Wind Farm Development in Coastal Michigan

An Introduction to Wind Energy

MICHIGAN STATE UNIVERSITY

LAND POLICY INSTITUTE

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Introduction

In recent years, political leaders at the state and national levels have emphasized the need for alternative sources of energy in the U.S. In 2008, Michigan passed a Renewable Portfolio Standard (RPS) into law, which requires 10 percent of electricity sold in the state come from renewable sources by 2015. Because most of the state's wind energy resources occur near the Great Lakes, proposals for commercial wind farms are expected to increase in and near communities along Michigan's coasts.

The Michigan State University Land Policy Institute (LPI) provides communities and policymakers with the data and planning tools needed to manage these kinds of land-use pressures. Michigan Sea Grant recently provided LPI with funds to assess the economic, environmental, and social issues raised by the development of wind farms in these communities.

As part of this assessment, the Land Policy Institute is asking members of these communities to share their thoughts about these issues. This booklet serves as a starting point for these conversations by providing background information on topics related to wind farm development in Michigan.

Integrated Assessment

The goal of an Integrated Assessment project is to synthesize scientific knowledge in order to guide decision-making around a particular environmental issue. These research projects are assessments because they involve a review and analysis of existing information. Rather than running additional experiments, experts summarize what's known and go a step beyond the facts and offer an assessment or an evaluation of those facts. These research projects integrate:

- Policy-makers, in order to identify scientific information needed to guide decision-making
- Stakeholders, typically community and business leaders with a stake in the issue
- Knowledge from several disciplines, typically physical, biological, and social sciences
- An analysis of the causes of and an analysis of the possible responses to a problem

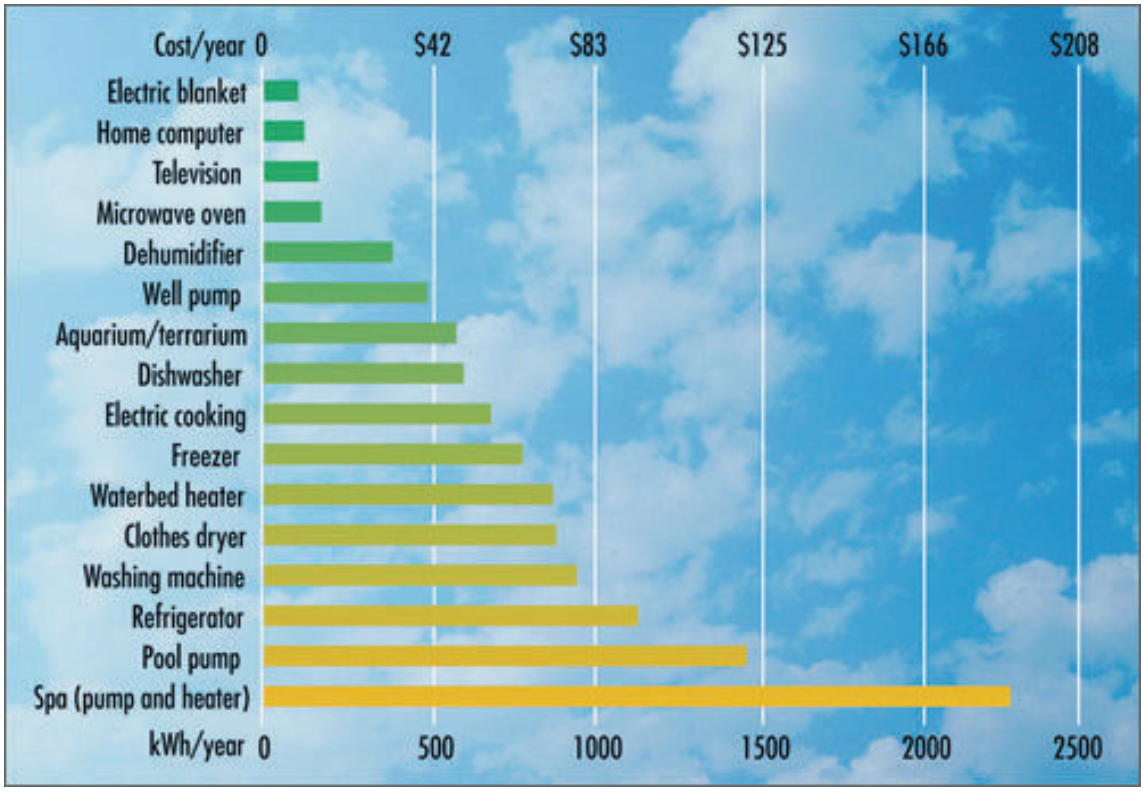
The focus of the Integrated Assessments approach is data analysis, synthesis, modeling, and stakeholder engagement (e.g., surveys, focus groups, workshops, panel discussions, and interactive policy analysis). Integrated Assessment can take many forms, but many use the framework below. Depending on the needs of decision-makers, certain objectives may be emphasized within the assessment.

- Define the policy–relevant question
- Document the status and trends of environmental, social, and economic conditions related to the issue
- Describe the causes and consequences of those trends
- Identify desired outcomes and policy options
- Provide forecasts of conditions under various policy options
- Provide technical guidance for implementing each option
- Provide an assessment of the level of certainty regarding the previous steps

Energy Basics

What is a Megawatt?

- The ability to generate electricity is measured in watts.
  - kilowatt (kW, 1,000 watts),
  - megawatt (MW, 1 million watts), and
  - gigawatt (GW, 1 billion watts)
- Electricity production and consumption are measured over time because that is how it is used.
  - Most commonly it is measured in kilowatt-hours (kWh). A kilowatt-hour means one kilowatt (1,000 watts) of electricity produced or consumed for one hour.
- An average U.S. household uses about 10,655 kilowatt-hours (kWh) of electricity each year.
- The output of a wind turbine depends on the turbine's size and the wind's speed through the rotor. Wind turbines being manufactured now have power ratings ranging from 250 watts to 5 megawatts (MW).

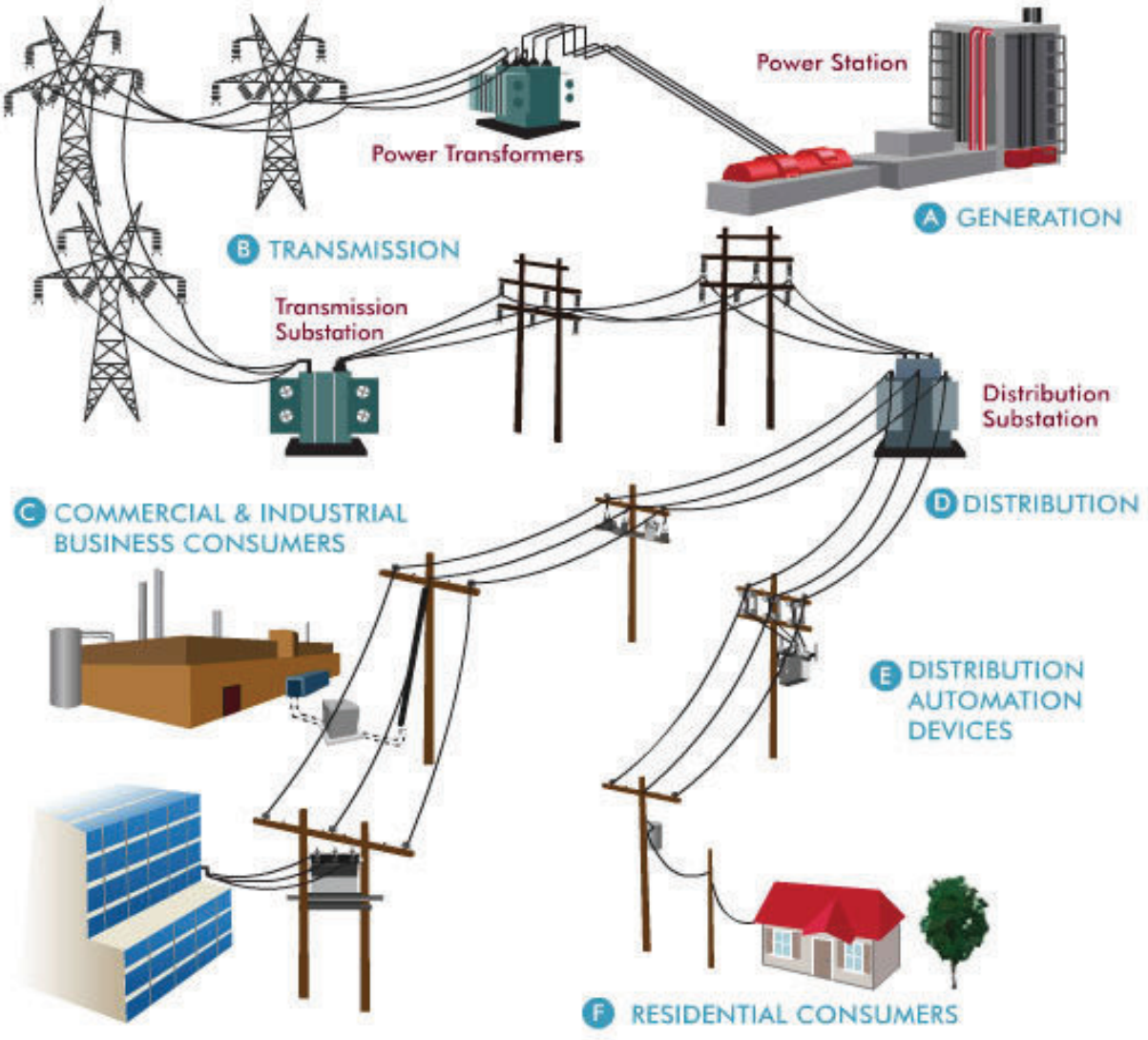


http://www1.eere.energy.gov/consumer/tips/appliances.html
http://www.awea.org/faq/wwt_basics.html

U.S. Electricity Systems

In the U.S., electricity is moved at two levels.

- Transmission: Electricity is converted to high voltage for movement over long distances. Some industrial consumers get their electricity directly from this system.
- Distribution: Electricity is converted to lower voltage for distribution to residential and commercial consumers.
- The transmission grid is similar to major highways while the distribution grid is similar to local streets.



Wind and Solar and other electricity sources are included in generation (A).

Michigan's Energy Situation

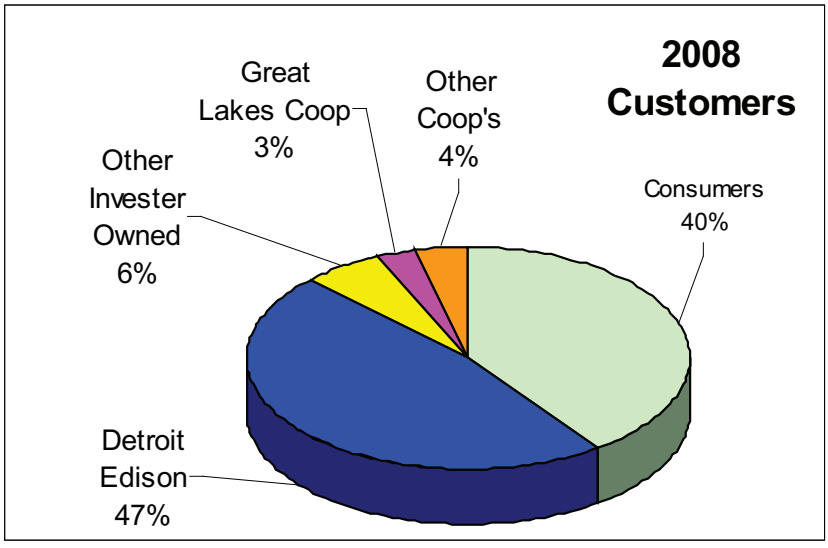
Michigan Energy Needs

MWH Sales in Michigan 2008

RESIDENTIAL	COMMERCIAL	INDUSTRIAL
32,465,802	33,155,534	28,546,157

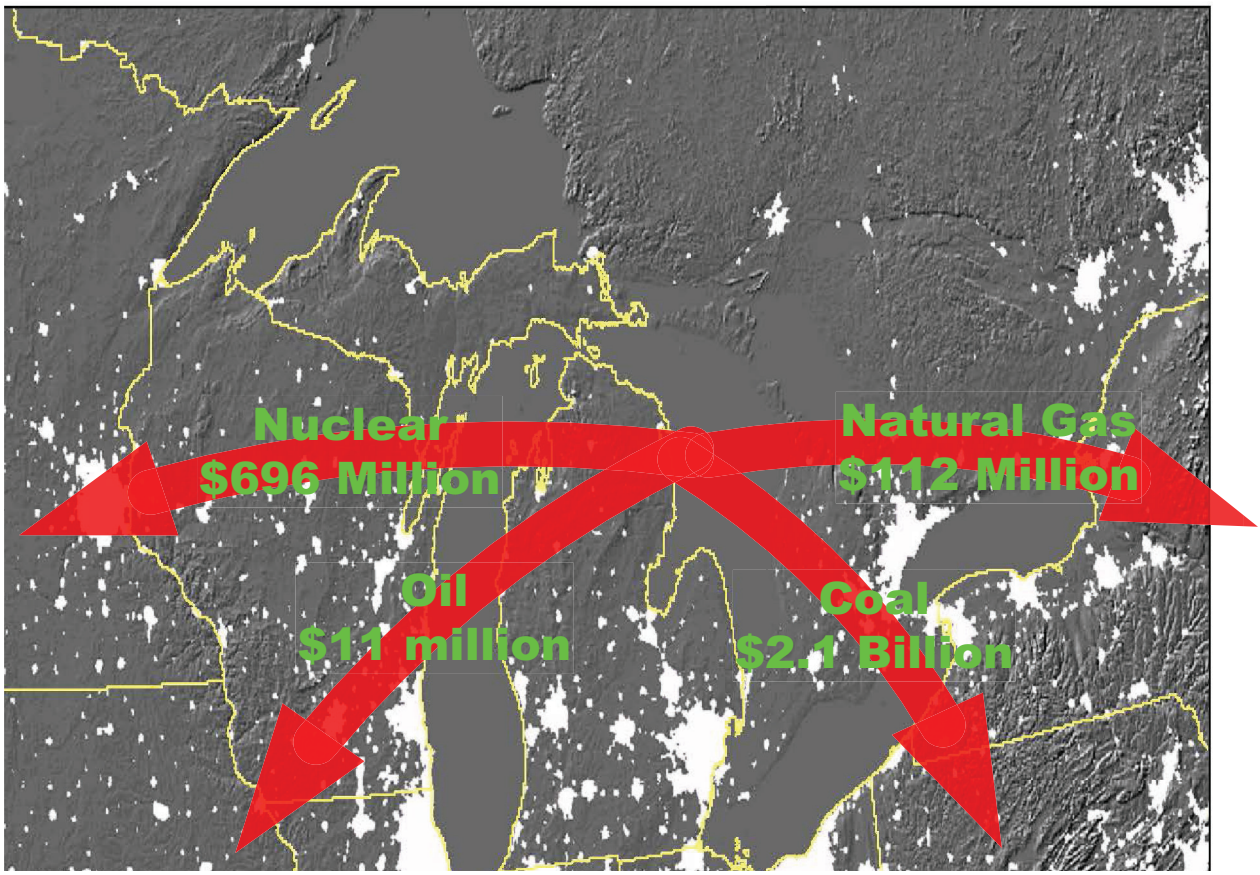
Electric Utility Customers 2008

RESIDENTIAL	COMMERCIAL	INDUSTRIAL
4,032,408	466,372	10,930



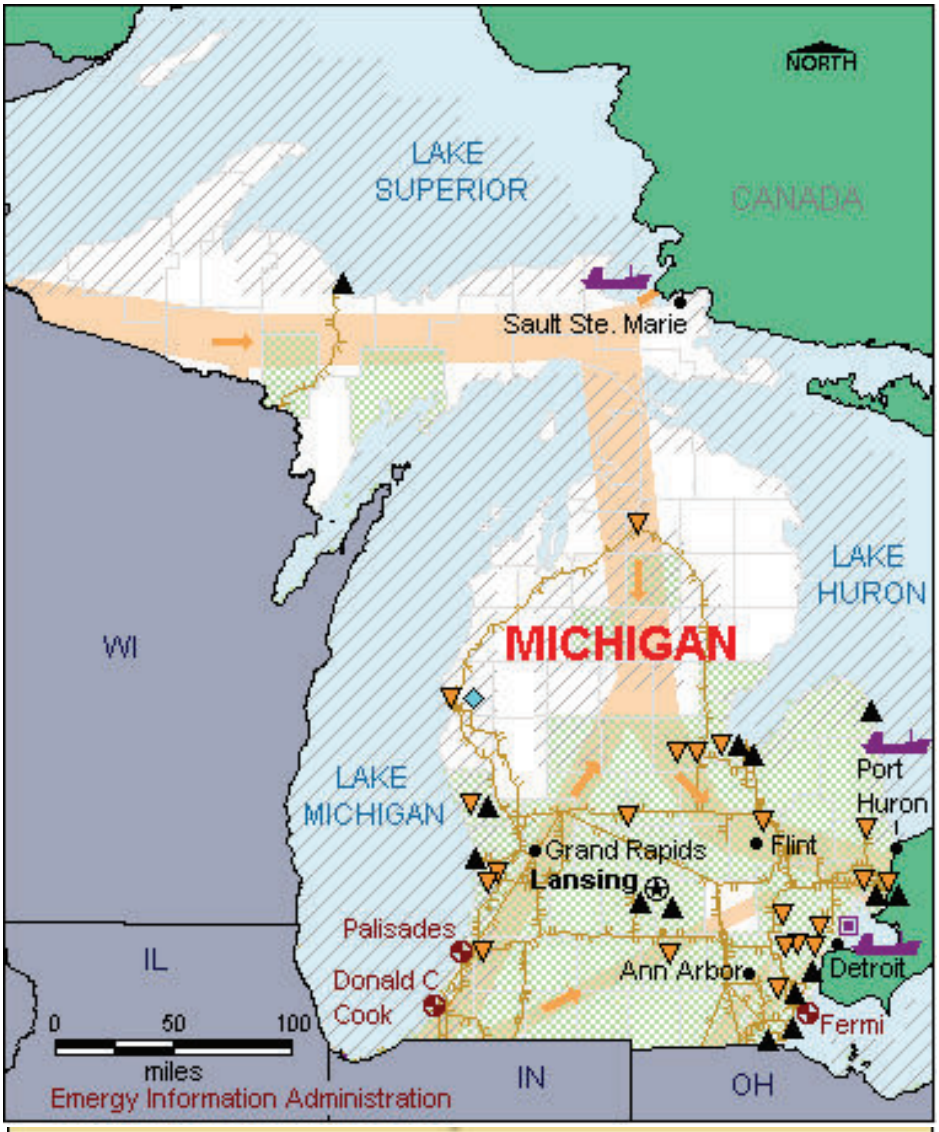
According to Michigan's 21st Century Electric Energy Plan, "Michigan's total electric generation requirements are expected to grow at an annual average rate of 1.3 percent from 2006 to 2025."

Michigan Energy Import/Export



- Michigan exports $3 billion dollars annually for electricity production.
  - (Individual fuel costs calculated by multiplying the Michigan Public Service Commission regional fuel mix by the PSC energy import estimate of $3 billion).

Energy Production in Michigan

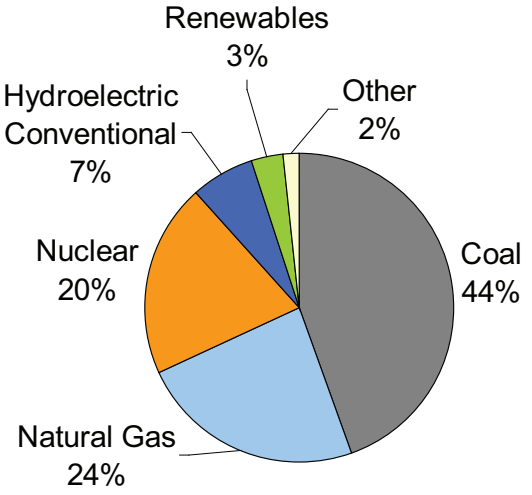


Coal Mine, Surface
Coal Mine, Underground
Natural Gas Hub
Petroleum Refinery
Oil Import Site
Oil Seaport
Electricity Transmission Line (>= 345 kV)
Natural Gas Flow (1 mile band width = 100 million cubic feet/day)
Oil and Gas Active Leases

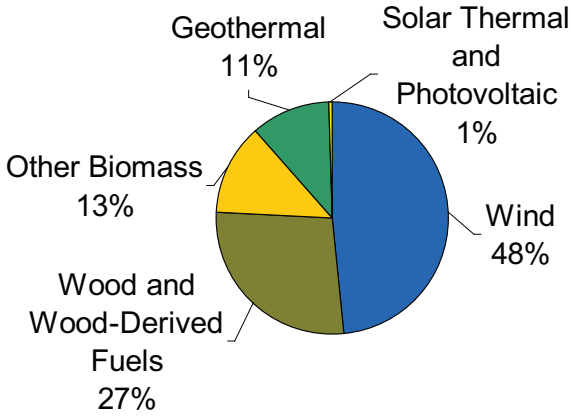
Major Electric Power Plants (>=100 MW)
Coal
Geothermal
Hydroelectric
Natural Gas
Nuclear
Petroleum
Solar
Wind
Wood
Other Renewable

Renewable Energy Potential
Biomass (>= 50 tons/sq km/yr)
Geothermal (>= 80 milliwatts/m2)
Solar (>= 6.0 kWh/m2/day)
Wind (>= 3 Power Class)

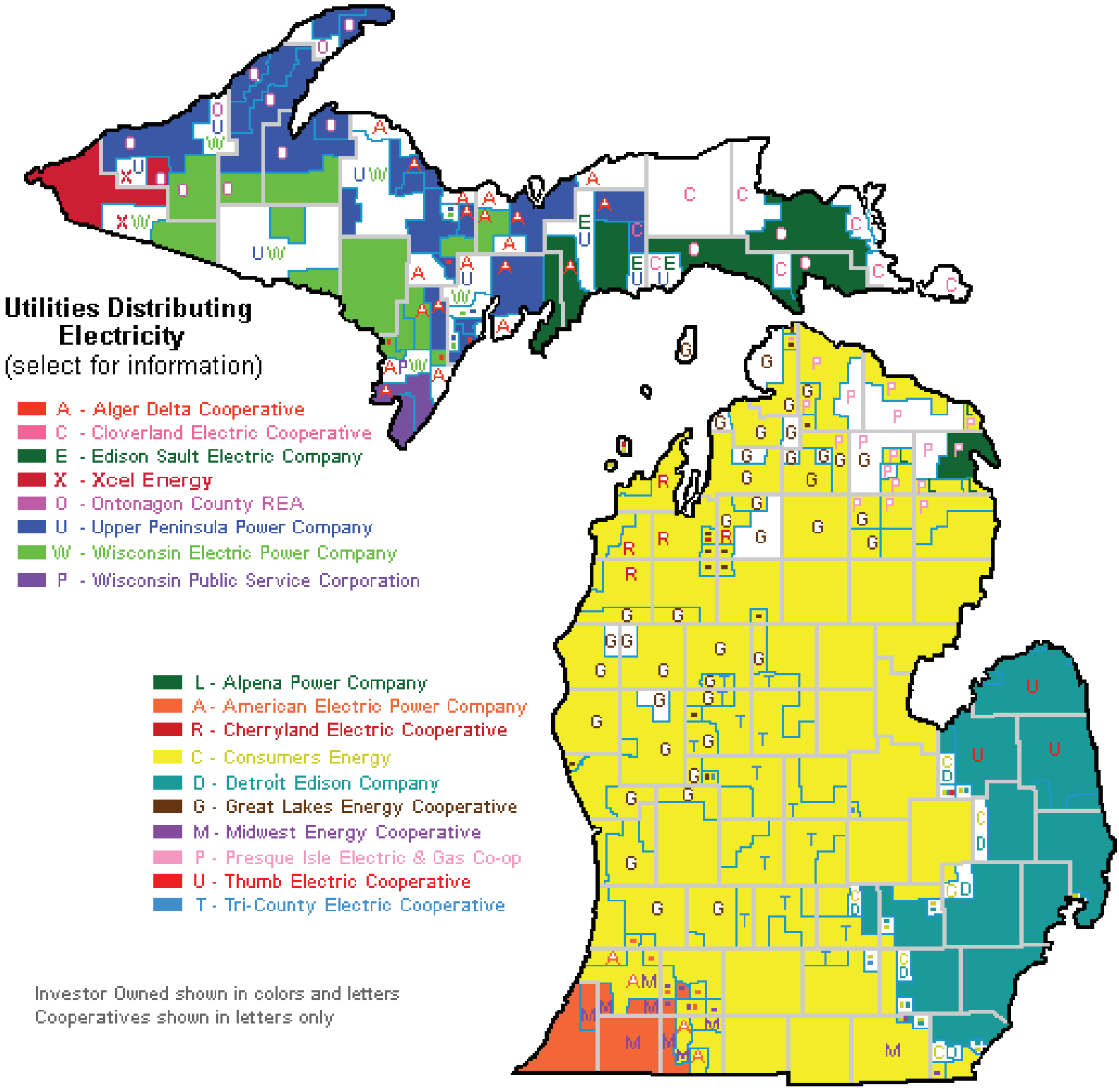
2009 Michigan Electricity Generation by Source



2009 Michigan Renewable Electric Generation Breakdown



Electric Utility Service Areas



Energy Production In Michigan

Types of Electric Utilities

- Investor Owned
  - A stockholder-owned utility company that provides public utility services to retail customers for a profit. In Michigan, investor-owned electric utilities are regulated by the Michigan Public Service Commission (MPSC).
- Electric Cooperatives
  - A member-owned electric utility company serving retail electricity customers. Electric cooperatives may be engaged in the generation, wholesale purchasing, transmission, and/or distribution of electric power to serve the demands of their members on a not-for-profit basis. The MPSC may regulate electric cooperatives.
- Municipal
  - A provider of utility services owned and operated by a city government. The MPSC does not regulate municipal utilities.
- Alternative Electric Supplier (AES)
  - The name given to certain competitive suppliers of retail electric services in Michigan. An AES may also be known as a marketer because they do not physically deliver electricity to customers. An AES operating in Michigan must be licensed by the MPSC.

http://www.dleg.state.mi.us/mpsc/electric/restruct/glossary.htm

Michigan Energy Policy

Public Act 295 of 2008
Renewable Portfolio Standard (RPS)

Establishes a standard of 10% of Michigan's electricity come from renewable energy by 2015.

Year	Amount*
2012	2%
2013	3.3%
2014	5%
2015	10%

*Percentage of the total number of kilowatt hours of electricity the provider sold to its Michigan retail customers for the calendar year

Wind Energy Resource Zone Board (WERZB)

The purpose of the board, as created under PA 295, is:

- Transmission Planning in high resource areas
- Potential for expedited siting for transmission in the final zones
- MPSC report to the legislature regarding local zoning in zones and its relationship to siting for generation

The board shall study:

- Wind energy production potential and the viability of wind as a source of commercial energy generation in this state.
- Availability of land in this state for potential utilization by wind energy conversion systems.
- Conduct modeling and other studies related to wind energy, including studying existing wind energy conversion systems, estimates for additional wind energy conversion system development, and average annual recorded wind velocity levels.
- The board's studies should include examination of wind energy conversion system requests currently in the applicable regional transmission organization's generator interconnection queue.

The board's report was required to include:

- A list of regions in the state with the highest level of wind energy harvest potential.
- A description of the estimated maximum and minimum wind generating capacity in megawatts that can be installed in each identified region of this state.
- An estimate of the annual maximum and minimum energy production potential for each identified region of this state.
- An estimate of the maximum wind generation capacity already in service in each identified region of this state.

Wind Energy Resource Zone Board Major Outcomes

The three major outcomes of the board's work were:

1. Transmission Planning in high wind resource areas and justification for funding of transmission installation.
2. Potential for expedited siting for transmission in final selected wind energy zones.
3. A report and recommendations to the legislature on effects of local policy on wind generation siting.

WERZB Final Regions

The board selected two regions in the state based on the board's study for expedited transmission planning.

The Land Policy Institute performed the analysis to determine potential zones based on the board's criteria. The board recommended four zones of which the Michigan Public Service Commission selected two.

Public Act 295 of 2008
(Rate Recovery)

Establishes Maximum rate recovery for renewable energy of:

- $3.00 for residential/month
- $16.58 for commercial/month
- $187.50 for industrial/month

Establishes Maximum rate recovery for Energy Optimization energy of:

- 2.2% of total sales in class
- Estimated to be approximately $1.50/month

Paying for Energy Production in Michigan

Overview of Rate Case Process

Michigan law requires some regulation of most utility companies doing business in Michigan. The Michigan Public Service Commission (MPSC) regulates natural gas and electric companies, rural electric cooperatives, and some telephone and trucking services.

A regulated natural gas or electric company must first obtain approval from the Commission when it wants to increase the rates it charges its customers. The company starts the MPSC rate case process by filing its request with the Executive Secretary Section.

A rate case is a legal process carried out much like a trial in a courtroom. An administrative law judge (ALJ) presides at the hearing. Parties are represented by attorneys. Hearings are conducted similar to proceedings in civil and other courts. However, a jury is not seated, and the ALJ does not render the final decision. The presiding ALJ issues his/her decision in a proposal for decision (PFD). Parties respond to the decision by filing exceptions to the PFD. The case is then "ripe" for a Commission decision. The Commission renders the final decision and order in all rate cases.

Basic issues of utility pricing usually include:

1. How much, if at all, a company should be permitted to revise its rates.
2. Which group of customers (that is, residential, commercial, or industrial) will see changes in their rates, and the respective rates.

Participants

Parties to the rate case most often include the following:

- the utility company,
- Michigan Public Service Commission staff, and
- parties, intervenors.

The Rate Case Step-by-Step

Utility Files for a Rate Change

The utility company files its application for a rate change.

Public Notice

Public hearings are scheduled and notices of hearing are published.

- Anyone may file a petition to participate and, if approved, becomes a party to the case.
- MPSC auditors review the applicant's financial books and records.
- MPSC staff and parties study the rate request, ask and answer written questions, prepare evidence, and submit testimony.

Public Hearing

The utility company presents proof in a courtroom setting before the presiding ALJ.

- MPSC staff and parties present their evidence and witnesses.
- All parties may ask questions of any witness.
- All parties may present written arguments.

ALJ Issues Proposal for Decision

The ALJ issues a PFD. Parties may file exceptions to the PFD.

Commission Issues Order

The Commission prepares and issues its opinion and order.

Order May Be Appealed

Parties may appeal the order:

- to the MPSC by requesting a rehearing or a reconsideration of the order; or
- to the court of appropriate jurisdiction.

Paying for Energy Production in Michigan

Following the adoption of a Renewable Portfolio Standard in Michigan, electric utility companies filed cases for rate recovery to the MPSC.

- DTE RPS rate recovery
  - $3 per residential meter, per month
- Consumers RPS rate recovery
  - $2.50 per residential meter, per month

Public Act 116

The Farmland and Open Space Preservation Program (PA 116) is designed to preserve farmland and open space through agreements that restrict development, and provide tax incentives for program participation.

What Does the Farmland and Open Space Act Do?

The act enables a farm owner to enter into a Development Rights Agreement with the state. The agreement ensures that the land remains in agricultural use for a minimum of 10 years, and is not developed for any non-agricultural use. In return for maintaining the land in agricultural use, the landowner may be entitled to certain income tax benefits, and the land is not subject to special assessments for sanitary sewer, water, lights or non-farm drain projects.

Wind Energy Property Tax

- Wind Energy Generation systems are taxed in Michigan as personal property.
- Value is determined by the local assessor.
- Depreciation is reported on the Wind Energy System Report (below).

PART A: EASEMENTS, RIGHTS OF WAY AND/OR LEASEHOLD INTERESTS
If none, enter "0."

			Assessor's Calculations of True Cash Value
Number of 1.5 MW Wind Turbine Towers in Service on this parcel (completed by taxpayer):	x $48,450	=	
Number of 1.65 MW Wind Turbine Towers in Service on this parcel (completed by taxpayer):	x $53,300	=	
Number of 2.0 MW Wind Turbine Towers in Service on this parcel (completed by taxpayer):	x $64,600	=	
Number of 2.5 MW Wind Turbine Towers in Service on this parcel (completed by taxpayer):	x $80,800	=	
	Total True Cash Value		

PART B: SITE IMPROVEMENTS
Include costs for the rotor, drive train, tower, controls, electric interface and tower foundation and all land improvements (except buildings), such as roads, fences and communication facilities. **Enter costs into the column to the right of the corresponding year.**

Year	
2009	1
2008	0.95
2007	0.9
2006	0.85
2005	0.8
2004	0.76
2003	0.7
2002	0.65
2001	0.6
2000	0.56
1999	0.5
1998	0.45
1997	0.4
1996	0.36
1995	0.3
Prior	0.3

Wind Energy Renaissance Zones

- Renaissance zones are virtually free of all state and local taxes for businesses located within their boundaries.
- Michigan Renewable Energy Renaissance Zones can be anywhere in the state if application from the local unit of government or renewable energy company is approved.
- Applicants must demonstrate positive economic impacts a project would have on local units of government and the state.

http://ref.michigan.org/medc/services/sitedevelopment/renzone/

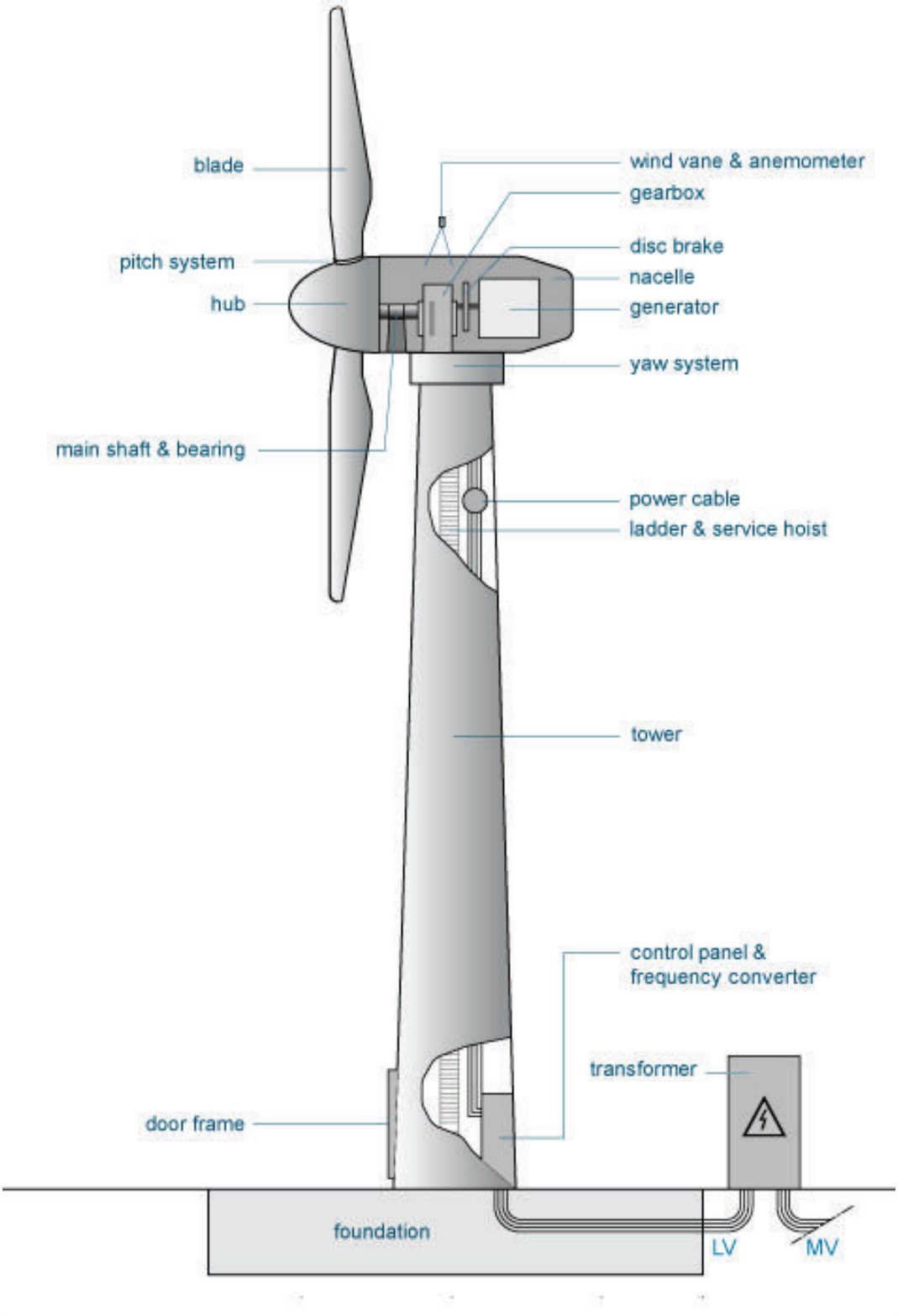
Wind Turbine Basics

Generator Overview:

Wind Turbine Size Comparison

Generator Overview:

Wind Turbine Components



Generator Breakdown

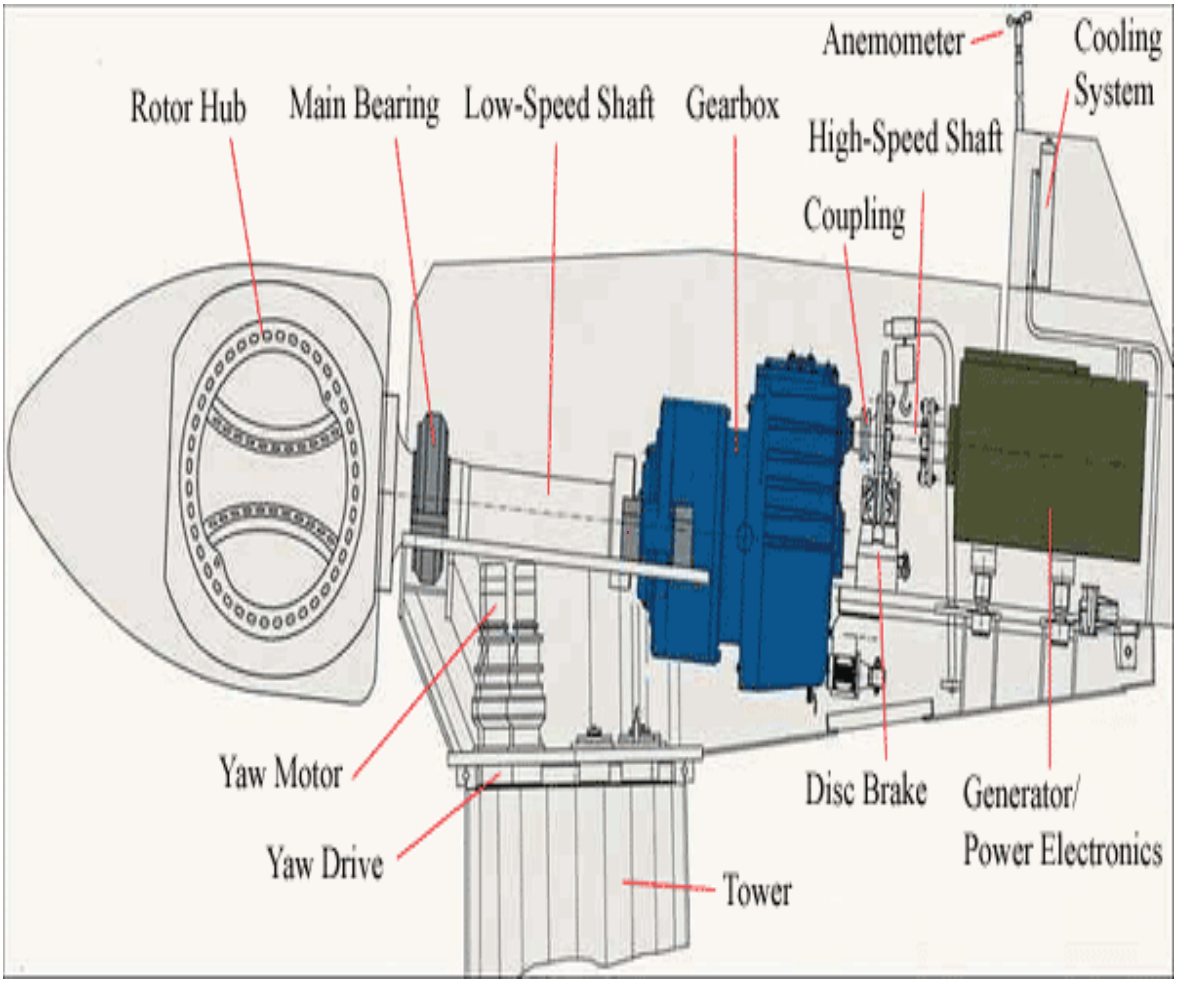
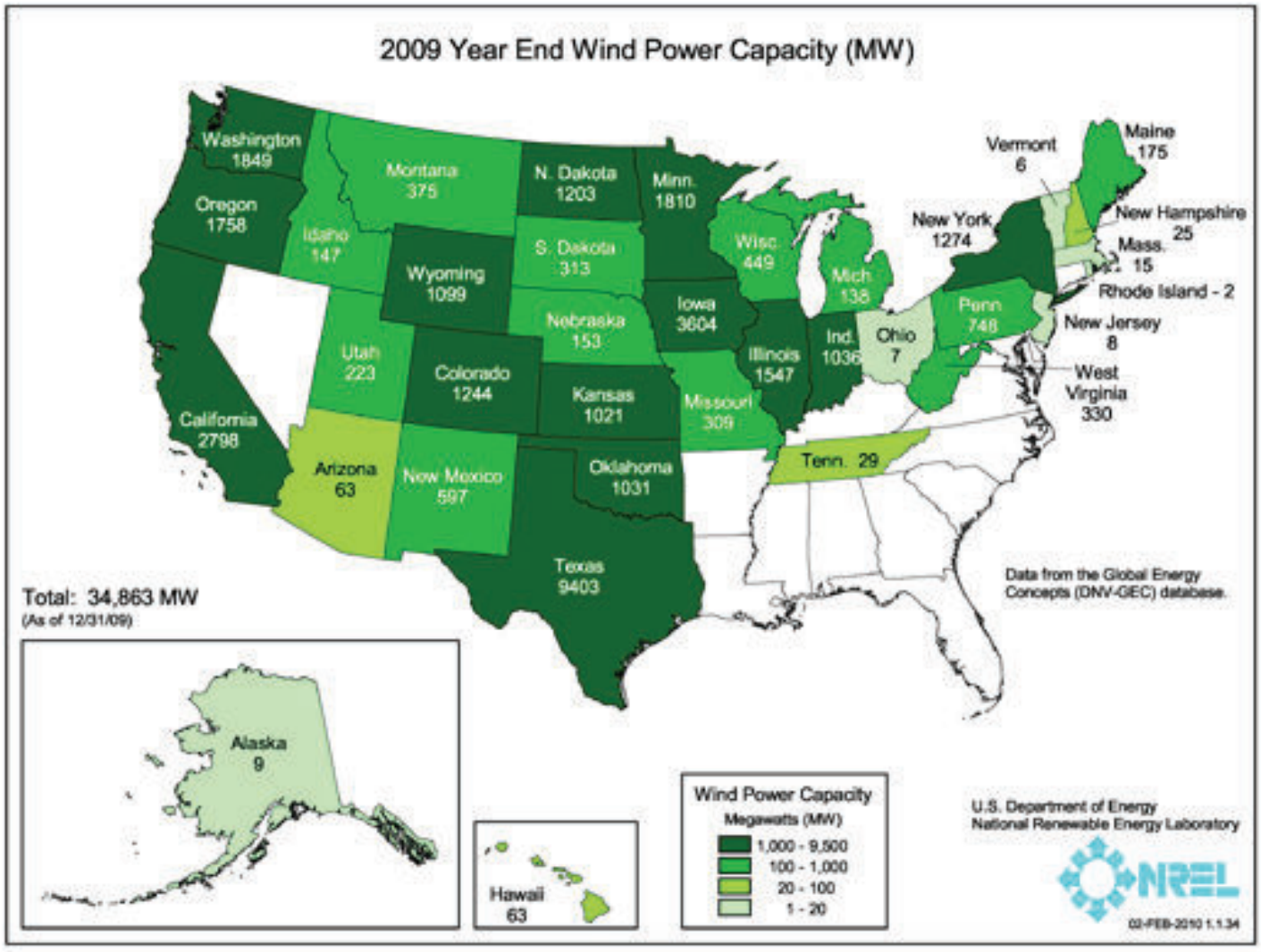


Image from the Renewable Energy Policy Project

Installed Wind Capacity in the United States



http://www.windpoweringamerica.gov/wind_installed_capacity.asp

Wind Resources

Wind Speed Classes

- Wind energy capacity is typically measured by wind density and speed.
- Wind classes 3 and above are typically suitable for electricity production.
- The energy available in a wind stream is proportional to the cube of its speed
  - Doubling the wind speed increases the available energy by a factor of eight.
  - Furthermore, the wind resource itself is seldom a steady, consistent flow.
  - Proper siting in windy locations, away from large obstructions, enhances a wind turbine's performance.

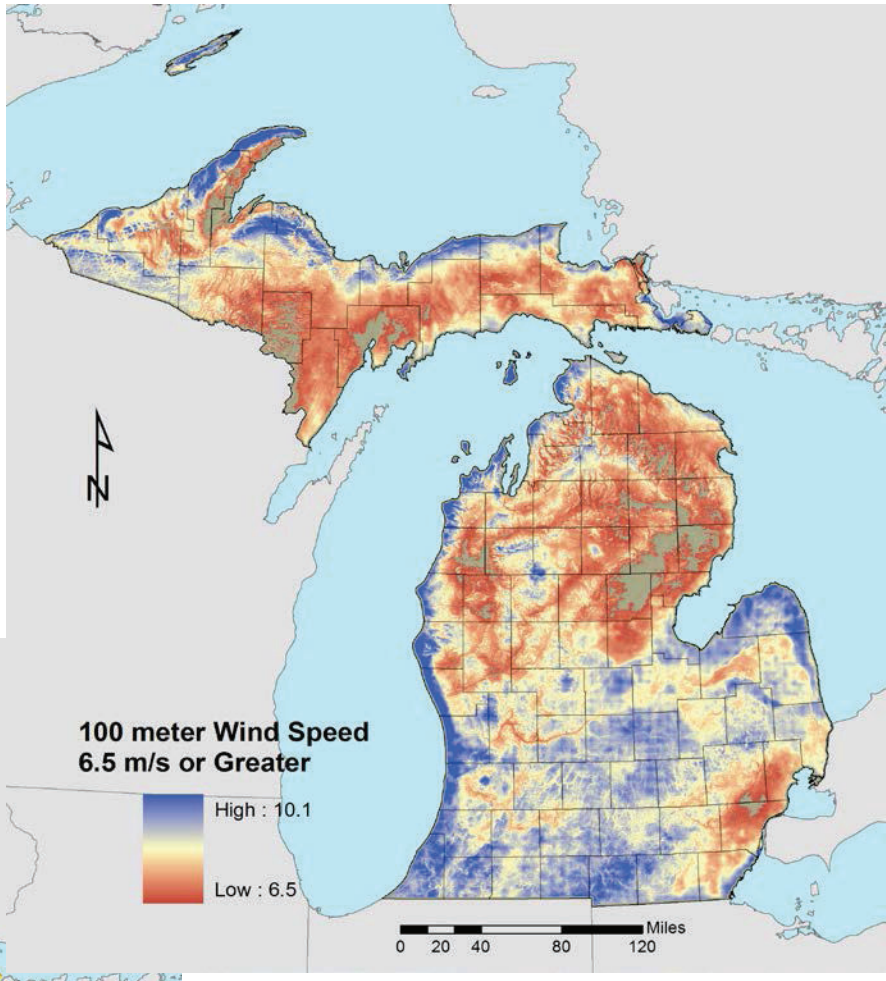
Wind Power Classification

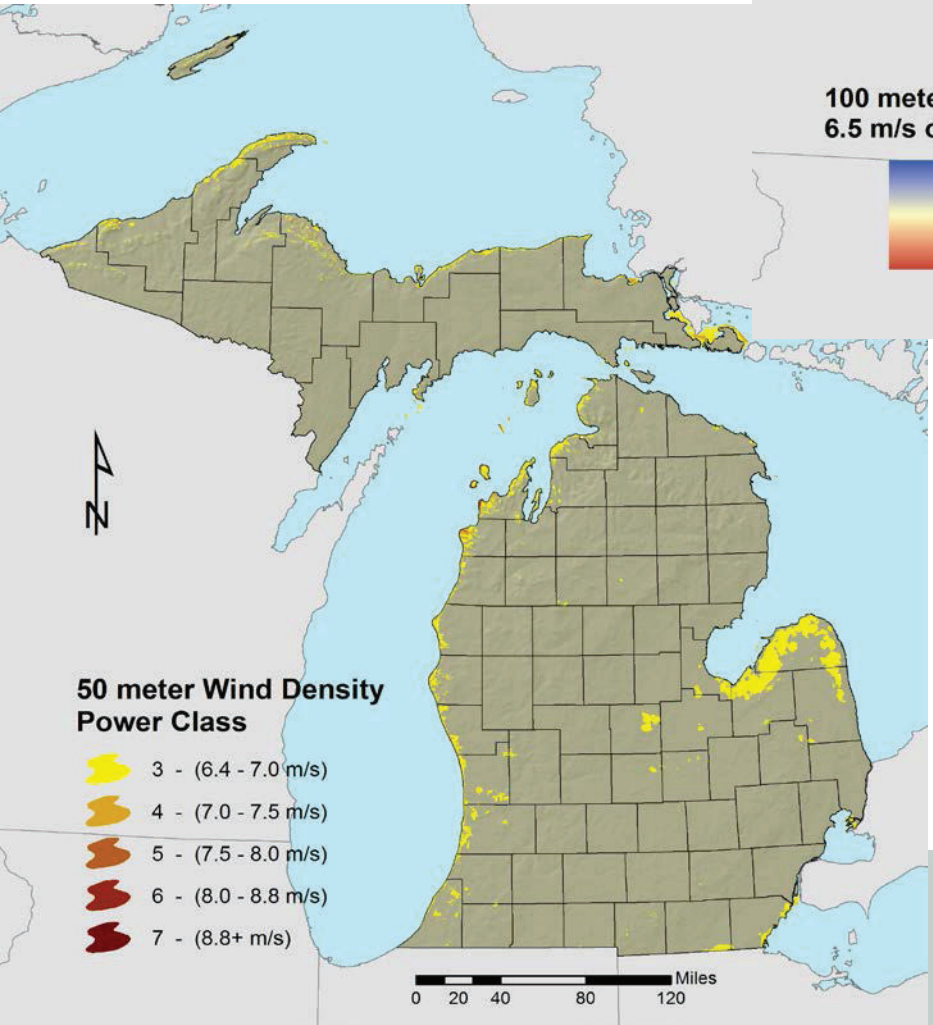
Wind Power Class	Resource Potential	Wind Power Density at 50 m W/m^2	Wind Speed[a] at 50 m m/s	Wind Speed[a] at 50 m mph
1	Poor	0 - 200	0.0 - 5.6	0.0 - 12.5
2	Marginal	200 - 300	5.6 - 6.4	12.5 - 14.3
3	Fair	300 - 400	6.4 - 7.0	14.3 - 15.7
4	Good	400 - 500	7.0 - 7.5	15.7 - 16.8
5	Excellent	500 - 600	7.5 - 8.0	16.8 - 17.9
6	Outstanding	600 - 800	8.0 - 8.8	17.9 - 19.7
7	Superb	> 800	> 8.8	> 19.7

[a] Wind speeds are based on a Weibull k of 2.0.

Wind Resources in Michigan

- Michigan is the 14th most wind abundant state in the nation
- 16,560 MW onshore potential. (USDOE, 2004)
- Over 300,000 MW offshore (Adelaja, 2008).





Michigan Potential

15 Windiest States

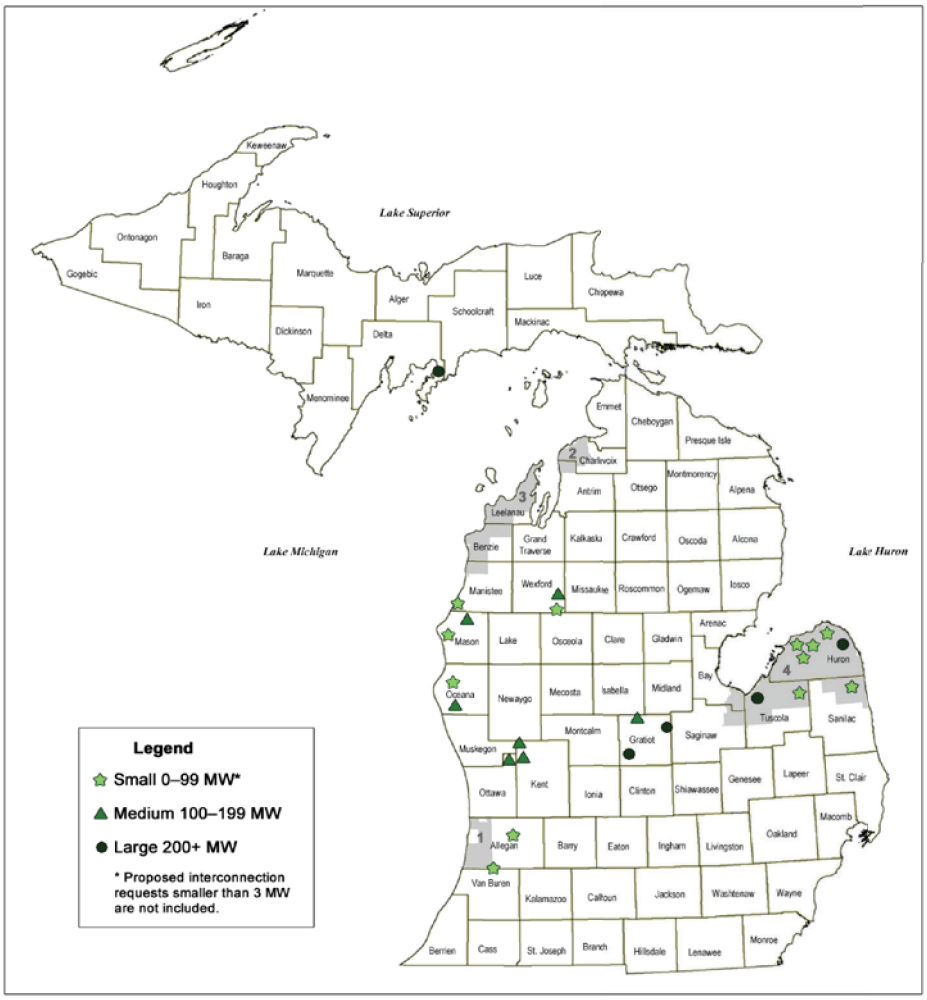
Wind Development

Proposed Wind Systems in Michigan

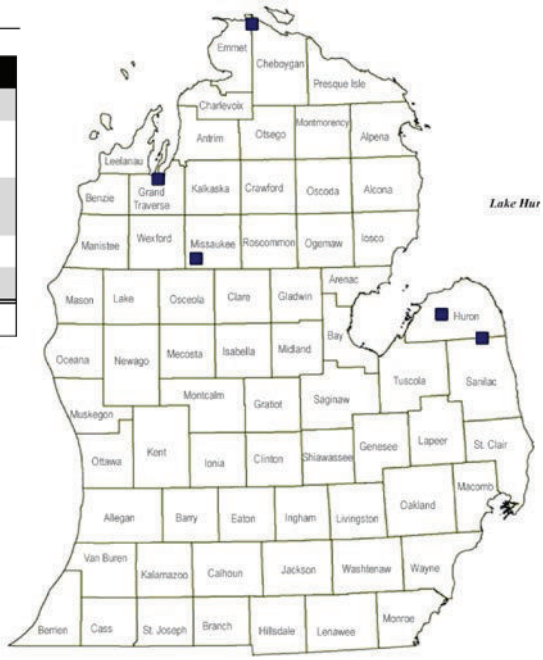
Active Wind Interconnection Requests in Queue, by Status, April 2009

Study status	Number	Megawatt (MW)
Feasibility	4	198
System Planning and Analysis (SPA)/System Impact Study*	2	280
Definitive Planning Phase (DPP)/Facility Study	8	798
Parked (One-Year Rule)	9	1,384
Awaiting interconnection agreement	1	36
Total	**24**	**2,696**

Active Wind Energy Projects in Interconnection Queue, April 2009



Wind Energy Systems in Michigan in Service, April 2009



Wind Development Steps

Three necessary elements for utility scale wind development.

- Land
  - Own
  - Easements
  - Leases
  - Transmission access or right of way
- Generation Equipment
  - Lead time and expense
- Regulatory approval
  - FERC – Federal Energy Regulatory Commission
  - MISO – Midwest Independent Systems Operator
  - MPSC – Michigan Public Service Commission
  - Local Zoning

Wind Development Steps

Ten Steps for Wind Farm Development

1. Understand the Wind Resource
2. Determine Proximity to Transmission
3. Secure Access to Land
4. Establish Access to Capital
5. Identify a Power Purchaser
6. Design Site in Context of Local Landscape
7. Procure Equipment that is Best Suited to the Regional Economic Realities
8. Obtain Planning and Zoning Approval
9. Establish Contracts with Engineering Firms, Developers, and Turbine Manufacturers
10. Secure Operations and Maintenance

(Adapted from American Wind Energy Association Factsheet)

Local Policy

Zoning Enabling

Wind energy generation in Michigan is a relatively new land use and in those jurisdictions facing development pressure there is a great deal of planning and zoning activity related to wind turbines.

There are two enabling acts in Michigan related to land use regulation:

1) **The Michigan Planning Enabling Act, PA 33 of 2008 (*MCL 125.3801*)**. Enables local communities to form legislative bodies (planning commissions), defines their purpose, delegate's authority to create a master plan for the jurisdiction, and provides requirements for meetings and their commission functions. The role of this body is to create and adopt a master plan for a community.

2) **The Michigan Zoning Enabling Act, Public Act 110 of 2006 (MCL 125.3101 *et seq*).** A community is authorized, but not required, to adopt zoning by state statute. Section 203(1) (MCL 125.3203) requires that:

> *"The zoning ordinance shall be based on a plan designed to propose the public health, safety and general welfare, to encourage the use of lands in accordance with the character and adaptability and to limit the improper use of land, to conserve natural resources and energy, to meet the needs of the state's residents for food, fiber, and other natural resources, places of residence, recreation, industry, trade, service, and other uses of the land, to insure that uses of the land shall be situated in appropriate locations and relationships, to avoid the overcrowding of population, to provide adequate light and air, to lessen congestion on public roads and streets, to reduce hazards to life and property, to facilitate adequate provision for a system of transportation, sewage disposal, safe and adequate water supply, education, recreation, and other public requirements, and to conserve the expenditure of funds for public improvements and services to conform with the most advantageous uses of land, resources, and properties."*

The regulations put forth in the zoning ordinance are required to be in furtherance with the goals of the master plan. The relationship between the two is to be evaluated and updated every five years, and each time a major amendment is made to either the plan or the zoning ordinance. Once a master plan and a zoning ordinance are put in place all changes, variances, and other legislative and regulatory changes must be consistent with the master plan.

In the absence of superseding federal or state regulation (e.g. the Endangered Species Act), the authority to plan and zone for wind energy rests with the local government and in the instance of a court challenge, local government enters the courtroom with the presumption of validity. That authority is, however, subject to some caveats. As authority is delegated under the public health, safety, and general welfare provisos in the Michigan Planning and Zoning Enabling Acts, a legitimate government interest must be defined in the master plan and the regulations pertaining to that interest enacted within the zoning ordinance. In addition the Michigan Zoning Enabling Act provides that:

> *"A zoning ordinance or zoning decision shall not have the effect of totally prohibiting the establishment of a land use within a local unit of government in the presence of a demonstrated need for that land use within either that local unit of government or the surrounding area within the state, unless a location within the local unit of government does not exist where the use may be appropriately located or the use is unlawful"* Sec. 207, PA 110 of 2006, MCL 125.3207).

Sample Zoning Language

Type of Impact:	Recommended Standard:
• Noise	-55 decibels at property line
• Bird kill	-cats kill more (avian study)
• Tower collapse	-setback 1 to 1.5 x height
• Ice throw	-covered by setback
• Shadow flicker	-setback and vegetation
• TV & radio reception	-statement re: interference
• Airport conflicts	-follow FAA regulations
• Construction impacts	-bond; restoration (lease)
• Visual & aesthetic	-community based standard
• Decommissioning	-financial assurance
• General public liability	-insurance requirements

- http://www.michigan.gov/documents/dleg/WindEnergySampleZoning_236105_7.pdf

Non-Wind Zoning Ordinances with Impact on Wind Development

- Airports
  - Installation of tall structures near airports is governed by two acts:
    - The Michigan Tall structures Act
    - The Michigan Airport Zoning Act
  - Height restrictions in areas surrounding airports are related to aviation safety.
- Wetlands Act
- National Resource Protection Act
- Critical Dunes Act
- Endangered Species Act

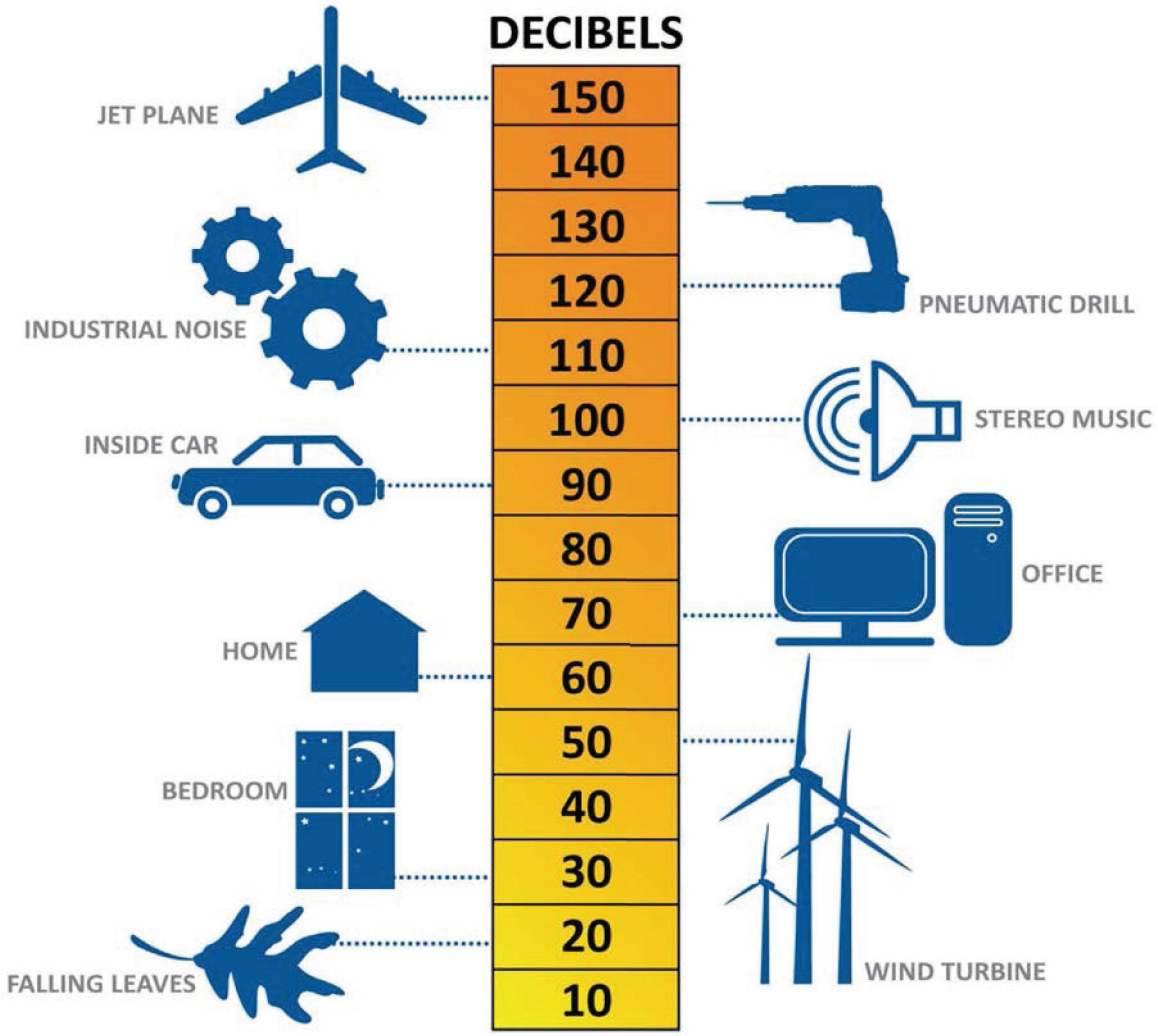
Typical Wind Farm Concerns

Value	Concerns
Environmental	• Emissions and air quality • Wildlife (especially birds and bats) • Construction impacts
Economic	• Lease payments • Jobs (construction and manufacturing) • Upfront investment • Energy independence • Property values • Tourism • Electricity rates
Quality of Life	• Energy reliability • Scenic quality • Farmland preservation • Noise • Construction activities (noise, traffic) • Shadow flicker • Safety • Community harmony
Fairness	• Decision making (Who? How?) • Policy making (local, state, and national) • Distribution of benefits/costs • Decommissioning

Noise

Decibels measurements are logarithmic. 20 decibels is ten times louder than 10 decibels instead of being twice as loud as would be the case if the decibel scale was linear.

Decibels	0	10	20	30
Factor	1	10	100	1000



http://www.windcapitalgroup.com/WindEnergy/environment.aspx

Wind Turbine Noise

Dr. Nina Pierpont, a doctor in NY, has written the book "Wind Turbine Syndrome"

- The book includes section for clinicians, section for non-clinicians, and specifics on 38 persons in her study.
- Study included 10 families from all around the world, 1 U.S., 5 Canadian, and 4 European families.
- She looked at symptoms (as reported to her in phone interviews) before, during, and after persons were exposed to wind turbines.
- "After exposure" was possible because people moved away.
- She believes case studies show a link between wind turbine low-frequency noise (10-200 Hz) and infranoise (4-20 Hz) and group of symptoms she calls wind turbine syndrome.
- Wind Turbine Syndrome includes sleep disturbance, headaches, ringing in ears, ear pressure, dizziness, vertigo, nausea, visual blurring, rapid heart rate, problems with memory & concentration, irritability, panic episodes, and feeling jittery inside (new type of internal or visceral sensation which she names VVVD or Visceral Vibratory Vestibular Disturbance).
- She indicated limitations of her research:
    1) Case studies can indicate a possible link but don't prove cause & effect.
    2) Limited number of persons.
    3) Self-selected which means big potential problem for bias.
    4) Phone interviews, very few actual tests.
- However, she believes research with control groups, larger numbers, etc. is justified by what she has found.

The American Wind Energy Association and the Canadian Wind Energy Association asked a panel of 8 experts (3 MD's, a PhD in noise vibration & acoustics, an acoustical engineer, and a PhD audiology) to review medical research and report findings.

- The panel concluded:
    1) Nothing unique about sounds and vibrations from wind turbines.
    2) Body of knowledge about health and sound is substantial.
    3) No evidence that audible or sub-audible sounds from wind turbines have direct adverse physiological effects.
- Hearing loss risk begins at 85 dBA for 8 hour day.
- Speech interference – people raise voices slightly above 50-55 dBA.
- Above 80-85, you have to shout.
- Task interference does not occur until 70 dBA.
- Sleep interference – EPA recommends that 24 hr indoor ave not exceed 45 dBA.
- Wind Turbine Syndrome – no scientific evidence of cause & effect.
- Body is full of sound and vibration at infrasonic and low frequencies from natural body processes, e.g. beating heart, muscle vibrations.
- Also they don't believe Nina Pierpont's basic premise of how this works is based on science.
- Indicate some persons will be annoyed by wind turbines and that annoyance can have physical and health impacts.

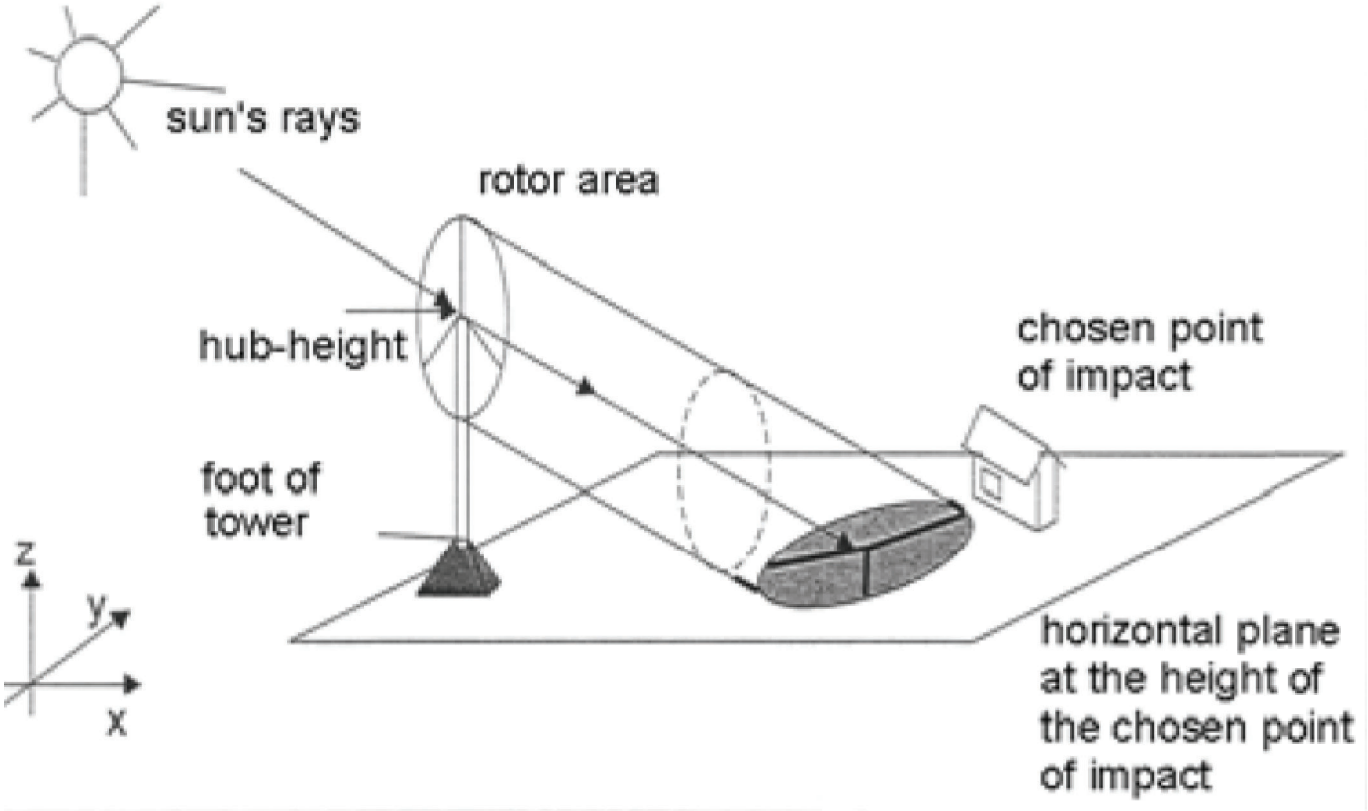
Visual Effects

Beauty is in the eye of the beholder. Some find the sight of windmills **appealing** – they are symbols of energy independence. Others find them **appalling** – they are an industrial intrusion.

Shadow Flicker

Occurs when:

- The turbine is between the sun and the viewer
- The rotor (blades) are perpendicular to the line between the sun and the viewer.



Shadow Flicker

- People will notice flicker up to about 50 Hz. (varies with intensity)
- Above 50 Hz, the brain's response to the flash lasts longer than the flash itself.
- 10-25 Hz causes problems
  - eye strain, headaches, nausea, seizures
- Effects vary with
  - Prominence
  - Distance
  - Color

Sources of Flicker

Source	Flicker Rate
Florescent lights	120 Hz
Computer screens	75 Hz (some are adjustable)
Televisions	60 Hz Interlaced
Vehicle turn signals	1-3 Hz
Wind Turbine Shadow	.5 – 1.25 Hz

http://www.ltu.edu/cm/attach/165D79C3-DD14-41EC-8A7F-CFA2D0C272DE/FlickerHandout.pdf

Avian Impacts

Predicted Bird Annual Avian Mortality

Mortality source	Annual mortality estimate	Percent composition
Buildings[1]	550 million	58.2 percent
Power lines[2]	130 million	13.7 percent
Cats[3]	100 million	10.6 percent
Automobiles[4]	80 million	8.5 percent
Pesticides[5]	67 million	7.1 percent
Communications towers[6]	4.5 million	0.5 percent
Wind turbines[7]	28.5 thousand	<0.01 percent
Airplanes	25 thousand	<0.01 percent
Other sources (oil spills, oil seeps, fishing by-catch, etc.)	not calculated	not calculated

Audubon's Position on Wind Power

"Audubon strongly supports properly-sited wind power as a clean alternative energy source that reduces the threat of global warming. Wind power facilities should be planned, sited and operated to minimize negative impacts on bird and wildlife populations."

Sierra Club's Position on Wind Power

"The Sierra Club strongly supports the development of substantial wind resources for electricity generation. Wind power is a reliable, clean, renewable resource that can help reduce our dependence on polluting fossil fuels (coal, oil, and natural gas) and nuclear power for electricity.... The Sierra Club believes that in most instances many of the negative impacts of wind can be managed. The most important management measures are site selection and careful site evaluation. "

Avian Impacts

- New USFWS Interim Guidance
  - To assist the wind energy industry in avoiding or minimizing impacts to wildlife and their habitats. Through:
    - (1) proper evaluation of potential Wind Resource Areas (WRAs), (2) proper location and design of turbines and associated structures within WRAs selected for development, and (3) pre- and post-construction research and monitoring to identify and/or assess impacts to wildlife
  - www.fws.gov/habitatconservation/wind.pdf
- GAO Report September 2005
  - Wind Power Impacts on Wildlife and Government Responsibilities for Regulating Development and Protecting Wildlife www.gao.gov/new.items/d05906.pdf

Construction Effects

- Turbine components are large and require planning and logistics for construction and access to installation sites. Potential construction issues include:
  - Traffic
  - Land Disturbance
    - Large space needed for raising
    - Minimal runoff
    - Drainage crushing
  - Road damage

Home Value Impacts

Berkeley Lab Study Finds No Widespread Impact of Wind Power Projects on Surrounding Residential Property Values in the U.S., (U.S. Department of Energy, Dec. 2009). A three years study by the U.S. Department of Energy's Lawrence Berkeley National Laboratory concludes "neither the view of wind energy facilities nor the distance of the home to those facilities was found to have any consistent, measurable, and significant effect on the selling prices of nearby homes. No matter how we looked at the data, the same result kept coming back - no evidence of widespread impacts."

Impact of windmill visibility on property values in Madison County, New York, (Bard Center for Environmental Policy, Bard College, Apr. 2006).Master's thesis. The paper finds no measurable affect on property values on 280 arms-length single family home transactions around an upstate New York wind farm.

An economic analysis of a wind farm in Nantucket Sound, (Beacon Hill Institute, May 2004). The authors use a survey methodology to poll tourists, residents and real estate agents as to the effect of a proposed wind farm in Massachusetts. Homeowners expect the project to decrease their home values by an average of 4.0%. A minority of real estate agents concurred.

The effect of wind development on local property values, (Renewable Energy Policy Project, May 2003). One of the main sources in support of wind farming, this study was one of the first detailed looks at the relationship between wind farming and property values. The study finds that wind farms have no impact on property values. However, opponents discount the report due to some statistical issues (problems with the study are outlined on pgs. 16-17 of the Bard College paper above). Still widely cited.

Final Report of the Wind Turbine Moratorium Study Committee, (Lincoln Township, WI, Feb. 2000). Lincoln Township in western Wisconsin undertook a study of local wind farms to gage their impact on the community. Excerpts of this report are often cited by wind farm opponents to bolster their case. However, the actual report states "the siting of the windmills has not had any significant negative impact on property values near them." (pg. 161 of pdf)

Addendum

Local Potential

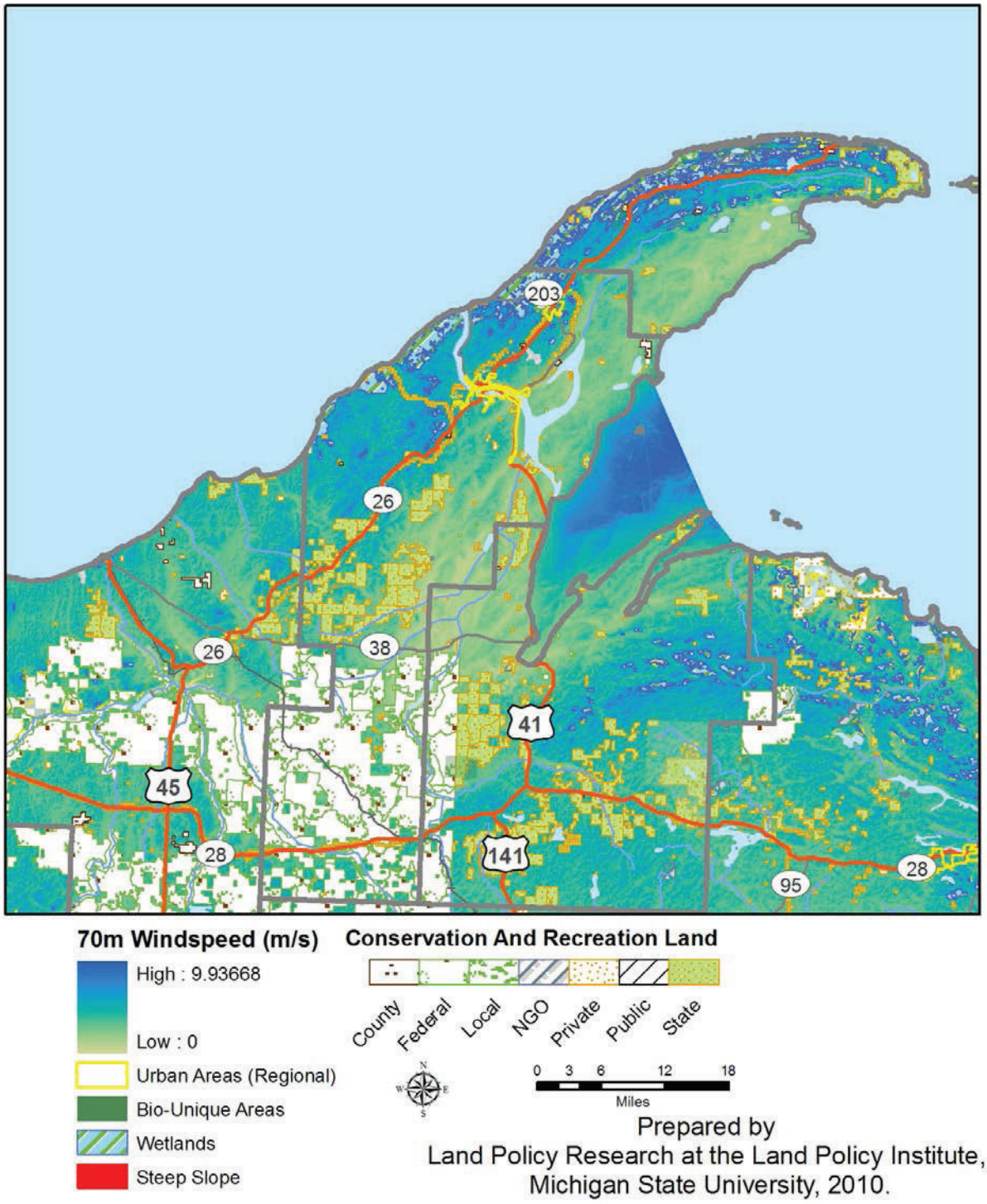
Based on wind density at 50m hub height with class 3 or better wind, and assuming 90% of the windy area is unavailable for wind farm development.

Houghton County

Local Government Name	Total possible number of towers if all Area is built	Total possible power generation if all Area is built	Total Acres of Class 3 or Above Wind	Towers Possible on 10% of resource area	MW of Power generation possible on 10% of resource area	Potential land lease value on 10% of resource area	Potential Maintence and upkeep jobs on 10% of resource area	Potential construction jobs on 10% of resource area
Calumet Twp	494	138	7,654	49	23	$98,800	7	100
Adams Twp	16	4	769	2	1	$3,200	0	3
Quincy Twp	3	1	54	0	0	$600	0	1
Hancock	0	0	2	0	0	$0	0	0
Torch Lake Twp	1	0	91	0	0	$200	0	0
Franklin Twp	3	1	44	0	0	$600	0	1
Stanton Twp	359	101	16,592	36	17	$71,800	5	73
Osceola Twp	170	48	2,291	17	8	$34,000	2	35
Hancock Twp	465	130	2,346	47	21	$93,000	6	94
Duncan Twp	0	0	40	0	0	$0	0	0
Schoolcraft Twp	13	4	366	1	1	$2,600	0	3

Keweenaw County

Local Government Name	Total possible number of towers if all Area is built	Total possible power generation if all Area is built	Total Acres of Class 3 or Above Wind	Towers Possible on 10% of resource area	MW of Power generation possible on 10% of resource area	Potential land lease value on 10% of resource area	Potential Maintence and upkeep jobs on 10% of resource area	Potential construction jobs on 10% of resource area
Grant Twp	492	138	14,662	49	23	$98,400	6	100
Allouez Twp	483	135	14,186	48	22	$96,600	6	98
Houghton Twp	564	158	11,892	56	26	$112,800	7	114
Eagle Harbor Twp	764	214	23,434	76	35	$152,800	10	155


203
26
26
38
41
45
28
141
95
28
70m Windspeed (m/s)
High : 9.93668
Low : 0
Urban Areas (Regional)
Bio-Unique Areas
Wetlands
Steep Slope
Conservation And Recreation Land
County
Federal
Local
NGO
Private
Public
State
0 3 6 12 18
Miles
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Notes

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