

Beyond cooperatives, another program of growing popularity in Europe is the "Distribution Line Upgrade Fund" which helps cover the costs of interconnecting DG systems. In Denmark this fund is derived from a tax assessed on all electricity customers. This approach addresses utility concerns about absorbing the cost of distribution line upgrades required for DG systems. It also addresses the concerns of the DG system owner about paying the full cost of a distribution line upgrade that benefits other ratepayers served by the utility as well.

Perhaps the most popular policy employed in Europe to promote renewable energy resources is the "Feed Law." This specifies that all renewable electricity generators are interconnected and paid a pre-set price, such as 85% of the retail rate, for electricity generated.

The pre-set rate for payments for electricity under the Feed Law is determined through a public process involving a number of different stakeholders including government representatives, utility engineers and economists. This group then comes to a consensus to determine the rate to be paid per kWh of electricity generated. The rate considers the particular community and regional needs where the price is in effect. Germany employs a two-tier Feed Law system that applies across the entire country. The fixed price for new installations declines gradually every year over a five-year fixed price period. In zones where the wind resource is marginal, higher payments for electricity may be offered in order to promote wind development dispersed throughout the entire country. Prices are re-negotiated every two years, which allows changes in the economy to be reflected in the price structure.

In part because of its Feed Law, Germany has installed more than 12,000 MW of wind generating capacity since 1991, more than any other single country. Farmers, households, co-ops and small businesses own two-thirds of Germany's total wind power capacity. Germany, Spain, Denmark and France all have highly successful Electric Feed Laws. Spain recently surpassed the U.S. in total wind

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[50] Minwind I & II: Innovative farmer-owned wind projects http://www.windustry.com/newsletter/2002FallNews.htm

power capacity and now ranks second in total installed wind capacity worldwide.[51]

Due in part to Feed Laws, banks in Europe now compete to offer loans for wind projects at attractive interest rates. Many farmers can band together to get a bank loan for a wind project in order to share the costs and benefits and to lower financial risks. This lessens development barriers, as banks are more willing to finance projects. Other European policies that help promote DG wind energy systems include capital grants, incentives for local ownership, subsidized interconnection and grid reinforcement costs, and open access to the grid.[52]

Europe has been successful in promoting renewable energy both because conventional generation is quite expensive, and because many countries minimize bureaucratic and legislative interference in wind power markets. Rather than dealing with many different complicated policies and laws, a consumer wanting to install a DG small wind energy system in Europe often simply installs the DG system without needing to involve lawyers.

RECOMMENDATIONS

The State of Wisconsin has developed and instituted relatively progressive net metering rules and other renewable energy policies over the past two decades. Yet few consumers in the state generate their own electricity with on-site distributed generation. Based on an analysis of existing Wisconsin policies, benchmarking other states and international models, and interviews with industry professionals, here are several recommendations for the state to undertake to help overcome current barriers to building a more vigorous distributed wind generation market, utilizing both residential and commercial-scale wind turbines:

- Raise the maximum size of system eligible for net metering from 20 kW to systems up to 2 MW. A recent study of market demand for wind in the state, performed by the Energy Center of Wisconsin for the Focus on Energy Renewable Energy Program, reported a high probability for development of medium sized wind turbines that reach to 100 kW. The study suggested that net metering arrangements should be expanded, in order to avoid squelching this market segment.[53]

- Adopt a key feature of the net metering program employed in California and a dozen other states known as "annualized time offset." This allows a net-metered customer to carry over excess electricity annually. Within any given year, excess generation in one month is carried over to the next as a credit. If electricity generation from a DG system exceeds consumption of grid power over the course of a single year, the excess electricity generation is delivered to the grid by the DG system without any compensation.

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[51] Gipe, Paul. "Electricity Feed Laws Power Renewable Energy" http://www.fuelandfiber.com/Athena/ElectricityFeedLawsNewAthenum.doc
[52] Cohen, Joseph & Tom Wind. "Distributed Wind Power Assessment," National Wind Coordinating Committee, February 2001. http://www.nationalwind.org/pubs/distributed/distributed_wind.pdf
[53] Wisconsin Renewable Energy Market Assessment. Bensch, I. et al. 2003. Wisconsin Focus on Energy.

- Require utilities to provide customers with education about DG technologies before distribution lines are extended, and consider assisting with financing of DG systems in proportion to line extension subsidies.

- Create a "Distribution Line Upgrade Fund" to assist with wind turbine interconnection costs, financed with funds embedded in utility rates for line extensions or state general fund revenues. This will serve to stimulate the wind generation market and make it more financially feasible for utilities to expand net metering options.

- Launch a pilot program on "aggregated net metering" with receptive utilities. The success or failure of such a pilot program could be evaluated, and adjustments made, before it is made available to customers statewide.

- Offer modest financial incentives for new storage technologies that would allow DG system owners to store renewable energy generation for use during critical peak periods of demand, including the consideration of non-wire alternatives as did the Bonneville Power Administration.

- Commission a study to identify the most cost effective additions and upgrades to the existing transmission and distribution lines in order to identify locations to encourage DG.

- Commission a study to identify the most advantageous locations for encouraging DG considering transmission congestion and the need to upgrade the distribution system.

- Develop and launch a public education program on net metering and renewable DG systems to highlight how net metering helps promote system reliability, stabilize prices by diversifying fuel sources, helps clean the air and mitigate global climate change, and boosts national security. It would be beneficial to target cooperatives that currently are not required by state policies to accept net metering.

- Launch pilot programs modeled on WindShare, Our Wind Co-op, and Corn-er Stone Co-op to demonstrate the viability of small-scale wind cooperatives for rural area landowners.

- Convene a group of stakeholders to explore how the "Feed Law" concept could apply in Wisconsin, and determine a recommended purchase price.

These steps will support efforts of people and organizations already working to overcome barriers to sustained market momentum and to building a robust renewable DG network in Wisconsin. These recommendations apply to other states as well. Those without interconnection standards are encouraged to adopt both the IEEE Standard Interconnection Procedures[54] which can reduce complexity and streamline the process for connecting DG wind energy systems to the grid, and the Interstate Renewable Energy Council's recommended standard review for generators (not exceeding 20 MW) that interconnect to

[54] Standard Interconnection Agreements & Procedures for Large Generators, http://www.ferc.gov/industries/electric/indus-act/gi/stnd-gen.asp

distribution lines.[55] As the recent blackouts in the Eastern U.S. demonstrate, distributed generation solutions are critically needed to help increase electric reliability and ease strains on utility grids.

[55] IREC Interconnection Project Releases New Version of Model Net Metering and DG Interconnection Rules, http://www.irecusa.org/articles/static/1/1062865888_987096450.html

Part 2

Section A: Analysis of Wind Farm Layout Schemes for Wisconsin

WIND UTILITY CONSULTING

INTRODUCTION

As the cost of wind power continues to decline, more wind farms are being built. This construction of wind farms may be in response to state mandates, or to the competitiveness of wind generation when compared to gas-fired generation. In either case, the process of adding wind generation usually involves a competitive bidding process by Independent Power Producers (IPP's). The bid award process usually is heavily weighted, or totally determined by the lowest bid cost per kWh. Although getting transmission service may be another important factor in the selection process, the lowest delivered cost per kWh almost always prevails in determining which proposed generation project is selected.

This competitive drive toward the lowest delivered cost results in wind farms being built in the windiest areas possible, with large wind turbines arranged in a relatively compact layout. The compact site design minimizes the length of collection circuits and access roads, and it also reduces the cost of construction. There are few large, contiguous land parcels in Wisconsin where a compact layout of wind turbines would be possible. As a result, wind turbines may have to be more spread out to accommodate the location of homes and the rolling topography. This study quantifies the additional incremental installation cost of having less compact wind farms.

OVERVIEW

An analysis was made to determine the relative costs for four different layout configurations of wind generation. These four wind farm configurations show the cost advantages of placing turbines close together versus spacing them out over a larger area. Wind turbines that are sited close together require shorter collection circuits, fewer and shorter access roads, and lower mobilization costs for equipment, especially the large erection crane. For example, a large 300 to 400 ton crane costs $30-50,000 to erect and tear down. If adjacent wind turbine sites are close together on relatively level terrain (less than 5% grade), then the crane can simply move under its own power, without being partly or completely dismantled. Moving the crane across intervening parcels of land or county roads might entail paying for crop damage, the filling of ditches or dropping electric lines. However, this would still be less expensive and faster than dismantling the crane, loading it onto a dozen semi trucks, and moving it to the next site.

Compact turbine layouts also require shorter collection circuits. Underground tap circuits are used to connect the individual wind turbines to the main collection circuits. These underground collection cables typically follow the access roads to the wind turbines. Wind farm layouts with more wind turbines per square mile require fewer total miles of main and tap collection circuits. Likewise, more compact wind farms also reduce the length of the access roads.

In this report, four different layout schemes are categorized and evaluated. The most compact scheme is called the "Tight" layout, while the least compact is called the "Single" layout scheme. These four schemes are defined as follows:

TIGHT LAYOUT

In this layout, the site allows the wind turbines to be sited close together so that the length of the access roads and collection feeders is minimized. The turbines are placed within the minimum distance possible to maintain safe operation. This ranges from 4 rotor diameters to 10 rotor diameters, depending upon the orientation. Other factors also contribute to lengthening the average distances between turbines. The separation distances are determined by considering the trade-off between wake losses and the length of access roads and collection circuits.

LOOSELY SETTLED LAYOUT

The wind turbines in this layout are spaced farther apart due to the lack of suitable adjacent sites. Proximity to nearby homes, forested areas, or lower elevation areas prevents turbines from being located in long strings. This increases the length of collection circuits and access roads, which increases wind farm costs. Construction costs are also higher because the large erection crane must be mobilized from one area to the next.

CLUSTER LAYOUT

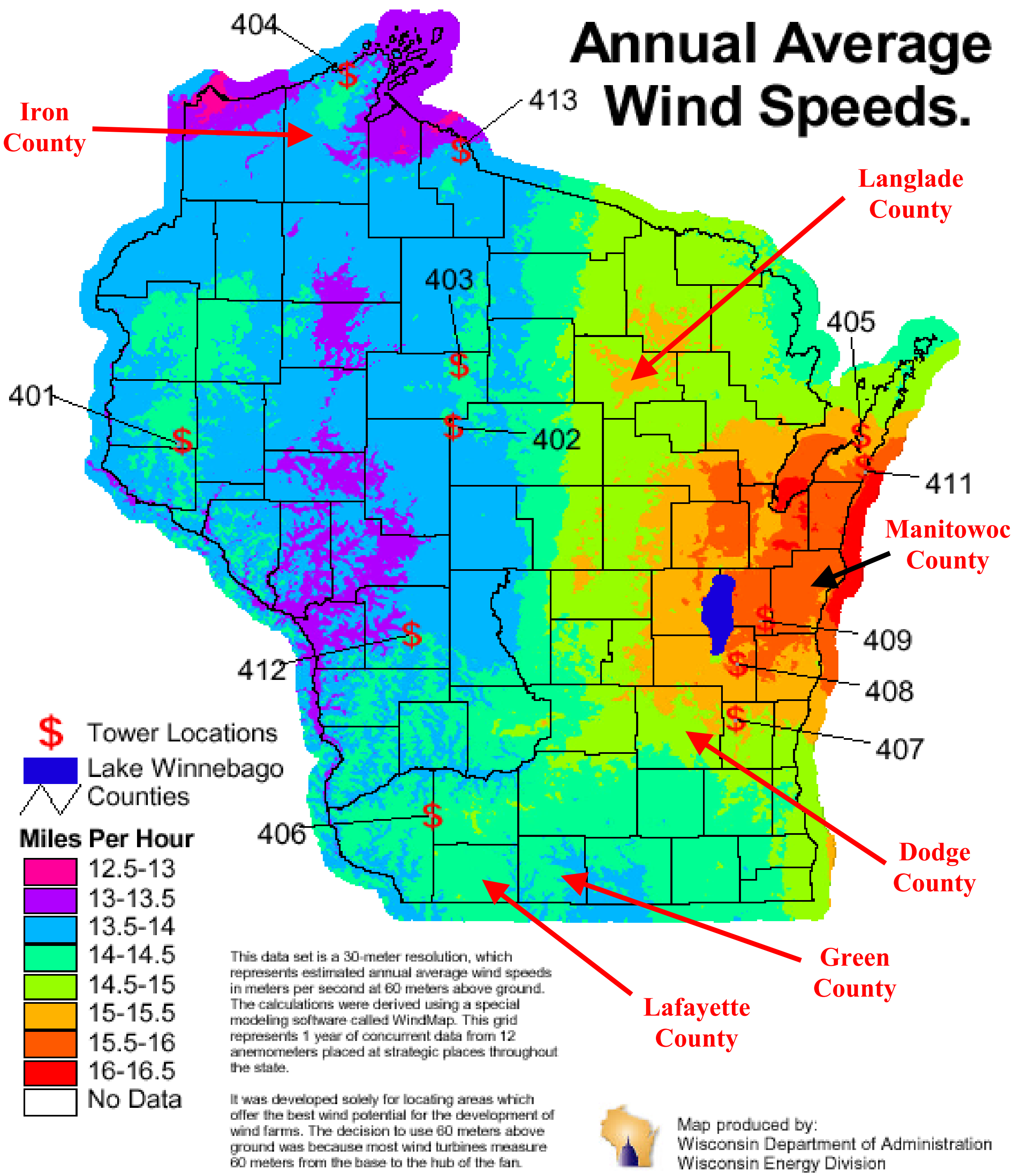
Small clusters of wind turbines characterize this layout. These clusters may contain from one to five wind turbines. As in the loosely settled layout, homes and topographical features prevent the installation of long strings of wind turbines.

SINGLE TURBINE LAYOUT

This layout combines individual wind turbines and small clusters. Again, difficulty in siting keeps wind turbines from being located in strings. The installation cost is higher than the other three layouts because of longer collection circuits, access roads, and crane and equipment mobilization costs.

This study models these four layouts for five different counties in Wisconsin. The counties are Dodge, Iron, Lafayette, Langlade, and Manitowoc Counties. The location of these five counties is shown on the wind speed map in Figure 1. The counties were selected to provide a wide range of topographical features, from relatively flat agricultural areas to forested hilly terrain, and from the northern border to the southern border of the state.

FIGURE 1: AVERAGE ANNUAL WIND SPEED AT 50 METERS HEIGHT



METHOD OF ANALYSIS

Certain information was necessary for determining suitable sites for wind turbines. The Energy Division of the Wisconsin Department of Administration provided detailed, computer-generated wind speed maps showing the average annual wind speed for Wisconsin, as illustrated in Figure 1. The wind speed is shown by color in 0.5 mph increments. The resolution of the data is 30 meters by 30 meters.

Additional data in the Geographical Information System (GIS) format was also provided and used with Arc View software, including county boundaries, roads, and major transmission lines. National Geographic Topographical software and maps were used to determine elevation contours, ground cover, and the detailed location of most homes. A Computer Aided Drafting (CAD) program was used for drawing wind turbine and electric collection circuits on the maps. The consultants also spent time in each of the counties noting topography, the types of land use, the density of rural development, and the location of electric transmission facilities.

Potential wind turbine sites were located in each of the five counties evaluated in this study. The consultants sought the best available wind resource in each county and selected areas where enough turbines could be sited to make up a 30 MW wind farm.

In all locations but Dodge County, wind turbines in this study were sized at 1,500 kW. Dodge County was evaluated using 660-750 kW wind turbines. A wind farm size of 30 MW was located in each of the five counties.

A total of 284 sites were found in the five counties. The sites were selected by observing a minimum spacing that ranged from 4 to 10 rotor diameters apart. The closest spacing was applied to turbines arranged in a northeast-to-southwest alignment, while the wider spacing was used for alignment in the opposite direction. For 660-750 kW wind turbines, this spacing ranged from 600 to 1,600 feet. Spacing for 1,500 kW wind turbines ranged from 950 to 2,350 feet. It should be noted that this study was based on a cursory evaluation of potential sites, because the main purpose was to compare different layout schemes. Consistency in the selection process was the primary criteria, rather than optimization of the wind turbine sites. A more in-depth evaluation by a professional wind farm developer would likely result in different site and layout selection.

EXAMPLE OF ANALYSIS

To better illustrate the analysis that was completed for this study, some examples are shown for both Dodge and Manitowoc Counties. Figure 2 is the Dodge County section of the wind speed map shown in Figure 1. This map also shows the towns, lakes, and major highways. The map also has shaded relief to depict the relative elevations of the land. The orange color of the map indicates that the average annual wind speed in the county at 50 meters elevation is generally between 15 and 15.5 mph. The resolution of the wind speed calculations is not fine enough to show that the actual wind speed is higher on the hills and lower in the draws and valleys. In this analysis, all wind turbines were sited on the higher areas, such as hilltops and ridges.

FIGURE 2: AVERAGE ANNUAL WIND SPEED AT 50 METERS HEIGHT IN DODGE COUNTY

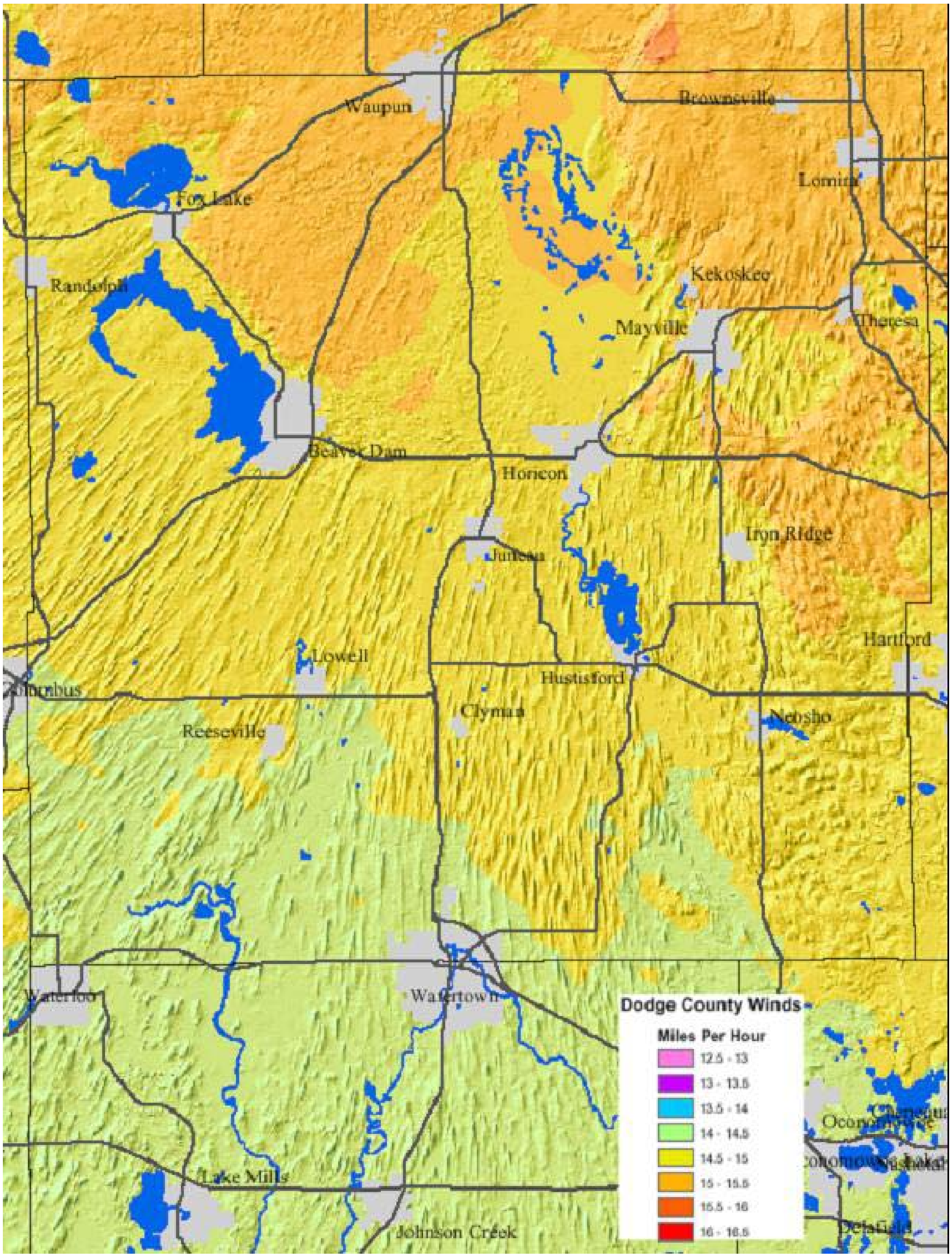
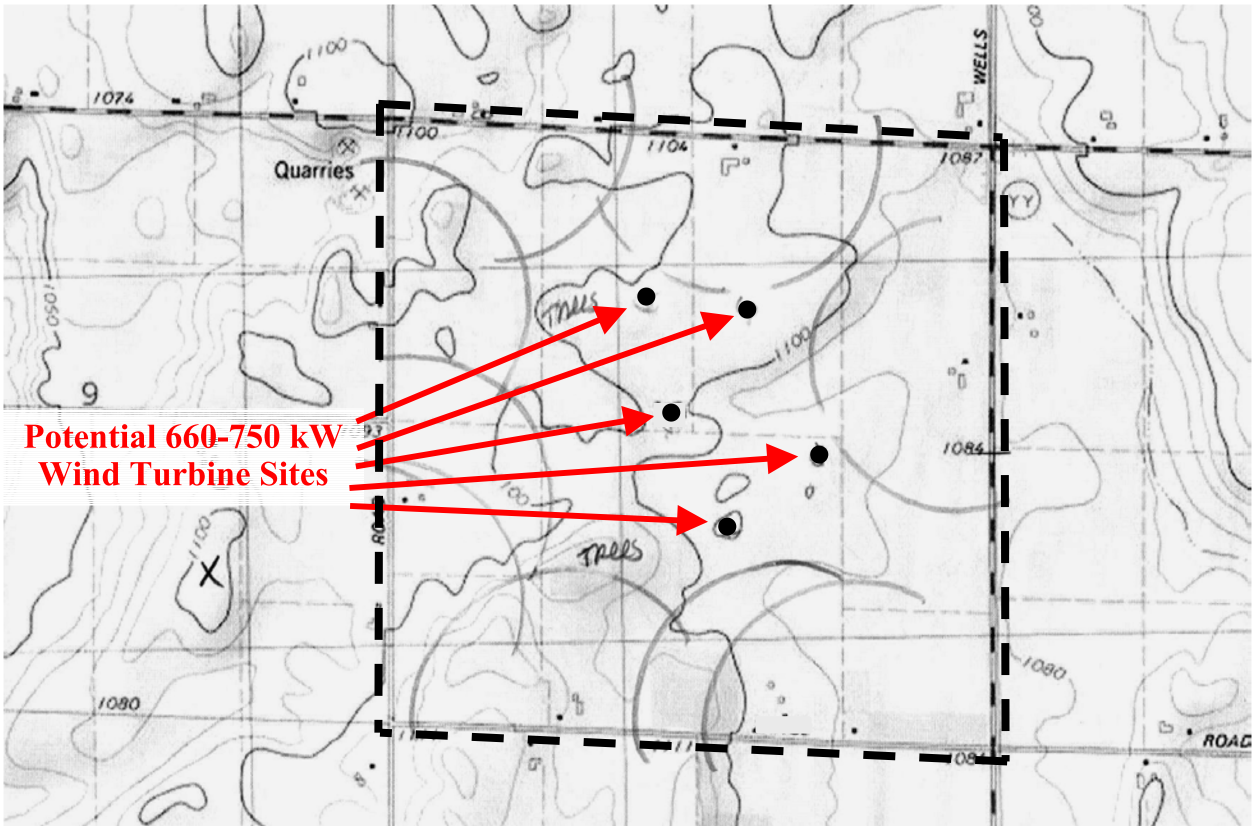


FIGURE 3: LOCATION OF FIVE POTENTIAL WIND TURBINE SITES IN ONE SECTION OF LAND IN DODGE COUNTY



The dashed square box in Figure 3 shows a 1-mile square section of land in Dodge County. In this 1-mile section of land, five 660-750 kW wind turbines could be sited. The semi-circles were drawn on the map as an aid to make sure there was adequate spacing between the wind turbine and nearby homes. Turbines in this size range were spaced 1,250 feet from nearby homes, which is a less-than-typical distance. This conservative number was used since a field survey was not made for most of the sites. A field survey might have found other homes not shown on the topographical map that would further restrict locations for the wind turbine. In this particular section, the wind turbines were sited at relatively high areas of 1,100-foot elevation. Similar drawings were made for 57 other sections of land in the county, which the consultants deemed to be the best areas for the development of a wind farm. In these 57 sections of land, a total of 137 potential wind turbine sites were found suitable for a 660-750 kW wind turbine. It should be noted that there are more than 137 potential sites in the county. However, wind turbines could not be put on all potential sites, because not all landowners will allow wind turbines on their land.

In many areas of Wisconsin, it is much more difficult to find areas where wind turbines can be closely spaced. For example, it was difficult finding areas in Manitowoc County where turbines could be sited close together to form a 30 MW wind farm. Figure 4 shows a section of land in Manitowoc County where only one site was found where a 1,500 kW wind turbine was sited. In this particular section, the wind turbine was sited at a relatively high spot at a 910-foot elevation. There was a higher spot with easier access but it was too close to a nearby home. The closest adjacent potential wind turbine site is ½ mile to the northwest (marked by the encircled "X"). A very conservative 2,000-foot spacing from a home was used for a 1,500 kW wind turbine. Finding suitable sites in Manitowoc County was difficult, due to the relatively large number of homes in the county's rural areas. High spots provide homeowners good views of the surrounding countryside. In many cases, just a few homes widely spaced in high spots precluded any wind turbines being sited in the best areas.

FIGURE 4: LOCATION OF POTENTIAL WIND TURBINE SITE IN ONE SECTION OF LAND IN MANITOWOC COUNTY

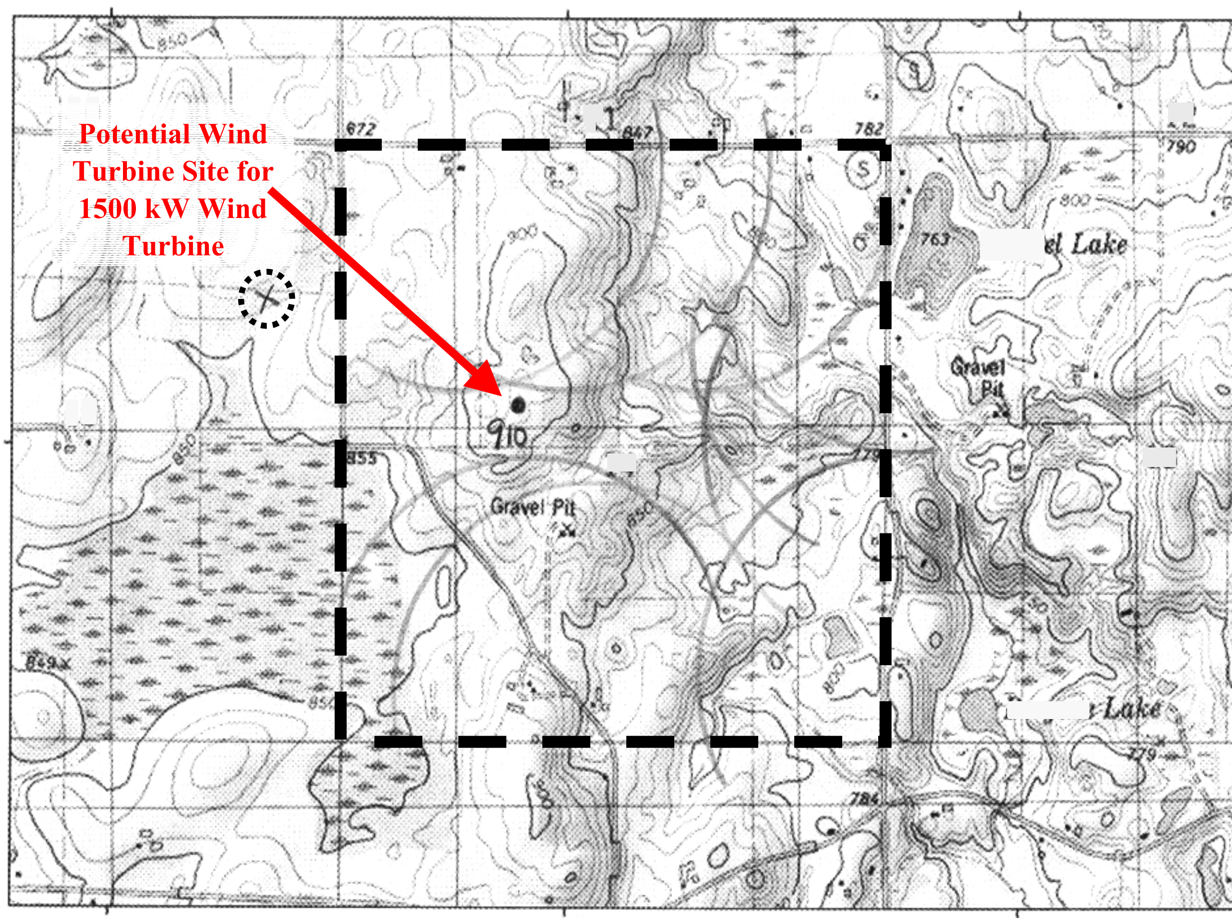


Figure 5 reveals the locations of 110 of the 137 potential wind turbine sites in Dodge County. The map in figure 4 shows elevations in shades of gray with the lightest areas being at the highest elevations. Wind turbines were sited at elevations ranging from 1,050' to 1,230'. Figure 6 displays the same potential locations on the Dodge County wind speed map. Almost all locations are in the same 15 to 15.5 mph wind speed range.

FIGURE 5: POTENTIAL WIND TURBINE LOCATIONS ON ELEVATION MAP FOR DODGE COUNTY

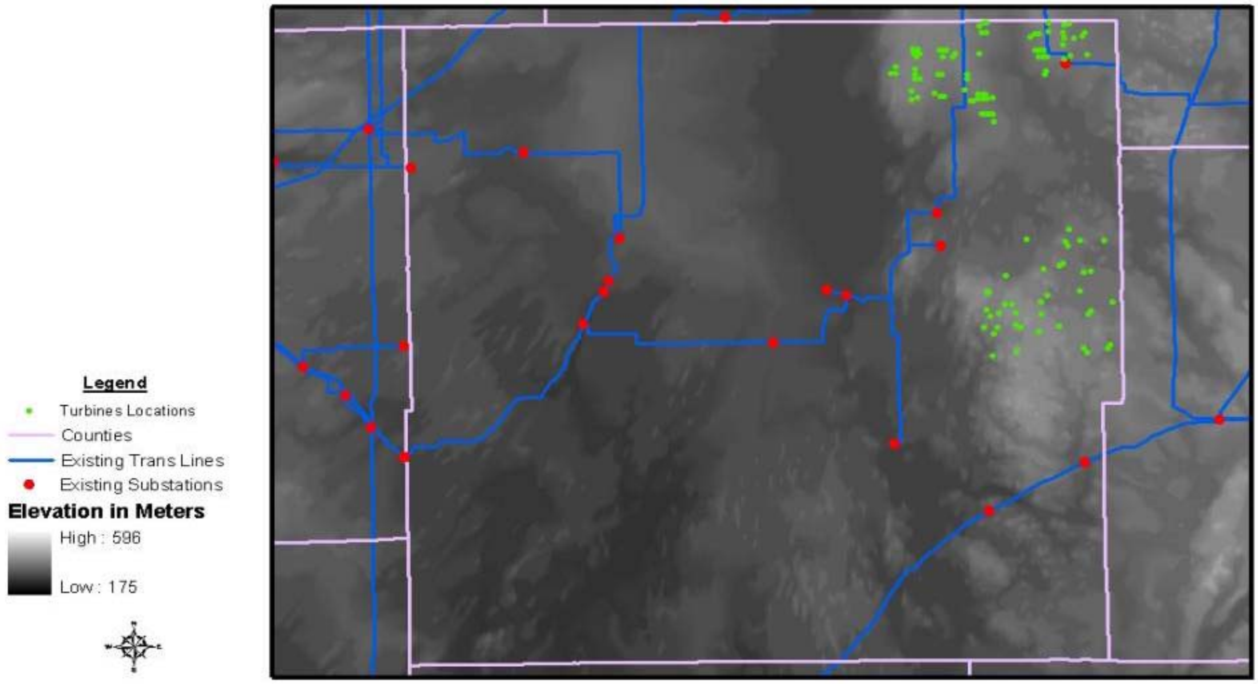
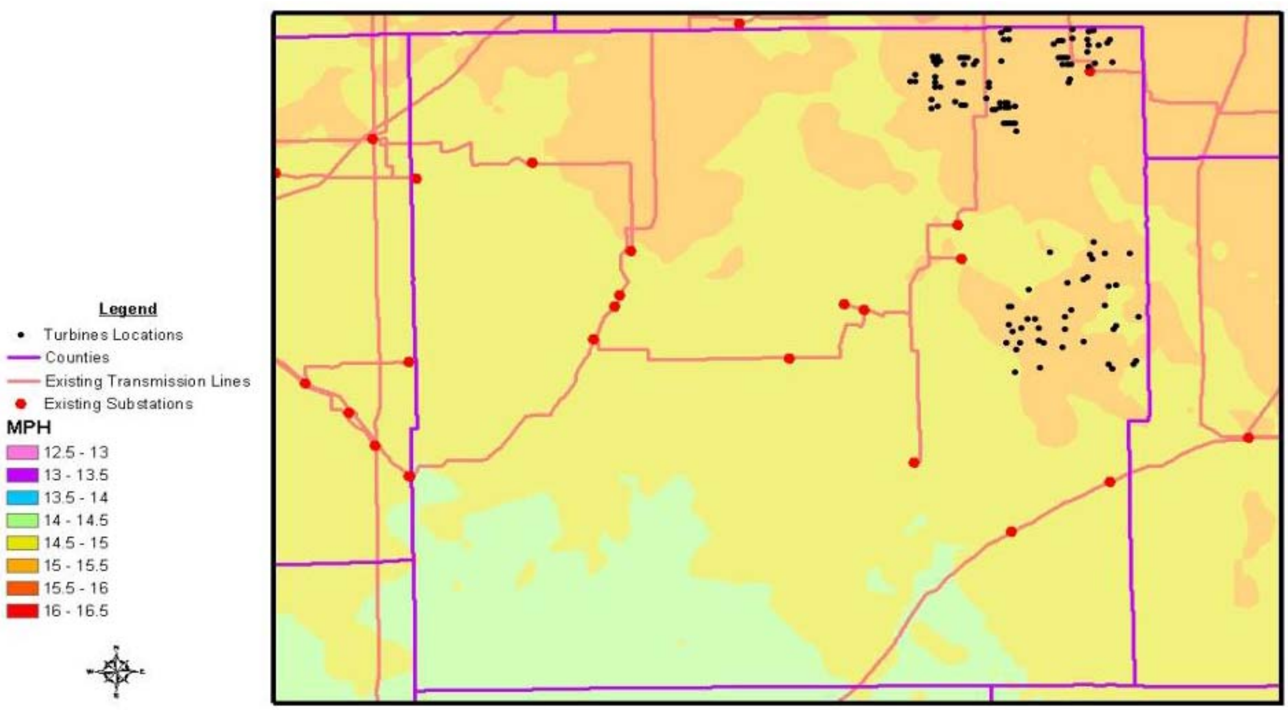


FIGURE 6: POTENTIAL WIND TURBINE LOCATIONS ON WIND SPEED MAP



Topography of areas where wind turbines were sited is shown in Figures 7 and 8. Wind turbine siting in the northeastern part of the county is shown in Figure 6. Figure 7 shows the topography of the east-central wind turbine area.

FIGURE 7: NORTHEASTERN AREA IN DODGE COUNTY SELECTED FOR WIND TURBINE LOCATIONS

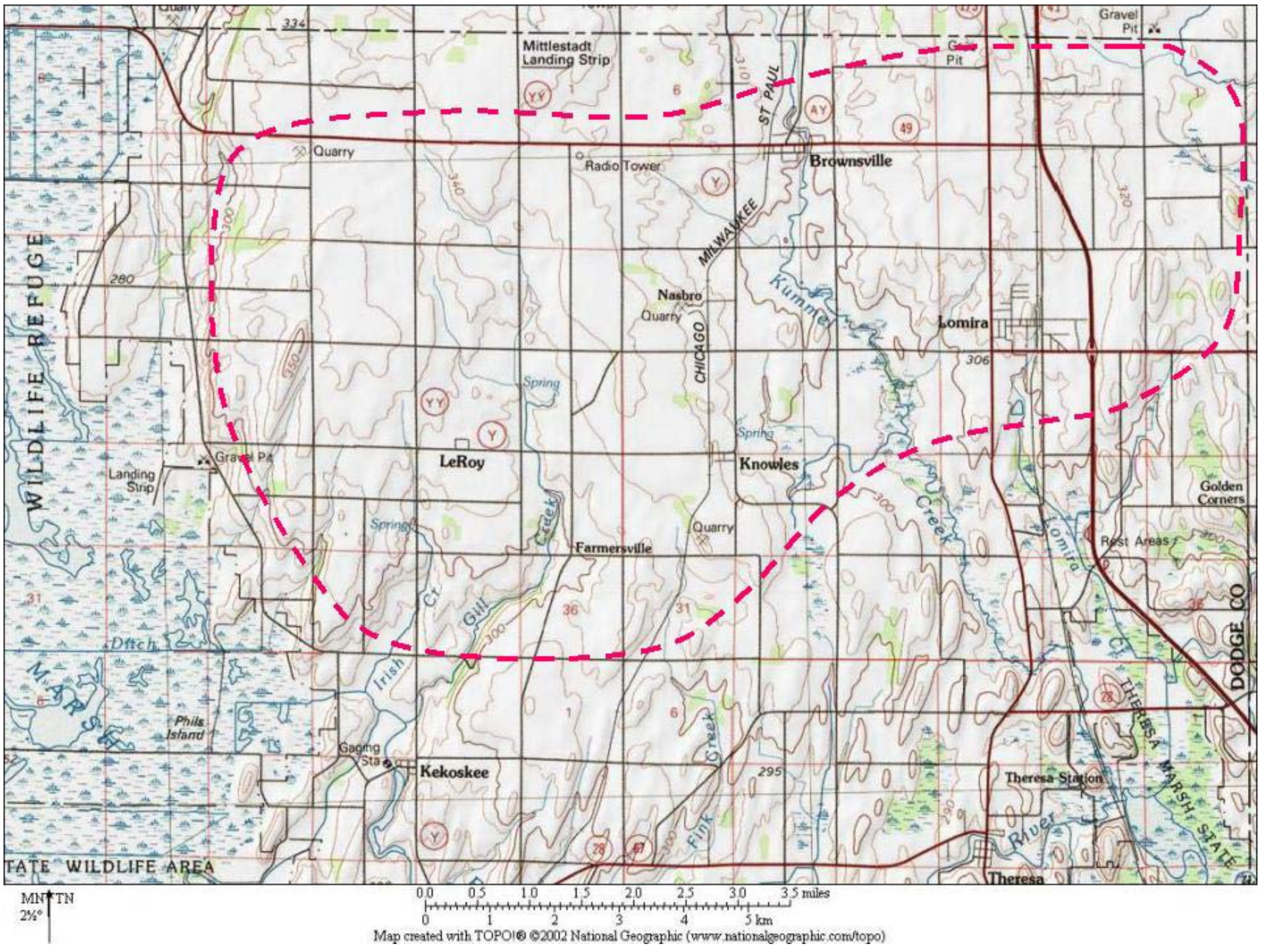


FIGURE 8: EAST-CENTRAL AREA IN DODGE COUNTY SELECTED FOR WIND TURBINE LOCATIONS

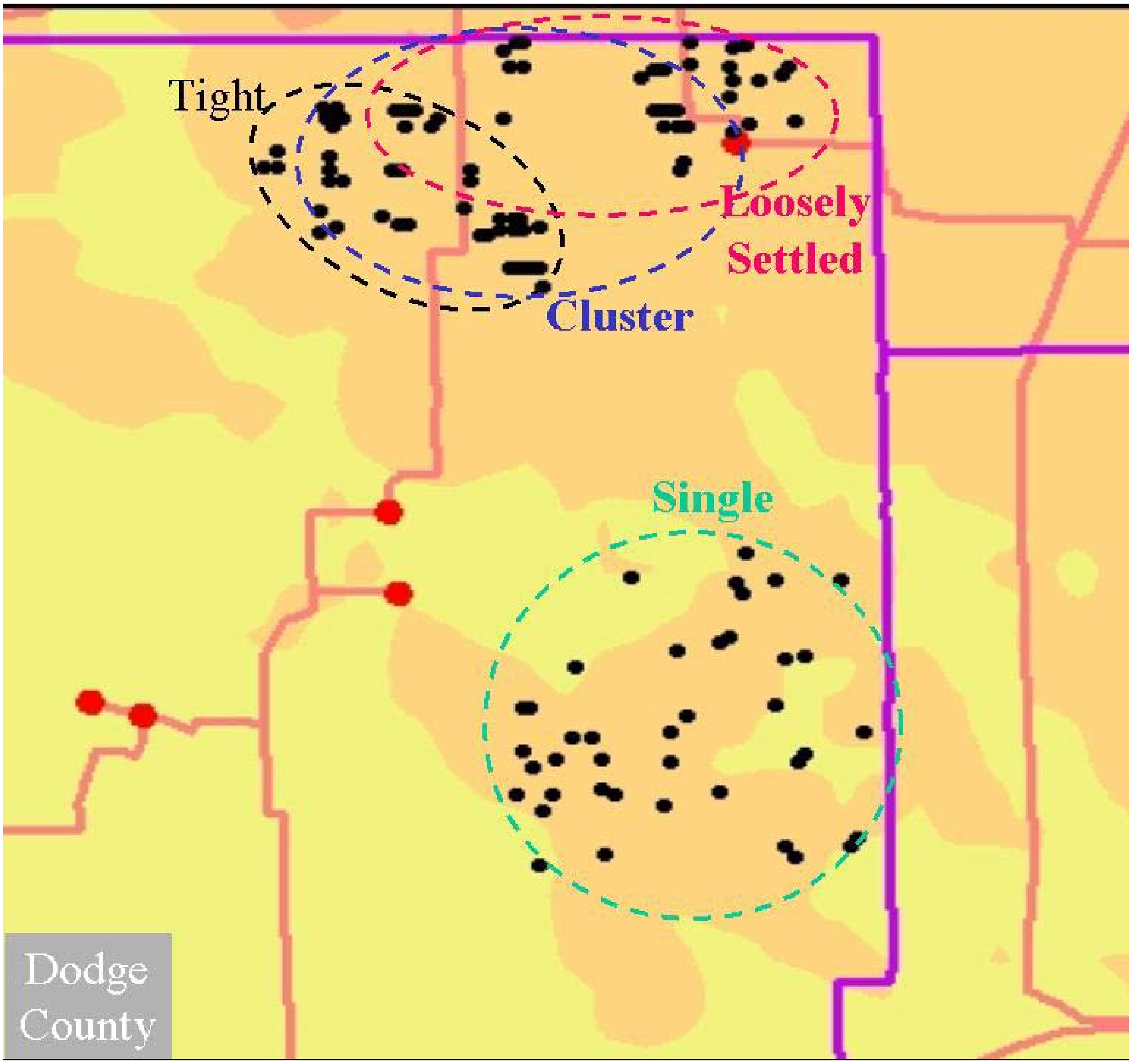
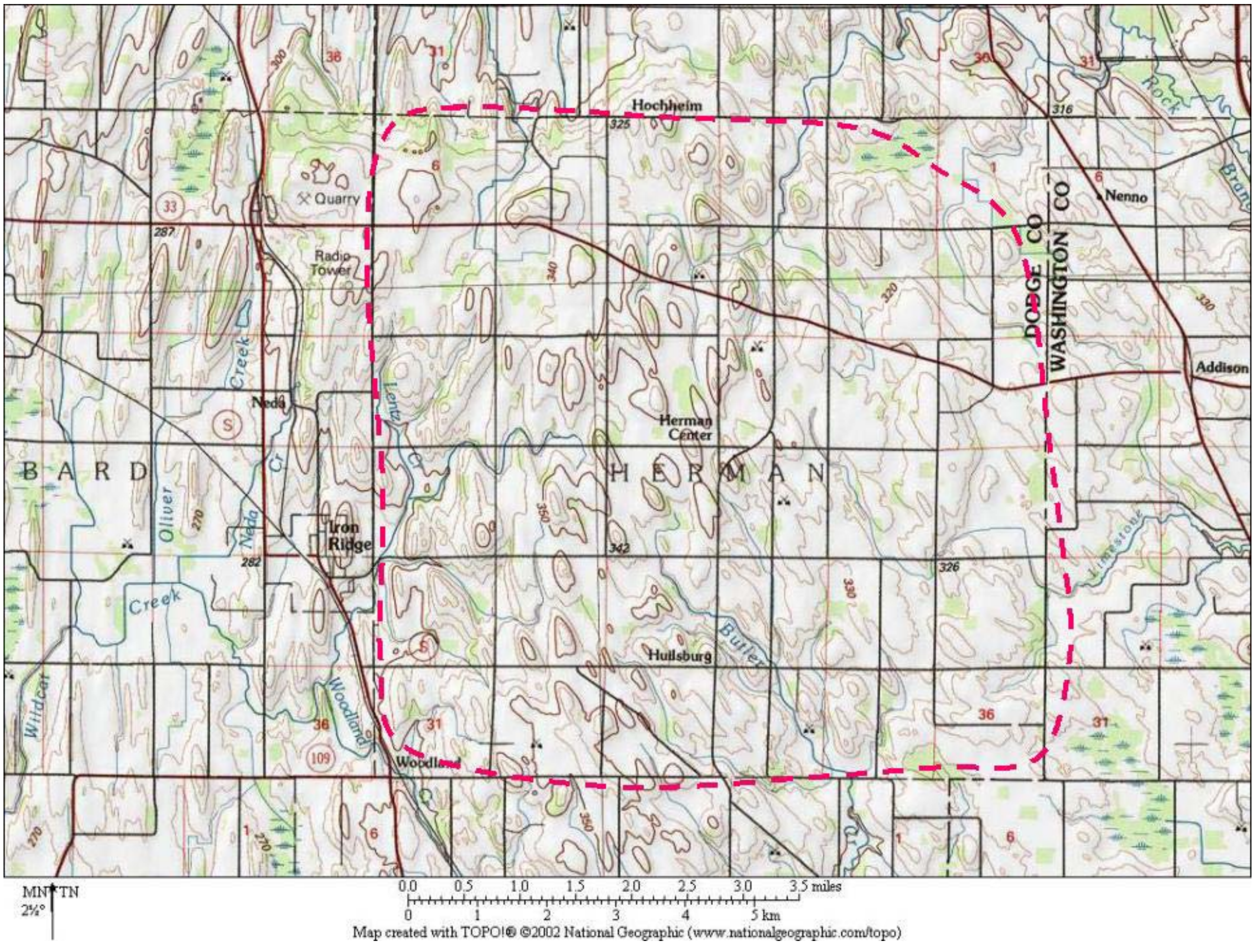


FIGURE 9: POTENTIAL LOCATIONS IN DODGE COUNTY USED FOR EACH LAYOUT SCENARIO



The 110 potential wind turbine sites in Dodge County were used in various combinations to form four different layout schemes, each using forty 750 kW wind turbines to total 30 MW. Figure 9 shows the general location of the four different layout schemes for Dodge County. For example, the tight layout scheme uses the 40 potential wind turbine locations shown inside the black dotted oval line at the top of the figure to form a 30 MW wind farm. Based on the consultant's analysis, this is the tightest, or most closely spaced set of sites that could be found in the higher elevation areas of Dodge County. This area is about 4 by 5 miles in size. It should be noted that many large wind farms have a more compact layout than this.

The other three layout schemes were devised by taking combinations of the potential sites. Obviously, in order to illustrate the less dense layouts for this study, adjacent wind turbine sites were sometimes not selected. A wind farm developer would always select adjacent sites to minimize the area and cost of the wind farm. For this study, however, it was impossible to find specific areas in each county having just the right characteristics to represent the four layout schemes. Therefore, selective use of potential wind turbine sites was used to achieve the desired density of the wind turbines.

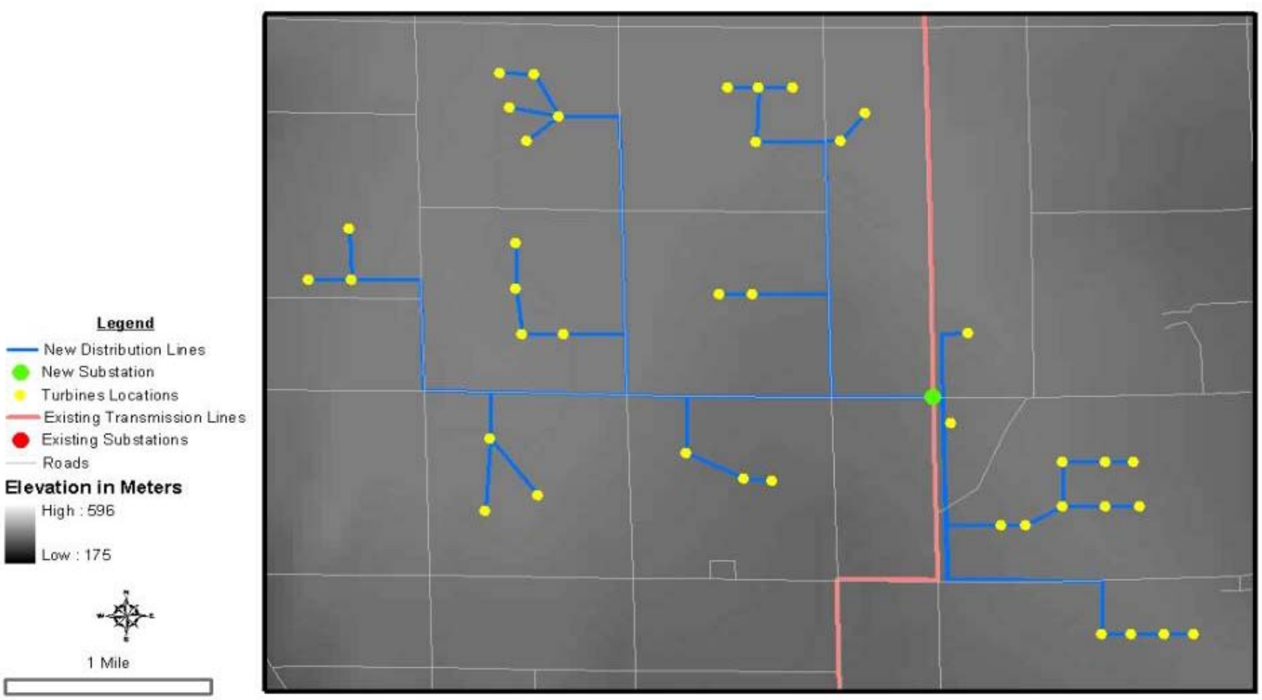
The loosely settled layout scheme for Dodge County is shown inside the red dashed oval in Figure 9. It is spaced out more than the tight layout scheme, with wind turbines in a 3-mile by 7-mile area.

The cluster layout area is shown with the blue dashed oval. It covers an area of 7 miles by 7 miles. This layout is more spread out than the loosely settled layout. The single turbine layout scheme shown inside the green dashed circle covers about the same area, but the wind turbines are more evenly scattered in the area.

The next four figures illustrate the actual locations of the wind turbines in each of the four different layout schemes. These figures show the elevations of the area in shades of gray, along with the county roads. The blue lines represent new distribution voltage level lines built to collect the wind power. These new lines converge on a new collection substation, shown by the green circle. This new collection substation is then connected to the existing transmission grid in the area. In Dodge County, the collection substation would be built adjacent to the existing transmission line. In other counties, a radial transmission line (69 kV or 138 kV) would be needed to connect the wind farm to the existing grid.

The tight layout scheme portrayed in Figure 9 shows the most compact arrangement of higher elevation sites that could be found for installing forty 750 kW wind turbines. In this scheme, most sections of land would contain 3 to 5 wind turbines, usually located toward the center away from roads and homes. This layout has 8.4 miles of overhead distribution voltage collection lines that would be placed along the existing roads. Another 9.2 miles of underground lines would be needed to connect the wind turbines to the overhead lines along the roads. A similar length of access roads would be required for the construction and ongoing operation and maintenance work.

FIGURE 10: TIGHT LAYOUT SCHEME FOR DODGE COUNTY



To construct this tight layout wind farm, it was estimated that the large crane would need to be moved, assembled, and then torn down 8 times. There would be 32 times when the crane could simply be moved from one site to an adjacent site under its own power, without tearing it down. These 32 simple low-cost moves would involve moving the crane across several parcels of land, and across four gravel roads.

FIGURE 11: LOOSELY SETTLED LAYOUT SCHEME FOR DODGE COUNTY

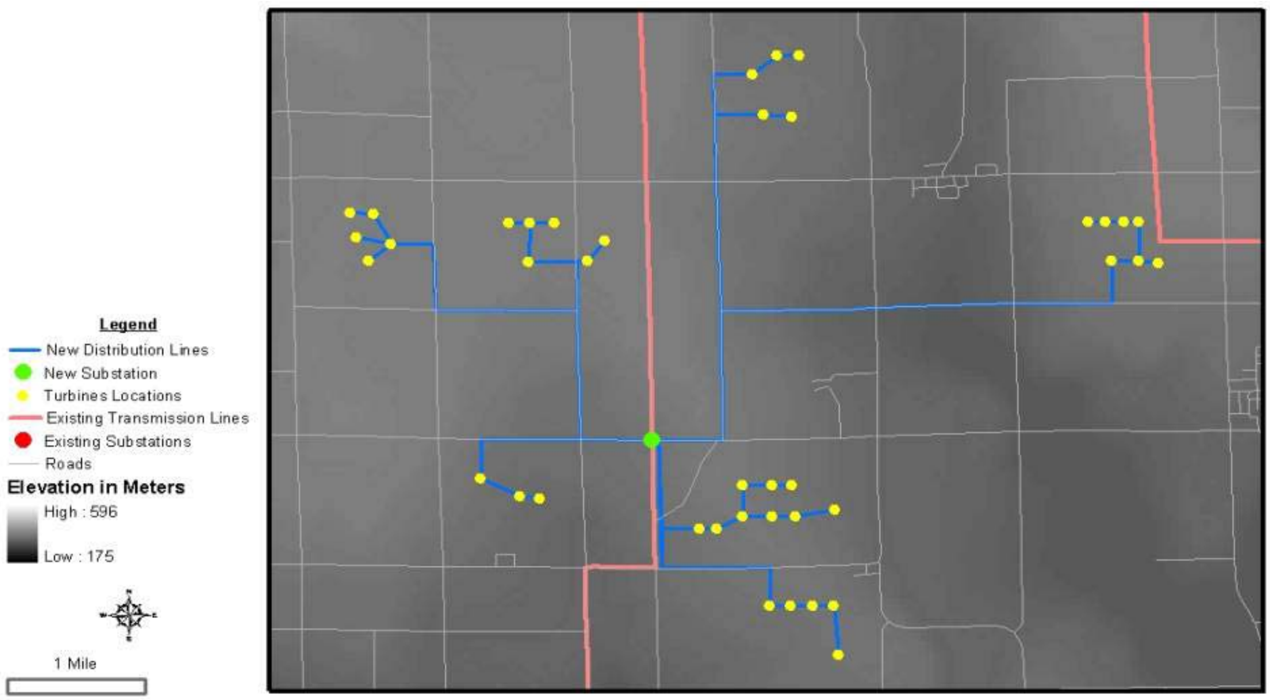


Figure 11 displays the loosely settled layout scheme for Dodge County. A 12-mile overhead collection circuit would need to be built, along with 8.8 miles of underground circuits. This particular selection of sites results in an estimated seven crane assembly/tear downs, with the remaining 33 sites requiring a simple move of the crane under its own power.

FIGURE 12: CLUSTERED LAYOUT SCHEME FOR DODGE COUNTY

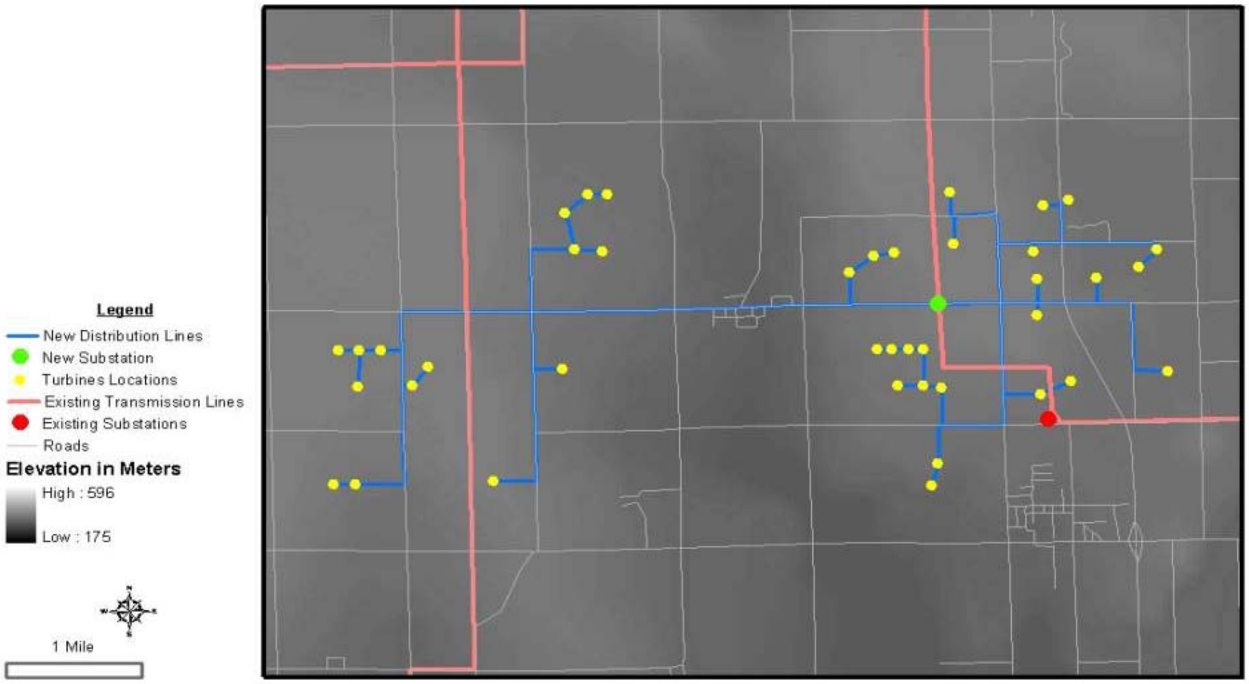


Figure 12 depicts the layout of the clustered layout scheme for Dodge County. A total of 13.6 miles of overhead collection circuit would need to be built, along with 8.2 miles of underground circuits. This particular selection of sites results in an estimated nine crane assembly/tear downs, with the remaining 31 sites requiring a simple move.

FIGURE 13: SINGLE LAYOUT SCHEME FOR DODGE COUNTY

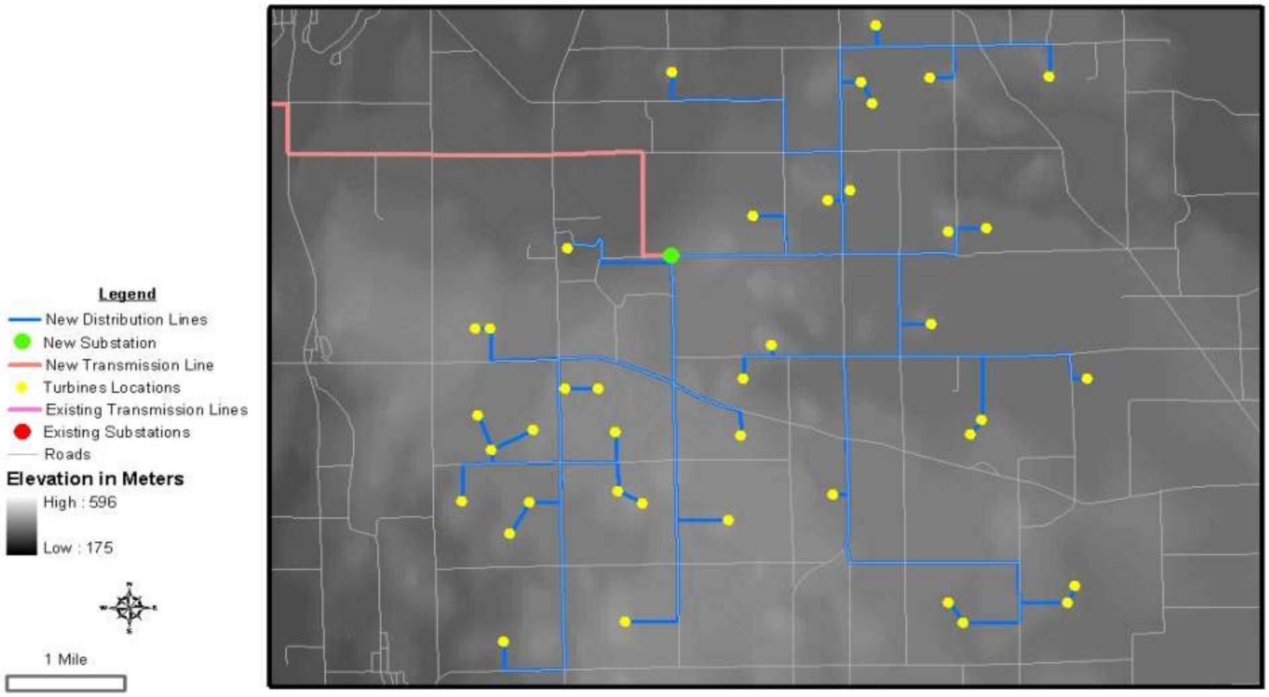


Figure 13 shows the single-turbine layout scheme for Dodge County. In this scheme, the wind turbine sites are generally sited in separate locations or in pairs. A total of 28.2 miles of overhead collection circuit would be needed, along with 10.3 miles of underground circuits. This layout results in an estimated 22 crane assembly/tear downs, with the remaining 18 sites requiring a simple move. In this particular location, a 5-mile long 69 kV line was built to connect the collection substation to an existing 69 kV line.

Similar analysis was done for all of the five counties in this study. Some additional siting analysis was also completed for Green County, Wisconsin. This county is immediately east of Lafayette County. This analysis determined how many wind turbines might be sited in a county where nearly all of the land was used for agriculture, and where there is little residential development. The hilly terrain reduces the potential number of wind turbine sites. It was surprising to find as many as 292 potential sites in Green County for 660-750 kW wind turbines. A further analysis of the four different layout schemes was not made for Green County.

STUDY FINDINGS

Table 1 summarizes the miles of collection circuits and access roads that were necessary for each layout scenario option. The table also shows the estimated number of times the large construction crane had to be assembled and torn down. Figures 14 and 15 illustrate some of the data in Table 1 so that comparisons can be made between the counties and the layout schemes. Because of the difficulty in obtaining the various layout schemes in Manitowoc County, the cost of the schemes did not rank in the same order as for the other counties.

Table 2 reveals the basic cost assumptions used for the various components, such as overhead circuits, underground circuits, access roads, and crane mobilization. The costs vary between counties because of the terrain. Open flat agricultural land allows the lowest construction cost, while hilly areas with trees require more time and expense for construction. The voltage of the overhead and underground circuits could be 13.8 kV, 24 kV, or 34.5 kV. The voltage level will determine the cost. The unit costs shown in Table 1 could be applicable to 13.8 kV or 24 kV, depending upon the type of construction and the labor rates. The last column in Table 2 shows the cost of each wind turbine, along with everything else not included in the previous columns. These costs again vary with the turbine size and the terrain, but should not vary with the layout scheme. Therefore, they were all included together.

In all cases, new collection circuits were assumed. While in some cases it might be possible to use existing distribution lines, separate metering requirements and control and monitoring of power sales might persuade the owner and developer of the ultimate value of building a new distribution line to each turbine. The only exception to this tendency would be a small (less than five MW) project owned by the same company as owns the distribution system. In this case, real-time control and sales would be less important because the generation owner and the power purchaser are one and the same.

In some cases, new transmission is required. Costs for transmission upgrades are included in the cost estimates, even though transmission projects would sometimes be expected to serve load beyond the 30-MW wind project. In this case, one could reasonably expect costs to be partially borne by the transmission company.

Table 3 shows costs for various components of the four layout schemes in each of the five counties. Figure 16 illustrates crane mobilization costs for each layout scheme in each county. The Dodge County costs were higher than normal despite the favorable terrain, because twice as many turbines were used. The Manitowoc County costs were abnormally high because of the number of times the construction crane had to be assembled and torn down due to layout and terrain.

Figure 17 compares the total cost of the wind farms by layout scheme and county. As the graph illustrates, the more compact layout schemes generally have lower construction costs. If the terrain is relatively flat and open, the cost difference between the layout schemes is less than if the terrain is hilly or forested.

TABLE 1: LENGTH OF LINES AND ACCESS ROADS, AND CRANE MOBILIZATIONS

	Dodge	Lafayette	Langlade	Manitowoc	Iron
	Overhead Collection Line Miles				
Tight Layout	8.4	1.9	5.2	22.5	6.2
Clustered Layout	12.0	3.3	8.8	19.5	12.7
Loosely Settled Layout	13.6	3.2	8.2	31.2	8.2
Single Layout	28.2	4.0	15.3	32.9	13.1
	Underground Collection Line Miles				
Tight Layout	9.2	4.7	4.0	6.8	5.1
Clustered Layout	8.8	5.2	3.8	5.4	6.3
Loosely Settled Layout	8.2	4.9	4.5	6.1	5.4
Single Layout	10.3	6.1	5.0	5.4	5.7
	New Access Road Miles				
Tight Layout	9.2	4.7	4.0	6.8	5.1
Clustered Layout	8.8	5.2	3.8	5.4	6.3
Loosely Settled Layout	8.2	4.9	4.5	6.1	5.4
Single Layout	10.3	6.1	5.0	5.4	5.7
	Number of Crane Assembly/Tear Downs				
Tight Layout	8	1	2	12	4
Clustered Layout	7	3	4	11	6
Loosely Settled Layout	9	4	6	15	6
Single Layout	22	6	10	19	6
	Number of Crane Moves				
Tight Layout	32	19	18	8	16
Clustered Layout	33	17	16	9	14
Loosely Settled Layout	31	16	14	5	14
Single Layout	18	14	10	1	14

FIGURE 14: MILES OF OVERHEAD COLLECTION CIRCUITS

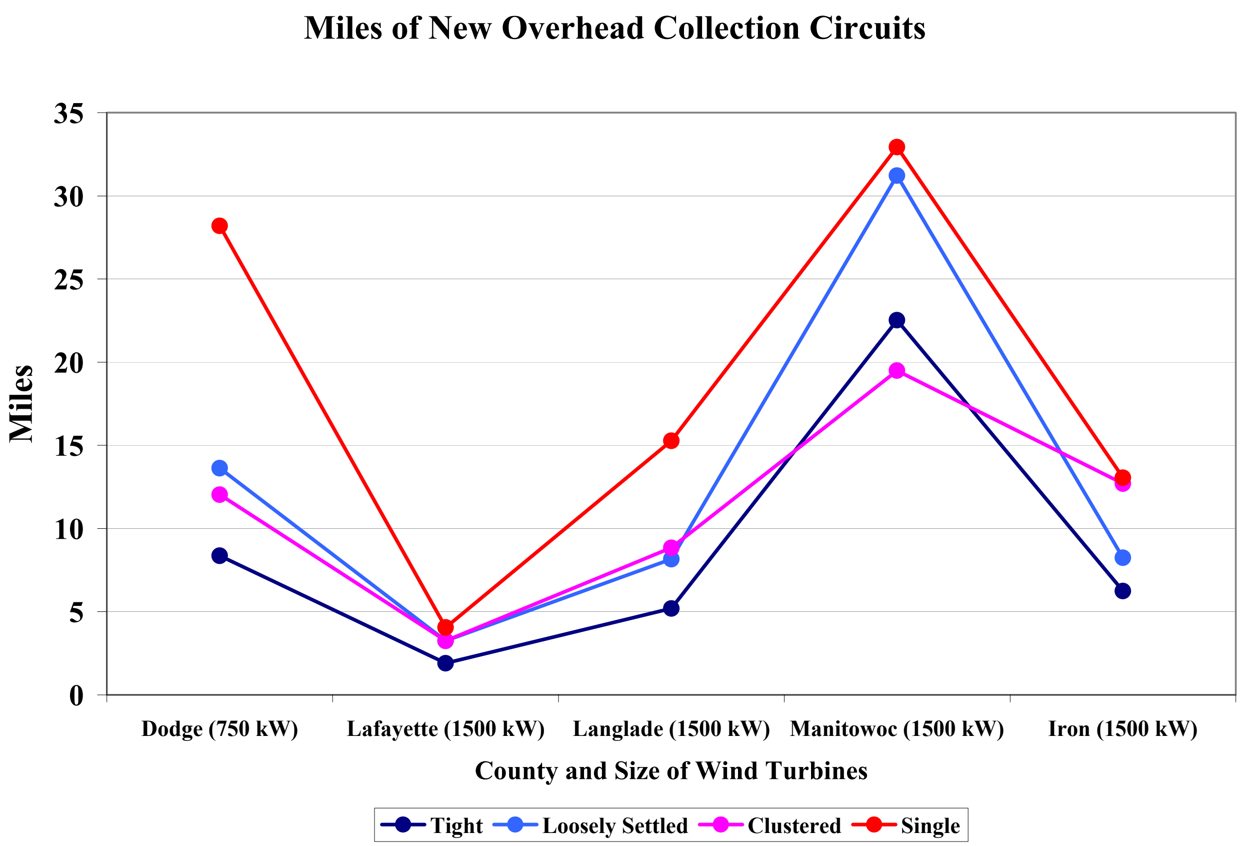


FIGURE 15: MILES OF UNDERGROUND COLLECTION CIRCUITS AND ACCESS ROADS

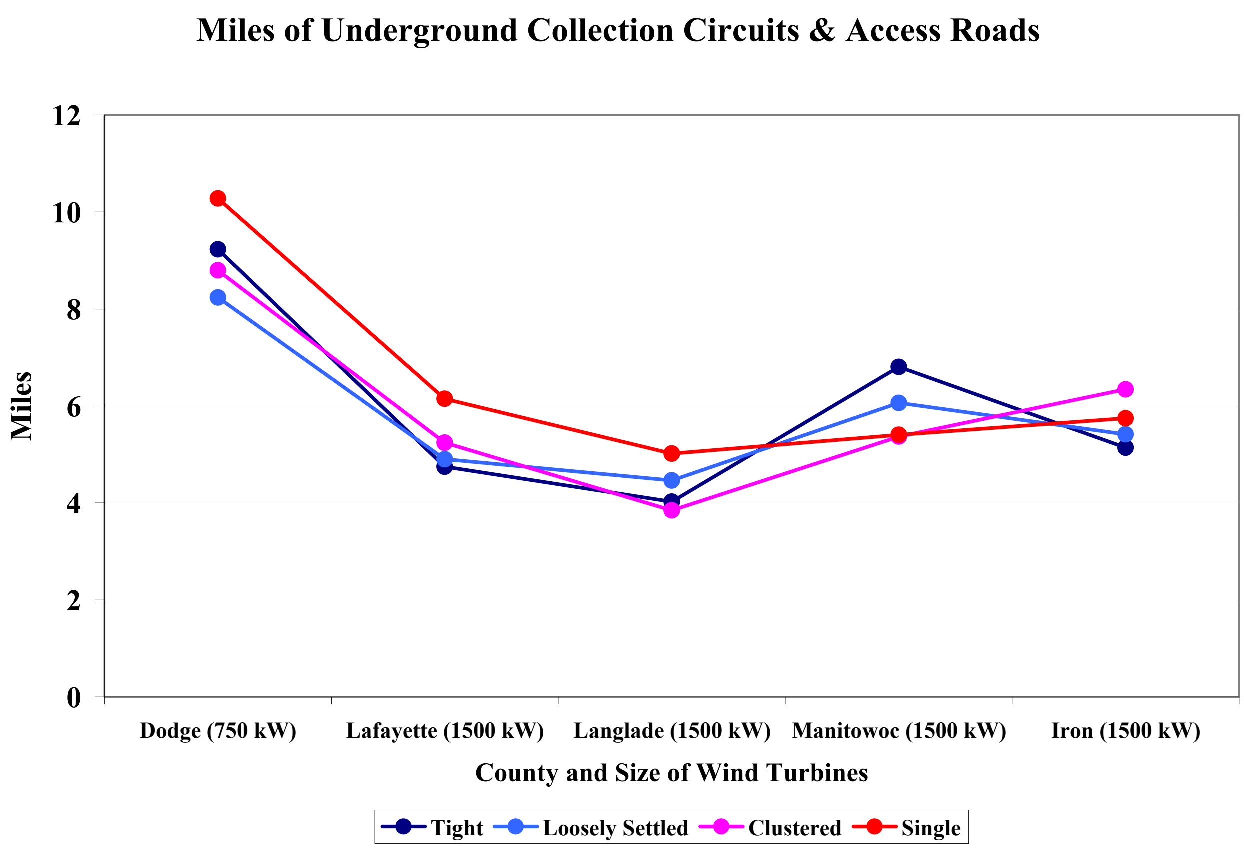


TABLE 2: UNIT COST OF LINES, ROADS, AND CRANE MOBILIZATION BY COUNTY

CONSTRUCTION COST ASSUMPTIONS USED FOR EACH COUNTY

			Collection Circuits					Turbines
	Terrain	69 kV	Overhead	Undergr.	Access	Crane Mobilization		& Balance
	Type	Transm.	Circuits	Circuits	Road	Assemble	Move	of Plant
		$ / Mile	$ / Mile	$ / Mile	$ / Mile	$ / Unit	$ / Unit	$ / Unit
Dodge Co. (750 kW)	2	$183,750	$68,250	$89,250	$78,000	$31,500	$6,300	$840,000
Iron Co. (1500 kW)	4	$232,750	$86,450	$113,050	$162,500	$50,000	$10,000	$1,782,500
Lafayette Co. (1500 kW)	1	$175,000	$65,000	$85,000	$65,000	$40,000	$8,000	$1,550,000
Langlade Co. (1500 kW)	1	$175,000	$65,000	$85,000	$65,000	$40,000	$8,000	$1,550,000
Manitowoc Co. (1500 kW)	2	$183,750	$68,250	$89,250	$78,000	$42,000	$8,400	$1,627,500

Terrain Type Definitions	1 - Flat/Gently Rolling Open Areas
	2 - Hilly Terrain with Some Trees
	3 - Forested Terrain
	4 - Forested & Hilly Terrain

TABLE 3: COST OF LINES, ROADS, CRANE MOBILIZATIONS, AND TOTAL COST

	Dodge	Lafayette	Langlade	Manitowoc	Iron
	Overhead Collection Line Miles				
Tight Layout	$570,689	$123,414	$338,080	$1,537,305	$539,411
Loosely Settled Layout	$930,359	$210,973	$530,279	$2,131,039	$712,844
Clustered Layout	$821,294	$211,589	$574,905	$1,330,713	$1,098,059
Single Layout	$1,924,217	$263,062	$993,158	$2,247,489	$1,129,064
	Underground Collection Line Miles				
Tight Layout	$823,724	$403,670	$342,093	$607,396	$581,134
Loosely Settled Layout	$735,087	$416,649	$379,522	$541,115	$612,038
Clustered Layout	$784,952	$445,767	$327,000	$479,212	$716,867
Single Layout	$917,221	$522,597	$426,409	$482,248	$649,828
	New Access Road Miles				
Tight Layout	$719,893	$308,688	$261,600	$530,833	$835,332
Loosely Settled Layout	$642,429	$318,614	$290,223	$472,907	$879,754
Clustered Layout	$686,009	$340,881	$250,059	$418,807	$1,030,437
Single Layout	$801,605	$399,633	$326,077	$421,460	$934,073
	Cost of Crane Mobilization				
Tight Layout	$453,600	$192,000	$224,000	$571,200	$360,000
Loosely Settled Layout	$478,800	$288,000	$352,000	$672,000	$440,000
Clustered Layout	$428,400	$256,000	$288,000	$537,600	$440,000
Single Layout	$806,400	$352,000	$480,000	$806,400	$440,000
	Total Cost of Wind Farm				
Tight Layout	$36,167,907	$33,068,077	$33,465,844	$35,796,735	$37,965,877
Loosely Settled Layout	$36,386,675	$32,922,387	$33,151,100	$36,367,062	$38,294,636
Clustered Layout	$36,320,655	$33,107,486	$33,039,042	$35,316,332	$38,935,363
Single Layout	$38,994,046	$33,390,542	$33,912,552	$36,507,597	$38,802,965

FIGURE 16: COST OF CRANE MOBILIZATION

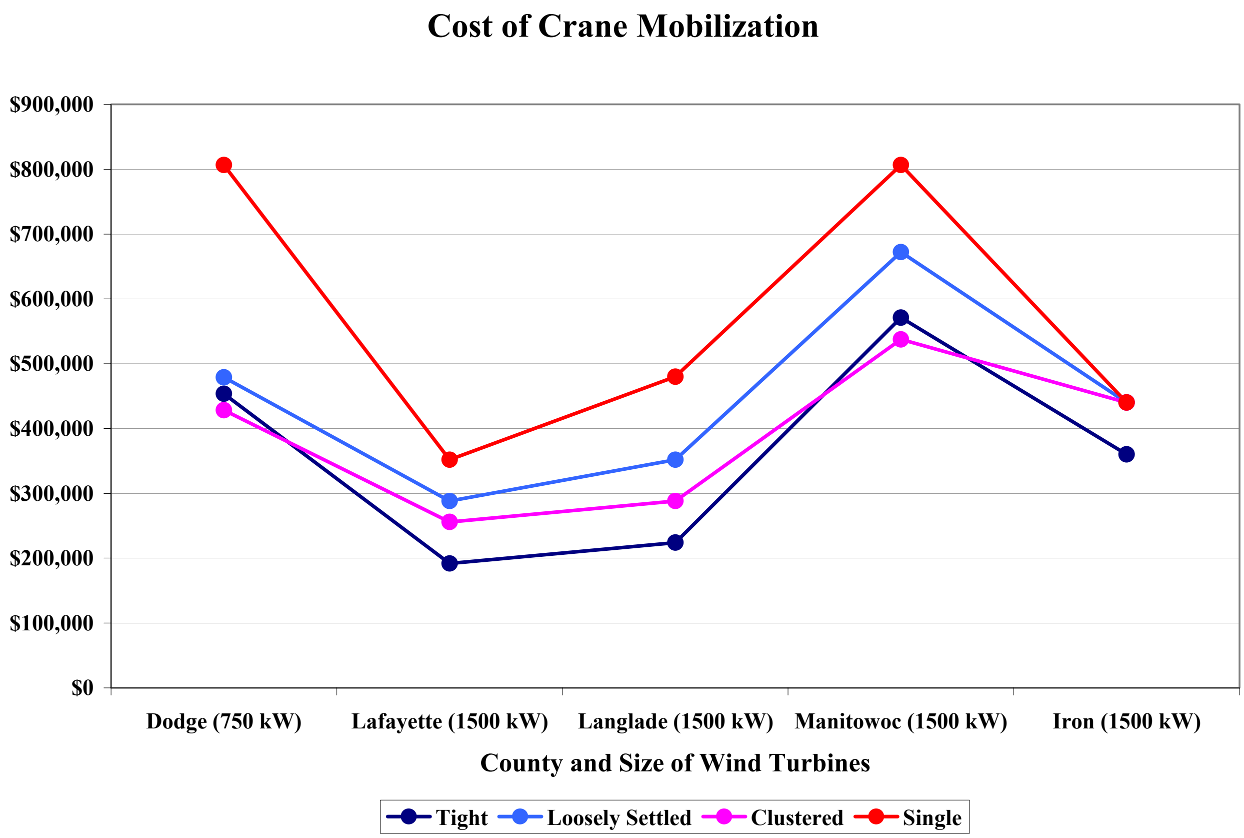
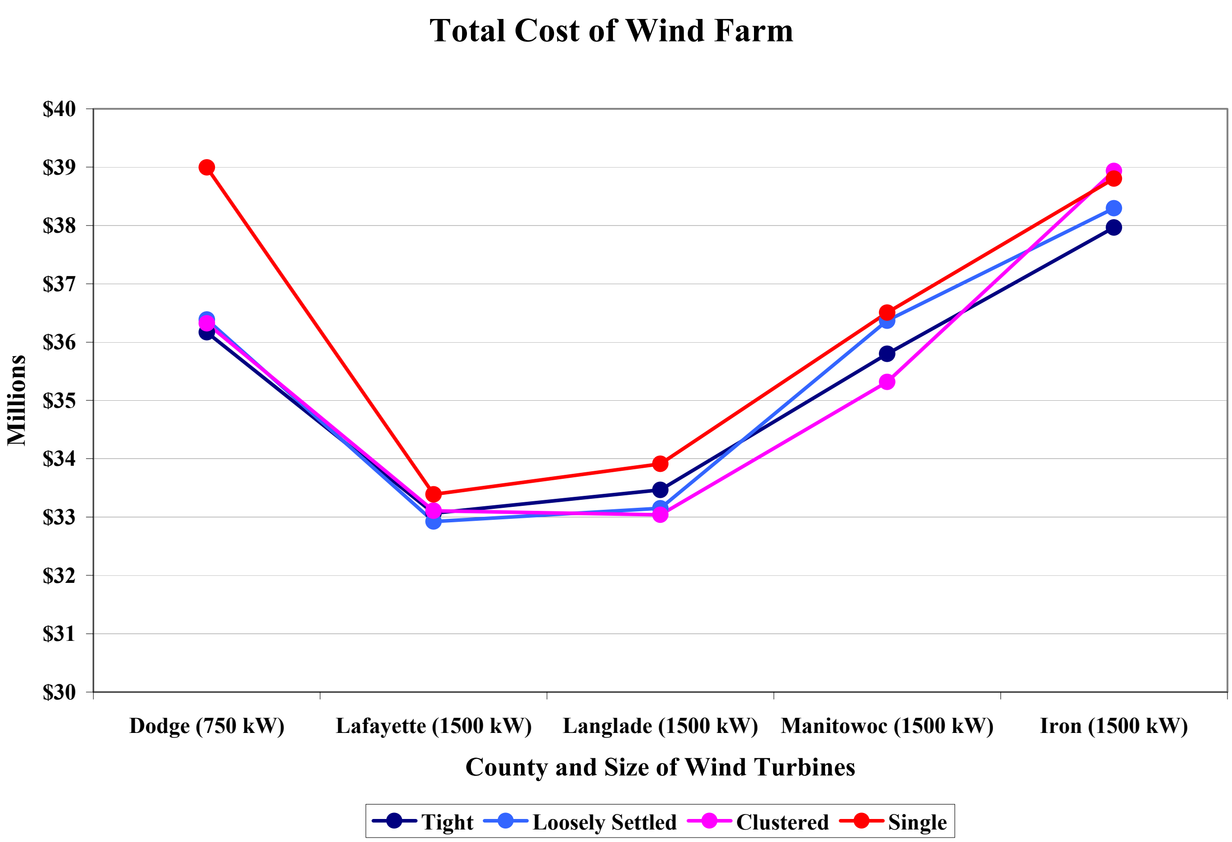


FIGURE 17: TOTAL COST OF WIND FARM



CONCLUSIONS

When a wind farm is designed, the developer tends to pick the most compact layout to minimize construction costs, without undertaking the type of analysis presented here. In this analysis of Manitowoc and Iron counties, it was difficult to find enough suitable wind turbine sites. The two counties lacked either ridgeline areas or high windy areas having adequate set back distances from homes, or both.

Suitable sites in Manitowoc and Iron County were so few that forming the four layout schemes became difficult. In Iron County, only two ridgelines were used. In these two counties, specific turbine locations were used in more than one scheme. This fact in turn minimizes the difference in wind farm total cost between different scenarios.

By contrast, in Dodge County a completely separate area was used for the analysis of the single turbine scenario. No turbine sites from the single-turbine layout were common to the other scenarios. This in turn yields the highest percentage difference in total wind farm cost, a 7.8% additional cost for developing a single-turbine, 30-MW facility versus developing a tight-layout, 30-MW facility. Of the $2.8 million difference in cost, $0.944 million is dedicated to 5.1 miles of new transmission lines for the single-turbine layout, which none of the other layouts in Dodge County require.

In all other counties, the cost difference is negligible, probably within the expected range of error in such an analysis. In Langlade and Manitowoc counties, the tight layout is estimated to be more expensive than the clustered layout.

In summary, the results of this study were not as definitive as desired due to the difficultly of finding suitable sites in some areas. Nevertheless, the consultants have concluded that compact wind farm layout schemes tend to be less costly to construct than more spread out schemes.

Part 2

Section B: Wisconsin Wind Plant Economic Impact Analysis

MRG & ASSOCIATES

This section continues the modeling process for the five-county study of four wind power siting scenarios. It addresses the question: "What are the employment and other macroeconomic benefits for the respective counties if any one of the 30 megawatt (MW) wind plants are constructed and operating?"

INPUT-OUTPUT ANALYSIS

Input-output modeling, sometimes referred to as multiplier analysis, is one tool that can assist in this type of macroeconomic evaluation. Input-output models were initially developed to trace supply linkages in the economy. For example, input-output models can show how purchases of wind turbines will benefit not only the turbine manufacturers, but also the fabricated metal industries and other businesses supplying materials or labor to those manufacturers.

In this study we have adapted the 1999 IMPLAN model for our analysis. [56] The IMPLAN employment multipliers represent the number of jobs directly or indirectly supported by each one million dollars spent in a given sector of the economy. These multipliers calculate for key sectors in the Wisconsin economy. This study tracks these sectors in each of five individual counties, and the average for the state as a whole. The affected sectors include agriculture, construction, manufacturing, utility services, wholesale and retail trade, services, and government, among others. Although the multipliers vary significantly from county to county, looking at the statewide averages we see the combined finance, insurance and real estate sector (FIRE) has the lowest ratio at 11.9 jobs per million dollars of demand, while the retail trade sector has the highest at 38.7. The retail sector is closely followed by the agriculture sector (36.7), other services (34.7) and then construction (24.7).

Much of the job creation from wind power development is derived from the short-term construction jobs, and jobs supported by ongoing operations, including plant employee spending. Ultimately, local employment generated by expenditures for constructing or operating wind power plants will depend on the structure of the local economy. Counties or states having the necessary construction capabilities and workforce, or which produce wind turbines or other wind system components benefit from expanded siting and operation of wind plants in ways that areas without these resources do not.

There is a direct relationship between local economic activity and levels of total employment. For purposes of this study, a job is defined as sufficient wages to employ one person full-time for one year. Table 1 below compares the employment multipliers for each of the five individual counties in the study and the average for the state of Wisconsin as a whole.

[56] = We have adapted data from the 1999 IMPLAN model to derive employment multipliers for the state of Wisconsin and the respective counties. See IMPLAN Professional, Version 2.0 User's Guide, Minnesota IMPLAN Group Inc., Stillwater, MN, April 1999. Table 1 presents what are referred to as Type II multipliers, incorporating the direct, indirect and induced effects of an expenditure.

TABLE 1: EMPLOYMENT MULTIPLIERS FOR SELECTED ECONOMIC SECTORS

	EMPLOYMENT MULTIPLIERS (JOBS PER $1 MILLION EXPENDED)					
Sector	**Dodge County**	**Iron County**	**Lafayette County**	**Langlade County**	**Manitowoc County**	**Wisconsin (average state-wide)**
Agriculture	22.9	35.7	24.2	29.3	19.6	36.7
Mining	12.2	49.8	17.7	16.1	13.2	14.0
Construction	17.6	29.2	19.4	19.9	17.7	24.7
Manufacturing	14.3	22.8	10.1	13.9	11.2	18.1
Transportation, Communication and Public Utilities	18.4	28.9	13.4	22.1	12.4	18.5
Wholesale Trade	17.3	15.5	20.8	14.3	14.6	13.2
Retail Trade	42.2	52.4	39.5	44.8	42.3	38.7
Finance, Insurance and Real Estate	10.8	20.9	15.1	12.4	10.9	11.9
Other Services	32.5	43.8	32.0	33.7	29.8	34.7
Professional Services	18.3	22.9	15.5	23.1	15.2	20.0
Government	22.1	17.9	27.5	23.6	21	22.2

Source: Derived from the 1999 IMPLAN database for the state of Wisconsin and the respective counties. The employment multipliers represent the direct, indirect and induced jobs supported by a one million-dollar expenditure for goods or services purchased from a given sector. The multipliers were derived by MRG & Associates.

EVALUATING THE WIND POWER PLANT SITING SCENARIOS

The employment analysis for each of the wind power siting scenarios involves comparing the wind power plant construction and operation costs with their appropriate employment multipliers. However, there are several factors that can significantly affect the results. Foremost among these is the proportion of local spending that results from the project. As noted earlier, this depends upon how the "local area" is defined,[57] structure of the local economy, the diversity of local businesses, and availability of a skilled local labor force.

As with any analysis of this type and scope, the assumptions used are key to obtaining meaningful results. Smaller counties typically have fewer of the necessary skilled workers and or businesses available to meet the labor needs and supply the goods and services during the construction phase and operation of the plants. By analyzing the impacts to a larger region (in this instance, the state as a whole) we are able to capture the additional spending that occurs outside a local project area but still within the state. Thus the state level analysis (compared with a county

[57] The local area is the region where we are analyzing the impacts. The local area can be a single county, an entire state, or a region comprised of several counties or states. In this study we have analyzed six local areas for each of the siting configurations. These areas are the five individual counties, and the state as a whole.

level analysis) shows the benefits that accrue to a broader representation of the state's businesses and workers from in-state expenditures on wind power plant construction and ongoing operations.

CONSTRUCTION

Construction cost analysis in this study includes hiring of construction firms or labor for site clearing and preparation, the building of access roads, pouring foundations, erecting towers, and making electrical interconnections. In addition to installation, related labor costs and expenditures also include purchasing wind power equipment (such as turbines and transformers), materials and supplies (concrete, rebar, wiring), rental of cranes and lifts, and utilizing professional services such as engineering and legal expertise, among others.

Table 2 summarizes the total construction expenditures for a 30 MW plant in each of the areas analyzed, along with the amount of money spent locally.[58] The total construction costs vary by site configuration and characteristics including terrain, access, and proximity to transmission lines within each geographic area. Total costs range from a high of $38.63 million for siting single turbines in Dodge County to a low of $32.67 million in Langlade County for a cluster configuration (both in 2003 dollars).

The local share of spending is greatest in the state level analysis, with the single turbine configuration being the highest, totaling $8.43 million or 23.4 percent of total construction expenditures. This is due in part to the higher construction costs associated with single turbine installation compared with the clustered and central station configurations. However, it is more significant that the greater local share is due to the larger number and greater diversity of businesses (materials and parts suppliers, construction, and services) and skilled workers to draw upon in the state as a whole relative to any of the individual counties, regardless of their size.

Dodge County and Manitowoc County, the two largest counties analyzed, both have local spending of approximately $3.0 million each, around 8 percent of the total wind plant construction costs in each county. The remaining counties, Iron, Lafayette, and Langlade, have local spending of between $0.5 million and $0.7 million during the construction period. Due to more limited hiring of local workers and construction related firms, this level of spending represents only between 1.4 and 1.9 percent of total construction costs, significantly less than for the larger counties or the state as a whole.

ONGOING OPERATIONS AND MAINTENANCE

For the ongoing operations and maintenance (O&M) analysis, expenditures include hiring plant employees who live, commute or relocate to the local area; purchasing of equipment; materials and services such as vehicles, motor fuel, insurance, tools and supplies; debt and equity payments; payments of taxes and fees to the government; and land lease payments.

[58] A more detailed cost breakout for each of the counties analyzed and the broader state level scenario appear at the end of this Section.

In each scenario it was assumed that 80 percent of the construction costs are financed through lending institutions, with the IPP or utility contributing 20 percent equity, except for the local developer, single turbine configuration. In this scenario, it was assumed the IPP contributed 30 percent equity, local investors contribute 20 percent[59] and lending institutions lend the remainder.

[59] In this scenario we assume local investors receive "interest only" repayment for the first ten years and take ownership from the IPP starting in the 11th year.

TABLE 2: SUMMARY OF LOCAL SPENDING OF CONSTRUCTION EXPENDITURES FOR WIND POWER PLANTS

	SITING CONFIGURATION*				
	Tight	**Clustered**	**Loosely Settled**	**Single**	
Developer type**	IPP	IPP	IPP or Utility	Utility	Local
Dodge County					
Construction Costs	$35.80	$35.96	$36.02	$38.63	$38.63
Local Spending	$2.99	$2.96	$2.96	$3.21	$3.21
Percent of Total	8.3%	8.2%	8.2%	8.3%	8.3%
Iron County					
Construction Costs	$37.60	$38.57	$37.93	$38.44	$38.44
Local Spending	$0.51	$0.53	$0.52	$0.52	$0.52
Percent of Total	1.4%	1.4%	1.4%	1.4%	1.4%
Lafayette County					
Construction Costs	$35.43	$34.95	$36.00	$36.14	$36.14
Local Spending	$0.67	$0.66	$0.67	$0.68	$0.68
Percent of Total	1.9%	1.9%	1.9%	1.9%	1.9%
Langlade County					
Construction Costs	$33.10	$32.67	$32.79	$33.55	$33.55
Local Spending	$0.50	$0.50	$0.51	$0.53	$0.53
Percent of Total	1.5%	1.5%	1.6%	1.6%	1.6%
Manitowoc County					
Construction Costs	$35.43	$35.96	$36.00	$36.14	$36.14
Local Spending	$2.83	$2.96	$2.86	$2.90	$2.90
Percent of Total	8.0%	8.2%	7.9%	8.0%	8.0%
Wisconsin average (statewide)					
Construction Costs	$34.93	$34.98	$35.06	$35.96	$35.96
Local Spending	$7.43	$7.47	$7.55	$8.43	$8.43
Percent of Total	21.3%	21.4%	21.5%	23.4%	23.4%

Notes: Analysis is based on construction of a 30 MW wind power plant. All dollar values are reported in 2003 dollars.

*Siting configurations: "tight" refers to conventional central station, "loosely settled" refers to more spread out central station, "clustered" refers to clusters of turbines, and "single" refers to dispersed single turbines.

**Developer types: "IPP" refers to independent power producers, "utility" refers to a regulated utility company, "local" refers to an ownership scenario whereby local investors partner with an IPP and provide 20 percent of the investment capital and take complete ownership after 10 years.

The State of Wisconsin currently exempts wind power plants from property taxes, so no taxes are included in the analysis.[60] However, the state does allow local jurisdictions to collect a utility tax and impact fees from project developers. In current practice, the utility tax and impact fees are negotiated rather than subject to a standard formula. This study uses an average value of $1,700 per MW in analyzing each scenario.[61] These taxes and fees generate annual revenues to counties totaling $51,000. Land lease payments to property owners are based on an annual per turbine charge of $2,667 per MW.[62]

Table 3 contains a summary of the total annual operations and maintenance expenditures[63] for the 30 MW plants in each of the counties, as well as the share of expenditures made in the local area.[64] Similar to the construction costs, O&M costs vary as well, depending upon the siting configuration and characteristics specific to each site. Annual O&M costs range from a high of $6.49 million for utility-owned single turbines in Dodge County to a low of $5.47 million in Langlade County for a cluster configuration.

Similar to the local share of construction spending, local O&M spending is also highest in the state level analysis for each of the siting configurations. The utility-developed single turbine configuration has the highest annual local spending with a total of $4.63 million, or just under 80 percent of total annual O&M expenditures.[65] This is due in part to the higher O&M costs associated with maintaining 30 MW of single turbines (compared with cluster or central station configurations), but again, more significantly, the higher level of spending is due to the larger number and greater diversity of businesses (materials and parts suppliers, construction, manufacturing, financial and other services) and skilled workers available throughout the state, relative to the individual counties. The local spending in each of the counties is fairly consistent since it is assumed most plant workers reside in the county where the plant is located. Annual local spending ranges between $0.28 million and $0.41 million, which makes up between 4.7 and 6.9 percent of total annual O&M costs.

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[60] See, Wisconsin Statute 70.111 (18).

[61] This value was derived from utility tax and impact fee data for Kewanee County wind plants. The data was provided by Alex DePillis, Wisconsin Department of Administration, Energy Division.

[62] There is no standard for estimating land lease payments; some are based on a percentage of revenues while others use a flat per turbine charge. Nevertheless, an average appears to be just under $2,700 KW. Utilizing the $2,667 rate per KW, annual lease payments for 750 KW turbines are set at $2000 and 1.5 MW turbines are set at $4,000.

[63] The annual O&M costs include debt repayment.

[64] A more detailed cost breakout for each of the regions analyzed appears at the end of this Section.

[65] The lower local annual spending and percent of total O&M expenditures for the local single turbine in the state level analysis is largely the result of interest only payments (i.e., no principal payments) to local investors during the early years of operations.

TABLE 3: SUMMARY OF LOCAL SPENDING OF O&M EXPENDITURES FOR WIND POWER PLANTS

	SITING CONFIGURATION				
	Tight	**Clustered**	**Loosely Settled**	**Single**	
Developer Type	IPP	IPP	IPP or Utility	Utility	Local
Dodge County					
Annual O&M Costs	$5.89	$5.95	$5.97	$6.49	$6.28
Local Spending	$0.32	$0.33	$0.34	$0.41	$0.41
Percent of Total	5.4%	5.6%	5.7%	6.3%	6.5%
Iron County					
Annual O&M Costs	$6.16	$6.38	$6.23	$6.37	$6.16
Local Spending	$0.31	$0.35	$0.32	$0.35	$0.35
Percent of Total	5.0%	5.4%	5.1%	5.5%	5.6%
Lafayette County					
Annual O&M Costs	$5.84	$5.75	$5.95	$5.98	$5.78
Local Spending	$0.31	$0.30	$0.32	$0.32	$0.32
Percent of Total	5.3%	5.2%	5.4%	5.4%	5.6%
Langlade County					
Annual O&M Costs	$5.48	$5.47	$5.48	$5.70	$5.52
Local Spending	$0.31	$0.33	$0.33	$0.38	$0.38
Percent of Total	5.6%	6.1%	6.0%	6.7%	6.9%
Manitowoc County					
Annual O&M Costs	$5.80	$5.95	$5.95	$5.98	$5.78
Local Spending	$0.28	$0.33	$0.33	$0.33	$0.33
Percent of Total	4.7%	5.6%	5.5%	5.6%	5.8%
Wisconsin average (statewide)					
Annual O&M Costs	$5.57	$5.62	$5.63	$5.82	$5.82
Local Spending	$4.44	$4.47	$4.48	$4.63	$3.06
Percent of Total	79.7%	79.6%	79.6%	79.4%	52.6%

Notes: All dollar values are reported in 2003 dollars.

MACROECONOMIC RESULTS

The investment and annual expenditure data from the siting analysis was used to generate three economic impact estimates for both the construction period and plant operation and maintenance on an annual basis. The resulting estimates demonstrate that the level of local spending really does matter. For example, in the construction analysis, the employment benefits to the state as a whole are significantly greater than for any of the individual counties. This, as noted earlier, is the direct result of a much larger portion of the plant expenditures being made within the state but not within the county where the plant is built. Once spending patterns are determined for each scenario, results can be analyzed to estimate the economic impact at both county and state levels.

The first of the three impact estimates explored here is how the employment base, as measured by full-time equivalent jobs, makes a net economic contribution at both the county and state levels. The second impact estimate concerns the net gain to the region's wage and salary compensation (income) measured in millions of 2003 dollars. The final estimate examines the contribution to output (sales), also measured in millions of 2003 dollars. Tables 4 and 5, on the following pages, summarize the economic impacts from both construction and annual operation of a 30 MW plant in all four siting scenarios for each of the counties, as well as the economic impact for the state as a whole.

These analyses do not include other benefits that might stem from the investments and ongoing operations. These benefits can be substantial, especially in the start-up of new businesses or services, and support for schools through increased student populations. Furthermore, in some instances there is tourism value related to wind power plants. To the extent these "co-benefits" add to the direct impacts, the economic outcomes will be amplified beyond those reported here. And equally important, if a large percentage of the wind power equipment itself is manufactured in Wisconsin, both the state and individual counties will enjoy significantly larger economic gains.

CONSTRUCTION IMPACTS

Several aspects of Table 4 are worth noting before examining the impact estimates in more detail. The first is that constructing wind plants in Wisconsin provides benefits to individual counties and to the state as a whole. Wage and salary earnings during and after the construction period are shown to rise by amounts ranging from $0.20 million and 7 jobs in individual counties, to over $7.8 million and 216 jobs for the state. At the same time, output is projected to increase by a low of $0.6 million in an individual county to almost $22.1 million for the state.

Second, while these numbers appear to show relatively small gains, the impacts can be significant, especially in small rural counties, where many farmers are struggling to keep their farms profitable. In these counties, any new economic activity that increases job opportunities and local government revenue offers substantive improvement. On the other hand, if the impacts are small in relation to the larger economy, it is only because the scale of investment is also relatively small. The local share of the anticipated $35 million in one-time construction costs and annual spending of as much as $6.5 million (from Table 2 and Table 3) represent a small portion of the state's 2001 gross state product of $182,629 million (in 2003 dollars).[66]

[66] See the U.S. Bureau of Economic Analysis at Http://www.bea.gov/bea/newsrel/gsp0503.xls.

TABLE 4: SUMMARY OF ECONOMIC IMPACTS FROM CONSTRUCTION PHASE OF 30 MW WIND PLANT, FTE JOBS AND EXPENDITURES IN $ MILLIONS

	SITING CONFIGURATION				
	Tight	Clustered	Loosely Settled	Single	
Developer	IPP	IPP	IPP or Utility	Utility	Local
Dodge County					
Employment	45	44	44	48	48
Construction Only	36	35	35	38	38
Income	$1.77	$1.76	$1.76	$1.91	$1.91
Output	$5.01	$4.96	$4.97	$5.39	$5.39
Iron County					
Employment	9	9	9	9	9
Construction Only	6	6	6	6	6
Income	$0.24	$0.25	$0.25	$0.25	$0.25
Output	$0.74	$0.76	$0.75	$0.75	$0.75
Lafayette County					
Employment	9	9	9	9	9
Construction Only	7	7	7	7	7
Income	$0.24	$0.23	$0.24	$0.25	$0.25
Output	$0.85	$0.82	$0.85	$0.87	$0.87
Langlade County					
Employment	7	7	7	7	7
Construction Only	5	5	5	5	5
Income	$0.20	$0.20	$0.21	$0.22	$0.22
Output	$0.59	$0.60	$0.61	$0.64	$0.64
Manitowoc County					
Employment	41	43	41	42	42
Construction Only	31	33	32	32	32
Income	$1.54	$1.61	$1.55	$1.58	$1.58
Output	$4.26	$4.45	$4.29	$4.35	$4.35
Wisconsin					
Employment	195	196	197	216	216
Construction Only	94	95	96	109	109
Income	$6.99	$7.03	$7.09	$7.80	$7.80
Output	$19.71	$19.82	$20.00	$22.06	$22.06

Notes: “Employment” represents the total full time equivalent jobs created. “Construction Only” refers to the construction related portion of the total employment generated (the numbers should not be added together). All dollar values are reported in 2003 dollars. The impacts noted in the table are considered gross since they do not account for alternate spending or displacement of other electrical generation resources.

As elsewhere, it should be noted that the results for each of the siting scenarios in Table 4 are not intended to be precise forecasts, but rather approximate estimates of overall impact. Indeed, while the aggregate totals offer reasonable insights into the benefits of developing and operating wind power plants in Wisconsin, impacts in some individual sectors are sufficiently small that the results will vary with even modest changes in the assumptions.

Looking at the results in more detail we see that the employment impacts in each of the smaller counties (Iron, Lafayette, and Langlade) range from 7 to 9 full time equivalent jobs during the construction phase. Of this number, between 70 and 80 percent are directly attributable to on-site construction jobs and the remainder are jobs added to the retail sector. Additional retail sector jobs result from spending by local as well as out-of-area construction workers, and local purchases of motor fuels and other supplies by the wind power plant itself. This local retail spending contributes between $0.20 million and $0.25 million in income, and between $0.59 million and $0.87 million in output (sales) to these three counties during the construction period.

Once again, the significantly smaller share of construction spending, and correspondingly smaller number of jobs, income and output in these counties results from the limited number of locally available skilled workers or contracting businesses with the appropriate capabilities. For instance, few primarily agriculturally based counties can support the large crane contractor needed to erect the turbine towers. Similarly, large-scale, specialized construction contractors typically perform the necessary road building, foundation and electrical work and bring in their own personnel to oversee and coordinate the installations.

The two larger counties, Dodge and Manitowoc, enjoy significantly greater benefits from the construction phase. Construction in Dodge County creates between 44 and 48 full time equivalent jobs, with the single turbine configurations providing slightly more than the others. On-site construction jobs represent approximately 80 percent of total jobs. The remaining jobs are created in the retail and service sectors. Consistent with the higher level of spending, local income increases between $1.76 million and $1.91 million.

As might be expected, when the construction expenditures are analyzed on a state level, between 195 and 216 full time equivalent jobs are supported during the construction period. Once again, due to slightly higher costs and greater local investment associated with the single turbine scenarios, the single turbines provide the largest number of job benefits (216). Conversely, the conventional central station (tight) scenario provides the lowest number of jobs (195).

Unlike the analysis in the individual counties, in the state level analysis, only about 50 percent of the jobs are in the construction sector. Of the other 50 percent, the largest numbers of jobs are in the service sectors (approximately 44 percent), retail sectors (approximately 22 percent), and manufacturing sectors (approximately 18 percent). The ratios stay fairly consistent regardless of the siting scenario. These sectors are the "big" winners for two reasons. First, they benefit from the actual or direct spending that occurs during plant construction. Second, they benefit from the higher level of goods and services produced and sold as these workers spend their earnings, and businesses rely on other businesses elsewhere in the economy. The remaining jobs, approximately 16 percent (of non-construction sector jobs), are fairly evenly distributed in the finance, insurance and real estate sectors (FIRE), wholesale trade, and transportation, communication and public utilities (TCPU) sectors.

Combined, these jobs account for between $6.99 million and $7.80 million dollars in earnings and $19.71 million to $22.06 million in output statewide. The distribution of earnings and output by sector is similar to the jobs sector distribution noted earlier, with the exception of the service sectors that account for a slightly higher share of each.

ONGOING OPERATIONS AND MAINTENANCE (O&M) IMPACTS

As with the construction impacts noted earlier, estimates of the economic impacts from ongoing operations and maintenance of the wind plants (reported in Table 5) are all positive but also have the added benefit of continuing for the operating life of the plant. Unlike the construction phase in most counties, plant workers typically live in the local area and thus provide an ongoing stimulus to the local economy when they spend their paychecks. Table 5 indicates that wage and salary earnings and employment rise from a low of $0.21 million and 9 jobs in individual counties, to over $1.7 million and 34 jobs in the state level analysis. At the same time, output is increased by a low of $0.28 million in an individual county to $2.80 million in the state level analysis.

As elsewhere, it should be noted that the results for each of the siting scenarios in Table 5 are not intended to be precise forecasts, but rather approximate estimates of overall economic impact.

Looking at the results in more detail, we see that the employment impacts are fairly consistent in each of the counties for all of the siting configurations, except those for single turbines. Annual employment figures range from a low of 9 full-time equivalent jobs for the tight configuration in Dodge and Lafayette counties, to a high of 21 jobs in Dodge County for the single turbine configuration. Of these total numbers, on-site jobs at the wind plants account for most of the jobs. New jobs range from 5 in most counties and for most configurations, to as many as 8 in the Dodge County single-turbine scenario. With plant workers' salaries representing between 50 and 60 percent of annual O&M expenses, and with most workers living in the local area, this ratio is not surprising. Remaining jobs generated by worker earnings, land lease payments and other local plant spending (motor fuels, tools, etc.) emerge primarily in the retail sector.

Similar to the numbers of jobs created, total earnings are relatively consistent between counties for the tight, loosely settled and cluster configurations. Across all configurations, earnings range from $0.21 million in Lafayette County (cluster) to $0.30 million in the in Iron and Langlade counties (also cluster). Output numbers range from a low of $0.29 million in the Lafayette tight configuration to a high of $0.40 million in the Manitowoc tight configuration. Again, earnings and output for single turbine configurations are somewhat higher in each of the counties, and in some instances, as much as double.

The higher O&M related employment and earnings associated with the single turbine configuration is in part due to the need for more plant workers in some counties. But also, in the case of the local developer scenario, more money circulates within the local economy as the initial investment is repaid to local investors.

TABLE 5: SUMMARY OF ANNUAL ECONOMIC IMPACTS FROM O&M OF 30 MW WIND PLANT, FTE JOBS AND EXPENDITURES IN $ MILLIONS

	SITING CONFIGURATION				
	Tight	Clustered	Loosely Settled	Single	
Developer	IPP	IPP	IPP or Utility	Utility	Local
Dodge County					
Employment	9	10	11	14	21
Plant Workers	5	5	6	8	8
Income	$0.24	$0.26	$0.27	$0.35	$0.52
Output	$0.31	$0.33	$0.34	$0.41	$0.88
Iron County					
Employment	11	13	12	14	16
Plant Workers	5	6	5	6	6
Income	$0.25	$0.30	$0.27	$0.30	$0.35
Output	$0.33	$0.37	$0.34	$0.38	$0.50
Lafayette County					
Employment	9	9	10	10	14
Plant Workers	5	5	5	5	5
Income	$0.22	$0.21	$0.24	$0.24	$0.31
Output	$0.29	$0.28	$0.30	$0.30	$0.53
Langlade County					
Employment	11	12	12	15	19
Plant Workers	5	6	6	7	7
Income	$0.26	$0.30	$0.29	$0.36	$0.46
Output	$0.36	$0.39	$0.38	$0.45	$0.70
Manitowoc County					
Employment	10	11	10	11	18
Plant Workers	5	5	5	5	5
Income	$0.25	$0.27	$0.27	$0.27	$0.45
Output	$0.40	$0.37	$0.37	$0.37	$0.87
Wisconsin					
Employment	27	28	28	31	34
Plant Workers	6	7	7	8	8
Income	$0.88	$0.92	$0.91	$0.99	$1.07
Output	$2.56	$2.62	$2.62	$2.74	$2.80

Notes: Employment figures represent full time equivalent jobs. All dollar values are reported in 2003 dollars. The impacts noted in the table are considered gross since they do not account for any displacement of other generation resources that may have been made.

In reviewing the state level impacts, we see a similar pattern in the numbers of plant worker jobs, but significantly more total jobs, earnings and output. Total state jobs created range from 27 for the tight configuration to 34 in the local developer, single turbine configuration. Earnings follow a similar trend, with $0.88 million generated in the tight configuration and $1.07 million for the local single turbine. Output figures range between $2.56 million from the tight configuration to $2.8 million from the local single turbine.

The additional employment for each of the siting configurations, relative to the employment generated in the individual counties, is the result of most of the plant expenditures occurring outside of the area where the plant is constructed but still within the state. In addition to most worker earnings being spent locally, in-state banks often administer the financing of loans and debt repayment. Out-of-area lending institutions typically handle financing for wind projects in the smaller counties. The additional in-state spending supports employment predominantly in the finance, insurance and real estate (FIRE) sectors, with additional but smaller job gains in the retail, service and manufacturing sectors. The FIRE sectors gain jobs directly from the in-state financing structure. Other sectors benefit from additional spending for supplies and materials as well as worker spending and interactions that occur as businesses rely on other businesses elsewhere in the local economy.

MANUFACTURING MARKET POTENTIAL

As the nation moves towards increasing wind generation capabilities, the prospect brightens for significant expansion of wind power equipment manufacturing within Wisconsin. The wind power industry can provide Wisconsin with a new environmentally sound industrial base and provide a significant source of jobs and income in the state.

Wisconsin is pursuing a number of initiatives to encourage development of renewable energy. Wisconsin's *renewable energy portfolio standard* is a primary example, as it requires the state's utilities to meet a minimum of 2.2 percent of the state's electric generating needs with renewable generation by the end of 2010. In addition to enhancing the state's ability to meet a portion of its own future energy needs with renewable energy, this initiative provides the opportunity for developing and expanding a wind manufacturing industry in Wisconsin. With growing interest worldwide for wind energy technologies, international markets can also be tapped.

Wisconsin's established industrial sector makes it a prime location for developing or expanding wind power manufacturing facilities. In addition, existing industries will benefit from providing the materials and fabrication associated with wind technology manufacturing and installation.

As Table 6 indicates, the Wisconsin manufacturing market potential associated with meeting a portion of the 967 MW of renewable electricity generating capacity (developed for in-state and national electricity needs) is just under $17.3 million in 2010. This assumes the manufacturing industry in Wisconsin has grown and has the capacity to produce at least 30 MW of wind turbines by that year. This level of investment will provide an additional 300 jobs to the Wisconsin economy in 2010. This total reflects the actual jobs associated with the growth in a newly developed wind manufacturing industry.

If in-state and national commitments for renewable generation occur sooner or more rapidly than anticipated and Wisconsin is able to develop the wind manufacturing industry to meet the technology needs, the expected job gains will take place even sooner. To the extent local industries are able to develop more quickly, the state may enjoy even larger gains.

Wisconsin may be able to expand its market share of the growing domestic and international wind export markets. If it can, it will share in the benefits of more jobs and income from exporting wind technologies to other regions in the United States and internationally.

TABLE 6: WISCONSIN WIND TURBINE MANUFACTURING MARKET POTENTIAL

	YEAR 2010
Manufacturing (MW)	30
Market Potential (Million 2003$)	$17.3
Job Gains	300

Notes: This analysis is based on in-state manufacturing of components necessary to meet a portion of the 967 MW of wind generation identified in a Union of Concerned Scientists projection of renewable energy facilities to be installed in the United States in 2010. The cost of wind technologies is projected to decline during the study period due to greater commercialization of the technology.

Part 3

Examining Wind Turbine Impact on Local Property Values

ENERGY CENTER OF WISCONSIN

INTRODUCTION

The presence of utility-scale wind turbines in the rural landscape is difficult to ignore, and some technical problems and negative perceptions have already received considerable attention. Part 1 of this Study discusses the technical aspects that wind developers have needed to address such as noise, blade flicker, and poor television reception. A growing body of research continues to explore turbine impact on bird and bat populations, and other concerns such as stray voltage or ice thrown from blades. However, one of the most contentious questions both in Wisconsin and elsewhere is whether or not wind turbines have a negative effect on property values in the area surrounding them. To address this question we review the literature surrounding this issue, and offer our own insights (mostly methodological) based on limited data gathering for wind developments in Iowa and Kewaunee Counties.

As detailed in the case studies in Part 1 of this report, the array of stakeholders surrounding wind development bring different perspectives to the prospect of wind development in their area. For landholders at the proposed site and local government officials, wind development may mean extra income. Nearby homeowners, on the other hand, may have concerns about the impact of a wind development on the view from their property. The purpose of this section is to explore in more detail the question of whether wind developments have an adverse effect on residential property values due to their aesthetic impact on the landscape for property holders who do not otherwise have a financial stake in the project.

LITERATURE REVIEW

Part of our project included a brief review of studies involving wind turbines and property values that have been done in other parts of the U.S. and abroad. We wanted to explore how others had approached the question of wind turbine proximity to residential properties, and whether similar barriers hampered the success of these other efforts as well. We found that for one reason or another, no one report has managed to satisfy critics on either side of the controversy. We also found that the variety of approaches attempted would indicate that others also found this to be a very complex issue.

We found four main types of studies of relevance to the issue of the impact of wind development on property values. In ascending order of direct applicability to the issue of wind development property values, these are:

- Studies of general attitudes toward wind energy
- Studies of property-value impacts from analogs such as utility transmission lines and highways
- Studies of willingness to pay to prevent or remove wind developments
- Studies of real estate values or sales data

The sections that follow highlight some of the literature that we uncovered.

GENERAL ATTITUDINAL STUDIES

Numerous studies analyzing public opinion towards wind power have been done in the U.S., Europe, Australia, and New Zealand. Attitudes toward the concept of wind power are generally positive, but because they are not based on actual experience, they cannot be considered particularly reliable.[67] In specific cases attitudes towards wind turbines have improved after the machines were installed.

It is difficult—if not impossible—to translate survey attitudes into impacts on property values. However, the fact that wind energy is generally viewed favorably does perhaps call into question the transferability of analog studies such as the impact of transmission lines on property values.

STUDIES OF ANALOGS SUCH AS THE VISUAL IMPACT OF TRANSMISSION LINES AND IMPACT OF HIGHWAY NOISE

Given the dearth of peer-reviewed studies of the property value impacts of wind turbines, researchers have speculated about the utility of using research analyzing other infrastructure to help estimate the impact of wind turbines.

The EcoNorthwest[68] report contains a review of six articles assessing the impact of electrical transmission towers on property values. Because perception studies have shown public views towards transmission lines to be much more negative for aesthetic and perceived health issues, authors of this study warned against using the impacts of transmission line towers for wind turbines. This review was performed to set an upper limit on potential impact of wind turbine towers.

Overall, the studies reviewed in the EcoNorthwest Report indicated a six to ten percent decrease in values for properties that have direct views of transmission lines. A 2002 study, however, found that properties that are near the line easement but away from the tower do not experience a decrease in value and may have a modest *increase* in value due to improved views and further distances to the nearest neighbor.[69]

A British study performed in 1994[70] attempted to calculate the economic impacts of wind farms. It did not survey property values directly. The impact of noise is estimated using techniques developed to calculate the impacts of highway noise.

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[67] Gipe, Paul. 1995. “Tilting at Windmills: Public Opinion Toward Wind Energy.” American Wind Energy Association (AWEA) web site: http://www.awea.org/faq/aesthetics_old.html
[68]Grover, Stephen. 2002. “Economic Impacts of Wind Power in Kittitas County.” ECONorthwest, Portland, OR for the Phoenix Economic Development Group
[69]Des Rosiers, Francois. 2002. “Power Lines, Visual Encumbrance and House Values: A Microspatial Approach to Impact Measurement.” *Journal of Real Estate Research*. Volume 23(3): 275-301
[70] Eyre, Nick. 1994. “Externalities of Fuel Cycles ‘Externe’ Project, Report Number 7, Wind Fuel Cycle: Estimation of Physical Impacts and Monetary Valuation for Priority Impact Pathways.” European Commission, Directorate-General XII, Science, Research and Development/Joint Research Centre, U.K.

These results have not been verified with actual property. Also the authors themselves questioned whether the results from calculations done for roads and highways were transferable to wind turbines, which are generally much quieter.

STUDIES OF WILLINGNESS TO PAY TO REMOVE OR PREVENT TURBINE INSTALLATION

As part of its 1996 study[71] the Institute of Local Government Studies (AKF) in Denmark performed interviews with 342 people living close to wind turbines. Interviewees were asked if they found wind turbine installations to be a burden either because of visual or auditory effects. The survey indicated that approximately 13% of respondents viewed the turbines as a nuisance. Within this latter group, interviewees were willing to pay 982 DKK ($140) per household per year to be without the turbines. The average among all interviewees was 152 DKK ($22) per household per year.

A British study performed in 1994[72] estimated the economic impacts of wind farms. Residents and tourists were asked how much they would be willing to pay to maintain a view unobstructed by wind turbines. Values of £24-27 per person per year ($29-44) were calculated. The authors did not attempt to translate this into property values.

REAL ESTATE VALUATION AND SALES STUDIES

Studies in this category attempt to more directly assess impacts on property values by gathering data on property valuations or actual sales data. While studies of sales prices make use of public sales data, studies of property values may be based on data from informants such as tax assessors or real estate agents who are knowledgeable about local property values.

Moreover, the studies differ in how they try to isolate the impact of wind development from other factors that affect property values and sales price. Some are derived from comparing property valuations or sales before and after a wind development; others compare property values near the development with more distant locations—and one study examined the data both ways.

Several studies based on tax assessor or real estate agent estimates of valuation impacts have been conducted. Two have been conducted in Wisconsin in the Town of Lincoln and in the Town of Glenmore.[73] In addition, the ECONorthwest study[74] reviewed the impact of wind projects in 13 different counties in eight states. They interviewed tax assessors about the effect of the turbines on real estate prices (the assessor mentioned above from the Town of Lincoln, Wisconsin was

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[71] Jordal-Jorgensen, Jorgensen. 1996. "Social Assessment of Wind Power.: Institute of Local Government Studies – Denmark. http://www.akf.dk/eng/wind0.htm
[72] Eyre, Nick. 1994. "Externalities of Fuel Cycles 'Externe' Project, Report Number 7, Wind Fuel Cycle: Estimation of Physical Impacts and Monetary Valuation for Priority Impact Pathways." European Commission, Directorate-General XII, Science, Research and Development/Joint Research Centre, U.K.
[73] Materials prepared for a Town of Red River Zoning Committee meeting, November 4, 1998, by Adeline D. Bernard of Harbour View Realty, Kewaunee, Wisconsin
[74] Economic Impacts of Wind Power in Kittitas County. 2002. ECONorthwest, Portland, Oregon

included in their study). The counties surveyed in the report represent different landscapes and differing population densities.

In addition, a report by letter to the Town of Addison Chairman from the assessor in Lincoln Township[75] compared the ratio of assessed value to recent selling price on properties within a mile of the turbines versus those over a mile away. He observed no difference but acknowledged that he had little data to work with. Again, this cannot be considered to be definitive given the small number of observations.

None of these surveys of realtors or local assessors were able to demonstrate any negative impact from the siting of wind farms. Generally, property values in the areas surveyed rose rather than fell, but it is unlikely that the presence of wind turbines were the primary cause.

In 1996, the Institute of Local Government Studies in Denmark performed a comparison of prices of homes near wind turbines with homes out of the vicinity and attempted to control for other factors.[76] This analysis found that homes located near single turbines averaged DKK 16,200 ($2314) less in value, and homes located near parks of 12 turbines averaged DKK 94,000 ($13,429) less in value. The citation from which these results are quoted did not list what the average total costs are, making it impossible to calculate percentage of impact. Moreover, the survey divided households into those *close* and those *far* away, but did not state actual distances.

By far the most ambitious study to date is one conducted by the Renewable Energy Policy Project (REPP), and released in May 2003.[77] The REPP study gathered publicly available property sales data near ten wind development projects scattered throughout the U.S. The projects covered by the report include the three Kewaunee County, Wisconsin developments, which were considered jointly in the study.

Because the study lacked the resources to determine whether individual properties had a direct view of the wind developments, a broader approach was used. For the area near each development, the study defined a "view shed" encompassing a five-mile radius surrounding each development. This distance was selected based on a review of literature on visual impacts of objects in the distance. The study also selected a nearby matched comparison area for each development that was not in the view shed, but was determined to be demographically similar.

The analysis looked at smoothed time trends in property sales price in three ways: (1) differences between the view shed and comparison area over a period covering several years before and after the wind development; (2) sales price trends for view shed properties before the wind development compared to after the development; and, (3) sales price trends for the view shed properties compared to the comparison area after the wind development.

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[75] Letter from Joe Jerabek, Town of Lincoln Assessor to Robert Bingen, Town of Addison Chairman, dated January 30, 2001 (unpublished; copy obtained from author)

[76] Munksgaard, Jesper and Anders Larsen. 1996. *Social Assessment of Wind Power.* The Institute of Local Government Studies (AKF), Copenhagen, Denmark.

[77] Sterzinger, George, Fredric Beck, Damian Kostiuk. 2003. "The Effect of Wind Development on Local Property Values." Renewable Energy Policy Project, Washington D.C.

The results of the study showed little evidence of adverse impacts by wind developments on local property values. For the majority of developments considered, property sales prices actually rose faster within the view shed than in the nearby comparison area, and prices rose faster within the view shed after the development occurred compared to before.

APPROACH

The REPP study was released at about the same time we were moving forward with conducting a study in Wisconsin of the effect of wind development on property values. While the overall approach taken by the REPP study—looking at trends in actual sales data—appealed to us, some specific aspects of the implementation concerned us. These are enumerated below.

1. **View shed "ground-truthing"** — Due to resource constraints, the REPP study could not verify whether individual properties had a direct view of the wind developments. This makes using the term "view shed" something of a misnomer in this context, since the view shed properties were actually all properties within a certain distance from the development, regardless of whether they had a direct line of sight to the turbines. The REPP researchers attempted to mitigate this potential issue by interviewing tax assessors and other local authorities by telephone to get an estimate of the proportion of properties within the REPP-defined view shed that had views of the developments. In most of the cases examined, a large proportion of the properties were judged to actually have a line of sight to the turbines. But for the Kewaunee County, Wisconsin case study that was of most interest to us, the local assessor contacted by the researchers estimated that only 20 to 25 percent of properties in one view shed township (Red River) had a view of the turbines, and no one was able to provide an estimate of this proportion for the other township and separate village included in the REPP view shed definition.

2. **Distance effects —** It would seem plausible that if wind developments do have an impact on property values, the impact would be strongest close to the turbines and decline with distance. However, the analysis used in the study did not incorporate distance from the development as a variable or weighting factor, so that a view shed property sale five miles from a development counted the same as one a quarter mile away. Moreover, simple geometry would suggest that the majority of properties in a view shed group are likely to be fairly distant from the development: 64 percent of the area of a five-mile circle is three miles or more from the center of the circle, and only four percent lies within the first mile. Though properties are not necessarily distributed evenly about the landscape, and property values conceivably can be affected by objects that are in the vicinity but not directly viewable from a property, these considerations suggest that there is some risk of the view shed groups being diluted with a substantial proportion of properties that either have only a distant view of the wind developments or no view at all. This might lead to missing impacts that would be detected for properties within, say, the first mile or two of a development.

3. **Statistical rigor —** The study relied on contrasting the average rate of increase in sales price before and after the wind development and between view shed properties and properties in the defined comparison group. These rates of increase were calculated

through simple regression of a smoothed average sales price against a time variable. Though the report discusses and reports the overall goodness-of-fit (r^2 statistic) for these regressions, that statistic is somewhat beside the point. For a study such as this one, the real statistic of interest is the confidence band surrounding the estimates of the *difference* in the two rates of increase being contrasted. Thus, if one calculates that, say sales prices among view-shed properties increased $50 per month faster than sales prices in the comparison group, then it makes a difference whether the statistical uncertainty in that point estimate is ± $25/month or ± $500/month. The former leads to a conclusion that it is unlikely that the wind development has a deleterious effect on local property values; the latter says that the data are inconclusive—there could be a large negative impact, a large positive impact, or no impact at all. Without these confidence intervals, it is impossible to determine whether the data at hand support any kind of conclusion as to whether wind development affects property values.

Despite our concerns about some of the details of the implementation of the REPP study, the basic approach of analyzing time trends in sales data appealed to us. We therefore scoped our Wisconsin effort to follow a similar approach as the REPP study, while attempting to correct what we saw as the potential deficiencies in the REPP study.

Our approach was as follows:

1. We would obtain property sales data for Kewaunee and Iowa Counties for a period spanning several years before and after the development occurred.

2. We would "ground-truth" the view sheds for the (three) developments in Kewaunee County and the Montfort development in Iowa County, and determine at least an approximate distance to the development for properties that sold during the period of interest, as well as whether the property had a line of sight to the development.

3. We would incorporate distance to the turbines in the analysis of differences in time trends and quantify the statistical uncertainty in the results.

To implement this agenda, Steve Buss of the Energy Center of Wisconsin obtained property sales data from the Wisconsin Department of Revenue, Bureau of Equalization. Electronic data for Kewaunee and Iowa counties were available for the period from 2000 through the third quarter of 2003. Prior data were available only in hardcopy format.

Steve also drove the roads in the vicinity of the developments to determine the view shed boundaries to the best of his ability from public roadways. He took photographs to document views of the developments from various points around the view sheds.

Given the expense required to identify and key in the hardcopy sales data, we decided to conduct a preliminary analysis using the electronic data, before attempting to key in the hardcopy data. Accordingly, we reduced the electronic data to arms-length sales in the vicinity of the developments and, ultimately, to sales transactions within the view sheds based on Steve's ground-truthing.

Unfortunately, the preliminary analysis indicated that there were too few actual sales within the view sheds to support a quantitative analysis like that used in the REPP study. We therefore decided not to proceed with additional analysis. Nonetheless the process of ground-truthing the view sheds and sifting the electronic sales data provide some important lessons for studies of this type, which we cover in the following section.

FINDINGS

Figures 1 and 2 show the view sheds of the Kewaunee and Iowa county developments as best they could be determined from public roadways. In the case of the Kewaunee developments, the actual view shed is substantially smaller than that defined in the REPP report, which used two entire townships and the village of Casco to define the view shed boundaries. Ground-truthing showed that the developments are not visible from the village of Casco, and are visible from only portions of the two townships.

The field investigations suggest that it is unusual for the developments to be visible from more than two miles away, and in some cases they are not visible from under half a mile away. Figures 3 through 12 show how the turbines appear from some selected points in the viewshed. Note how the presence or absence of local topography and obstructions—especially trees—is an important determinant of whether the turbines can be seen from a particular vantage point. Given that at any distance beyond about two-thirds of a mile one can blot out a turbine with a blade height of 300 feet by holding one's thumb out at arm's length, it is not surprising that it takes very little intervening topography or obstructions to hide turbines that are two miles or more distant. Moreover, in some cases (e.g., Figures 12 and 13), the turbines are visible, but are arguably not the least aesthetic feature of the local landscape.

FIGURE 1: KEWAUNEE COUNTY WIND DEVELOPMENT VIEW SHED

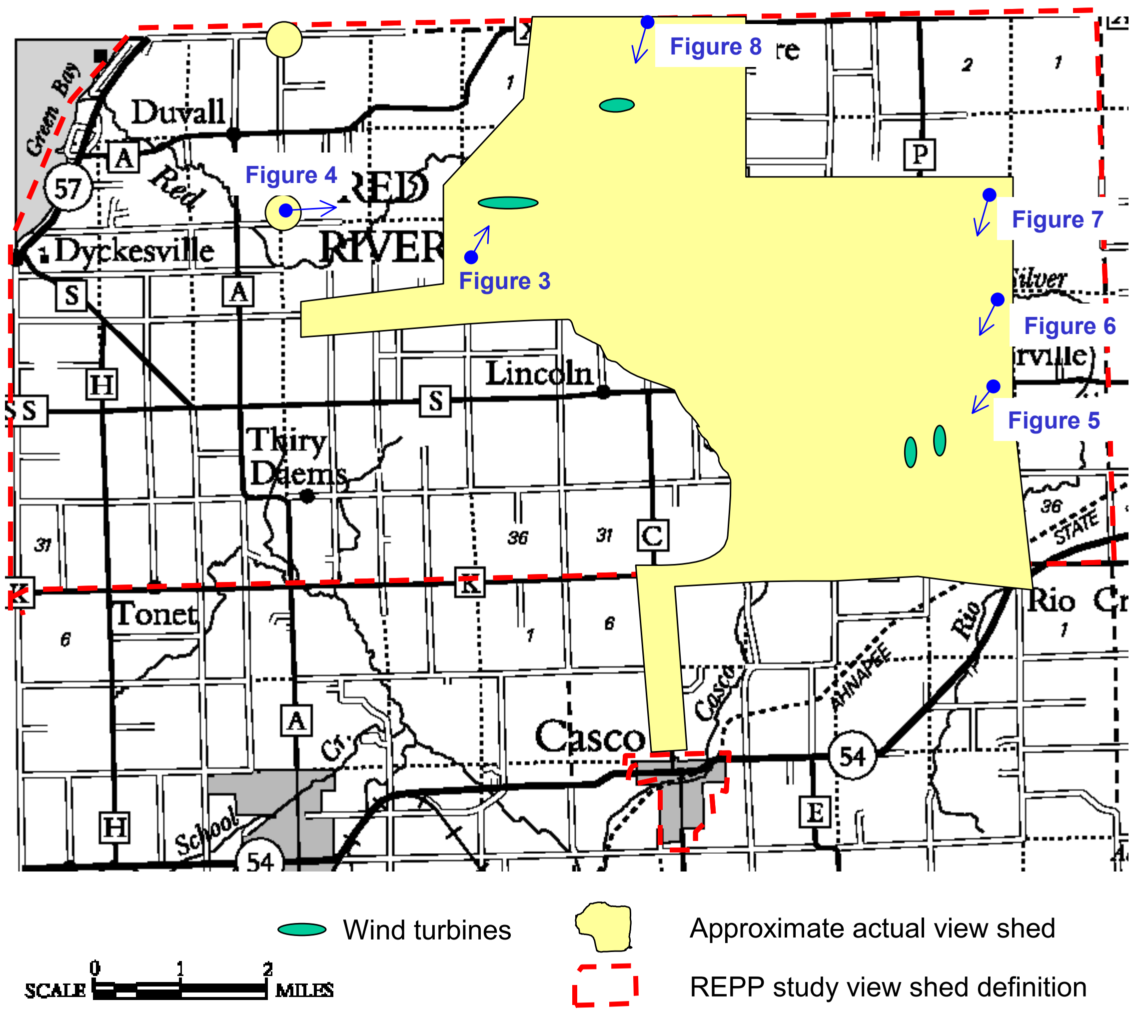

FIGURE 2: IOWA COUNTY WIND DEVELOPMENT VIEW SHED

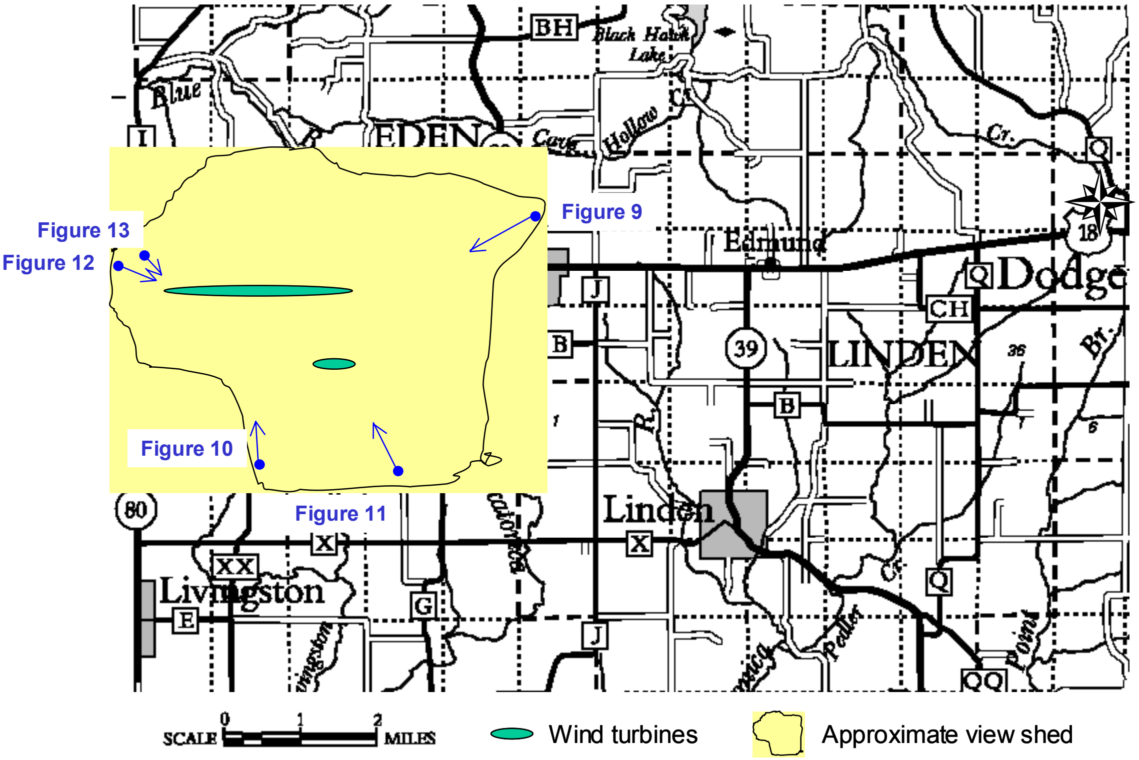

FIGURE 3: KEWAUNEE COUNTY, FAMAREE RD, <0.5 MILE FROM NEAREST TURBINE

FIGURE 4: KEWAUNEE COUNTY, INTERSECTION OF ROCKY AND MACCO ROADS, APPROX.2.5 MILES FROM NEAREST TURBINE

FIGURE 5: KEWAUWNEE COUNTY, INTERSECTION OF CTY. P AND CTY. S, APPROX. 0.75 MILES FROM NEAREST TURBINE

FIGURE 6: KEWAUNEE COUNTY, BLACK ASH ROAD, APPROX. 2 MILES FROM NEAREST TURBINE

FIGURE 7: KEWAUNEE COUNTY, BLACK ASH ROAD, APPROX. 2.5 MILES FROM NEAREST TURBINE

FIGURE 8: KEWAUNEE COUNTY, CTY. K, APPROX. 0.75 MILES FROM NEAREST TURBINE

FIGURE 9: IOWA COUNTY, INTERSECTION OF WI 60 AND TOMAS ROAD, APPROX. 2.25 MILES FROM NEAREST TURBINE

FIGURE 10: IOWA COUNTY, INTERSECTION OF CTY. IG AND CTY. XX, APPROX. 2.25 MILES FROM NEAREST TURBINE

FIGURE 11: IOWA COUNTY, INTERSECTION OF CTY. IG AND DRINKWATER RD., APPROX. 1.5 MILES FROM NEAREST TURBINE

FIGURE 12: IOWA COUNTY, VILLAGE OF MONTFORT, APPROX. 0.75 MILES FROM NEAREST TURBINE

FIGURE 13: IOWA COUNTY, VILLAGE OF MONTFORT, APPROX. 0.75 MILES FROM NEAREST TURBINE

We turn next to the property sales data, which are summarized in Table 1. A surprise (to us, anyway) was the discovery that nearly half of the property sales at the county level could not be considered arms-length transactions. In particular, a large proportion of the sales that failed this screen (70 percent for Kewaunee County, 66 percent for Iowa County) were coded as transfers between family members. Sales or property divisions between blood relatives, bank foreclosures, sheriffs' sales, and divorce settlements all yield sale prices that are likely to be different (usually lower) than a normal market sale between unrelated persons.

We also found that even after screening down to the townships and villages in the immediate vicinity of the wind developments, fewer than one in three transactions (28 percent for both counties) involved properties that were actually within the view shed of the development. This left us with only 47 view shed properties in Kewaunee County and 23 in Iowa County—far too few to support a statistical analysis relying on time trends and averages, even if one considered adding in additional hardcopy data from prior years.

TABLE 1: 2000 – 2003 PROPERTY SALES FOR KEWAUNEE AND IOWA COUNTIES

	Kewaunee	Iowa
Sales for entire county[a]	3,497	4,579
Arms-length sales[b]	1,614	2,266
Initial screen for proximity to development[c]	1,053	95
Residential and farm sales only	935	80
Final screen for proximity to development[d]	166	80
Within view shed	47	23
Remaining property types		
Empty lot, residential	8	3
Empty lot, agricultural	12	5
Improved lot, residential	25	13
Improved lot, agricultural	2	2

[a]For the period 1/1/2000 through September 30, 2003.

[b]Arms-length sales defined as those with no relationship between the seller and buyer, the type of transfer is an ordinary sale (vs. gift, exchange, etc.), and sales in which the seller transfers all rights to the buyer

[c]For Kewaunee County, this includes the townships of Red River, and Lincoln, along with properties for which township was unspecified; for Iowa County, the screen included the township of Eden and the villages of Monfort and Cobb.

[d]This screen was applied only to the Kewaunee properties, and was a manual identification of location for properties where the township was not identified. Properties outside the townships of Red River and Lincoln were excluded.

It is worth noting that for Kewaunee County, the actual proportion of properties in the REPP view-shed group that actually have a line of sight to the turbines is probably lower than the 28 percent we found. This is because the REPP view-shed group included the village of Casco along with the townships of Lincoln and Red River, while four search was limited to the two townships (since ground-truthing had already shown that the village of Casco was not within view of the developments). Nonetheless, if we conservatively estimate that 28 percent of the REPP-study view shed group was actually within the view shed for Kewaunee County, then only about 90 of the 329 property sales used in the REPP study view-shed group probably had a view of the development.

Finally, it is noteworthy that among the view shed property transactions, only about half were residential properties with homes. A significant number of properties were unimproved agricultural or residential lots. That is not to say that there might not be a property-value impact on unimproved or non-residential properties, but it does suggest a more complex analysis situation than simply lumping all property sales together.

CONCLUSIONS

While there is appeal to the idea of using actual property sales data to assess whether wind development has an impact on local property values, in practice the approach faces some significant hurdles. In our opinion, to be credible, such a study needs to:

1. include only arms-length transactions, and account for different property types;

2. incorporate ground-truthing of the visibility of the development from specific properties in the analysis;

3. explicitly account for distance to the nearest visible turbine; and,

4. be based on enough transactions to provide statistically meaningful results based on calculated confidence intervals.

The first three items above are not at all insurmountable, though they do add to the cost of conducting such a study. The fourth, however, may pose a challenge that is difficult to overcome, since wind development tends to occur in rural areas with low population density.

Indeed, there are inherently opposing forces at work here, in the sense that while impacts on property values are likely to be strongest close to the development and taper off with distance, the number of property transactions decreases the closer one approaches the development. Casting too wide a net creates a risk of missing a real effect on property values. This dilution effect—along with the lack of ground-truthing of view sheds and lack of reporting of the uncertainty band on impacts—tends to somewhat undermine the credibility of the REPP study conclusion that "there is no support for the claim that wind development will harm property values."

On the other hand, the infrequent transactions that occur within the immediate vicinity of a development are not amenable to statistical analysis that relies on large-sample averages to overcome all the unrelated factors that affect property values. At the same time, the very fact that there were few property transactions within the view sheds of the two Wisconsin developments that we examined says something about the potential scope of the problem, if indeed there is one. There is value in knowing the number of potentially affected properties from rural wind development in Wisconsin, even if the actual measurement of property value impacts remains intractable.