Regional Response to a Statewide Renewable Energy Standard

Status and Trends of Wind Energy Development in West Michigan

Grand Valley Wind Energy Integrated Assessment Project Team

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A stakeholder steering committee provided guidance on this project. The list of steering committee participants can be found at the project web site (http://www.gvsu.edu/wind).

List of Acronyms

GIS	geographic information system
HBPW	Holland Board of Public Works
ISO	independent system operator
kW	kilowatt, one thousand (1,000) watts
MAREC	Michigan Alternative and Renewable Energy Center
MPSC	Michigan Public Service Commission
MW	megawatt, one million (1,000,000) watts
MWh	megawatt-hour
NREL	National Renewable Energy Laboratory
PA 295	Public Act 295, the Clean, Renewable, and Efficient Energy Act
REC	renewable energy credit
RPS	renewable portfolio standard

Project Overview

Michigan recently passed the Clean, Renewable, and Efficient Energy Act of 2008 (PA 295). The act requires that Michigan's electricity providers generate ten percent of their electricity using renewable sources by 2015. Wind is an abundant, cost-effective resource for meeting this renewable energy target. The Michigan Department of Environmental Quality (DEQ) was concerned that some communities may have limited capacity to address the potential challenges associated with wind energy development in coastal counties. The DEQ collaborated with Michigan Sea Grant in requesting an integrated assessment that would examine the causes, consequences, and approaches to minimizing the impacts of wind energy development in Michigan's Great Lakes coastal zone.

Integrated assessment is "a formal approach to synthesizing and delivering relevant, independent scientific input to decision making through a comprehensive analysis of existing natural and social scientific information in the context of a policy or management questions" (Michigan Sea Grant, 2005). Public participation is central to the integrated assessment process.

A team of researchers at Grand Valley State University (GVSU) responded to the request with a proposed integrated assessment of on- and offshore wind energy development in West Michigan, including Oceana, Muskegon, Ottawa, and Allegan counties. The proposal was funded by Michigan Sea Grant and includes the following phases:

Project Phase	Estimated completion date
1. Documenting the status and trends of wind energy development in West Michigan	January 2010
2. Assessing the causes, consequences, and approaches to overcoming the challenges to wind energy development in the study area.	November 2010
3. Providing a range of forecasts of likely future environmental, social, and economic conditions.	February 2011
4. Providing technical guidance to West Michigan communities.	May 2011

The project team consisted of Grand Valley State University staff from its Natural Resources Management Program, the Annis Water Resources Institute, and the Seidman College of Business. A stakeholder steering committee was assembled to provide guidance to the project team. The steering committee included representatives from the business community, environmental advocacy organizations, township planning and zoning boards, wind developers, electric utilities, and the farming community. Geographically, these representatives span the four-county study area.

This report, *Regional Response to a Statewide Renewable Energy Standard: Status and Trends of Wind Energy Development in West Michigan*, is the culmination of the project's first phase.

Executive Summary

Background

The deployment of thousands of wind energy facilities required to meet various renewable energy targets will bring changes to the nation's landscapes, communities, and economies. Identifying and reconciling the trade-offs that inevitably arise from projects such as locating wind energy facilities is a major challenge to successfully meeting renewable energy targets. These complex challenges span scientific disciplines, involve multiple scales, lack well-defined solutions, and involve public values. Integrated assessment has been used effectively to address a number of complex challenges, ranging from climate change to "dead zones" in the Gulf of Mexico. The intent of this integrated assessment project, and this paper in particular, is to comprehensively analyze the challenges to siting on- and offshore wind turbines in one particular region of coastal West Michigan, including Oceana, Muskegon, Ottawa and Allegan counties. By combining science and public participation, our integrated assessment will empower citizens and local governments to make informed decisions about wind energy facilities in their communities. Our project will enhance capacity to find locally appropriate solutions regarding wind energy development, and will help Michigan achieve its ten-percent renewable energy target in a manner that is environmentally, economically, and socially sustainable.

Key Findings

More than half of Michigan's electricity in 2007 was generated from coal. Michigan's three nuclear power plants accounted for more than one-quarter of the state's electricity generation. Renewable sources, including wind, accounted for less than three percent.

As of July 2009, Michigan had 83 utility-scale wind turbines with a combined nameplate capacity of nearly 130 MW.

There are no utility-scale wind turbines presently in the four-county West Michigan study area. There are no offshore wind energy facilities in the US as of the end of 2008, though nearly 2,000 MW of offshore wind capacity have been proposed in seven states.

On October 6, 2008, Governor Granholm signed into law Public Act 295, the Clean, Renewable, and Efficient Energy Act (PA 295). The goals of PA 295 included diversifying energy resources; enhancing energy security through the use of indigenous energy resources; encouraging private investment in renewable energy and efficiency; and improving air quality. PA 295 established a Renewable Energy Standard, which directs electric providers to meet a minimum renewable energy capacity portfolio, if applicable, and a renewable energy credit portfolio. By 2015 all covered electric providers must have a renewable credit portfolio that is equivalent to ten-percent of their total electricity sales

Though the state government issued the renewable energy mandate, managing the deployment of wind energy facilities is left to local governments. Of the 73 townships in the study area, 37 (48 percent) have zoning ordinances currently in place (as of July 29, 2009), 15 townships are in the process of developing an ordinance and 21 do not have an ordinance (Figure 5). Oceana County has the highest proportion of townships with ordinances in place (69 percent), while Allegan had the lowest (38 percent).

The Wind Energy Resource Zone Board identified Allegan County as one of four regions with the highest wind power production, all in the Lower Peninsula. Eight wind projects are currently in the planning stage across the West Michigan study area. These projects represent 28 percent of the currently planned wind capacity for the whole state.

Governor Granholm established the Great Lakes Wind Council in 2009 to identify 1) criteria that could be used to review applications for offshore wind energy facilities; and 2) criteria for identifying and mapping categorical exclusion zones and zones most favorable for wind development. The Council reported that about 7 percent of Michigan's Great Lakes shallow bottomlands are most favorable for development. The council also recommended a set of legislative and rule changes for the review offshore wind energy projects. Grand Valley State University and the Michigan Alternative and Renewable Energy Center (MAREC) have proposed placing a wind test platform in Lake Michigan to collect year-round wind data and test various technical challenges.

Michigan lags behind many states in installed wind capacity, but its manufacturing base is an asset to the wind turbine component industry. In 2008, eight Michigan manufacturing facilities opened new manufacturing capacity, announced upcoming openings, or branched into manufacturing wind turbine components. Two of these facilities are located within the West Michigan study area.

Next steps and conclusions

The next phase of the integrated assessment project will specifically analyze the environmental, social and economic foundations and interactions that make wind energy development a complex challenge. We will also investigate approaches for mitigating adverse effects so that the net benefits of wind energy can be maximized. The demand for renewable energy, and wind energy in particular, is growing rapidly. The challenge will be to supply the quantity of renewable energy need to meet this demand in a manner that is economically, socially, and environmentally appropriate. Integrated assessment is an effective tool for analyzing complex, policy-relevant problems like wind energy development. By opening a dialogue among stakeholders and providing access to the latest science on the topic, the integrated assessment project will help citizens and local governments make informed decisions about wind energy development in their communities.

Introduction

The widespread deployment of renewable energy systems signifies a change from the centralized model of electricity generation that has developed over the last one hundred years to more distributed electricity generation. While one wind turbine might be viewed as a curiosity, the deployment of thousands of wind energy facilities required to meet various renewable energy targets will bring changes to the nation's landscapes, communities, and economies (Fig. 1). Though the net total benefits to society of renewable energy systems may be positive, these changes will affect individuals, groups, and particular natural systems in various ways, sometimes adversely. Identifying and reconciling the trade-offs that inevitably arise from projects such as locating wind energy facilities is a major challenge to successfully meeting renewable energy targets. These complex challenges span scientific disciplines, involve multiple scales, lack well-defined solutions, and involve public values (Rittel and Weber, 1973).

Integrated assessment has been used effectively to address a number of complex challenges, ranging from climate change (Dowlatabadi and Morgan, 1993) to "dead zones" in the Gulf of Mexico (National Science and Technology Council Committee on Environment and Natural Resources, 2000). The United Nations Environment Programme defines integrated assessment as

> "a participatory process of combining, interpreting, and communicating knowledge from various disciplines in such a way that a cause-effect chain – involving environmental, social, and economic factors – associated with a proposed public policy, plan or programme can be assessed to inform decision-making" (United Nations Environment Programme, 2009).

The intent of this integrated assessment project, and this paper in particular, is to comprehensively analyze the challenges to siting wind turbines in one particular region of coastal West Michigan. This analysis builds on several other assessments of Michigan's wind energy potential, including:

- Offshore Wind Energy Development in the Great Lakes: A preliminary briefing paper for the Michigan Renewable Energy Program (Pryor et al., 2005).
- Michigan's Offshore Wind Potential (Adelaja and McKeown, 2008).
- Final Report of the Wind Energy Resource Zone Board (Public Sector Consultants, Inc. and Land Policy Institute, 2009).
- Report of the Michigan Great Lakes Wind Council (Mikinetics Consulting LLC and Public Sector Consultants, Inc., 2009).

Unlike previous analyses, this project uses the integrated assessment methodology and geographic information systems (GIS) to investigate the environmental, social and economic foundations and interactions that make on- and offshore wind energy development a complex challenge. We will also explore approaches for mitigating adverse effects so that the net benefits of wind energy can be maximized. Our study area focuses on four counties in West Michigan: Oceana, Muskegon, Ottawa, and Allegan (Fig. 1). By combining science and public participation, our integrated assessment will empower citizens and local governments to make informed decisions about wind energy facilities in their communities. Our project will enhance local capacity to find locally appropriate solutions regarding wind energy development, and will help Michigan achieve its ten-percent renewable energy target in a manner that is environmentally, economically, and socially sustainable.

Here we present a case study documenting the status of Michigan's renewable energy policy and the trends in how its targets are being met by local and regional electric providers. The article begins with a summary of Michigan's current energy portfolio, then describes Michigan's Clean, Renewable, and Efficient Energy Act of 2008 (PA 295). The article further describes how municipal and investor-owned electric providers in the West Michigan region plan to meet this statewide renewable energy mandate. This report will provide a foundation for discussion in the project's public participation phase. For more information about the scope of the integrated assessment project, links to state and national wind energy information, and more project documents, please see the project web site: htpp://www.gvsu.edu/wind.

Figure 1: A pair of 1.8 MW wind turbines in Bowling Green, Ohio (photo by E. Nordman). These turbines are part of a four-turbine, 7.2 MW wind farm at the Wood County landfill.

Status of Wind Energy in Michigan

Michigan's Current Energy Portfolio

Michigan's electricity production increased between 1990 and 2007; though the amount of coal consumed for electricity generation has been relatively steady (Figure 2). Michigan generated 119,309,936 MWh of electricity in 2007, the most recent data available. Coal was the primary source (58 percent), while renewable sources accounted for less than three percent of electricity generation (Figure 3). Commercial wind supplied 2,723 MWh of electricity in 2007. Michigan's three nuclear power plants accounted for more than one-quarter of the state's electricity generation (Energy Information Administration, 2009a).

This energy portfolio presents several challenges for Michigan. First, the state has no domestic coal resources. All of the coal is imported from other states, mostly in the West. Second, while Michigan does have abundant natural gas reserves in the Antrim shale of the northern Lower Peninsula, this resource only accounts for about 30 percent of Michigan's natural gas consumption. The rest is imported from other states and western Canada (Energy Information Administration, 2009b). Third, coal's life-cycle carbon emissions per unit energy is nearly twice that of natural gas (Jaramillo et al., 2007) and up to 100 times that of wind energy (Lenzen and Munksgaard ,2002) (Table 1).

Table 1: Comparison of life-cycle CO_2 emissions from electricity production.

Fuel	Life-cycle CO_2 intensity (lbs CO_2/MWh)	Source
Coal	2100	Jaramillo et al. 2007
Natural gas	1100	Jaramillo et al. 2007
1 MW wind turbine	22-49	Lenzen and Munksgaard 2002

For these and other reasons, the Michigan Public Service Commission (MPSC) issued the Michigan 21st Century Energy Plan and recommended establishing a renewable portfolio standard (Lark, 2007). The renewable portfolio standard (RPS) is an increasingly popular policy tool for encouraging the generation of electricity from renewable sources. Twenty-four states have adopted binding renewable portfolio standards and five others have non-binding renewable fuel targets for electricity providers. (Office of Energy Efficiency and Renewable Energy, 2009). An RPS is "a mandate to increase the use of wind, solar, biomass, and other alternatives to fossil and nuclear electric generation" (Hurlburt ,2008, p. 1). State targets range from 8 percent by 2020 (Pennsylvania) to 40 percent by 2017 (Maine) (Office of Energy Efficiency and Renewable Energy, 2009). In October 2008, Michigan became the latest state to adopt an RPS.

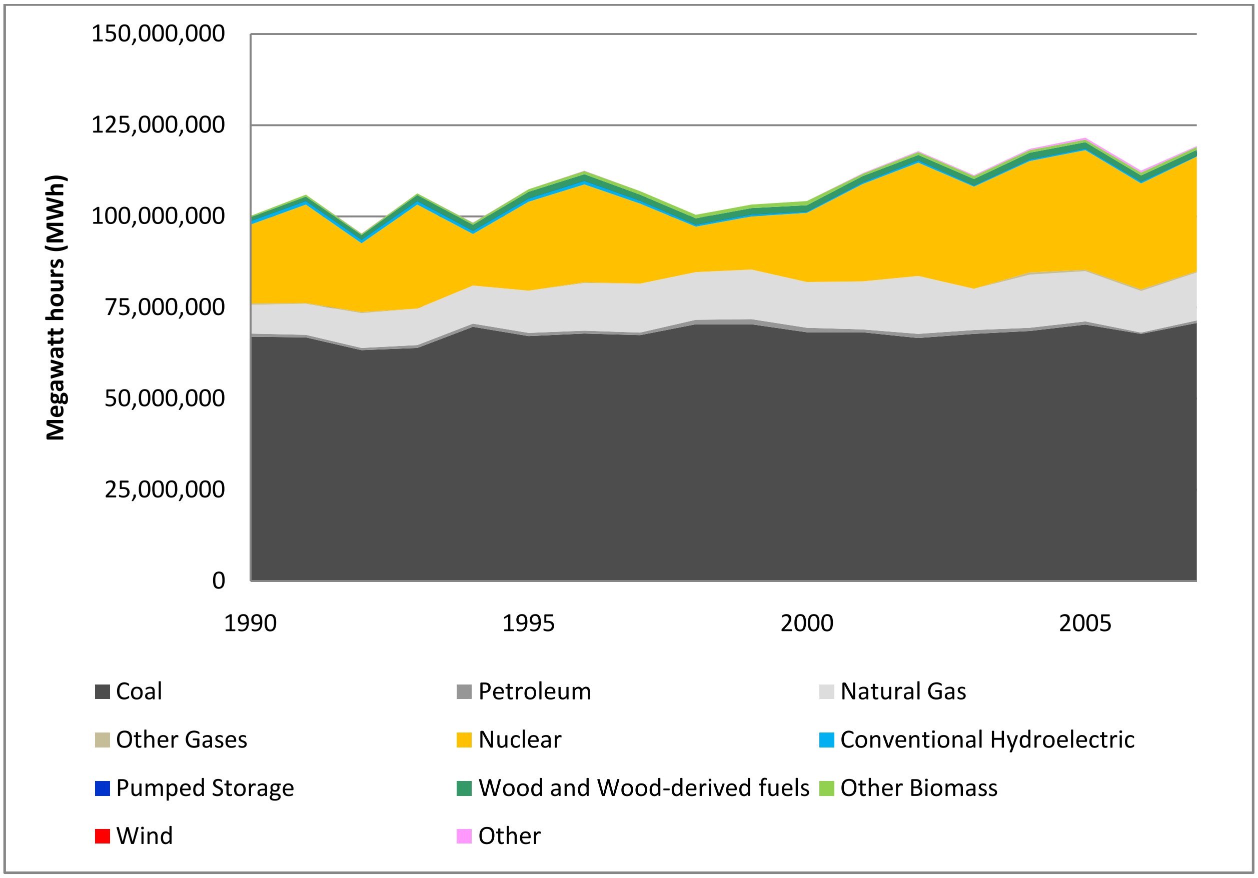

Figure 2: Michigan's electricity generation mix, 1990-2007 (Energy Information Administration, 2009a).

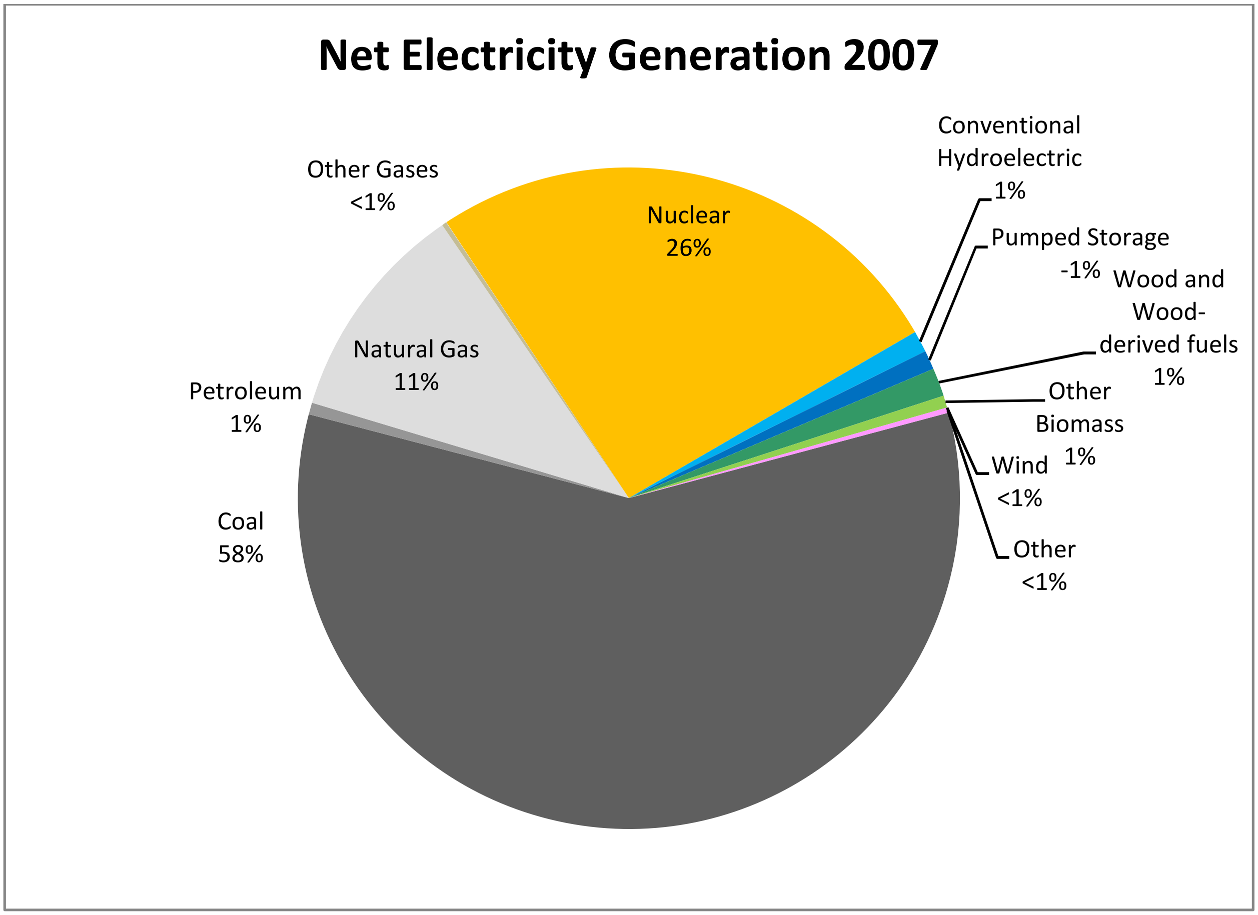

Figure 3: Michigan's net electricity generation, 2007 (Energy Information Administration, 2009a). Note: pumped storage is reported as a negative number because the electricity used in pumping was originally generated from other sources.

Current Wind Facilities in Michigan

As of July 2009, Michigan had 83 utility-scale wind turbines with a combined nameplate capacity of nearly 130 MW (Figure 4, Table 2). Michigan's first utility-scale wind turbine was erected in 1996 in Traverse City. This single-turbine installation has a 600 kW capacity. Mackinaw Power established a pair of 900 kW capacity turbines in Mackinaw City in 2001. John Deere Energy owns two large wind farms in the Thumb region of Michigan. The 52.8 MW Harvest Wind Farm and the 69 MW Michigan Wind I both went online in 2008. Heritage Sustainable Energy is expanding its 2 turbine, 5 MW Stoney Corners installation with an additional 7 turbines and 14 MW of capacity (American Wind Energy Association, 2009). There are no utility-scale wind turbines presently in the four-county study area. There are no offshore wind energy facilities in the US as of the end of 2008, though nearly 2,000 MW of offshore wind capacity have been proposed in seven states (Wiser and Bolinger, 2009).

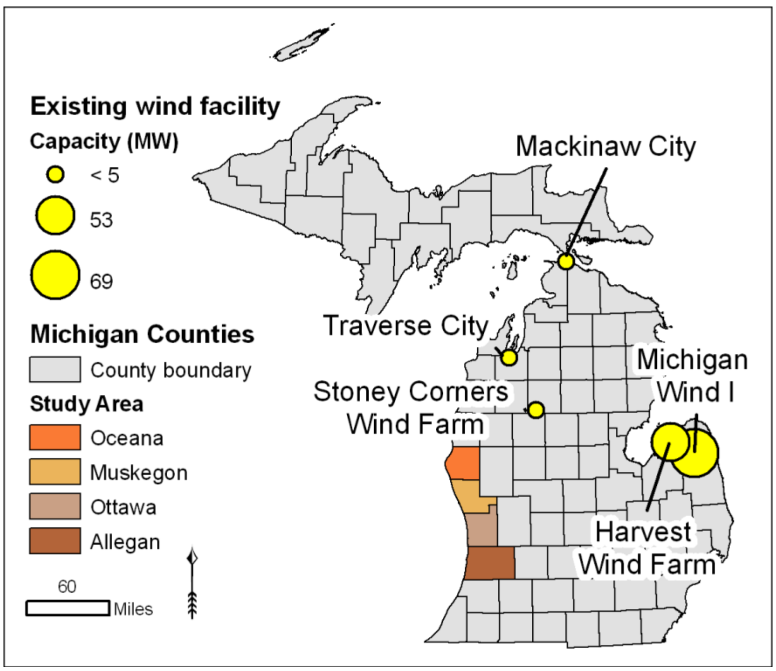

Figure 4: Study area with existing wind energy resources.

Table 2: Michigan's current wind energy capacity (American Wind Energy Association, 2009).

Name	Developer	Location	Number of turbines	Nameplate Capacity (MW)	Year Online
Traverse City Light and Power	Traverse City Light and Power	Traverse City	1	0.6	1996
Mackinaw City	Mackinaw Power	Mackinaw City	2	1.8	2001
Harvest Wind Farm	John Deere Wind Energy	Oliver Twp. and Chandler Twp.	32	52.8	2008
Stoney Corners Wind Farm	Heritage Sustainable Energy	McBain	2	5.0	2008
Michigan Wind 1	Noble Environmental Power	Huron County	46	69.0	2008
Total			**83**	**129.2**	

Michigan's Clean, Renewable, and Efficient Energy Act: PA 295

On October 6, 2008, Governor Granholm signed into law Public Act 295, the Clean, Renewable, and Efficient Energy Act (PA 295). The goals of PA 295 include:

- Diversifying energy resources
- Enhancing energy security through the use of indigenous energy resources
- Encouraging private investment in renewable energy and efficiency
- Improving air quality (State of Michigan, 2008).

PA 295 established a Renewable Energy Standard, which directs electric providers to meet a minimum renewable energy capacity portfolio, if applicable, and a renewable energy credit portfolio. The act also directs electric providers to file energy optimization plans, the state government to promote energy conservation and efficiency, the MPSC to establish a Wind Energy Resource Zoning Board, and the MPSC to establish a statewide net metering program. This section focuses on the Renewable Energy Standard.

PA 295 established a system of renewable energy credits (RECs). One REC is equivalent to one megawatt hour of electricity generated from renewable sources (Sec. 39 (1), p. 12). Electric providers may trade, sell, and/or bank RECs. The act created a special class of RECs called Michigan Incentive Renewable Energy Credits. Under this provision, an electric provider may earn bonus RECs by, for example, using solar power, generating at peak demand, using advanced storage technology or pumped hydroelectric, or using equipment made in Michigan by Michigan residents (Sec. 39 (2), p. 12). PA 295 also makes provisions for substituting a limited number of energy optimization credits and advanced cleaner energy system credits for RECs (Sec. 27 (6), p.8). PA 295 mandates that the renewable energy systems that generate the RECs are, for the most part, located within Michigan. Specifically, the qualifying generating systems must be located within the state, or outside of the state but within the retail electric customer service territory of a qualifying provider, exclusive of alternative electric providers. Certain exemptions are allowed (Sec 29 (1), p. 9).

States vary on what each considers a renewable fuel source. PA 295 defines a renewable energy resource as one that "naturally replenishes over a human, not a geological, time frame and this is ultimately derived from solar power, water power, or wind power" (Sec. 11 (i), p. 4). The following sources meet the criteria for "renewable":

- Biomass
- Solar and solar thermal
- Wind
- Kinetic energy of moving water (waves, tides, currents and conventional hydroelectric)
- Geothermal
- Municipal solid waste
- Landfill gas

By 2015 all covered electric providers must have a renewable credit portfolio that is equivalent to ten-percent of their total electricity sales. Providers may meet this requirement by generating electricity from renewable sources or by purchasing or trading the RECs with or without the associated electricity. The legislation allows stepped implementation of the portfolio. The portfolio must be fully implemented (100%) by 2015. Leading up to that, the provider may meet the standard at 20 percent of full implementation in 2012, 33 percent in 2013, and 50 percent in 2014. After 2015, the number of required RECs will not drop below the number required for 2015 (Sec. 27, (3), (4), p. 8). Electricity providers are allowed to bank RECs for up to three years and certain provisions are made for renewable capacity that was developed prior to the enactment of PA 295. Electricity providers with more than one million retail customers must have a renewable credit portfolio with not more than 50 percent of its RECs coming from owner-operated renewable systems (Sec. 33, pp. 10-11).

Michigan's two largest electricity providers are required to meet the renewable capacity portfolio standard as well. Providers with between one and two million retail customers (i.e. Consumers Energy) must have a renewable energy capacity portfolio of at least 200 MW by the end of 2013 and at least 500 MW by the end of 2015. Providers with more than two million retail customers (i.e. Detroit Edison) must have a renewable energy capacity portfolio of at least 300 MW by the end of 2013 and at least 600 MW by the end of 2015.

This capacity must be new and additional, that is, it must not have been in commercial operation prior to October 6, 2008 (Sec. 27 (1) and (2), p. 8).

The state expects wind to be the primary source of new renewable generation. PA 295 directed the state of Michigan to create a Wind Energy Resource Zone Board to examine wind energy production potential, the viability of commercial power generation, the availability of land for such activities, and other issues related to wind energy systems (Sec. 143, p. 26; Sec. 145, p. 27).

Local Capacity

Though the state government issued the renewable energy mandate, managing the deployment of wind energy facilities is left to local governments. Ottawa County, part of the four county study area, has developed a model wind ordinance establishing guidelines for siting wind turbines of all sizes, including utility scale turbines. The Ottawa County Planning Commission, in partnership with Michigan State University Extension Office, designed the ordinance to promote the safe, effective and efficient use of turbines and to limit the potential adverse effects. Under this model ordinance, utility scale wind turbines would be allowed by special use permit only in non-residential areas (Ottawa County Planning Commission, 2009). The Michigan Department of Energy, Labor, and Economic Growth (2008) also published a sample zoning ordinance for wind energy systems.

We contacted the supervisor or zoning administrator for each township in the study area to discover how townships are meeting the challenge of siting utility-scale wind energy facilities. Many townships have used the model ordinances to develop their own ordinances or adopted it verbatim. Of the 73 townships in the study area, 37 (48 percent) have zoning ordinances currently in place (as of July 29, 2009), 15 townships are in the process of developing an ordinance and 21 do not have an ordinance (Figure 5). Oceana County has the highest proportion of townships with ordinances in place (69 percent), while Allegan had the lowest (38 percent). Some townships adopted language nearly identical to the state or Ottawa County model ordinance, while some wrote their own. A preliminary analysis of the ordinances shows a range of attitudes toward turbines. These ordinances will be analyzed in greater detail in subsequent phases of this project.

We used GIS overlay analysis to analyze the wind ordinances of townships with wind power classes suitable for utility-scale development. The National Renewable Energy Laboratory (NREL) provides information about wind resources through its Wind Powering American program. NREL uses wind speeds, typically at 50 meters above ground level, to classify wind resources into wind power classes. Class 1 contains the lowest wind power and Class 7 the highest. Class 3 is typically the minimum required for utility-scale wind development (US Department of Energy, 2009). The 50-meter wind power density data has been verified by NREL. Wind speeds generally increase with altitude, so utility-scale turbines would be able to exploit even greater wind energy potential. This analysis based on 50-meter data is therefore a conservative estimate.

This analysis used NREL wind measurements made at 50 meters above ground level. Suitable wind was found offshore, along the shoreline, and in isolated pockets inland (Figure 6). All of the townships with suitable wind power classes in Oceana and Muskegon counties had zoning regulations in place (Figure 7). In Ottawa County, Georgetown and Holland townships possessed suitable wind power classes but lacked zoning regulations covering wind energy facilities. Overisel, Saugatuck, and Clyde townships in Allegan County also possessed suitable wind power classes but lacked appropriate zoning regulations. Clyde Township was specifically identified as a top-priority wind resource area by the Wind Energy Resource Zone Board (Public Sector Consultants, Inc., and Land Policy Institute 2009). Allegan County had the lowest proportion of townships with zoning regulations for wind turbines in the four-county study area. These five townships in Ottawa and Allegan Counties may be especially vulnerable to conflict.

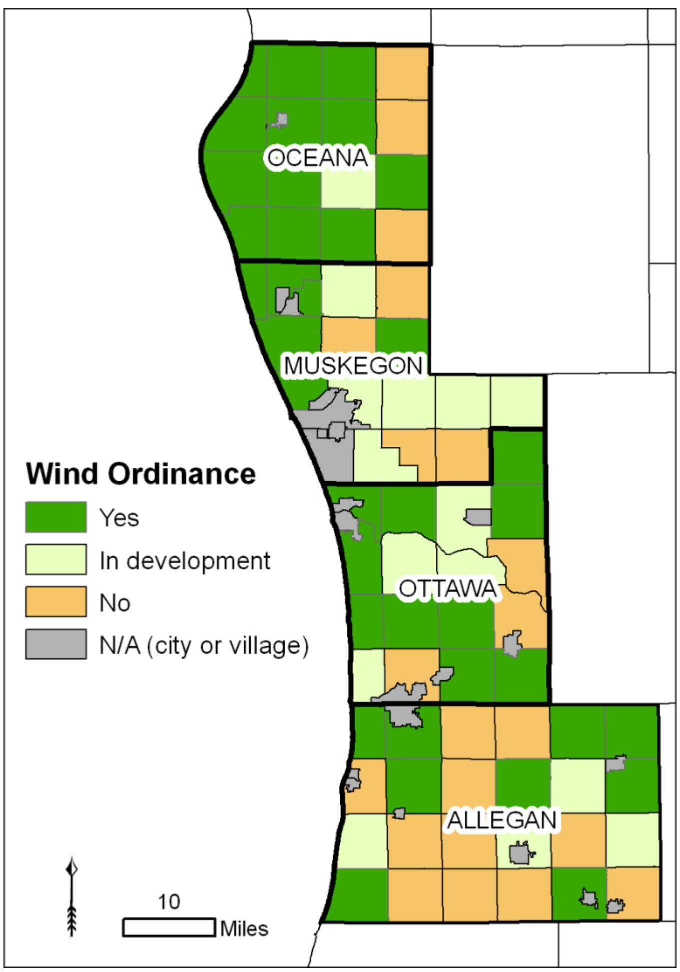

Figure 5: Study area townships with utility-scale wind energy zoning ordinances.

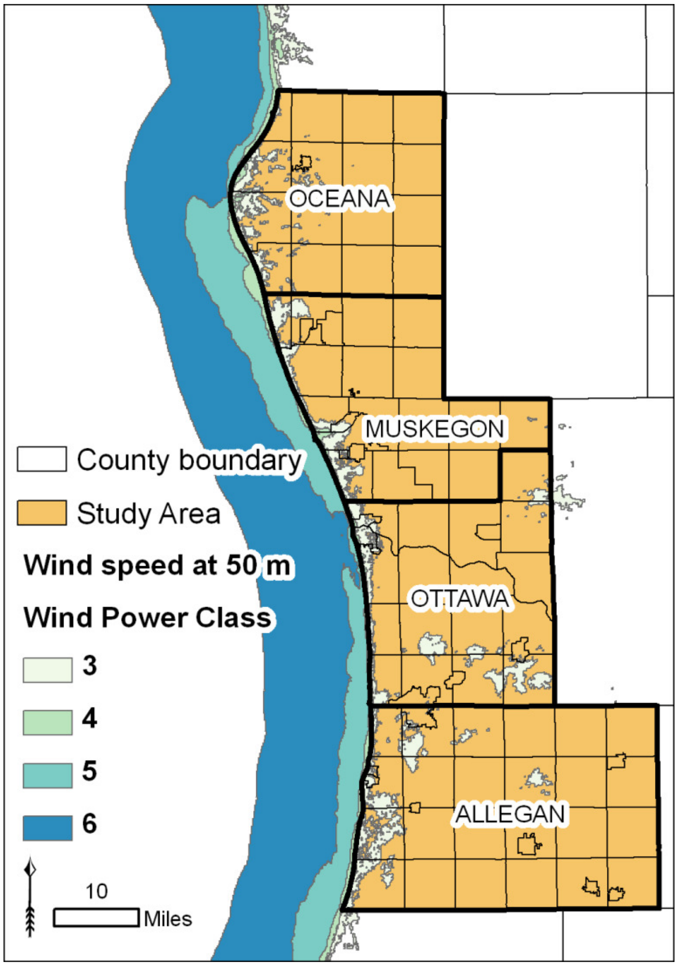

Figure 6: Wind power classes in study area. Power classes 3 and higher are suitable for utility-scale wind development.

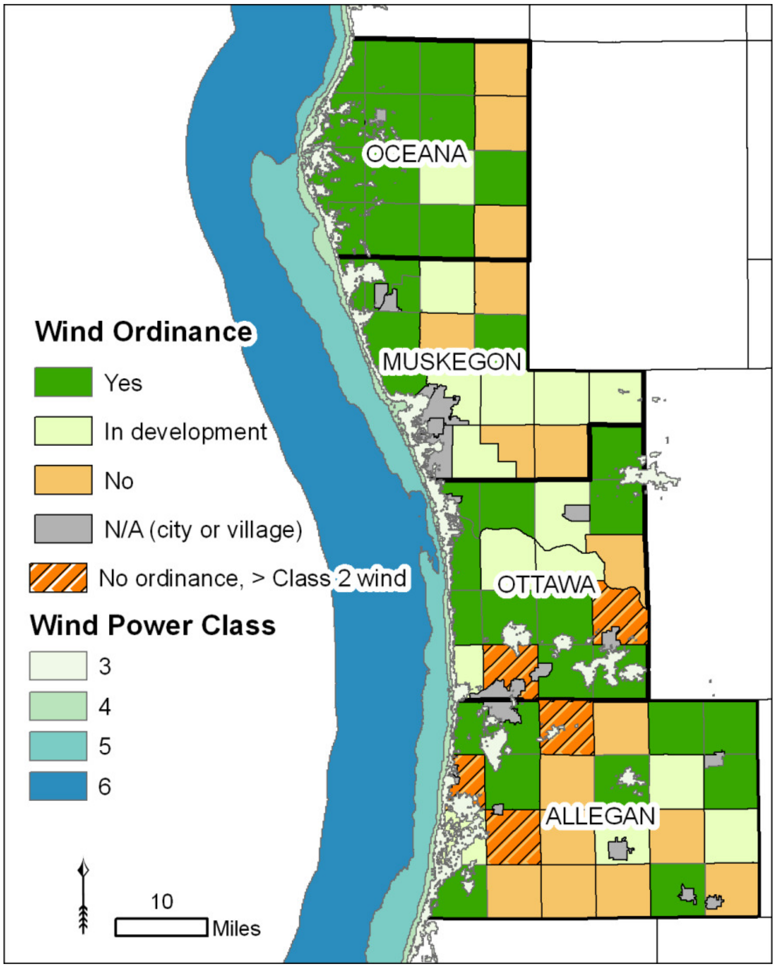

Figure 7: Townships that have suitable wind power classes but lack utility-scale wind ordinances. Wind power classes 3 and higher are considered suitable for utility-scale development.

Trends in Wind Energy Development

Windy West Michigan

Wind is expected to be the primary source of additional renewable energy capacity. Compared to most other renewable energy sources, wind is a mature technology, reliable generators are available, the costs are competitive with fossil fuels, the electricity generation process produces no emissions, and the energy resource is vast (Kempton et al., 2005). In this section, we documented the trends in wind energy development in West Michigan by reviewing recent reports from state agencies, workgroups and the US Forest Service; examining the PA 295 renewable energy plans; summarizing offshore wind energy potential; and investigating shifts in manufacturing.

The Michigan Bureau of Energy Systems (2009) forecasts more than 2000 MW of wind energy capacity will be installed in Michigan by 2015, up from the current 130 MW. The Land Policy Institute at Michigan State University estimated that 1,250 utility-scale wind turbines with a total nameplate capacity of 2,150 MW would be required to meet the ten-percent renewable energy standard in PA 295 (Land Policy Institute, 2007).

The Wind Energy Resource Zone Board identified four regions with the highest wind power production, all in the Lower Peninsula: Allegan County (Region 1); Charleviox-Antrim Counties (Region 2); Leelenau-Benzie-Manistee Counties (Region 3); and the Thumb (Region 4) (Figure 8). Of the counties in the study area, only Allegan was considered in the top tier for wind power production. The Board estimated that Allegan County could support between 166 and 296 wind turbines for a capacity range between 249 and 445 MW. Areas in Ottawa, Muskegon, and Oceana counties have adequate wind resources (Figure 5), but other factors contributed to their lower-priority status. Primary among these was land availability based on distance from airports and urbanization, especially in Ottawa and Muskegon counties. Other exclusion factors were proximity to Great Lakes shoreline, developed land uses, wetlands, and proximity to lakes and rivers. The Board did not report the potential capacities of the other nine priority zones. (Public Sector Consultants, Inc. and Land Policy Institute, 2009).

Portions of Oceana and Muskegon Counties lie within the boundary of Huron-Manistee National Forests. The US Forest Service analyzed solar and wind energy potential on all national forest lands by national forest unit. The screening criteria included a wind resource in wind power Class 3 and above, proximity (25 miles) to transmission lines and graded roads, and location outside of roadless areas. The Forest Service estimated that the Huron-Manistee National Forests have a maximum wind development potential of 114 MW. However, the report did not identify the portions of Huron-Manistee National Forest that support the most wind development. The Huron-Manistee National Forests were not among the top 25 National Forest System Units with areas having high wind energy potential (Karsteadt et al., 2005). Our analysis shows that suitable wind conditions exist only in the Manistee National Forest section (Figure 9). The suitable areas are limited to a small portion of northern Muskegon County and along the coast in Mason County, which is north of Oceana County and outside of our study area. The Huron National Forest section, in the northeastern Lower Peninsula, did not have any areas with a Class 3 wind power rating.

EXHIBIT 11
Regions with the Highest Wind Energy Production Potential

SOURCE: Public Sector Consultants Inc., 2009, using map from Michigan State University Land Policy Institute, 2009, prepared for WERZ Board

Figure 8: Areas with the highest wind energy harvest potential, based on Wind Energy Resource Zone Board criteria. Figure from the Final Report of the Michigan Wind Energy Resource Zone Board Report, reprinted with permission (Public Sector Consultants and MSU Land Policy Institute, 2009).

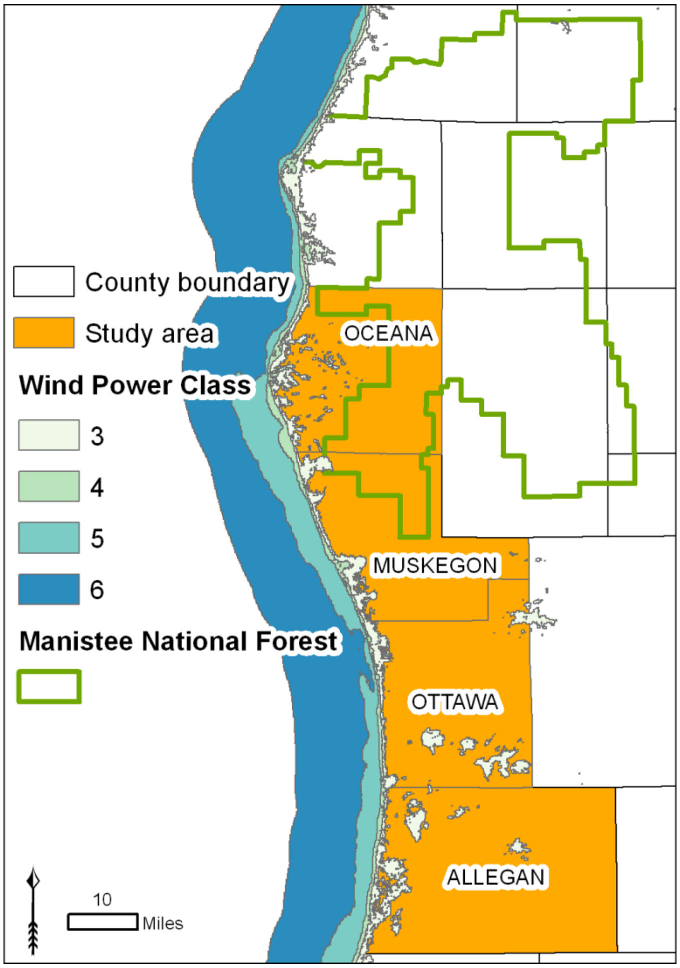

Figure 9: Wind energy resources in the Huron-Manistee National Forest, Manistee section. Wind power classes 3 and higher are considered suitable for utility-scale development.

Renewable Energy Plans

PA 295 requires all Michigan electric providers to submit renewable energy plans. Electric providers operating in the study area may choose to meet their PA 295 requirements by building wind farms in this area, or they may build facilities or purchase RECs from outside the area. Conversely, electric providers operating in other parts of the state may choose to locate wind facilities in West Michigan. The difficulty in defining the boundaries of the study area is typical of complex challenges in planning (Rittel and Weber, 1973). Here we summarize electric provider responses to PA 295, with particular attention to how the wind resources of the West Michigan coastal zone are being used to meet the requirements. Electric providers planning to use other means to obtain RECs, such as landfill gas, are not included.

Although the Wind Energy Resource Zoning Board only identified one of the four counties in our study area as a prime wind energy zone, the region is attracting attention from a variety of electricity providers. In the remainder of this section, we summarize the wind-related renewable energy plans of area providers and examine the Midwest Independent System Operator Integration Queue – the "waiting list" for potential wind power projects. We also explore the region's offshore wind potential.

Consumers Energy, one of the two largest electric providers in Michigan, plans to meet almost all of its renewable capacity portfolio and renewable credit portfolio requirements through wind energy. Consumers Energy intends to go beyond the 500 MW renewable capacity requirement and add a total of 900 MW of renewable capacity by 2017. The utility is choosing wind because, according to them, other types of renewable fuels are relatively limited in Michigan (Consumers Energy, 2009a).

The cost of wind power has dropped substantially since the 1980s (Wiser and Bolinger, 2009). Nevertheless, a wind farm is, like other energy projects, a major capital investment. Consumers Energy estimates that their renewable energy plan, which is based mostly on wind, will have a life cycle cost of $198/MWh, compared to $133/MWh for a new conventional coal-fired power plant. The conventional coal-fired plant cost does not include carbon capture and storage, which would raise the cost substantially. The company plans to offset some of the additional costs of renewable energy through its energy optimization plan. Consumers Energy estimates the construction cost of installing a wind farm at $2,500/kW, 70-75 percent of which is allocated to purchasing and transporting the turbines themselves. The bulk of the remaining cost is in the construction of the wind farm (Consumers Energy, 2009a). For comparison, the US Department of Energy reported that the capacity-weighted average for projects built in 2008 was $1,915/kW. The same report showed that for 10 projects in the Great Lakes region in 2007-2008, the installed wind project costs were approximately equal to the national average (Wiser and Bolinger, 2009).

Great Lakes Energy Cooperative is one of four all-requirements electric energy purchasers of Wolverine Power, which has entered a 20-year long-term purchase power agreement, including RECs, from the Harvest Wind Farm. This wind farm is already operational and no additional capacity was proposed under Great Lakes' renewable energy plan (Great Lakes Energy Cooperative, 2009).

The Holland Board of Public Works (HBPW) has proposed a two-part plan to satisfy the regulation. In Phase I, HBPW will obtain renewable power and RECs through purchase agreements with the Grayling (Biomass) Generation Station, and Michigan Public Power Agency for Granger Landfill energy. HBPW also operate two small wind turbines but these are not included in the plan. HBPW is pursuing a number of wind power projects in Phase II, located both inside and outside the study area. HBPW is investigating the potential of installing 4.95 MW wind farm with one to three 1.65 MW turbines at Windmill Island in the city of Holland. HBPW has collected 18 months of wind data at a potential wind farm site south of Muskegon, Michigan, also within the study area. HBPW is considering building several turbines on the site with a nameplate capacity of 3.2 MW. Additional potential projects outside the study area include a partnership with the Michigan Public Power Agency and Wyandotte (Michigan) Municipal Services to purchase energy and RECs from a 5.5 MW wind farm near the Detroit River. HBPW is also evaluating a potential wind farm site in Chippewa County, Michigan, in the Upper Peninsula. This site could hold as many as 20 to 25 1.65 MW turbines, for a total capacity of 41.25 MW (Holland Board of Public Works, 2008).

Detroit Edison does not serve customers in the West Michigan region, but it is the largest electric provider in the state. It is possible that Detroit Edison would consider siting wind energy facilities in the study area. Detroit Edison's Renewable Energy Plan states that the company intends on owning utility scale wind farms featuring turbines with at least 1.5 MW nameplate capacity. Detroit Edison has already begun the process of obtaining easements for wind farms sites though no sites in the West Michigan study area were explicitly named. The company plans to own 25 MW of wind power capacity in 2011 and increase its assets to 565 MW of wind capacity in 2029 (Detroit Edison Company,2009).

MISO Queue

The Midwest Independent Transmission System Operator (Midwest ISO) manages the bulk power system for parts of 13 states and one Canadian province, from Pennsylvania to Montana. All but a small part of southwestern Michigan falls under Midwest ISO's jurisdiction. Midwest ISO manages the integration of new electricity generation into the electricity grid through the MISO Generator Interconnection Queue (Midwest ISO 2009). Projects in the queue go through a number of feasibility studies and analyses, and all may not be developed. However, the queue is a required step in the process and can be used to assess where developers are looking to site wind energy projects.

Projects in the queue receive an overall project status designation of active, inactive, or done. For the entire state, 48 projects totaling 8,081 MW of new capacity for all fuel types are in the queue as either active or done. Of these, 25 were wind projects with a total capacity 2,782 MW, representing 34 percent of the total planned new capacity for the state (Midwest ISO, 2009).

As of August 21, 2009, five "done" wind projects were in the queue for Michigan, one of which was in the West Michigan study area. The project has components in both Oceana and Manistee Counties (which are not adjacent) and had a listed capacity of 140 MW.

Another 20 active wind projects were listed in Michigan's queue, seven of which were located in the study area. Two were located in Oceana County (100 MW, 60 MW), three were located in Ottawa/Kent Counties (150 MW, 150 MW, and 120 MW), and two were located in Allegan County (74 MW, 64 MW) (Table 3). The active and done projects in the four-county study area represent 28 percent of the capacity in the queue for the whole state (Midwest ISO, 2009).

Table 3: Proposed wind energy projects in the MISO queue in study area.

County	Number of proposed projects	Additional proposed capacity (MW)
Oceana	3	300
Muskegon	0	0
Ottawa	3	420
Allegan	2	111
Total	8	831

Offshore Wind

A recent report from the National Renewable Energy Laboratory noted "there is interest in offshore wind in several parts of the country due to the proximity of offshore wind resources to large population centers, advances in technology, and potentially superior capacity factors" (Wiser and Bolinger, 2009, p. 11). While the world offshore capacity now stands at 1,421 MW, offshore wind remains absent from the US energy portfolio. The National Renewable Energy Laboratory suggested this is because of "the availability of low-cost onshore wind resources, regulatory delays and uncertainty associated with offshore development, turbine supply shortages, high and uncertain offshore project costs, and public acceptance concerns" (Wiser and Bolinger 2009, p. 11).

A recent report from the Land Policy Institute at Michigan State University (Adelaja and McKeown, 2008) described several advantages of tapping Michigan's offshore wind potential, including the following:

- Michigan has sole jurisdiction of about 40 percent of the Great Lakes surface water area.
- The Great Lakes bottomland that is within Michigan's jurisdiction is held in public trust and owned and operated by the state.
- Great Lakes state coastal management zones are not bound to the 18-mile limit imposed on state marine coasts.
- The freshwater nature of the Great Lakes makes project implementation easier, cheaper, and could lead to greater infrastructure durability than in saltwater regions.

Governor Granholm established the Great Lakes Wind Council in 2009 to identify 1) criteria that could be used to review applications for offshore wind energy facilities; and 2) criteria for identifying and mapping categorical exclusion zones and zones most favorable for wind development (Mikinetics LLC and Public Sector Consultants, Inc., 2009). Criteria for categorical exclusion included coastal airport setbacks, international and state boundaries, military operation areas, submerged utility infrastructure, and areas designated for nautical commerce, such as aids to navigation, channels and shipping lanes. The council also identified biological, physical, and protected feature criteria that apply to conditional areas. Most favorable were designated at those outside the categorical and conditional areas. These designations were for policy and planning purposes, not site-specific assessments (Mikinetics LLC and Public Sector Consultants, Inc., 2009).

The council reported that about 20 percent of Michigan's 38,000 square miles of Great Lakes bottomlands have a depth of 30 meters or less, the practical depth limit of today's offshore technology. Of these shallow areas, 23 percent (1,836 square miles) were categorically excluded and 7 percent (559 square miles) were rated most favorable. The remaining bottomlands were identified as conditional areas. The council also recommended a set of legislative and rule changes for the review offshore wind energy projects. Such a process is not yet in place and the current review process was deemed inadequate (Mikinetics LLC and Public Sector Consultants, Inc., 2009).

Much of Lake Michigan off the coast of the study area counties was categorized as most favorable or conditional. Areas with suitably shallow water (less than 30 meters) were generally within five to ten miles of shore and most of these areas fell into the conditional category. No shallow areas along the study area shoreline were rated as most favorable. A "bubble" of categorically excluded areas surrounded most large towns and cities along the study area's shoreline (Mikinetics LLC and Public Sector Consultants, Inc., 2009).

Michigan State University's Land Policy Institute has also investigated offshore potential in the Great Lakes. The Land Policy Institute imposed exclusion zones based on minimum distance to shore (1 km, 5 km, 10 km, and 15 km) and maximum depth (30 m and 60 m). At the more practical 30 m depth, the researchers estimated the potential offshore capacity at 55,250 MW, or 18,782 Seimens STW 3.6 MW wind turbines. Based on these assumptions, the total power available offshore in Michigan is more than triple that of land-based wind energy facilities. When distance restrictions are added to the 30 m depth restriction, potential offshore capacity ranges from 47,360 MW at 1 km to 926 MW at 15 km (Adelaja and McKeown, 2008).

Consumers Energy (2009b) projects that the cost of close-to-land offshore wind energy facilities would be 140–200 percent greater than comparable onshore wind farms. Projects far from land could be up to 300 percent more expensive. The steadier and stronger winds may increase the capacity factor up to 25-40 percent from the 28 percent standard from onshore wind facilities. However the capacity factor increase does not, according to their estimates, offset the additional costs for offshore wind. Consumers Energy identified several other challenges to offshore wind development, including environmental factors such as icing, construction and operation; public objections; lack of transmission infrastructure; and technology risk (Consumers Energy, 2009b).

While offshore wind energy facilities are currently operating in other parts of the world, all of them are in saltwater. Placement of a wind farm in a freshwater system like the Great Lakes would pose unique challenges. Saltwater does not freeze in temperate climates, while the Great Lakes often experience substantial winter ice cover. Grand Valley State University's Michigan Alternative and Renewable Energy Center (MAREC) has proposed placing a wind test platform in Lake Michigan. The platform, to be sited six to ten miles offshore from Muskegon, would collect year-round wind data. It would also test the technical challenges of anchoring the platform to the lakebed and coping with winter ice. It would also serve as a test-run of the regulatory permitting process (Alexander, 2009).

Manufacturing

The US Department of Energy reported that the "soaring demand for wind spurred expansion of US wind turbine manufacturing" (Wiser and Bolinger, 2009, p. 15). In 2008, eight Michigan facilities opened new manufacturing capacity, announced upcoming openings, or branched into manufacturing wind turbine components. Two of these facilities were located within the study area (Wiser and Bolinger ,2009). These facilities are Carlton Creek Iron Works of Rothbury, Michigan, which manufactures ductile iron for castings, and Genzink Steel of Holland, Michigan, a manufacturer of gearbox covers and housings (Frank Oteri, National Renewable Energy Laboratory, personal communication). Carlton Creek Iron Works has ceased operations, at least temporarily.

Next steps

Michigan is committed to pursuing its ten-percent renewable energy target in a manner that is economically, socially, and environmentally appropriate. Michigan has abundant onshore and offshore wind resources which are expected to be the primary renewable energy source. Many West Michigan communities are preparing to meet the challenge of siting wind energy facilities and are working on or have already adopted zoning ordinances covering wind turbines. Nevertheless, some townships in key wind resource zones lack such regulations.

West Michigan's abundant wind resources are drawing energy developers to the area. The MISO queue lists 813 MW of proposed capacity in the study area. Additionally, Holland Board of Public Works has proposed more than 8 MW of capacity in Ottawa and Muskegon Counties. It is likely that at least some of the additional renewable capacity needed to meet the PA 295 target will come from wind energy facilities located in West Michigan. While offshore wind development does not appear imminent in West Michigan, citizens should be prepared for the possibility. As the technology matures and onshore resources become fully developed, offshore locations may become more attractive.

Public participation is a key element of integrated assessment. This report documented the status of wind energy in West Michigan and the trends that are shaping both Michigan's energy portfolio and West Michigan's landscape. It will be made available to a wide range of stakeholders in the study area. The status of wind energy and its development trends described here will inform the discussions of the project's stakeholder steering committee and broader public outreach activities. The next phase of the integrated assessment project will specifically analyze the environmental, social and economic foundations and interactions that make wind energy development a complex challenge. We will also investigate approaches for mitigating adverse effects so that the net benefits of wind energy can be maximized.

The demand for renewable energy, and wind energy in particular, is growing rapidly. The challenge will be to supply the quantity of renewable energy need to meet this demand in a manner that is economically, socially, and environmentally appropriate. Integrated assessment is an effective tool for analyzing complex, policy-relevant problems like wind energy development. By opening a dialogue among stakeholders and providing access to the latest science on the topic, the integrated assessment project will help citizens and local governments make informed decisions about wind energy development in their communities.

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