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Readying Michigan to Make Good Energy Decisions

Michigan Energy Public Forum Statement Card

If you wish to speak today, please complete the following:

Name: Louis J Colletta

Affiliation (if any): Knowlund. ORG

Phone: 989-856-2777

Email: ~~Knowlund~~ INFO@Knowlund.ORG

Topics you wish to address today:

a. X Renewable Energy Portfolio Standards

b. ___ Energy Optimization / Efficiency Standards

c. ___ Electric Choice

d. ___ Other Additional Energy Topic

(Please specify): Economic Aspects

Please prioritize and focus your comments to afford as many as possible, the opportunity to speak. The amount of time allowed for each speaker will be dependent upon the number of people requesting to speak. Please prepare for the time limit for each speaker to be in the 2 – 5 minute range.

Please leave a copy of any written or electronic materials at the welcome center.

You are encouraged to submit written feedback at www.michigan.gov/energy.

Just what are Public Utilities paying for?

Saturday's 2/23/2013 issue of the Huron Daily Tribune
Article: **Report: Renewable energy pays off for state**

L A N S I N G — T h e Michigan Public Service Commission issued a report this week stating that Michigan's renewable energy standard is boosting the state's economy and utilities are on track to meet the 10 percent goal by 2015.....

Other highlights of the report include:

- **DTE Energy's three wind parks in the Thumb are expected to contribute $150 million in economic benefits to the state.**

As I see it, DTE Energy is taking the $3.00/mo., **Renewable Energy Plan Surcharge** (see below) that we, the consumers, are paying and calling it **their contribution**.

Think about the dinners they have put on and the promotional contributions. These are not monies from profits that companies usually use for such ventures but money that is taken from so called ***Renewable Energy Plan Surcharge***, **OUR MONEY**. God forbid they, DTE, upset their shareholders and top executives by reducing perks.

I know that people will say that we will pay anyway but this is a direct out pocket and not from the corporate profits. How much is being federally funded through subsidies that we are also paying for?

Remember this is only one company, I wonder about Consumers Energy?

Read the **Renewable and Efficient Energy Act, PA 295**: RPS, Renewable Portfolio Standard, Compliance

On October 6, 2008, Public Act 295 was signed into law. This Act, known as the Clean, Renewable and Efficient Energy Act, established a Renewable Energy Standard for the State of Michigan. The Renewable Energy Standard ***requires Michigan electric providers*** *to achieve a retail supply portfolio that includes at least ten percent renewable energy by 2015.*

Maybe the interpretation by the utilities was **Michigan electric consumers not providers**.

October 2009 – Start of DTE Energy's (Detroit Edison) $3.00 a month for **Renewable Energy Plan Surcharge** on our electric bills.

2009 - 3 mos.
2010 - 12 mos.
2011 - 12 mos.
2012 - 12 mos.
2013 - 3 mos.
Total of 42 mos.

$3.00/month X **2.5 million customers** = **$7.5 million/month** X **42 months** = **$315,000,000.00** plus Federal Subsidies and credits.

Louis J. Colletta

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If you wish to speak today, please complete the following:

Name: NANCY K JANOCH

Affiliation (if any): Midland CARES (Clean Air and Renewable Energy Solutions)

Phone: 989-631-0434

Email: _____

Topics you wish to address today:

a. ✓ **Renewable Energy Portfolio Standards**

b. ___ **Energy Optimization / Efficiency Standards**

c. ___ **Electric Choice**

d. ___ **Other Additional Energy Topic**

(Please specify): _____

Requested time to speak: ✓ **< 5 minutes** ____ **5 minutes**

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Ensuring Michigan's Future - Governor Snyder's Energy Forum

March 4, 2013 Delta College

Renewable Energy- Question #13 - What affect did Michigan's requirement that renewable energy be built in a defined geographic area have? What job growth is attributable to that requirement? What cost reliability and environmental impacts are attributable?

Michigan has been successful in growing our renewable energy industry. Renewable Portfolio Standards (RPS) have driven the creation of 1/3 of non-hydro renewable electricity in the US. In our area, Ontario, Canada produces 25% of its electricity from non-hydro renewable energy, so we know this is attainable (*Ramping Up Renewables* - US Partnership for Renewable Energy Finance, June 2012.) What *new* RPS will Michigan set, to insure future investment (both public and private) in our growing renewable energy industry and economic success? (29 states plus Washington, DC have a Renewable Portfolio Standard - RPS).

For decades, we have relied upon the coal plants to provide most of our energy. But these aging and out-dated plants are near retirement and it makes no economic sense to keep them. The heat trapping nature of Co2 gases (http://climate.nasa.gov/evidence/) released by these coal plants, have changed our Michigan climate, the coastline and water levels of our state. They threaten our economic success in quality of living, our agriculture and our waterways. Their continued use seriously endangers the health of our citizens and our environment. How are we planning for the retirement of the polluting coal plants that cause asthma, lung disease, strokes (EPA 2010, NRC 2010), death (650), and heart attacks (1,100 in Michigan in 2010 alone, according to the Clean Air Task Force)?

As renewable energy production increases nation-wide, states will build the most economical renewable energy generating plants, depending on their natural capabilities. Will Michigan develop our long-term plans and take action now? According to the "Ramping Up Renewables" study, by the U. S. Partnership for Renewable Energy Finance, which includes such members as Bank of America, Merrill Lynch, Citi, Credit Suisse, Deutsche Bank, and Goldman Sachs), "a well-designed policy can drive down costs for supplying energy" and can provide developers with "Transparency, Longevity and Certainty (TLC) in a timely, cost-effective manner." The study suggests many ways to secure a solid financial result.

Michigan has been doing well in wind generation on land. But we are behind in many other areas of renewable energy for our state. Across the U.S., states are ramping up their renewable energy capacity - some more than others. As we go forward as a nation, those states that have more power, will, as now, begin to sell and exchange their power. Will Michigan be the one that has to pay *others*, or will we set the industry standard and prices for selling our *excess* capacity of available power?

Our own Michigan Economic Development Corporation indicates that we are "the international hub of the clean energy economy." This state, famous for the huge automotive industry, ranks "among the top *four* states in industrial capacity to develop and *manufacture* wind and energy systems." We also have the capacity for the research and design, the engineering, the technology and the scientific, business and creative expertise to be the *top* state in renewable energy production.

In the future, will we move forward and be the leaders of success in this country, or will we cling to a past that we perceive is more obvious and "secure"? The Michigan workforce is ready and waiting for increased employment. This expanding industry will build our economy - increasing jobs at *every* level, growing businesses, schools, retail, commercial, and private opportunities, strengthening *all* communities around the state. This increasing economic impact will push Michigan to a powerful future. *-Nancy K. Janoch*

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If you wish to speak today, please complete the following:

Name: JOHN BARKER

Affiliation (if any): _____

Phone: 989-954-0299

Email: john.f.barker@gmail.com

Topics you wish to address today:

a. ___ **Renewable Energy Portfolio Standards**

b. ___ **Energy Optimization / Efficiency Standards**

c. ___ **Electric Choice**

d. X **Other Additional Energy Topic**

(Please specify): energy policy

Requested time to speak: X **< 5 minutes** ___ **5 minutes**

Please leave a copy of any written or electronic materials at the welcome center.

Thank you for this opportunity to offer my humble input on Michigan's energy public policy.

My name is John Barker and I am from Union Township in Isabella County the home of Central Michigan University and the Saginaw Chippewa Indian Tribe. Unlike many of the other presenters I am not an expert, but a very concerned citizen.

My mother often accused me a of being a bit of a dreamer and there is no doubt I have been inspired by many dreamers and when it comes to Michigan's public policy about energy, I guess I am a dreamer here as well.

First I dream that in the not too distant future a vast majority of our public officials will realize that global climate change is something that all of us must do something about NOW whether we are at the local level the state level or the national level.

I also dream that our public policy will truly reflect the seriousness of the situation and without delay move our state and national officials to understand the importance of clean renewable energy and how it is the only logical long term solution to ending our dependence on energy that could destroy our planet.

I hope I am not just dreaming that more and more communities like Ann Arbor and Union Township where I live will be joined by every community in Michigan seeking to lower their carbon footprints with vigorous efforts to reduce energy consumption and use more renewable energy. And I hope I am not dreaming when I see our state government encouraging every community with public policies that reward those efforts.

And I dream that our state government will deploy renewable energy at every public facility both to reduce costs, but more importantly to reduce our state government's carbon footprint.

I have a dream also that someday Michigan will become a leader in setting ambitious goals to transform our state into one of the greenest states in America, just as I worked to transform Union Township into becoming one of the greenest townships in Michigan.

You see, sometimes dreams come true. Perhaps, not always to the degree we would like to see them, but all too often I see public leaders who go through the motions. They listen to great ideas as you are today, but fail to follow through. Their dreams are not big enough.

So my new dream is that Michigan's public policies on energy will help our planet heal and not make things worse. I dream this for my children and for my grandchildren and their grandchildren.

And as my friends on the Saginaw Chippewa Indian Reservation might say I dream this out to the seventh generation that they might say about us, we thought about our future and our legacy. And I dream that legacy is one that will make us proud to be citizens of Michigan.

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If you wish to speak today, please complete the following:

Name: William Schumacher

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Email: csch.wm@gmail.com

Topics you wish to address today:

a. ___ **Renewable Energy Portfolio Standards**

b. ___ **Energy Optimization / Efficiency Standards**

c. ___ **Electric Choice**

d. ✓ **Other Additional Energy Topic**

(Please specify): Cost on citizens custom resident living in Wind Zone 2

Requested time to speak: ____ **< 5 minutes** ____ **5 minutes**

Please leave a copy of any written or electronic materials at the welcome center.

I have read the 2012 report on the status of electric competition in Michigan , and I have to ask, does anyone on this public service commission really care about the rate payers in this state. In 2012 Michigan's average residential retail rates ranked eighth highest among the 16 jurisdiction with restructured markets at $0.1416/kWh, in 2000 Michigan ranked fifth lowest, of the five surrounding states to Michigan we have the highest priced electric, of the ten largest states by population are rates were third highest. Michigan' s rates have been above the national average since 2009. The same is true with commercial retail rates. In 2012 Michigan ranked highest among are five surrounding states and for the ten largest states by population are rates were third highest. The story for industrial rates is the same, in 2012 Michigan ranked eighth highest among the sixteen jurisdictions with restructured markets, in 2000 Michigan was eighth lowest, and again in comparison to are five surrounding states we rank highest in industrial rates. As evident by the number of customers in queue to get into the Alternative Electric Supplier program it is clear to say that are rates in Michigan are too high. One of the reasons for this is your quest for green energy because they don't work 24/7 365 days a year. Every turbine , every solar panel has to be backed up by a consistent source of dependable conventional energy kept fired up to kick in when needed. I have to wonder when Consumers Energy states on their bills that , for the average Michigan residential customer, renewable energy is estimated to avoid an additional 3.90 per month cost verses a new coal fire plant , do they even consider the added cost of providing backup for when the wind doesn't blow or the sun doesn't shine. Until you can solve this problem you're just wasting are money . We can not afford another 10% of this sort of green energy. Have some patience , stop looking in the rearview mirror thinking only wind and solar will be the future, because when you turn your eyes to look straight ahead I don't think you will see any there. As for the job creating aspect of building out the green energy program the decades long term burden on the rate payers far exceed whatever short term benefit is gained in the construction of these projects. It would be cheaper to put these workers on welfare.

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If you wish to speak today, please complete the following:

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Email: KPethers@SunsiaRay.com

Topics you wish to address today:

a. ___ Renewable Energy Portfolio Standards

b. ? Energy Optimization / Efficiency Standards

c. ___ Electric Choice

d. X Other Additional Energy Topic

(Please specify): Healing Policy

Requested time to speak: ✓ < 5 minutes ___ 5 minutes

Please leave a copy of any written or electronic materials at the welcome center.

Excerpt from **Renewable Energy World International Magazine** Article January/February 2010 "The Last Word: A New Beginning"

For decades, power utilities all around Europe and the world have been lobbying for specific power business issues and politicians have been naÃ¯vely following their arguments and policies. This is even though 50% of the European energy demand is for heating and cooling, a sector which has been kept out of the energy discussions so far. The consequence is that energy policies revolve around power issues, which account for just 20% of European energy consumption and CO_2 emissions. It is, however, obvious we are not going to solve energy problems by only addressing a relatively small fraction of the energy pie chart!"

Ken,
The rebate is based on estimated therm savings for one year.
So the rebate is $14.50 per therm of offset and goes down X% every year after the first one. This was done just to get the industry jump started based on the California PV rebate.
If it is OG-300 (hot water system) rated the savings are figured based on the SRCC BTU output per year for that location. If it is OG-100 (collector only or bigger then OG-300 rating) rated then an engineer has to figure the BTU savings per year and the rebate is figured off of their numbers at the same $14.50 per therm.
Attached is a spread sheet that someone made up for me for estimating the rebate amount for your collectors.
Let me know if that is clear as mud and if you need anything else.
Russ

Solar Thermal Performance Calculations 2/12/2013
Western Nevada Supply - Russ Cartwright
Solar Thermal Air Collectors for Space Heating
This worksheet calculates estimated solar thermal production in kWhs/yr based on
SRCC OG-100 BTU solar performance data for specific solar thermal systems using Northern Nevada weather data
WRCC Climate Summaries

Reno, NV Collector Manufacturer	Panel Model #	No. of Collectors	SRCC Performance Ratings Weather	BTUs/Panel/Day	WRCC Days/Yr	Estimated BTUs/Yr	Space Heating BTUs/yr	ESTIMATED REBATE AMOUNT
Reno						**Reno**	**Reno**	
Northern Comfort	NC-32	1	Clear Day	41,800	210	8,778,000	**4,936,122**	
SRC Certification #		1	Mildly Cloudy Day	31,800	82	2,607,600	**1,466,328**	
2007049A		1	Cloudy Day	21,900	73	1,598,700	**898,995**	
Heating Degree Days hrs/yr	4,926							
				Total Est. BTUs/yr		**12,984,300**	**7,301,445**	1058.00
				Total Est. Therms/yr		**130**	**73**	
				Total Est. kWhs/yr		**3,805**	**2,140**	
				Equiv. kW Capacity		**0.43**	**0.24**	
Winnemucca						**Winnemucca**	**Winnemucca**	
Heating Degree Days hrs/yr	6306	1	Clear Day	41,800	138	5,768,400	**4,152,458**	
		1	Mildy Cloudy Day	31,800	89	2,830,200	**2,037,356**	
		1	Cloudy Day	21,900	138	3,022,200	**2,175,570**	
				Total Est. BTUs/yr		**11,620,800**	**8,365,384**	1212.17
				Total Est. Therms/yr		**116**	**84**	
				Total Est. kWhs/yr		**3,406**	**2,452**	
				Equiv. kW Capacity		**0.39**	**0.28**	
Elko						**Elko**	**Elko**	
Heating Degree Days hrs/yr	7065	1	Clear Day	41,800	130	5,434,000	**4,382,558**	
		1	Mildy Cloudy Day	31,800	99	3,148,200	**2,539,045**	
		1	Cloudy Day	21,900	136	2,978,400	**2,402,100**	
				Total Est. BTUs/yr		**11,560,600**	**9,323,703**	1351.03
				Total Est. Therms/yr		**116**	**93**	
				Total Est. kWhs/yr		**3,388**	**2,733**	
				Equiv. kW Capacity		**0.39**	**0.31**	

Estimated performance above 34,000,000 BTUs/yr requires approved BTU metering.

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If you wish to speak today, please complete the following:

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Affiliation (if any): _____

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Email: pschumacher82@gmail.com

Topics you wish to address today:

a. [X] **Renewable Energy Portfolio Standards**

b. [ ] **Energy Optimization / Efficiency Standards**

c. [ ] **Electric Choice**

d. [X] **Other Additional Energy Topic**

(Please specify): Wind Turbines' effects on rural residents.

Please prioritize and focus your comments to afford as many as possible, the opportunity to speak. The amount of time allowed for each speaker will be dependent upon the number of people requesting to speak. Please prepare for the time limit for each speaker to be in the 2 – 5 minute range.

Please leave a copy of any written or electronic materials at the welcome center.

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Pamela Schuemacher
Bay County
Merritt Township
Farmer Public Sector

Rural Residents Speak Out

"Quality of Life" and Property Values Negatively Affected by Wind Turbines

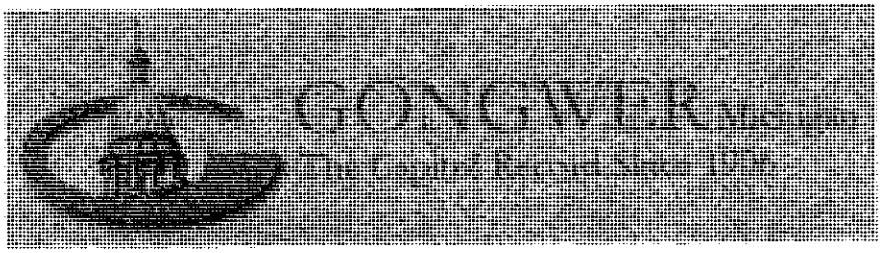
We, the residents of Michigan, hope that you will hear OUR voice. Last November, we voted overwhelmingly to defeat Proposal 3--which would have raised the renewable energy standards to 25% for the power companies. We, the residents, cannot **ALL** COME AGAIN to public hearings across that state (scheduled between 1:00 and 5:00 p.m.) to express our Voices over and over. We need to be at work at our jobs to support our families. We, the residents, have already spoken!

Now, the wind industry and other pro-wind groups will try to convince you that Proposal 3 was defeated only because it involved amending our state constitution. But that is not the case. Residents in rural communities, in the Thumb and across the state, have been researching the negative impacts on "quality of life" and decreases in property values for residents living within a ½ mile of a wind turbine. There is an award-winning study done by the Minnesota Department of Health attached to this document. The report concludes that "safe distances" for lessening the impact of wind turbines on residents dictate that a half mile minimum setback should be utilized. (Also, this report was NOT funded by the wind industry with our tax dollars—like most of the wind studies.) Wind turbine companies, however, insist upon convincing and forcing residents to accept a ¼ mile setback from homes—claiming in one of their reports that wind turbines won't make you deaf and they won't kill you.

However, none of the wind energy company employees themselves choose to live within ½ mile of the turbines. And yet, thousands of rural residents are FORCED to listen to the low frequency noise coming from the turbines—the type of sound that you can feel as well as hear. It is often described as the sound of a "pulsating helicopter" that never leaves. Also, home values of the residents living within the footprint of the wind farm are now decreased by 50% to 100%--since no sensible person would pay full price to live in a home that no longer offers "quality of life". These thousands of rural residents receive NO COMPENSATION for their losses; while the wind energy companies make about 3 million dollars per turbine, per year. It's no wonder that they are constantly lobbying for renewable energy mandates.

The wind industry will also try to convince you that renewable energy is cheaper than other forms of energy. If that were true, then why did the wind industry fight so hard all last year to maintain their high level of federal subsidies which were only passed in the "11th Hour" as part of a larger, last minute, budget deal pushed through in December by the Democrats in Washington. Also, why is there currently an additional surcharge for renewable energy on our energy bills? And why, after adding several new "wind farms" to the power grid in Michigan last year, did our energy bills now increase, yet again? If wind energy and other renewables are as economically viable as their proponents proclaim, then why not let market forces take over; and energy companies would turn to alternative energy without any state mandates put upon them.

Furthermore, just about a year ago, plans for a "clean coal" plant (for Consumers Energy) in Bay City, Michigan, was cancelled because "the demand for electricity was down" according to a Consumers Energy Spokesman.—See the article I have attached containing that text. Therefore, why should we have mandates for renewable energy or other energy that we do not need? While, at the same time, the rural residents are being targeted as "ground zero" for wind turbine projects that destroy their "quality of life" and destroy the value of perhaps their only substantial asset—their home property value.



News Update

Friday, December 2, 2011, 03:00 PM

Consumers Ending Plans For New Coal Plant, Set To Mothball 7 Others

Consumers Energy is announcing this afternoon it is canceling its plans to build a $2 billion, 830-megawatt coal plant near Bay City - a project it announced more than four years ago.

Also, the company plans to mothball seven of its older and smaller coal-fired units around the state by January 1, 2015, citing market conditions and pending state and federal environmental regulations that if enacted, would make the units no longer economical.

Those units are in Muskegon, Bay City and Erie.

Environmental groups and others fought the proposed coal plant in Bay City from the beginning. In May, the Jackson-based utility announced it was deferring its plans for the plant, saying the demand for electricity was down because of the recession and an abundance of cheap natural gas pushed down prices.

Consumers Energy spokesperson Jeff Holyfield said those remain the reasons why they are now canceling plans for the plant.

"It's just not economically feasible," he said.

Rep. Charles Brunner (D-Bay City) happened to be at the plant this afternoon for a scheduled "pizza and politics" event and was advised of the news as he was leaving to attend it.

"It's very disappointing," he said.

Mr. Holyfield added the utility still plans to invest $6 billion in the state over the next five years, and that is only possible because of the 2008 energy law. Those include two new wind farms now being developed.

"We have plans in place to make sure we have enough adequate power to serve our customers," Mr. Holyfield said.

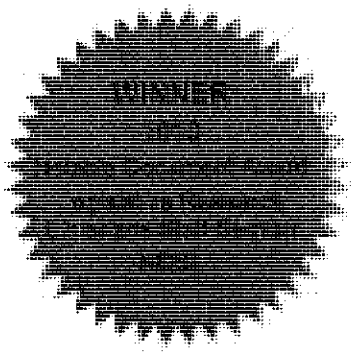
Gongwer will have more in Friday's Michigan Report.

Public Health Impacts
of
Wind Turbines

Prepared by:
Minnesota Department of Health
Environmental Health Division

In response to a request from:
Minnesota Department of Commerce
Office of Energy Security

May 22, 2009



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I. Introduction

In late February 2009 the Minnesota Department of Health (MDH) received a request from the Office of Energy Security (OES) in the Minnesota Department of Commerce, for a "white paper" evaluating possible health effects associated with low frequency vibrations and sound arising from large wind energy conversion systems (LWECS). The OES noted that there was a request for a Contested Case Hearing before the Minnesota Public Utilities Commission (PUC) on the proposed Bent Tree Wind Project in Freeborn County Minnesota; further, the OES had received a long comment letter from a citizen regarding a second project proposal, the Lakeswind Wind Power Plant in Clay, Becker and Ottertail Counties, Minnesota. This same commenter also wrote to the Commissioner of MDH to ask for an evaluation of health issues related to exposure to low frequency sound energy generated by wind turbines. The OES informed MDH that a white paper would have more general application and usefulness in guiding decision-making for future wind projects than a Contested Case Hearing on a particular project. (Note: A Contested Case Hearing is an evidentiary hearing before an Administrative Law Judge, and may be ordered by regulatory authorities, in this case the PUC, in order to make a determination on disputed issues of material fact. The OES advises the PUC on need and permitting issues related to large energy facilities.)

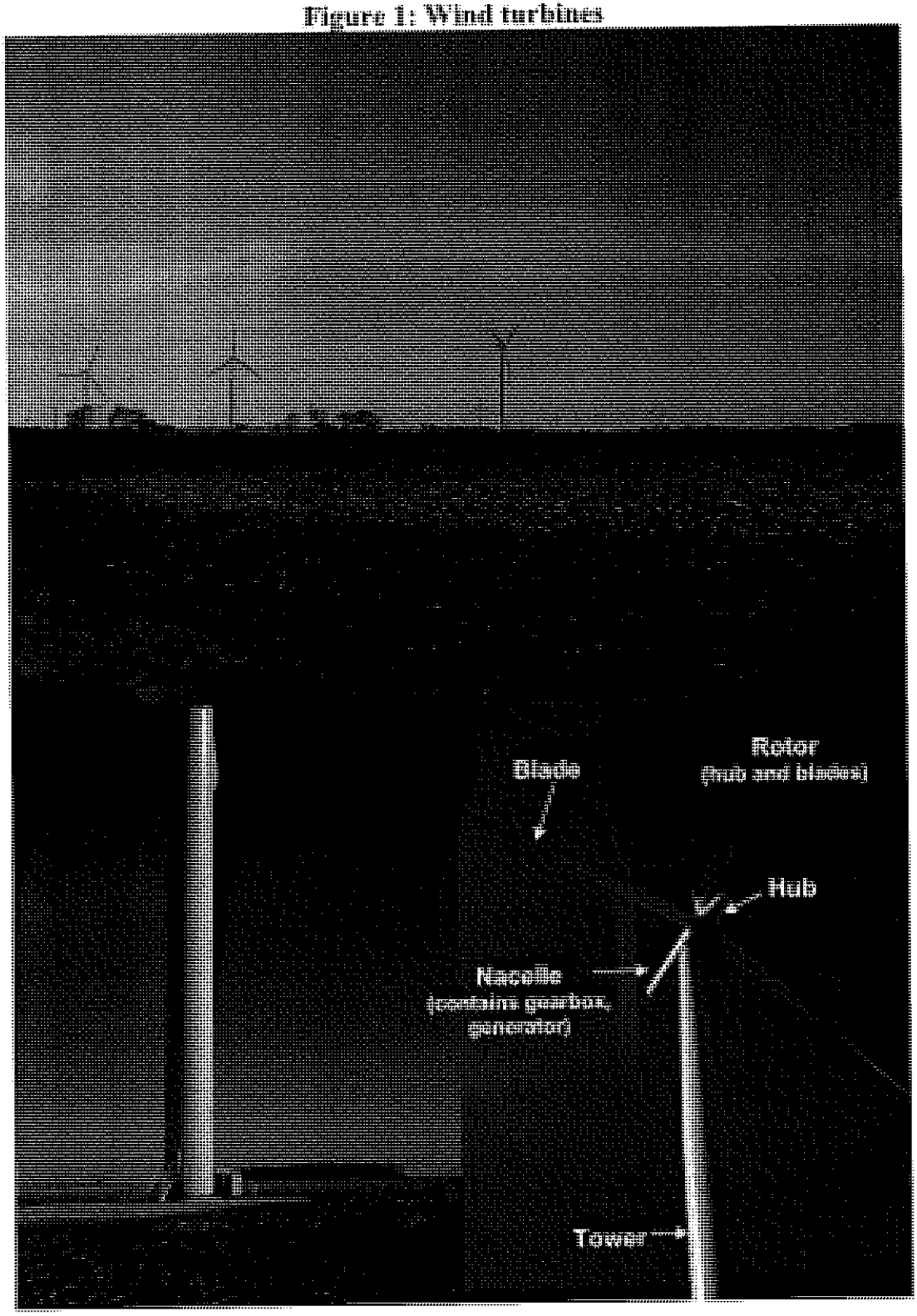
In early March 2009, MDH agreed to evaluate health impacts from wind turbine noise and low frequency vibrations. In discussion with OES, MDH also proposed to examine experiences and policies of other states and countries. MDH staff appeared at a hearing before the PUC on March 19, 2009, and explained the purpose and use of the health evaluation. The Commissioner replied to the citizen letter, affirming that MDH would perform the requested review.

A brief description of the two proposed wind power projects, and a brief discussion of health issues to be addressed in this report appear below.

A. Site Proposals

Wind turbines are huge and expensive machines requiring large capitol investment. Figure 1 shows some existing wind turbines in Minnesota. Large projects require control of extensive land area in order to optimize spacing of turbines to minimize turbulence at downwind turbines. Towers range up to 80 to 100 meters (260 to 325 feet), and blades can be up to 50 meters long (160 feet) (see Tetra Tech, 2008; WPL, 2008). Turbines are expected to be in place for 25-30 years.

Figure 1: Wind turbines



1. Bent Tree Wind Project in Freeborn County

This is a proposal by the Wisconsin Power and Light Company (WPL) for a 400 megawatt (MW) project in two phases of 200 MW each (requiring between 80 and 130 wind turbines). The cost of the first phase is estimated at $497 million. The project site area would occupy approximately 40 square miles located 4 miles north and west of the city of Albert Lea, approximately 95 miles south of Minneapolis (Figure 2) (WPL, 2008). The Project is a LWECS and a Certificate of Need (CON) from the PUC is required (*Minnesota Statutes 216B.243)*. The PUC uses the CON process to determine the basic type of facility (if any) to be constructed, the size of the facility, and when the project will be in service. The CON process involves a public hearing and preparation of an Environmental Report by the OES. The CON process generally takes a year, and is required before a facility can be permitted.

WPL is required to develop a site layout that optimizes wind resources. Accordingly, project developers are required to control areas at least 5 rotor diameters in the prevailing (north-south) wind directions (between about 1300 and 1700 feet for the 1.5 to 2.5 MW turbines under consideration for the project) and 3 rotor diameters in the crosswind (east-west) directions (between about 800 and 1000 feet). Thus, these are minimum setback distances from properties in the area for which easements have not been obtained. Further, noise rules promulgated by the Minnesota Pollution Control Agency (MPCA; *Minnesota Rules* Section 7030), specify a maximum nighttime noise in residential areas of 50 A-weighted decibels (dB(A). WPL has proposed a minimum setback of 1,000 feet from occupied structures in order to comply with the noise rule.

2. Noble Flat Hill Wind Park in Clay, Becker and Ottertail Counties

This is a LWECS proposed by Noble Flat Hill Windpark I (Noble), a subsidiary of Noble Environmental Power, based in Connecticut. The proposal is for a 201 MW project located 12 miles east of the City of Moorhead, about 230 miles northwest of Minneapolis (Figure 3) (Tetra Tech, 2008). The cost of the project is estimated to be between $382 million and $442 million. One hundred thirty-four GE 1.5 MW wind turbines are planned for an area of 11,000 acres (about 17 square miles); the site boundary encompasses approximately 20,000 acres. Setback distances of a minimum of 700 feet are planned to comply with the 50 dB(A) noise limit. However, rotor diameters will be 77 meters (250 feet). Therefore, setback distances in the prevailing wind direction of 1,300 feet are planned for properties where owners have not granted easements. Setbacks of 800 feet are planned in the crosswind direction.

Figure 2: Bent Tree Wind Project, Freeborn County

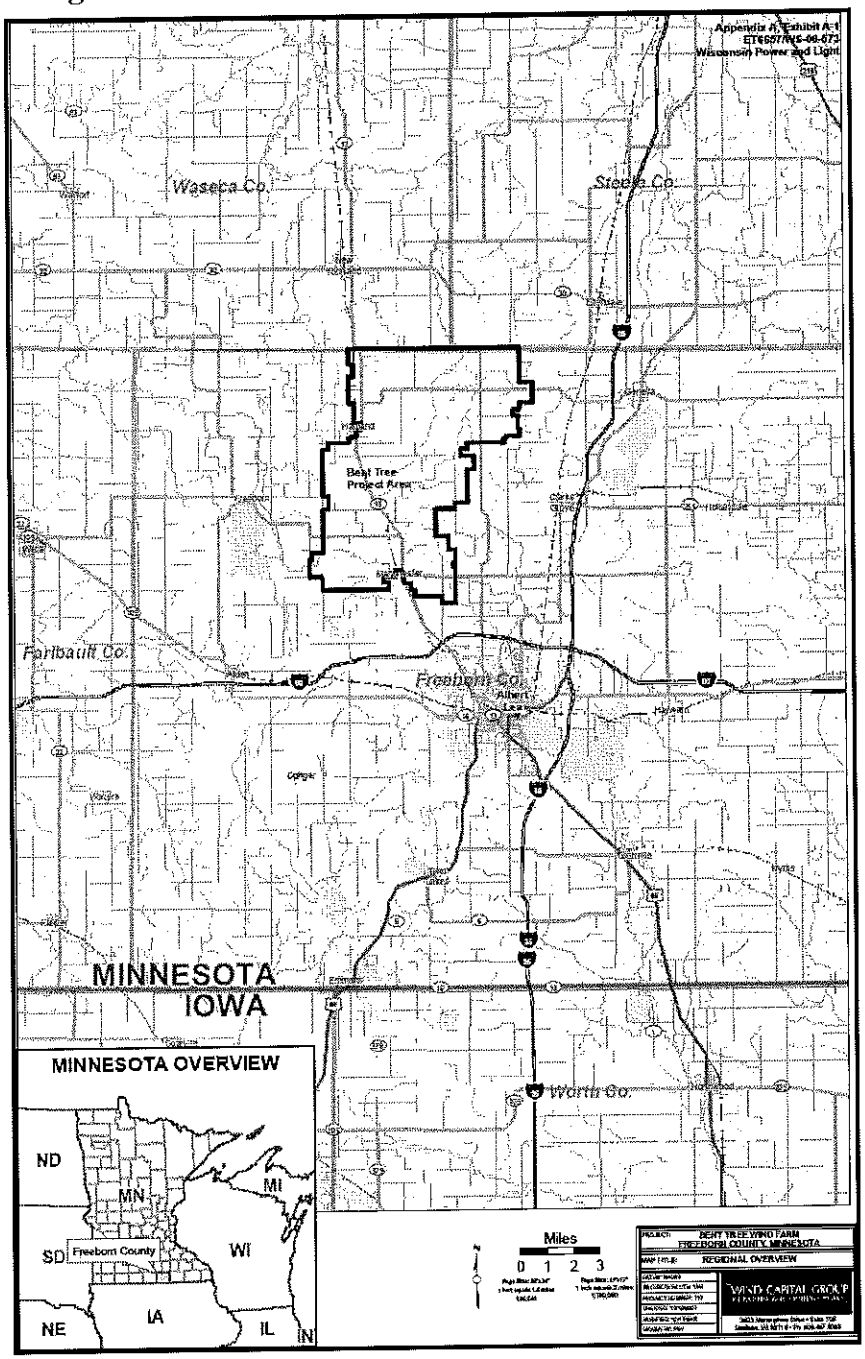
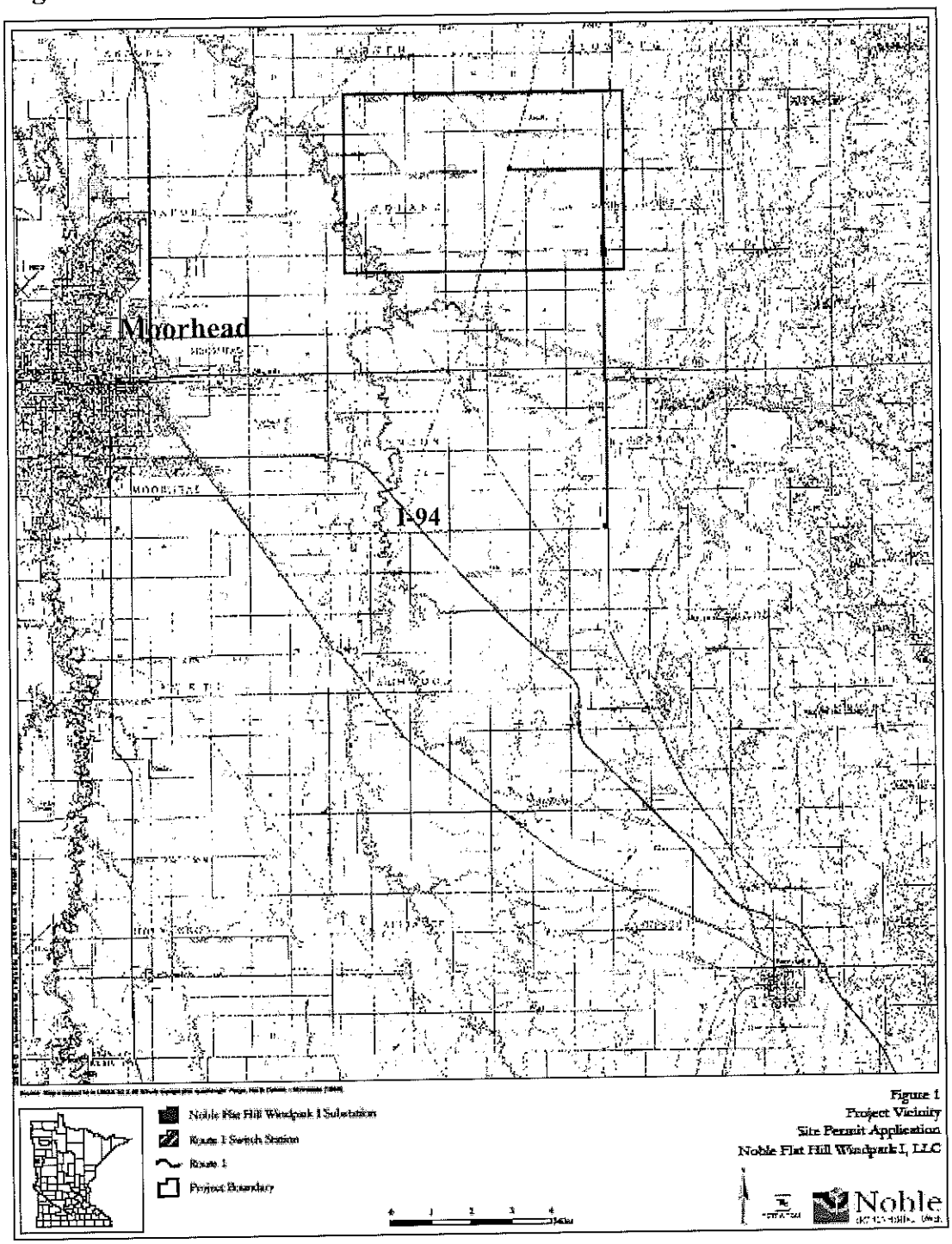


Figure 3: Noble Flat Hill Wind Park, Clay, Becker, Ottertail Counties



B. Health Issues

The National Research Council of the National Academies (NRC, 2007) has reviewed impacts of wind energy projects on human health and well-being. The NRC begins by observing that wind projects, just as other projects, create benefits and burdens, and that concern about impacts is natural when the source is near one's home. Further, the NRC notes that different people have different values and levels of sensitivity. Impacts noted by the NRC that may have the most effect on health include noise and low frequency vibration, and shadow flicker. While noise and vibration are the main focus of this paper, shadow flicker (casting of moving shadows on the ground as wind turbine blades rotate) will also be briefly discussed.

Noise originates from mechanical equipment inside the nacelles of the turbines (gears, generators, etc.) and from interaction of turbine blades with wind. Newer wind turbines generate minimal noise from mechanical equipment. The most problematic wind turbine noise is a broadband "whooshing" sound produced by interaction of turbine blades with the wind. Newer turbines have upwind rotor blades, minimizing low frequency "infrasound" (i.e., air pressure changes at frequencies below 20-100 Hz that are inaudible). However, the NRC notes that during quiet conditions at night, low frequency modulation of higher frequency sounds, such as are produced by turbine blades, is possible. The NRC also notes that effects of low frequency (infrasound) vibration (less than 20 Hz) on humans are not well understood, but have been asserted to disturb some people.

Finally, the NRC concludes that noise produced by wind turbines is generally not a major concern beyond a half mile. Issues raised by the NRC report and factors that may affect distances within which wind turbine noise may be problematic are discussed more extensively below.

II. Elementary Characteristics of Sensory Systems and Sound

A. Sensory Systems

1. Hearing

Sensory systems respond to a huge dynamic range of physical stimuli within a relatively narrow dynamic range of mechanical, chemical and/or neuronal (electrophysiological) output. Compression of the dynamic range is accomplished by systems that respond to logarithmic increases in intensity of physical stimuli with arithmetically increasing sensory responses. This general property is true for hearing, and has been recognized since at least the mid-19th century (see e.g., Woodworth and Schlosberg, 1964). "Loudness" is the sensory/perceptual correlate of the physical intensity of air pressure changes to which the electro-mechanical transducers in the ear and associated neuronal pathways are sensitive. Loudness increases as the logarithm of air pressure, and it is convenient to relate loudness to a reference air pressure (in dyne/cm^2 or pascals) in tenths of logarithmic units (decibels; dB). Further, the ear is sensitive to only a relatively narrow frequency range of air pressure changes: those between approximately 20 and 20,000 cycles per second or Herz (Hz). In fact, sensitivity varies within this range, so that the sound pressure level relative to a reference value that is audible in the middle of the range

(near 1,000 Hz) is about 4 orders of magnitude smaller than it is at 20 Hz and about 2 orders of magnitude smaller than at 20,000 Hz (Fig. 3). Accordingly, measurements of loudness in dB generally employ filters to equalize the loudness of sounds at different frequencies or "pitch." To approximate the sensitivity of the ear, A-weighted filters weigh sound pressure changes at frequencies in the mid-range more than those at higher or lower frequencies. When an A-weighted filter is used, loudness is measured in dB(A). This is explained in greater detail in Section B below.

The ear accomplishes transduction of sound through a series of complex mechanisms (Guyton, 1991). Briefly, sound waves move the eardrum (tympanic membrane), which is in turn connected to 2 small bones (ossicles) in the middle ear (the malleus and incus). A muscle connected to the malleus keeps the tympanic membrane tensed, allowing efficient transmission to the malleus of vibrations on the membrane. Ossicle muscles can also relax tension and attenuate transmission. Relaxation of muscle tension on the tympanic membrane protects the ear from very loud sounds and also masks low frequency sounds, or much background noise. The malleus and incus move a third bone (stapes). The stapes in turn applies pressure to the fluid of the cochlea, a snail-shaped structure imbedded in temporal bone. The cochlea is a complex structure, but for present purposes it is sufficient to note that pressure changes or waves of different frequencies in cochlear fluid result in bending of specialized hair cells in regions of the cochlea most sensitive to different frequencies or pitch. Hair cells are directly connected to nerve fibers in the vestibulocochlear nerve (VIII cranial nerve).

Transmission of sound can also occur directly through bone to the cochlea. This is a very inefficient means of sound transmission, unless a device (e.g. a tuning fork or hearing aid) is directly applied to bone (Guyton, 1991).

2. Vestibular System

The vestibular system reacts to changes in head and body orientation in space, and is necessary for maintenance of equilibrium and postural reflexes, for performance of rapid and intricate body movements, and for stabilizing visual images (via the vestibulo-ocular reflex) as the direction of movement changes (Guyton, 1991).

The vestibular apparatus, like the cochlea, is imbedded in temporal bone, and also like the cochlea, hair cells, bathed in vestibular gels, react to pressure changes and transmit signals to nerve fibers in the vestibulocochlear nerve. Two organs, the utricle and saccule, called otolith organs, integrate information about the orientation of the head with respect to gravity. Otoliths are tiny stone-like crystals, embedded in the gels of the utricle and saccule, that float as the head changes position within the gravitational field. This movement is translated to hair cells. Three semi-circular canals, oriented at right angles to each other, detect head rotation. Stimulation of the vestibular apparatus is not directly detected, but results in activation of motor reflexes as noted above (Guyton, 1991).

Like the cochlea, the vestibular apparatus reacts to pressure changes at a range of frequencies; optimal frequencies are lower than for hearing. These pressure changes can be caused by body movements, or by direct bone conduction (as for hearing, above) when vibration is applied directly to the temporal bone (Todd et al., 2008). These investigators

found maximal sensitivity at 100 Hz, with some sensitivity down to 12.5 Hz. The saccule, located in temporal bone just under the footplate of the stapes, is the most sound-sensitive of the vestibular organs (Halmagyi et al., 2004). It is known that brief loud clicks (90-95 dB) are detected by the vestibular system, even in deaf people. However, we do not know what the sensitivity of this system is through the entire range of sound stimuli.

While vestibular system activation is not directly felt, activation may give rise to a variety of sensations: vertigo, as the eye muscles make compensatory adjustments to rapid angular motion, and a variety of unpleasant sensations related to internal organs. In fact, the vestibular system interacts extensively with the "autonomic" nervous system, which regulates internal body organs (Balaban and Yates, 2004). Sensations and effects correlated with intense vestibular activation include nausea and vomiting and cardiac arrhythmia, blood pressure changes and breathing changes.

While these effects are induced by relatively intense stimulation, it is also true that A-weighted sound measurements attuned to auditory sensitivity, will underweight low frequencies for which the vestibular system is much more sensitive (Todd et al., 2008). Nevertheless, activation of the vestibular system *per se* obviously need not give rise to unpleasant sensations. It is not known what stimulus intensities are generally required for for autonomic activation at relatively low frequencies, and it is likely that there is considerable human variability and capacity to adapt to vestibular challenges.

B. Sound

1. Introduction

Sound is carried through air in compression waves of measurable frequency and amplitude. Sound can be tonal, predominating at a few frequencies, or it can contain a random mix of a broad range of frequencies and lack any tonal quality (white noise). Sound that is unwanted is called noise.

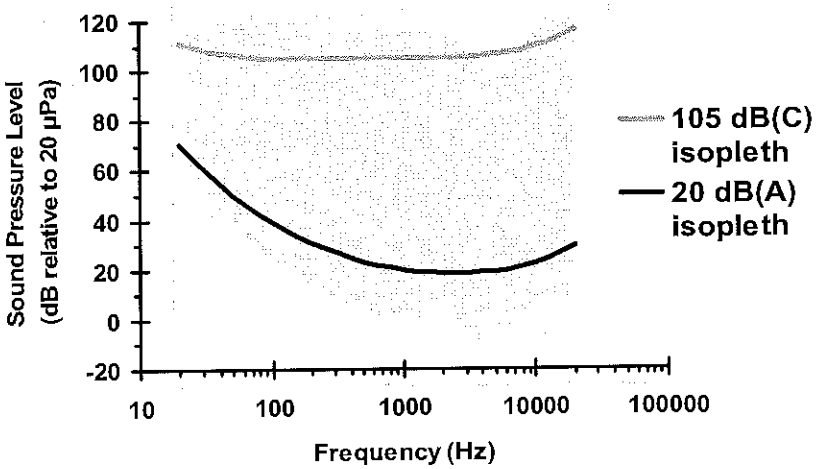
Audible Frequency Sound

Besides frequency sensitivity (between 20 and 20,000 Hz), humans are also sensitive to changes in the amplitude of the signal (compression waves) within this audible range of frequencies. Increasing amplitude, or increasing sound pressure, is perceived as increasing volume or loudness. The sound pressure level in air (SPL) is measured in micro Pascals (μPa). SPLs are typically converted in measuring instruments and reported as decibels (dB) which is a log scale, relative unit (see above). When used as the unit for sound, dBs are reported relative to a SPL of 20 μPa. Twenty μPa is used because it is the approximate threshold of human hearing sensitivity at about 1000 Hz. Decibels relative to 20 μPa are calculated from the following equation:

$$\text{Loudness (dB)} = \text{Log}\left(\left(\text{SPL} / 20\ \mu\text{Pa}\right)^2\right) * 10$$

Figure 4 shows the audible range of normal human hearing. Note that while the threshold sensitivity varies over the frequency range, at high SPLs sensitivity is relatively consistent over audible frequencies.

Figure 4: Audible Range of Human Hearing



Equivalence curves for different frequencies, when sound meter readings in dB are taken with A or C-weighting filters. (Adapted from EPD Hong Kong SAR, 2009)

Sub-Audible Frequency Sound

Sub-audible frequency sound is often called infrasound. It may be sensed by people, similar to audible sound, in the cochlear apparatus in the ear; it may be sensed by the vestibular system which is responsible for balance and physical equilibrium; or it may be sensed as vibration.

Resonance and modulation

Sound can be attenuated as it passes through a physical structure. However, because the wavelength of low frequency sound is very long (the wavelength of 40 Hz in air at sea level and room temperature is 8.6 meters or 28 ft), low frequencies are not effectively attenuated by walls and windows of most homes or vehicles. (For example, one can typically hear the bass, low frequency music from a neighboring car at a stoplight, but not the higher frequencies.) In fact, it is possible that there are rooms within buildings exposed to low frequency sound or noise where some frequencies may be amplified by resonance (e.g. ½ wavelength, ¼ wavelength) within the structure. In addition, low frequency sound can cause vibrations within a building at higher, more audible frequencies as well as throbbing or rumbling.

Sounds that we hear generally are a mixture of different frequencies. In most instances these frequencies are added together. However, if the source of the sound is not constant, but changes over time, the effect can be re-occurring pulses of sound or low frequency modulation of sound. This is the type of sound that occurs from a steam engine, a jack hammer, music and motor vehicle traffic. Rhythmic, low frequency pulsing of higher frequency noise (like the sound of an amplified heart beat) is one type of sound that can be caused by wind turbine blades under some conditions.

2. Human Response to Low Frequency Stimulation

There is no consensus whether sensitivity below 20 Hz is by a similar or different mechanism than sensitivity and hearing above 20 Hz (Reviewed by Møller and Pedersen, 2004). Possible mechanisms of sensation caused by low frequencies include bone conduction at the applied frequencies, as well as amplification of the base frequency and/or harmonics by the auditory apparatus (eardrum and ossicles) in the ear. Sensory thresholds are relatively continuous, suggesting (but not proving) a similar mechanism above and below 20 Hz. However, it is clear that cochlear sensitivity to infrasound (< 20 Hz) is considerably less than cochlear sensitivity to audible frequencies.

Møller and Pedersen (2004) reviewed human sensitivity at low and infrasonic frequencies. The following findings are of interest:

- When whole-body pressure-field sensitivity is compared with ear-only (earphone) sensitivity, the results are very similar. These data suggest that the threshold sensitivity for low frequency is through the ear and not vestibular.
- Some individuals have extraordinary sensitivity at low frequencies, up to 25 dB more sensitive than the presumed thresholds at some low frequencies.
- While population average sensitivity over the low frequency range is smooth, sound pressure thresholds of response for individuals do not vary smoothly but are inconsistent, with peaks and valleys or "microstructures". Therefore the sensitivity response of individuals to different low frequency stimulation may be difficult to predict.
- Studies of equal-loudness-levels demonstrate that as stimulus frequency decreases through the low frequencies, equal-loudness lines compress in the dB scale. (See Figure 4 as an example of the relatively small difference in auditory SPL range between soft and loud sound at low frequencies).
- The hearing threshold for pure tones is different than the hearing threshold for white noise at the same total sound pressure.

3. Souud Measurements

Sound measurements are taken by instruments that record sound pressure or the pressure of the compression wave in the air. Because the loudness of a sound to people is usually the primary interest in measuring sound, normalization schemes or filters have been applied to absolute measurements. dB(A) scaling of sound pressure measurements was intended to normalize readings to equal loudness over the audible range of frequencies at low loudness. For example, a 5,000 Hz (5 kHz) and 20 dB(A) tone is expected to have the same intensity or loudness as a 100 Hz, 20 dB(A) tone. However, note that the absolute sound pressures would be about 200 μPa and 2000 μPa, respectively, or about a difference of 20 dB (relative to 20 μPa), or as it is sometimes written 20 dB(linear).

Most sound is not a single tone, but is a mixture of frequencies within the audible range. A sound meter can add the total SPLs for all frequencies; in other words, the dB readings over the entire spectrum of audible sound can be added to give a single loudness metric. If sound is reported as A-weighted, or dB(A), it is a summation of the dB(A) scaled sound pressure from 20 Hz to 20 kHz.

In conjunction with the dB(A) scale, the dB(B) scale was developed to approximate equal loudness to people across audible frequencies at medium loudness, and dB(C) was developed to approximate equal-loudness for loud environments. Figure 4 shows isopleths for 20 dB(A) and 105 dB(C). While dB(A), dB(B), dB(C) were developed from empirical data at the middle frequencies, at the ends of the curves these scales were extrapolated, or sketched in, and are not based on experimental or observational data (Berglund et al., 1996). As a result, data in the low frequency range (and probably the highest audible frequencies as well) cannot be reliably interpreted using these scales. The World Health Organization (WHO, 1999) suggests that A-weighting noise that has a large low frequency component is not reliable assessment of loudness.

The source of the noise, or the noise signature, may be important in developing equal-loudness schemes at low frequencies. C-weighting has been recommended for artillery noise, but a linear, unweighted scale may be even better at predicting a reaction (Berglund et al., 1996). A linear or equal energy rating also appears to be the most effective predictor of reaction to low frequency noise in other situations, including blast noise from mining. The implication of the analysis presented by Berglund et al. (1996) is that annoyance from non-tonal noise should not be estimated from a dB(A) scale, but may be better evaluated using dB(C), or a linear non-transformed scale.

However, as will be discussed below, a number of schemes use a modified dB(A) scale to evaluate low frequency noise. These schemes differ from a typical use of the dB(A) scale by addressing a limited frequency range below 250 Hz, where auditory sensitivity is rapidly changing as a function of frequency (see Figure 4).

III. Exposures of Interest

A. Noise From Wind Turbines

1. Mechanical noise

Mechanical noise from a wind turbine is sound that originates in the generator, gearbox, yaw motors (that intermittently turn the nacelle and blades to face the wind), tower ventilation system and transformer. Generally, these sounds are controlled in newer wind turbines so that they are a fraction of the aerodynamic noise. Mechanical noise from the turbine or gearbox should only be heard above aerodynamic noise when they are not functioning properly.

2. Aerodynamic noise

Aerodynamic noise is caused by wind passing over the blade of the wind turbine. The tip of a 40-50 meter blade travels at speeds of over 140 miles per hour under normal operating conditions. As the wind passes over the moving blade, the blade interrupts the laminar flow of air, causing turbulence and noise. Current blade designs minimize the amount of turbulence and noise caused by wind, but it is not possible to eliminate turbulence or noise.

Aerodynamic noise from a wind turbine may be underestimated during planning. One source of error is that most meteorological wind speed measurements noted in wind farm literature are taken at 10 meters above the ground. Wind speed above this elevation, in

the area of the wind turbine rotor, is then calculated using established modeling relationships. In one study (van den Berg, 2004) it was determined that the wind speeds at the hub at night were up to 2.6 times higher than modeled. Subsequently, it was found that noise levels were 15 dB higher than anticipated.

Unexpectedly high aerodynamic noise can also be caused by improper blade angle or improper alignment of the rotor to the wind. These are correctable and are usually adjusted during the turbine break-in period.

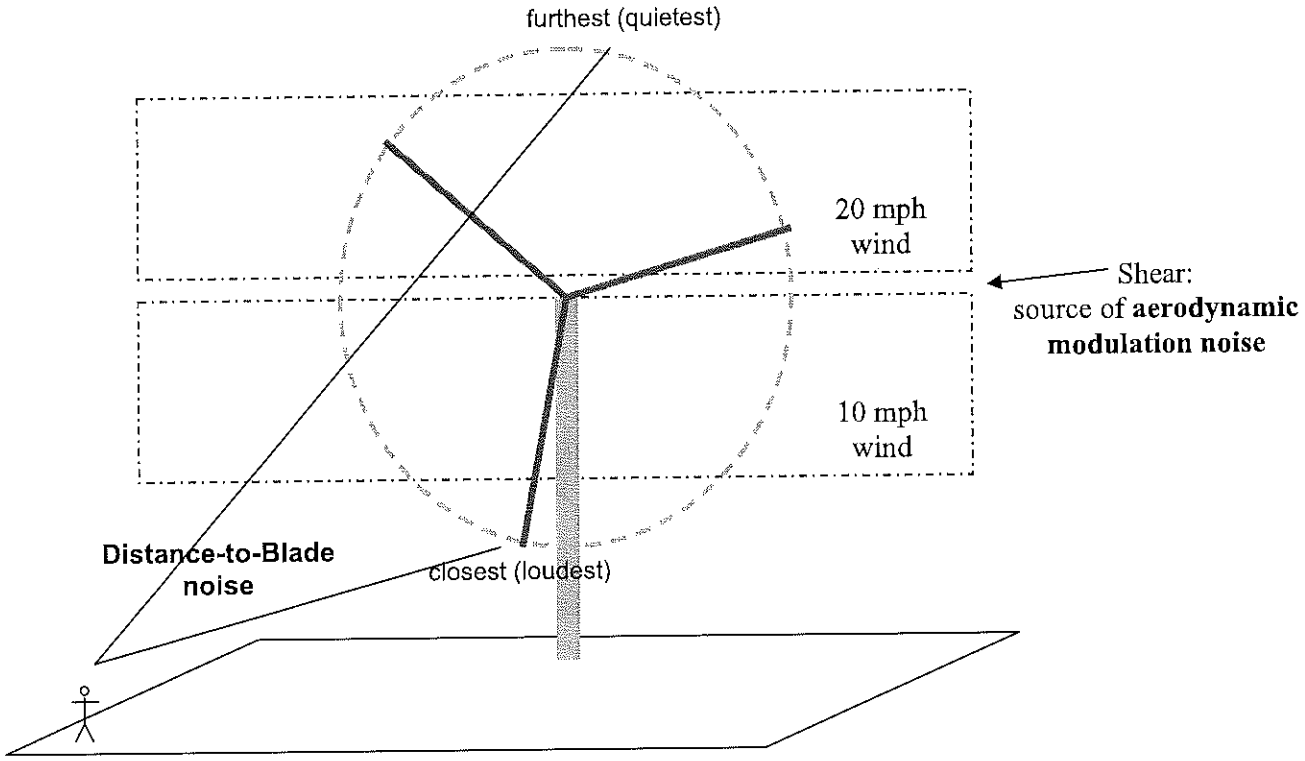
3. Modulation of aerodynamic noise

Rhythmic modulation of noise, especially low frequency noise, has been found to be more annoying than steady noise (Bradley, 1994; Holmberg et al., 1997). One form of rhythmic modulation of aerodynamic noise that can be noticeable very near to a wind turbine is a distance-to-blade effect. To a receptor on the ground in front of the wind turbine, the detected blade noise is loudest as the blade passes, and quietest when the blade is at the top of its rotation. For a modern 3-blade turbine, this distance-to-blade effect can cause a pulsing of the blade noise at about once per second (1 Hz). On the ground, about 500 feet directly downwind from the turbine, the distance-to-blade can cause a difference in sound pressure of about 2 dB between the *tip* of the blade at its farthest point and the *tip* of the blade at its nearest point (48 meter blades, 70 meter tower). Figure 5 demonstrates why the loudness of blade noise (aerodynamic noise) pulses as the distance-to-blade varies for individuals close to a turbine.

If the receptor is 500 feet from the turbine base, in line with the blade rotation or up to 60° off line, the difference in sound pressure from the *tip* of the blade at its farthest and nearest point can be about 4-5 dB, an audible difference. The tip travels faster than the rest of the blade and is closer to (and then farther away from) the receptor than other parts of the blade. As a result, noise from other parts of the blade will be modulated less than noise from the tip. Further, blade design can also affect the noise signature of a blade. The distance-to-blade effect diminishes as receptor distance increases because the relative difference in distance from the receptor to the top or to the bottom of the blade becomes smaller. Thus, moving away from the tower, distance-to-blade noise gradually appears to be more steady.

Another source of rhythmic modulation may occur if the wind through the rotor is not uniform. Blade angle, or pitch, is adjusted for different wind speeds to maximize power and to minimize noise. A blade angle that is not properly tuned to the wind speed (or wind direction) will make more noise than a properly tuned blade. Horizontal layers with different wind speeds or directions can form in the atmosphere. This wind condition is called shear. If the winds at the top and bottom of the blade rotation are different, blade noise will vary between the top and bottom of blade rotation, causing modulation of aerodynamic noise. This noise, associated with the blades passing through areas of different air-wind speeds, has been called aerodynamic modulation and is demonstrated in Figure 5.

Figure 5: Sources of noise modulation or pulsing



In some terrains and under some atmospheric conditions wind aloft, near the top of the wind turbine, can be moving faster than wind near the ground. Wind turbulence or even wakes from adjacent turbines can create non-uniform wind conditions as well. As a result of aerodynamic modulation a rhythmic noise pattern or pulsing will occur as each blade passes through areas with different wind speed. Furthermore, additional noise, or thumping, may occur as each blade passes through the transition between different wind speed (or wind direction) areas.

Wind shear caused by terrain or structures on the ground (e.g. trees, buildings) can be modeled relatively easily. Wind shear in areas of flat terrain is not as easily understood. During the daytime wind in the lower atmosphere is strongly affected by thermal convection which causes mixing of layers. Distinct layers do not easily form. However, in the nighttime the atmosphere can stabilize (vertically), and layers form. A paper by G.P. van den Berg (2008) included data from a study on wind shear at Cabauw, The Netherlands (flat terrain). Annual average wind speeds at different elevations above ground was reported. The annual average wind speed at noon was about 5.75 meters per second (m/s; approximately 12.9 miles per hour(mph)) at 20 m above ground, and about 7.6 m/s (17 mph) at 140 m. At midnight, the annual averages were about 4.3 m/s (9.6 mph) and 8.8 m/s (19.7 mph) for 20m and 140 m, respectively, above ground. The data show that while the average windspeed (between 20m and 140m) is very similar at noon and midnight at Cabauw, the windspeed difference between elevations during the day is

much less than the difference at night (1.85 m/s (4.1 mph) and 4.5 m/s (10 mph), respectively). As a result one would expect that the blade angle can be better tuned to the wind speed during the daytime. Consequently, blade noise would be greater at night.

A number of reports have included discussion of aerodynamic modulation (van den Berg, 2005; UK Department of Transport and Industry, 2006; UK Department for Business Enterprise and Regulatory Reform, 2007; van den Berg, 2008). They suggest that aerodynamic modulation is typically underestimated when noise estimates are calculated. In addition, they suggest that detailed modeling of wind, terrain, land use and structures may be used to predict whether modulation of aerodynamic noise will be a problem at a proposed wind turbine site.

4. Wind farm noise

The noise from multiple turbines similarly distant from a residence can be noticeably louder than a lone turbine simply through the addition of multiple noise sources. Under steady wind conditions noise from a wind turbine farm may be greater than noise from the nearest turbine due to synchrony between noise from more than one turbine (van den Berg, 2005). Furthermore, if the dominant frequencies (including aerodynamic modulation) of different turbines vary by small amounts, an audible beat or dissonance may be heard when wind conditions are stable.

B. Shadow Flicker

Rhythmic light flicker from the blades of a wind turbine casting intermittent shadows has been reported to be annoying in many locations (NRC, 2007; Large Wind Turbine Citizens Committee, 2008). (Note: Flashing light at frequencies around 1 Hz is too slow to trigger an epileptic response.)

Modeling conducted by the Minnesota Department of Health suggests that a receptor 300 meters perpendicular to, and in the shadow of the blades of a wind turbine, can be in the flicker shadow of the rotating blade for almost 1½ hour a day. At this distance a blade may completely obscure the sun each time it passes between the receptor and the sun. With current wind turbine designs, flicker should not be an issue at distances over 10 rotational diameters (~1000 meters or 1 km (0.6 mi) for most current wind turbines). This distance has been recommended by the Wind Energy Handbook (Burton et al., 2001) as a minimum setback distance in directions that flicker may occur, and has been noted in the Bent Tree Permit Application (WPL, 2008).

Shadow flicker is a potential issue in the mornings and evenings, when turbine noise may be masked by ambient sounds. While low frequency noise is typically an issue indoors, shadow flicker can be an issue both indoors and outdoors when the sun is low in the sky. Therefore, shadow flicker may be an issue in locations other than the home.

Ireland recommends wind turbines setbacks of at least 300 meters from a road to decrease driver distraction (Michigan State University, 2004). The NRC (2007) recommends that shadow flicker is addressed during the preliminary planning stages of a wind turbine project.

IV. Impacts of Wind Turbine Noise

A. Potential Adverse Reaction to Sound

Human sensitivity to sound, especially to low frequency sound, is variable. Individuals have different ranges of frequency sensitivity to audible sound; different thresholds for each frequency of audible sound; different vestibular sensitivities and reactions to vestibular activation; and different sensitivity to vibration.

Further, sounds, such as repetitive but low intensity noise, can evoke different responses from individuals. People will exhibit variable levels of annoyance and tolerance for different frequencies. Some people can dismiss and ignore the signal, while for others, the signal will grow and become more apparent and unpleasant over time (Moreira and Bryan, 1972; Bryan and Tempest, 1973). These reactions may have little relationship to will or intent, and more to do with previous exposure history and personality.

Stress and annoyance from noise often do not correlate with loudness. This may suggest, in some circumstances, other factors impact an individual's reaction to noise. A number of reports, cited in Staples (1997), suggest that individuals with an interest in a project and individuals who have some control over an environmental noise are less likely to find a noise annoying or stressful.

Berglund et al. (1996) reviewed reported health effects from low frequency noise. Loud noise from any source can interfere with verbal communication and possibly with the development of language skills. Noise may also impact mental health. However, there are no studies that have looked specifically at the impact of low frequency noise on communication, development of language skills and mental health. Cardiovascular and endocrine effects have been demonstrated in studies that have looked at exposures to airplane and highway noise. In addition, possible effects of noise on performance and cognition have also been investigated, but these health studies have not generally looked at impacts specifically from low frequency noise. Noise has also been shown to impact sleep and sleep patterns, and one study demonstrated impacts from low frequency noise in the range of 72 to 85 dB(A) on chronic insomnia (Nagai et al., 1989 as reported in Berglund et al., 1996).

Case studies have suggested that health can be impacted by relatively low levels of low frequency noise. But it is difficult to draw general conclusions from case studies. Feldmann and Pitten (2004)) describe a family exposed during the winter to low frequency noise from a nearby heating plant. Reported health impacts were: "indisposition, decrease in performance, sleep disturbance, headache, ear pressure, crawl parästhesy [crawling, tingling or numbness sensation on the skin] or shortness of breath."

Annoyance, unpleasant sounds, and complaints

Reported health effects from low frequency stimulation are closely associated with annoyance from audible noise. "There is no reliable evidence that infrasounds below the hearing threshold produce physiological or psychological effects" (WHO, 1999). It has not been shown whether annoyance is a symptom or an accessory in the causation of

health impacts from low frequency noise. Studies have been conducted on some aspects of low frequency noise that can cause annoyance.

Noise complaints are usually a reasonable measure of annoyance with low frequency environmental noise. Leventhall (2004) has reviewed noise complaints and offers the following conclusions:

> " The problems arose in quiet rural or suburban environments
> The noise was often close to inaudibility and heard by a minority of people
> The noise was typically audible indoors and not outdoors
> The noise was more audible at night than day
> The noise had a throb or rumble characteristic
> The main complaints came from the 55-70 years age group
> The complainants had normal hearing.
> Medical examination excluded tinnitus.
>
> " These are now recognised as classic descriptors of low frequency noise problems."

These observations are consistent with what we know about the propagation of low intensity, low frequency noise. Some people are more sensitive to low frequency noise. The difference, in dB, between soft (acceptable) and loud (annoying) noise is much less at low frequency (see Figure 4 audible range compression). Furthermore, during the daytime, and especially outdoors, annoying low frequency noise can be masked by high frequency noise.

The observation that "the noise was typically audible indoors and not outdoors" is not particularly intuitive. However, as noted in a previous section, low frequencies are not well attenuated when they pass through walls and windows. Higher frequencies (especially above 1000 Hz) can be efficiently attenuated by walls and windows. In addition, low frequency sounds may be amplified by resonance within rooms and halls of a building. Resonance is often characterized by a throbbing or a rumbling, which has also been associated with many low frequency noise complaints.

Low frequency noise, unlike higher frequency noise, can also be accompanied by shaking, vibration and rattling. In addition, throbbing and rumbling may be apparent in some low frequency noise. While these noise features may not be easily characterized, numerous studies have shown that their presence dramatically lowers tolerance for low frequency noise (Berglund et al., 1996).

As reviewed in Leventhall (2003), a study of industrial exposure to low frequency noise found that fluctuations in total noise averaged over 0.5, 1.0 and 2.0 seconds correlated with annoyance (Holmberg et al., 1997). This association was noted elsewhere and led (Broner and Leventhall, 1983) to propose a 3dB "penalty" be added to evaluations of annoyance in cases where low frequency noise fluctuated.

In another laboratory study with test subjects controlling loudness, 0.5 – 4 Hz modulation of low frequency noise was found to be more annoying than non-modulated low

frequency noise. On average test subjects found modulated noise to be similarly annoying as a constant tone 12.9 dB louder (Bradley, 1994).

B. Studies of Wind Turbine Noise Impacts on People

1. Swedish Studies

Two studies in Sweden collected information by questionnaires from 341 and 754 individuals (representing response rates of 68% and 58%, respectively), and correlated responses to calculated exposure to noise from wind farms (Pedersen and Waye, 2004; Pedersen, 2007; Pedersen and Persson, 2007). Both studies showed that the number of respondents perceiving the noise from the wind turbines increased as the calculated noise levels at their homes increased from less than 32.5 dB(A) to greater than 40 dB(A). Annoyance appeared to correlate or trend with calculated noise levels. Combining the data from the two studies, when noise measurements were greater than 40 dB(A), about 50% of the people surveyed (22 of 45 people) reported annoyance. When noise measurements were between 35 and 40 dB(A) about 24% reported annoyance (67 of 276 people). Noise annoyance was more likely in areas that were rated as quiet and in areas where turbines were visible. In one of the studies, 64% respondents who reported noise annoyance also reported sleep disturbance; 15% of respondents reported sleep disturbance without annoyance.

2. United Kingdom Study

Moorhouse et al. (UK Department for Business Enterprise and Regulatory Reform, 2007) evaluated complaints about wind farms. They found that 27 of 133 operating wind farms in the UK received formal complaints between 1991 and 2007. There were a total of 53 complainants for 16 of the sites for which good records were available. The authors of the report considered that many complaints in the early years were for generator and gearbox noise. However, subjective analyses of reports about noise ("like a train that never gets there", "distant helicopter", "thumping", "thudding", "pulsating", "thumping", "rhythmical beating", and "beating") suggested that aerodynamic modulation was the likely cause of complaints at 4 wind farms. The complaints from 8 other wind farms may have had "marginal" association with aerodynamic modulation noise.

Four wind farms that generated complaints possibly associated with aerodynamic modulation were evaluated further. These wind farms were commissioned between 1999 and 2002. Wind direction, speed and times of complaints were associated for 2 of the sites and suggested that aerodynamic modulation noise may be a problem between 7% and 25% of the time. Complaints at 2 of the farms have stopped and at one farm steps to mitigate aerodynamic modulation (operational shutdown under certain meteorological conditions) have been instituted.

3. Netherlands Study

F. van den Berg et al. (2008) conducted a postal survey of a group selected from all residents in the Netherlands within 2.5 kilometers (km) of a wind turbine. In all, 725 residents responded (37%). Respondents were exposed to sound between 24 and 54 dB(A). The percentage of respondents annoyed by sound increased from 2% at levels of 30 dB(A) or less, up to 25% at between 40 and 45 dB. Annoyance decreased above 45 dB. Most residents exposed above 45 dB(A) reported economic benefits from the

turbines. However, at greater than 45 dB(A) more respondents reported sleep interruption. Respondents tended to report more annoyance when they also noted a negative effect on landscape, and ability to see the turbines was strongly related to the probability of annoyance.

4. Case Reports

A number of un-reviewed reports have catalogued complaints of annoyance and some more severe health impacts associated with wind farms. These reports do not contain measurements of noise levels, and do not represent random samples of people living near wind turbines, so they cannot assess prevalence of complaints. They do generally show that in the people surveyed, complaints are more likely the closer people are to the turbines. The most common complaint is decreased quality of life, followed by sleep loss and headache. Complaints seem to be either from individuals with homes quite close to turbines, or individuals who live in areas subject to aerodynamic modulation and, possibly, enhanced sound propagation which can occur in hilly or mountainous terrain. In some of the cases described, people with noise complaints also mention aesthetic issues, concern for ecological effects, and shadow flicker concerns. Not all complaints are primarily about health.

Harry (2007) describes a meeting with a couple in Cornwall, U.K. who live 400 meters from a wind turbine, and complained of poor sleep, headaches, stress and anxiety. Harry subsequently investigated 42 people in various locations in the U.K. living between 300 meters and 2 kilometers (1000 feet to 1.2 miles) from the nearest wind turbine. The most frequent complaint (39 of 42 people) was that their quality of life was affected. Headaches were reported by 27 people and sleep disturbance by 28 people. Some people complained of palpitations, migraines, tinnitus, anxiety and depression. She also mentions correspondence and complaints from people in New Zealand, Australia, France, Germany, Netherlands and the U.S.

Phipps (2007) discusses a survey of 619 households living up to 10 kilometers (km; 6 miles) from wind farms in mountainous areas of New Zealand. Most respondents lived between 2 and 2.5 km from the turbines (over 350 households). Most respondents (519) said they could see the turbines from their homes, and 80% of these considered the turbines intrusive, and 73% considered them unattractive. Nine percent said they were affected by flicker. Over 50% of households located between 2 and 2.5 km and between 5 and 9.5 km reported being able to hear the turbines. In contrast, fewer people living between 3 and 4.5 km away could hear the turbines. Ninety-two households said that their quality of life was affected by turbine noise. Sixty-eight households reported sleep disturbances: 42 of the households reported occasional sleep disturbances, 21 reported frequent sleep disturbances and 5 reported sleep disturbances most of the time.

The Large Wind Turbine Citizens Committee for the Town of Union (2008) documents complaints from people living near wind turbines in Wisconsin communities and other places in the U.S. and U.K. Contained in this report is an older report prepared by the Wisconsin Public Service Corporation in 2001 in response to complaints in Lincoln County, Wisconsin. The report found essentially no exceedances of the 50 dB(A) requirement in the conditional use permit. The report did measure spectral data

accumulated over very short intervals (1 minute) in 1/3 octave bands at several sites while the wind turbines were functioning, and it is of interest that at these sites the sound pressure level at the lower frequencies (below 125 Hz) were at or near 50 dB(A).

Pierpont (2009) postulates wind turbine syndrome, consisting of a constellation of symptoms including headache, tinnitus, ear pressure, vertigo, nausea, visual blurring, tachycardia, irritability, cognitive problems and panic episodes associated with sensations of internal pulsation. She studied 38 people in 10 families living between 1000 feet and slightly under 1 mile from newer wind turbines. She proposes that the mechanism for these effects is disturbance of balance due to "discordant" stimulation of the vestibular system, along with visceral sensations, sensations of vibration in the chest and other locations in the body, and stimulation of the visual system by moving shadows. Pierpont does report that her study subjects maintain that their problems are caused by noise and vibration, and the most common symptoms reported are sleep disturbances and headache. However, 16 of the people she studied report symptoms consistent with (but not necessarily caused by) disturbance of equilibrium.

V. Noise Assessment and Regulation

1. Minnesota noise regulation

The Minnesota Noise Pollution Control Rule is accessible online at: https://www.revisor.leg.state.mn.us/rules/?id=7030 . A summary of the Minnesota Pollution Control Agency (MPCA) noise guidance can be found online at: http://www.pca.state.mn.us/programs/noise.html . The MPCA standards require A-weighting measurements of noise; background noise must be at least 10 dB lower than the noise source being measured. Different standards are specified for day and night, as well as standards that may not be exceeded for more than 10 percent of the time during any hour (L10) and 50 percent of the time during any hour (L50). Household units, including farm houses, are Classification 1 land use. The following are the Class 1 noise limits:

Table 1: Minnesota Class 1 Land Use Noise Limits

Daytime		Nighttime	
L50	L10	L50	L10
60 dB(A)	65 dB(A)	50 dB(A)	55 dB(A)

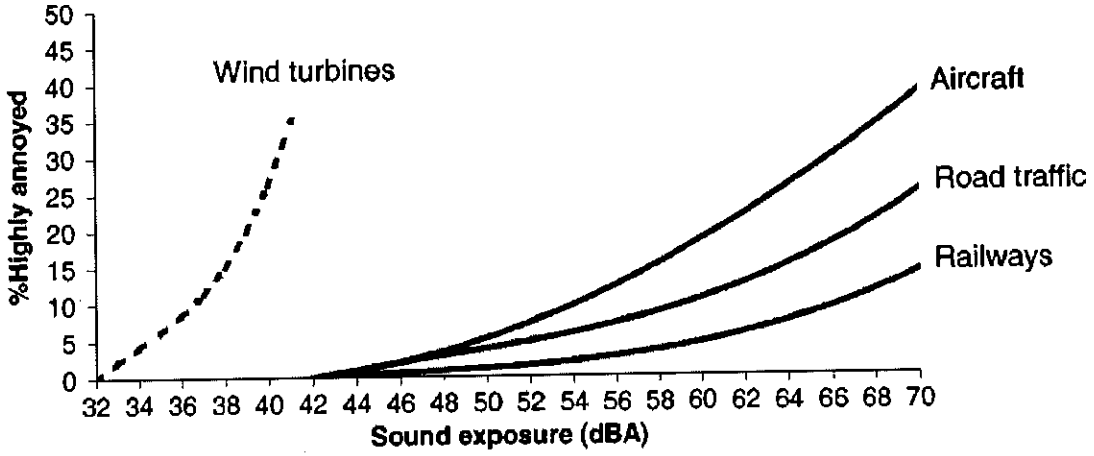
These noise limits are single number limits that rely on the measuring instrument to apply an A-weighting filter over the entire presumed audible spectrum of frequencies (20 Hz to 20 KHz) and then integrating that signal. The result is a single number that characterizes the audible spectrum noise intensity.

2. Low frequency noise assessment and regnlation

Pedersen and Waye (2004) looked at the relationship between total dB(A) sound pressure and the annoyance of those who are environmentally exposed to noise from different sources. Figure 6 demonstrates the difficulty in using total dB(A) to evaluate annoyance. Note how lower noise levels (dB(A)) from wind turbines engenders annoyance similar to

much higher levels of noise exposure from aircraft, road traffic and railroads. Sound impulsiveness, low frequency noise and persistence of the noise, as well as demographic characteristics may explain some of the difference.

Figure 6: Annoyance associated with exposure to different environmental noises



Reprinted with permission from Pedersen, E. and K.P. Waye (2004). Perception and annoyance due to wind turbine noise–a dose-response relationship. The Journal of the Acoustical Society of America 116: 3460. Copyright 2004, Acoustical Society of America.

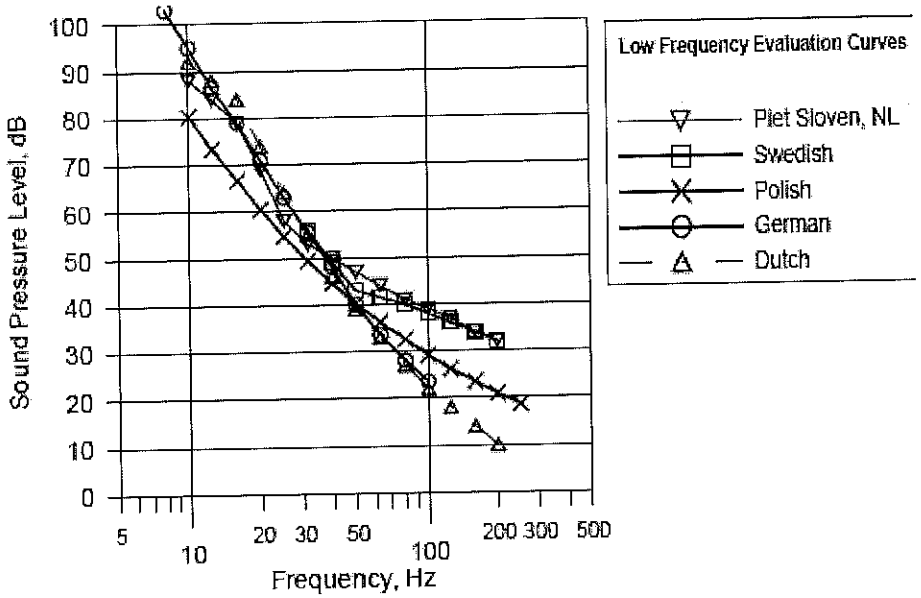
Kjellberg et al. (1997) looked at the ability of different full spectrum weighting schemes to predict annoyance caused by low frequency audio noise. They found that dB(A) is the worst predictor of annoyance of available scales. However, if 6 dB ("penalty") is added to dB(A) when dB(C) – dB(A) is greater than 15 dB, about 71% of the predictions of annoyance are correct. It is important to remember that integrated, transformed measurements of SPL (e.g. dB(A), dB(C)) do not measure frequencies below 20 Hz. While people detect stimuli below 20 Hz, as discussed in above sections, these frequencies are not measured using an A-weighted or C-weighted meter.

The World Health Organization (WHO) recommends that if dB(C) is greater than 10 dB more than dB(A), the low frequency components of the noise may be important and should be evaluated separately. In addition, WHO says "[i]t should be noted that a large proportion of low-frequency components in noise may increase considerably the adverse effects on health." (WHO, 1999)

Many governments that regulate low frequency noise look at noise within bands of frequencies instead of summing the entire spectrum. A study by Poulsen and Mortensen (Danish Environmental Protection Agency, 2002) included a summary of low frequency noise guidelines. German, Swedish, Polish, and Dutch low frequency evaluation curves were compared (see Figure 7). While there are distinctions in how the evaluation curves are described, generally, these curves are sound pressure criterion levels for 1/3 octaves from about 8 Hz to 250 Hz. Exceedance in any 1/3 octave measurement suggests that the noise may be annoying. However, note that regulations associated with low frequency

noise can be quite complex and the regulatory evaluations associated with individual curves can be somewhat different.

Figure 7: 1/3 Octave Sound Pressure Level Low frequency Noise Evaluation Curves



(Danish Environmental Protection Agency, 2002)

The Danish low frequency evaluation requires measuring noise indoors with windows closed; SPL measurements are obtained in 1/3 octave bands and transformed using the A-weighting algorithm for all frequencies between 10 and 160 Hz. These values are then summed into a single metric called $L_{pA,LF}$. A 5 dB "penalty" is added to any noise that is "impulsive". Danish regulations require that 20 dB $L_{pA,LF}$ is not exceeded during the evening and night, and that 25 dB $L_{pA,LF}$ is not exceeded during the day.

Swedish guidance recommends analyzing 1/3 octave bands between 31.5 and 200 Hz inside a home, and comparing the values to a Swedish assessment curve. The Swedish curve is equal to the United Kingdom (UK) Department of Environment, Food and Rural Affairs (DEFRA) low frequency noise criterion curve for overlapping frequencies (31.5 – 160 Hz).

The German "A-level" method sums the A-weighted equivalent levels of 1/3 octave bands that exceed the hearing threshold from 10 – 80 Hz. If the noise is not tonal, the measurements are added. The total cannot exceed 25 dB at night and 35 dB during the day. A frequency-dependent adjustment is applied if the noise is tonal.

In the Poulsen and Mortensen, Danish EPA study (2002), 18 individuals reported annoyance levels when they were exposed through earphones in a controlled environment to a wide range of low frequency environmental noises, all attenuated down to 35 dB, as depicted in Table 2. Noise was simulated as if being heard indoors, filtering out noise at

higher frequencies and effectively eliminating all frequencies above 1600 Hz. Noise levels in 1/3 octave SPLs from 8 Hz to 1600 Hz were measured and low frequencies (below 250 Hz) were used to predict annoyance using 7 different methods (Danish, German A-level, German tonal, Swedish, Polish, Sloven, and C-level). Predictions of annoyance were compared with the subjective annoyance evaluations. Correlation coefficients for these analyses ranged from 0.64 to 0.94, with the best correlation in comparison with the Danish low frequency noise evaluation methods.

As would be expected, at 35 dB nominal (full spectrum) loudness, every low frequency noise source tested exceeded all of the regulatory standards noted in the Danish EPA report. Table 2 shows the Danish and Swedish regulatory exceedances of the different 35 dB nominal (full spectrum) noise.

Table 2: 35 dB(A) (nominal, 8 Hz-20KHz) Indoor Noise from Various Outdoor Environmental Sources

	Traffic Noise	Drop Forge	Gas Turbine	Fast Ferry	Steel Factory	Generator	Cooling Compressor	Discotheque
Noise	67.6 dB(lin)	71.1 dB(lin)	78.4 dB(lin)	64.5 dB(lin)	72.7 dB(lin)	60.2 dB(lin)	60.3 dB(lin)	67.0 dB(lin)
Noise ≥ 20 Hz	35.2 dB(A)	36.6 dB(A)	35.0 dB(A)	35.1 dB(A)	33.6 dB(A)	36.2 dB(A)	36.6 dB(A)	33.6 dB(A)
	62.9 dB(C)	67.3 dB(C)	73.7 dB(C)	61.7 dB(C)	66.0 dB(C)	58.6 dB(C)	59.0 dB(C)	57.8 dB(C)
Danish Environmental Protection Agency	14.5 dB	21.5 dB *	14.8 dB	15.0 dB	13.1 dB	16.1 dB	14.0 dB	18.0 dB *
Swedish National Board of Health and Welfare	14.1 dB	19.7 dB	15.9 dB	16.8 dB	15.5 dB	18.3 dB	16.0 dB	10.0 dB
* includes 5 dB "penalty"								

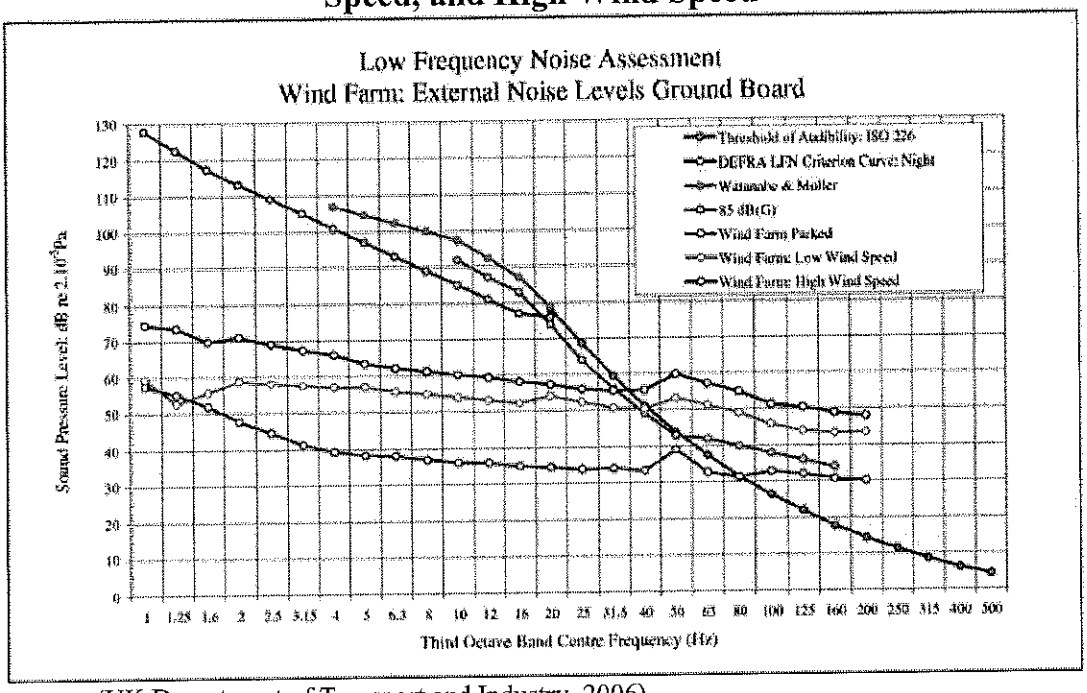
Noise adjusted to dB(lin), dB(A), dB(C) scales. Calculated exceedances of Danish and Swedish indoor criteria. (data from Danish Environmental Protection Agency, 2002)

In their noise guidance, the WHO (1999) recommends 30 dB(A) as a limit for "a good night's sleep". However, they also suggest that guidance for noise with predominating low frequencies be less than 30 dB(A).

3. Wind turbine sound measurements

Figure 8 shows examples of the SPLs at different frequencies from a representative wind turbine in the United Kingdom. Sound pressure level measurements are reported for a Nordex N-80 turbine at 200 meters (UK Department of Transport and Industry, 2006) when parked, at low wind speeds, and at high wind speeds. Figure 8 also includes, for reference, 3 sound threshold curves (ISO 226, Watanabe & Moller, 85 dB(G)) and the DEFRA Low Frequency Noise Criterion Curve (nighttime).

Figure 8: Low Frequency Noise from Wind Farm: Parked, Low Wind Speed, and High Wind Speed

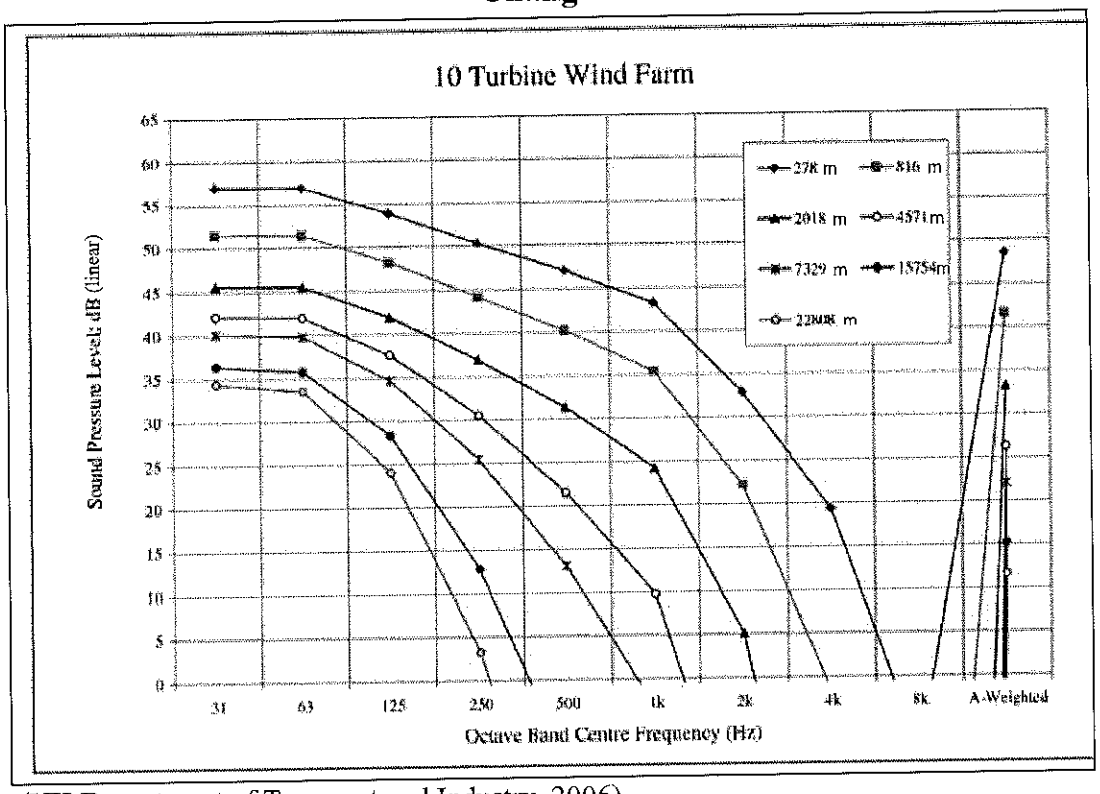


(UK Department of Transport and Industry, 2006)

In general, sound tends to propagate as if by spherical dispersion. This creates amplitude decay at a rate of about -6 dB per doubling of distance. However, low frequency noise from a wind turbine has been shown to follow more of a cylindrical decay at long distances, about -3 dB per doubling of distance in the downwind direction (Shepherd and Hubbard, 1991). This is thought to be the result of the lack of attenuation of low frequency sound waves by air and the atmospheric refraction of the low frequency sound waves over medium to long distances (Hawkins, 1987).

Figure 9 shows the calculated change in spectrum for a wind farm from 278 meters to 22,808 meters distant. As one moves away from the noise source, loudness at higher frequencies decreases more rapidly (and extinguishes faster) than at lower frequencies. Measurement of A-weighted decibels, shown at the right of the figure, obscures this finding.

Figure 9: Change in Noise Spectrum as Distance from Wind Farm Changes



(UK Department of Transport and Industry, 2006)

Thus, although noise from an upwind blade wind turbine is generally broad spectrum, without a tonal quality, high frequencies are efficiently attenuated by both the atmosphere, and by walls and windows of structures, as noted above. As a result, as one moves away from a wind turbine, the low frequency component of the noise becomes more pronounced.

Kamperman and James (2008) modeled indoor noise from outdoor wind turbine noise measurements, assuming a typical vinyl siding covered 2X4 wood frame construction. The wind turbine noise inside was calculated to be 5 dB less than the noise outside. Model data suggested that the sound of a single 2.5 MW wind turbine at 1000 feet will likely be heard in a house with the windows sealed. They note that models used for siting turbines often incorporate structure attenuation of 15dB. In addition, Kamperman and James demonstrate that sound from 10 2.5 MW turbines (acoustically) centered 2 km (1¼ mile) away and with the nearest turbine 1 mile away will only be 6.3 dB below the sound of a single turbine at 1000 feet (0.19 mile).

4. Wind turbine regulatory noise limits

Ramakrishnan (2007) has reported different noise criteria developed for wind farm planning. These criteria include common practices (if available) within each jurisdiction for estimating background SPLs, turbine SPLs, minimum setbacks and methods used to

assess impacts. Reported US wind turbine noise criteria range from: ambient + 10 dB(A) where ambient is assumed to be 26 dB(A) (Oregon); to 55 dB(A) or "background" + 5 dB(A) (Michigan). European criteria range from 35 dB(A) to 45 dB(A), at the property. US setbacks range from 1.1 times the full height of the turbine (consenting) and 5 times the hub height (non-consenting; Pennsylvania); to 350 m (consenting) and 1000 m (non-consenting; Oregon). European minimum setbacks are not noted.

VI. Conclusions

Wind turbines generate a broad spectrum of low-intensity noise. At typical setback distances higher frequencies are attenuated. In addition, walls and windows of homes attenuate high frequencies, but their effect on low frequencies is limited. Low frequency noise is primarily a problem that may affect some people in their homes, especially at night. It is not generally a problem for businesses, public buildings, or for people outdoors.

The most common complaint in various studies of wind turbine effects on people is annoyance or an impact on quality of life. Sleeplessness and headache are the most common health complaints and are highly correlated (but not perfectly correlated) with annoyance complaints. Complaints are more likely when turbines are visible or when shadow flicker occurs. Most available evidence suggests that reported health effects are related to audible low frequency noise. Complaints appear to rise with increasing outside noise levels above 35 dB(A). It has been hypothesized that direct activation of the vestibular and autonomic nervous system may be responsible for less common complaints, but evidence is scant.

The Minnesota nighttime standard of 50 dB(A) not to be exceeded more than 50% of the time in a given hour, appears to underweight penetration of low frequency noise into dwellings. Different schemes for evaluating low frequency noise, and/or lower noise standards, have been developed in a number of countries.

For some projects, wind velocity for a wind turbine project is measured at 10 m and then modeled to the height of the rotor. These models may under-predict wind speed that will be encountered when the turbine is erected. Higher wind speed will result in noise exceeding model predictions.

Low frequency noise from a wind turbine is generally not easily perceived beyond ½ mile. However, if a turbine is subject to aerodynamic modulation because of shear caused by terrain (mountains, trees, buildings) or different wind conditions through the rotor plane, turbine noise may be heard at greater distances.

Unlike low frequency noise, shadow flicker can affect individuals outdoors as well as indoors, and may be noticeable inside any building. Flicker can be eliminated by placement of wind turbines outside of the path of the sun as viewed from areas of concern, or by appropriate setbacks.

Prediction of complaint likelihood during project planning depends on: 1) good noise modeling including characterization of potential sources of aerodynamic modulation noise and characterization of nighttime wind conditions and noise; 2) shadow flicker modeling; 3) visibility of the wind turbines; and 4) interests of nearby residents and community.

VII. Recommendations

To assure informed decisions:

- Wind turbine noise estimates should include cumulative impacts (40-50 dB(A) isopleths) of all wind turbines.
- Isopleths for dB(C) - dB(A) greater than 10 dB should also be determined to evaluate the low frequency noise component.
- Potential impacts from shadow flicker and turbine visibility should be evaluated.

Any noise criteria beyond current state standards used for placement of wind turbines should reflect priorities and attitudes of the community.

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DEPARTMENT OF LICENSING & REGULATORY AFFAIRS
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MICHIGAN ENERGY OFFICE
STEVE BAKKAL, DIRECTOR

Readying Michigan to Make Good Energy Decisions

Michigan Energy Public Forum Statement Card

If you wish to speak today, please complete the following:

Name: Annette DuRussel

Affiliation (if any): IICC / Merritt Township, Bay County

Phone: 989-650-2084

Email: mtr-tsd@gmail.com

Topics you wish to address today:

a. ___ **Renewable Energy Portfolio Standards**

b. ___ **Energy Optimization / Efficiency Standards**

c. ___ **Electric Choice**

d. X **Other Additional Energy Topic**

(Please specify): wind energy developments at the township level

Please prioritize and focus your comments to afford as many as possible, the opportunity to speak. The amount of time allowed for each speaker will be dependent upon the number of people requesting to speak. Please prepare for the time limit for each speaker to be in the 2 – 5 minute range.

Please leave a copy of any written or electronic materials at the welcome center.

You are encouraged to submit written feedback at www.michigan.gov/energy.

Annette

Position Paper—Wind Turbines in Merritt Township

This position paper has been written on behalf of the concerned citizens of Merritt Township (in Bay County, Michigan) to maintain our "quality of life" which will be impacted by the establishment of a utility-scale wind turbine farm in our township. Wind turbines are not the issue.—The issue is "**safe distances**" from residential dwellings. Our concern is that sound public policy must require that we consider long-run effects and all people, not simply short-run effects and a few people. In Merritt Township, our current Zoning Ordinance (regarding wind turbine placement) does not meet the principles of a "sound public policy" because it fails to provide adequate protection of residents' health and environment.

Background

Some of our families live in the southeast corner of Merritt Township where NextEra (Boulevard Associates LLC) has recorded 50 property lease agreements in Bay County. In the 4 square mile section (with boundaries of Kinney Road, Munger Road, Nolet Road, and Brown Road) that we live, there will be potentially 14 wind turbines and an additional 2 to the southeast of this section to connect the wind farm to the power grid. From our estimates, approximately only 12 property leasers will be given wind turbines of the 50 leases recorded. This is our best estimate having not seen a completed survey map (8-27-11) or plot map.

On August 11, 2011, one of our concerned residents began driving house-to-house in the 4 square mile section on a "Good Samaritan" mission to inform the neighbors of the permanent change to their environment that is about to take place in May 2012. Of the 28 homes visited, only 3 were in favor of the wind farm. Twenty-four homes were either completely unaware of the impending change, were under the assumption that since there has been "no more talk" of the wind farm that the wind project had been terminated, were assuming that only 1-2 wind turbines would be erected, or that the placement of the wind turbines were to be near M-15 and not in our area; and 1 resident refused to take a position either for or against the project. To say the least, the neighbors are reeling in shock and disbelief over their impending fate.

Safe Distances

Concerned residents of Merritt Township have a quest to change the current ordinance adopted by the Merritt Township Board in Feb. 2010. The existing ordinance adopted the minimum distance recommended by NextEra which is a **1/4 mile placement from a residence**. This 1/4 mile placement is measured from the corner of a person's home, not from the property line. Thus, wind turbines potentially standing as tall as 466 feet, when blades are fully

extended vertically upward, will be placed 1,320 feet from the corner of a person's home. According to our research, this is not considered a safe distance from a residence. Our research recommends a **minimum distance of 1/2 mile up to just less than 2 miles from a residence.** With turbine placement this close to residents, ill health effects arise. The National Research Council (NRC) of the National Academies have noted that wind projects may have the most effect on health regarding noise and low frequency vibration, and shadow flicker. The NRC concludes that noise produced by wind turbines is generally not a major concern **beyond a 1/2 mile.** Low frequency noise generated by the turbines is primarily a problem that may affect some people in their homes, especially at night. Low frequency noise from a wind turbine is generally not easily perceived **beyond a 1/2 mile.** The noise from multiple turbines similarly distant from a residence can be noticeably louder than a lone turbine simply through addition of multiple noise sources. Under steady wind conditions, noise from a wind turbine farm may be greater than noise from the nearest turbine due to synchrony between noise from more than one turbine. ("Public Health Impacts of Wind Turbines" 22 May 2009 Minnesota Dept. of Health)

During the winter months, ice is an additional problem. **Ice** builds up on the blades when the blades are still and **is flung off** when the wind turbine's blades start spinning. Ice chunks have been found **as far as 1,500 feet** from the wind turbines. Catapulted ice has the potential to hit homes and residential property beyond the existing ordinance of 1,320 feet. ("A Problem with Wind Power" 5 Sept. 2006, Eric Rosenbloom)

According to the Minutes of the Merritt Township Town Hall Meeting, January 25, 2010, NextEra's representative, Scott Hawken, responded to questions posed by audience members with the following information: "Safe decibel level is one that does not exceed 45 decibels." **To the contrary,** the Environmental Protection Agency (EPA) recommends a day-night indoor average sound level of 45 decibels, and a night-time average level of **35 decibels** to protect against sleep disturbances. Adverse health effects are increased when sleep disruption is chronic, and sleep disturbance is repeatedly reported as a negative side effect from noise created by wind turbines. Excess noise is a leading quality of life issue in communities across the nation. Studies have linked noise exposure with increased gastric emptying, peristaltic esophageal contraction, anxiety, stress, increased aggression, less helpful behavior, physiological changes in sleep, elevations in blood pressure, and adverse cardiovascular effects. ("Noise in Our Community?" June 2003)

The most common complaint in various studies of wind turbine effects on people is annoyance or an impact on quality of life. Sleeplessness and headaches are the most common health complaints. With regards to shadow flicker, rhythmic light flicker from the blades of a wind

turbine casting intermittent shadows has been reported to cause headaches and nausea in many locations. With current wind turbine designs, most wind turbines' **shadow-flicker should not be an issue at distances over 0.6 mile** (which is 3,168 feet, not as close as 1,320 feet). **This distance** has been recommended by the Wind Energy Handbook (Burton et al., 2001) **as a minimum setback distance** in directions that flicker may occur. So, how much land is enough to prevent a wind turbine from having a negative impact on the neighborhood? The **National Academy of Science recommends a 2,600 foot setback, about ½ mile, from the nearest home.**

We have also discovered a document submitted by Ted Weissman, representative of NextEra, to the Executive Secretary Michigan Public Service Commission. See the website document: http://efile.mpsc.state.mi.us/efile/docs/15899/0063.pdf

In the document, Ted Weissman asserts the following positions, **and I quote**:

> Shadow-Flicker: Shadow-flicker should be modeled and limited to 30-40 hours per year per exposed household. Shadow-flicker, if it is an annoyance, can be eliminated by placing of trees, use of curtains or window shades, or other obstructions.

In the quote, Mr. Weissman, a representative of NextEra, **ADMITS** that **shadow-flicker DOES EXIST**. He suggests that residents with shadow-flicker annoyance can eliminate it by: 1) planting trees (Who is going to be responsible for selecting the variety of tree, planting the trees, at whose expense, and on whose property?) and 2) using curtains or window shades [What if the resident does not have curtains or shades on his/her windows before the wind turbines are erected? Who is going to be responsible for selecting, buying, and installing the curtains/blinds? What if the resident does not want to close existing curtains or shades on his/her windows because s/he likes the view of his/her property seen through the window and routinely (past precedent) never closed the curtains/blinds prior to the construction of the wind turbine? Should a resident be forced to adjust his/her quality of life in an effort to diminish an annoyance upon his/her property created by and produced by an intrusion of a business's operation, when the resident previously enjoyed his/her quality of life prior to the operation of a wind turbine?]

These findings generate additional rational questions: If the wind developer causes the problem, should the wind developer fix the problem? Should it fall on the resident (victim) to maintain his/her previous quality of life? The suggestions and solutions put forth in this document by NextEra's representative, Ted Weissman (who has attended meetings in Merritt Township) do not address the costs and other variables associated with solving shadow-flicker.

Should an industry be allowed to shift some of its costs of doing business to others? Does an industry, which acknowledges a negative side-effect (shadow-flicker) associated with its operation, have the right to **establish**, conduct, operate, and **profit from** its business in a location where the negative side-effect has a potentially high-risk of manifestation, thus diminishing the quality of life of near-by property owners? **Does not** an industry, which acknowledges a negative side-effect (shadow-flicker) associated with its operation, have a legal obligation to near-by property owners to conduct its operation so as to not be a public nuisance? Does an industry, which acknowledges a negative side-effect (shadow-flicker) associated with its operation, have the right to force a near-by resident/property owner to **TOLERATE** a condition which negatively impacts his/her quality of life?

Residents in Huron County filed a lawsuit in May 2010 against the companies responsible for the Ubly area Michigan Wind I development. The plaintiffs are seeking in excess of $25,000 and an injunctive relief ordering the companies to cease and desist their activities citing a loss of property value and quality of life as a result of the wind farm. The defendants' actions resulted in the existence or creation of a hazardous or dangerous condition to plaintiffs and other members of the general public. Plaintiffs, during previous county board of commissioners and planning commission meetings, asked the county to amend its wind zoning ordinance so others in the future are not negatively affected as they say they have been. In October of 2005, a petition was submitted which asked for a review of the overlay zoning amendment, which was adopted by the county in the summer of 2005. The group supporting the petition claimed it was not an attempt to stop a wind park from being developed in the Ubly area. Instead, it was intended to create "better and more fair zoning for all citizens of Huron County. ("Residents Sue Wind Companies," 7 June 2010, *Huron Daily Tribune*)

The lawsuit claims the wind companies had a duty to use reasonable care in the design and construction of the wind farm, **specifically in relation to selecting turbine locations**. The wind companies ignored available data regarding the probability of negative health effects associated with placing the turbines in close proximity to the plaintiffs' homes. The wind companies "negligently, carelessly and recklessly" sited the wind turbines in a way that increased the negative health effects and other damages. The wind companies carelessly and recklessly failed to construct the turbines at a **safe distance from the plaintiff's residences** and failed to exercise reasonable care to prevent an unsafe condition and unreasonable risk of harm, thus resulting in the negligent design of its wind farm. ("Residents Sue Wind Companies," 7 June 2010, *Huron Daily Tribune*)

The lawsuit claims the wind companies made false representations in board of commissioner and planning commissioner meetings and public hearings when company representatives said

the wind farm's operation would not result in a noise nuisance or cause adverse health effects to adjacent landowners. While seeking approval to construct a wind turbine farm in Huron County, the wind companies had a duty to use reasonable care to provide Huron County and its citizens with both accurate and complete information. The wind companies provided inaccurate and/or incomplete information about the audible turbine noise levels, and no information about low frequency noise, infrasound and/or impulse noise emitted from the turbines. **Huron County relied on the information from the wind companies when approving the project.** ("Residents Sue Wind Companies," 7 June 2010, *Huron Daily Tribune*)

The plaintiffs claim they have property rights and privileges with respect to the use and enjoyment of their property, and the defendants interfered with those rights by creating, through the operation of the wind farm, "significant and material intrusions upon the plaintiffs' property." Intrusions detailed in the lawsuit include: amplitude modulation, low frequency noise and subaudible infrasound, a flicker/strobe light effect that covers the plaintiffs' properties when sunlight passes through the rotating turbine blades, and/or impulse noise created by and emitted from the wind turbines, which **range as close as 1,100 and 1,700 feet away from each plaintiff's home**. The plaintiffs suffered increased harm to their health and well being that resulted from the close proximity of the turbines to their primary residences. Physical harm and negative health effects listed in the lawsuit included: inability to sleep and repeated awakening during sleep, headaches, dizziness, stress and tension, extreme fatigue, diminished ability to concentrate, nausea, and other physiological and cognitive effects. The lawsuit notes the symptoms experienced by two plaintiffs' family forced the family to rent an apartment away from the wind farm in order to avoid the adverse health effects. ("Residents Sue Wind Companies," 7 June 2010, *Huron Daily Tribune*)

The June 4, 2009 *Huron Daily Tribune*'s article "Wind Park Complaints Considered" quotes several of the plaintiffs with regards to diminished quality of life. Two residents filing the lawsuit stated in a letter sent to Huron County officials May 15, 2009: "We thought it would be, as we were told from the beginning of the turbine project, 'no louder than a clothes dryer.'" . . . "Now we realize that no one wants to stand right next to a running clothes dryer 24 hours a day. This is the reality of it." . . . "Our family's ability to get a good nights' sleep is dismal, to say the least," . . . "The feeling we get from the spinning turbines is not only heard, but felt in our bodies as well." Other letters submitted by four Ubly residents, who are also plaintiffs in the lawsuit, to the Huron County commissioners in March 2009, reported problems of extreme noise increases and outside noise that resembles a distant jet with an intermittent whoosh sound. The residents' letter written on March 10, 2009 reads: "Inside our house, we have a low hum vibration that sounds like a truck running outside. This noise makes sleep difficult."

According to the Draft Eagle Conservation Plan Guidance U.S. Fish & Wildlife Service January 2011 (which is a guide for wind-facility projects starting from earliest conceptual planning phase), a high to moderate risk exists for eagles' survival when a wind turbine project is located within 10 miles of eagles' habitats. Thus, federal laws mandate that eagles are to be protected, and wind turbines should be at least 10 miles from their habitats. These findings lead one to a rational question: If the federal government of the United States of America provides for a **10 mile safe distance** for eagles' habitats, is a **1,320 ft distance** from a residential dwelling a sufficient, objective, research-based, non-threatening, safe distance for a human being, a **citizen** of the United States of America?

Florida Light and Power Drops Lawsuit against the Village of Lee, DeKalb County, Illinois

In September 2009, FPL Energy Illinois Wind, LLC filed a complaint on the ground that the Lee Village Board arbitrarily denied the company's application for permits for building six wind turbines. The company demanded approval of the permits and permission to construct. The lawsuit also sought monetary damages for delay. ("FPL Energy Illinois Wind Files Lawsuit Against Lee Village Board in DeKalb County Court" 18 Sept 2009, EBR Staff Writer) The attorney, Keith Foster, for the Lee Village Board had argued that the Board's denial was based on input it received from the wind company and after hearing potential reasons for denying the request during two public meetings. The attorney said the Board's reasons met the requirement for denying the permits. Mr. Foster said, "The reason would have to have a reasonable basis so any reason at all that is considered rational by an ordinary person would be a basis for denial." The village Board's reasons for the denials included feeling the 450-foot tall turbines would be too close to homes. ("Lee Wants Suit by Wind Farm Company Dismissed" 24 Sept 2009, NoWindFarm) Three months later in December of 2009, FPL dismissed/dropped the lawsuit. ("FPL dismisses lawsuit against Village of Lee" 25 Dec 2009, *Daily Chronicle, The DeKalb, IL*)

Size of Wind Turbines

To give you a perspective on the enormity of these wind turbines, here are a few comparisons. The wind turbines are called utility-scale turbines, which correspond to large turbines (900 kW to 2MW per turbine) intended to generate bulk energy for sale in power markets (see "Wind Turbine Technology Overview" online from powernaturally.org). They are 306 feet tall and blades are 160 feet long (michiganthumb.com "Incoming Turbine" 8-25-11). If you do the math, then the complete height of the structure is 466 feet tall with blade fully extended vertically upward. To put this in comparison for people, the Statue of Liberty from the base to the top is only 306 ft tall (dwarfed by the turbine by 160 feet), Niagara Falls is only 167 feet tall (dwarfed by the turbine by 299 feet), and the turbines would reach to the 38th floor of the Empire State Building (see "Wind Turbine Technology Overview"). Wind power stations/farms are not parks; they are industrial and commercial installations. ("A Problem with Wind Power" 5 Sept. 2006, Eric Rosenbloom)

Current Legislation

Our concerned citizens group met with Charles Brunner and Mike Green's representative with our concerns for the wind project. They informed us that there is currently **no legislation** in the state of MI governing the business of wind farms in relation to "safe distances" for setbacks from residential dwellings. Essentially, the wind farms have been given "free will" to do business as they "see fit" with no regulations from the state government. In essence, wind farm projects are an **unregulated industry** in Michigan. Along with this, legislation does not exist to protect citizens who are made to tolerate the permanent changes to their environment, whether or not they may suffer ill effects in the future from the wind turbines. We are left on our own to fight for our rights against the wind turbine company.

Agricultural Impact: Loss of Crop Dusting Services for Farmers

One of the major concerns for the local farmers who have not signed property leases with NextEra (and perhaps some who have signed leases and simply are not yet aware of this negative impact on farming) is the **inability to use aerial spraying** (crop dusters) to control disease and pests in the fields near the wind farm once the wind turbines are erected. Proximity to wind turbine towers will prevent area farmers from receiving this service. The cost to farmers could be lost crops, lost revenue, and increased cost to control pests and disease by the use of **ground** application of farm chemicals in place of aerial spraying. Aerial spraying is considered necessary to apply fungicides to increase crop production and can provide a more timely service to farmers when time is a factor in controlling fungal growth. Farmers are

concerned about the potential financial losses and will want to know who will "make good on their losses." ("Wind Turbine vs. Crop Dusters again," 29 Mar 2010) The local crop duster pilot, who flies out of the Caro airport, informed one of our concerned residents that he is unable to fly within a 3/4 mile of wind turbines due to turbulence; thus, a potential area of 13.375 square miles will no longer be able to receive crop dusting services in Merritt Township.

Disruption of Current Aircraft Flight Paths

The local crop duster pilot also informed one of our concerned residents that the Caro airport manager has "fought off" wind turbine projects from his airport within a 10 mile radius. The wind farm project in Merritt Township is within 10 miles of both Clements and Brown airports. We are unaware as to whether or not Clements and Brown airports know about the closeness of the incoming wind farm.

One of our concerned residents spoke with the head of the MDOT Aeronautics Division in Lansing, MI. We learned that aircraft must fly 1,000 feet above the highest obstacle; thus, any aircraft using the airspace above the southeast corner of Merritt Township must now fly at a minimum of 1,466 feet. It is well known in our area that our airspace is used as a direct flight path for St. Mary and Covenant helicopters on emergency runs into the Thumb area. The airspace is regularly used by the military in route from Detroit to Grayling. The airspace is also regularly used for pilot training from Brown airport and a local Frankenmuth airport. Additionally, a personal airstrip is located on Finn Road, which has its east end (take-off and landing end) within 1 mile of the wind turbines.

Radio, TV, & Cell Phone Reception Interferences

Other factors concerning the local residents include interference with radio, TV, and cell phone reception. The American Wind Energy Association (AWEA) **readily admits** on its website that wind turbines can interfere with television, radio and cell phone signals, particularly when the turbines are located between the transmitter and receiver. The AWEA suggests that cable or satellite would be reasonable alternatives but, in some locations, neither of these are possible because the area is not serviced by cable and some of us may have line of site issues with satellite. (www.ppdlw.org/bwrs_cell.htm) Even so, should the financial burden fall on the residents to pay an additional $30 or more per month for the rest of their lives to maintain the current quality of life? If the wind project causes such a problem . . . the wind developer should be made to fix the problem without cost to the homes affected. Should an industry be allowed to shift some of its costs of doing business to others? Currently, some homes in the area do not have cable or satellite TV reception; the homes receive digital signals through a converter box.

Public Safety and Emergency Response

Additionally, the 100 or 150 foot rotating blades of wind turbines create interference with microwave link radio equipment used by firefighters, rescue teams, and EMTs. This poses a public safety hazard since these people are dispatched using radios and coordinate their efforts via radio. In the event of a fire call, the interference from the turbines could limit or eliminate critical communication between firefighters from neighboring departments. The cost of the solution should not fall upon the taxpayers. Public safety should be first and foremost in civil servants' consideration when adopting public policy. (www.ppdlw.org/bwrs_cell.htm)

An additional concern for local area firefighters should be how to fight a fire that is 306 feet in the air. Will our volunteer firefighters in Merritt Township be equipped and trained to fight a fire at such an elevation? When a 154,300 pound wind turbine generator starts on fire at 306 feet above ground in mid-to-late July in a dried down wheat field or in the middle of Sept. or Oct. in a dried-down soybean/corn field, will the firefighters have any chance of saving a home that is within 1,320 feet of the wind turbine? On a windy day, the fire would spread quickly, and the turning blades could potentially exasperate the fire. We are not talking about a stationary transformer on a utility pole outside a person's home which seldom catch on fire and are approximately only 30 feet above ground. We are talking about a fire 306 feet above the ground within a 154,300 pound generator (michiganthumb.com "Incoming Turbine" 8-25-11) containing 200 gallons of oil in the turbine. The transformer at the base of each turbine contains up to 500 additional gallons of oil, and the wind turbine blades' tips moving at 178 mph to "fuel the fire." ("A Problem with Wind Power" 5 Sept. 2006, Eric Rosenbloom; http://nowindfarms.com/blog/wind-turbine-sound-abc-charles-gibson/) If you go online to http://nowindfarms.com/blog/, you can see a video clip of an actual turbine exploding and sending debris up to **½ mile away**. Many of the situations referred to in this position paper are also addressed on this website.

Decreased Property Values & Impact on Property Tax Revenue

Decreased property values are also a major concern. In Arcadia, MI, the residents are facing similar problems as Merritt Township residents in regard to wind turbine placement. According to the McCann Appraisal, LLC which evaluated the impact of wind turbines in Illinois, (arcadiawindstudygroup.org):

> 1. Residential property values are adversely and measurably impacted by close proximity of industrial-scale wind energy turbine projects to the residential properties, with value losses measured up to 2-miles from the nearest turbine(s),

in some instances. ***(Please note that Merritt Township Turbines will be utility-scale turbines, which ore larger than industrial-scale turbines)***

2. Impacts are most pronounced within "footprint" of such projects, and many ground-zero homes have been completely unmarketable, thus depriving many homeowners of reasonable market-based liquidity or pre-existing home equity.

3. Noise and sleep disturbance issues are mostly affecting people within 2-miles of the nearest turbines and 1-mile distances are commonplace, with many variables and fluctuating range of results occurring on a household by household basis.

4. Real estate sale data typically reveals a range of 25% to approximately 40% of value loss, with some instances of total loss as measured by abandonment and demolition of homes, some bought out by wind energy developers and others exhibiting nearly complete loss of marketability.

5. Serious impact to the "use & enjoyment" of many homes is an on-going occurrence, and many people are on record as confirming they have rented other dwellings, either individual families or as a homeowner group-funded mitigation response for use on nights when noise levels are increased well above ambient background noise and render their existing homes untenable.

6. Reports often cited by industry in support of claims that there is no property value, noise or health impacts are often mischaracterized, misquoted and/or are unreliable. The two most recent reports touted by wind developers and completed in December 2009 contain executive summaries that are so thoroughly cross-contingent that they are better described as "disclaimers" of the studies rather than solid, scientifically supported conclusions. Both reports ignore or fail to study very relevant and observable issues and trends.

7. If Adams County approves a setback of 1,000 feet, 1,500 feet, or any distance less than 2-miles, these types of property use and property value impacts are likely to occur to the detriment of Adams County residences and citizens for which the nearest turbines are proposed to be located.

8. The approval of wind energy projects within close proximity to occupied homes is tantamount to an inverse condemnation, or regulatory taking of private property rights, as the noise and impacts are in some respects a physical invasion, an easement in gross over neighboring properties, and the direct impacts reduce property values and the rights of nearby neighbors.

9. A market value reduction of **$6.5 million** is projected for the residential property located in the footprint and within 2-miles of the pending Prairie Mills project located in east Adams County.

In April 2011, two West Michigan legislators have introduced legislation to ban wind turbines in Michigan's Great Lakes. State Reps. Ray Franz and Jon Bumstead have proposed this House Bill because in Bumstead's words: "off shore turbines would diminish property values, create unacceptable views from shore, and are not cost effective." (West Michigan Lawmakers Propose Total Ban of Wind Turbines on Michigan's Great Lakes," 6 Apr 2011, *Muskegon Chronicle*) Therefore, if offshore turbines will diminish property values for onshore residents and create unacceptable views, it is quite obvious to conclude that property values for residents living only 1,320 feet from a wind turbine will have **even greater** diminished property values.

A document submitted by Ted Weissman, a NextEra representative, to the Executive Secretary Michigan Public Service Commission states the following position/claim. See the website document: http://efile.mpsc.state.mi.us/efile/docs/15899/0063.pdf

In the document, Ted Weissman asserts the following position, **and I quote**:

> 9. Property taxes are designed to distribute revenue from an industrial facility to provide for the general welfare. Approximately half of the property taxes go to local school districts. The large property tax bills paid by wind farms directly benefit all people in the region of the wind farm.
>
> (page 2)

Minutes from the Merritt Township Town Hall Meeting on January 25, 2010 state **and I quote**:

> Scott Hawken of Nextera Energy gave an overview of the proposed wind energy project. There would be 66 turbines total in Bay and Tuscsola Counties. The wind farm would be up and running by 2011. Nextera develops, constructs and operates the wind farm.
>
> The remainder of the meeting was devoted to answering questions by residents. Topics were as follows:
>
> - . . .
> - There is no connection between turbines and property values.
> - . . .

- Turbines will not be closer than 1400 feet to a habitable structure.
- . . .
- Government gives wind companies a Production Tax Credit. This credit in only received if turbines are running and operating. Wind farms can be profitable without tax credits.
- . . .
- A wind farm "should" reduce rates to consumers in the area.
- . . .
- There is no known problems of a turbine interfering with satellite dishes.
- . . .
- Safe decibel level is one that does not exceed 45 decibels.

We question the claims of the above quoted information provided by NextEra's representatives, Ted Weissman and Scott Hawken. The following paragraphs outline our concerns with regard to the validity and accuracy of such statements.

1. NextEra's First Assertion: Approximately half of property taxes go to local school districts from taxes levied on the wind farm.

   Inaccurate: Wind turbines are Industrial Personal Property which **can** be exempt from the 6 mill state education tax and also exempt from up to 18 mills levied for school operating purposes. (Michigan Taxes Department of Treasury, "Personal Property Tax Reductions and Related Michigan Business Tax Credits," www.michigan.gov) Furthermore, individual school districts receive payments from the State of Michigan on a per pupil basis—not on the basis of overall state revenue.

   Additionally, when property values decline (agricultural land and home values), the result is an automatic loss in the overall tax base resulting in less tax revenue for the township. Furthermore, since turbines can discourage home growth, a loss of future potential property tax revenue from these properties occurs. This loss of tax based revenue could very well exceed any tax income from the wind turbine project for the township.

   Currently, Governor Snyder is seeking a tax reform which would eliminate Michigan's industrial personal property tax completely; therefore futuristically, **no tax revenue income** would be collected for townships from the wind turbines.

(*Crain's Detroit Business*, 14 August 2011, "Snyder targets $800M biz tax: Communities want plan if personal property tax dies")

2. Contradiction: to The Environmental Protection Agency's (EPA) recommendations for night-time average. The EPA recommends a day-night indoor average sound level of 45 decibels, and a night-time average level of **35 decibels** to protect against sleep disturbances. Scott Hawken responded to questions posed by audience members at the January 25, 2010 town hall meeting in Munger, MI, with the following information: "Safe decibel level is one that does not exceed 45 decibels."

It is important to note that area/local utility rates **will not decrease** as a direct result of the wind turbines in Merritt Township. Instead, according to the *Huron Daily Tribune*, August 26, 2011, all electricity from the Merritt Township turbines will be sold to DTE in Detroit, MI. Furthermore, the electricity generated from this wind farm will not be utilized within our local unit of government (township) or surrounding area. Our township (Merritt) and Bay County receive electrical utility services from Bay City Light and Power and Consumers Power. Additionally, wind energy is a more costly source of power than coal and would not be financially viable without current federal tax breaks and subsidies. According to Dennis Hastert, retired Speaker, U.S. House of Representatives, *"Wind and solar today furnish less than 2% of our energy needs. Neither are cost effective when they stand by themselves, but must have government subsidies and tax credits to make them economically feasible. These costs are born by American taxpayers and energy users."* (http://nowindfarms.com/blog/) The tax reform that Governor Snyder is seeking would eliminate Michigan's industrial personal property tax completely. Such federal programs and governmental policies can withdraw financial support at any time bringing the wind turbines to a standstill.

Impact on New Home Construction: Water Line Debt Reduction Implications

Back in 1999/2000, a water line petition to bring city water to parts of Merritt Township was circulated by the residents. The waterline was voted through, and residents currently enjoy the benefits of city water. Residents were told by the Merritt Township Board that having city water would encourage growth potential in the local area of the water line. As more homes were built and tapped into the water line, the current pay-off amount for residents who were already connected would decrease over the 20 year period of the water line debt. With wind turbines in the area of the current water lines, these turbines will discourage growth and any future home construction. It would be highly unlikely that anyone would choose to build in the middle or on the fringe of a wind farm. Therefore, the water line debt **will not be reduced** as expected. In Huron County, the local government acknowledges property value destruction by

making it a virtue. A recent amendment to the County master plan states that wind farms are desirable because they **discourage residential development**. This leads to the logical question of what happens to the value of existing residential property. (http://www.thumbpower.net/wind%20farm%20community.htm)

Enbridge Pipeline

Furthermore, the Enbridge Pipeline is buried within the boundaries of the 4 square mile wind farm. In order to connect the wind turbines to the power grid, electrical wiring will have to be buried under the Enbridge Pipeline, which contains various substances at various times including gas, oil, and other petroleum based products. Part of the wind farm is on the west side of the pipeline, and part of the wind farm is on the east side of the pipeline; therefore, tunneling underneath the pipeline is a potential environmental hazard.

Ground/Soil Instabilities

As detailed in our *Proposed Amendments to Merritt Township Wind Turbine Ordinance* document, the southern section of Merritt Township contains numerous ground/soil instabilities. These existing instabilities are due to coal mine tunnels from two layers of coal, abandoned coal mine shafts, former strip mining, salt well drilling, and a definite abnormal geological formation under this area of Merritt Township (according to John Esch of the Michigan DEQ, Office of Geological Survey, Petroleum and Mining Geology Unit). The existing instabilities are yet another reason to amend the current wind ordinance regarding placement of wind turbines.

Agricultural Impact: Decrease of Bat Population to Control Insects

Another concern for local farmers would be the devastation of the local bat population. The moving blades cause a drop in pressure that makes the delicate lungs of bats suddenly expand, bursting the tissue's blood vessels. This is known as a barotraumas, and is well-known to scuba divers. Bats eat nocturnal insects including agricultural pests, so if wind turbines affected their population levels, this could affect the rest of the local ecosystems. ("Wind turbines make bat lungs explode" 25 August 2008 by Catherine Brahic) Estimating the economic importance of bats in agriculture systems is challenging, but published estimates of the value of pest suppression services provided by bats ranges from about $12 to $173/acre (with a most likely scenario of $74/acre) in a cotton-dominated agricultural landscape in south-central Texas. (1 April 2011 Vol 332 Science; www.sciencemag.org)

Property Deed/Conflict of Interest

Our land deed record search has made us aware of a lease agreement recorded (Feb. 23, 2011) in Merritt Township with NextEra by Tina M. Fleischmann (deed #02789-00345 6-56120 signed on Dec. 2, 2010) who is the current Merritt Township Treasurer. It is our belief that her lease agreement with the wind farm project is a conflict of interest. She is a voting member of the Merritt Township Board who has been given two proposed amendments to Merritt Township Wind Turbine Ordinance for consideration regarding the wind farm project. The proposals have been submitted by the concerned group of residents to the Zoning Board; and one of the Zoning Board members, Jim Peplinski, then submitted the proposed amendments to the Merritt Township Board. Essentially, the proposed amendments seek either (1) a "No Wind Zone" along the south and south-east borders of the township (similar to what already exists in neighboring Portsmouth Township) to promote growth on the water line district in an effort to reduce the water line debt or (2) a "Safe Distance of ½ Mile from Residential Dwellings" as opposed to the current ¼ mile.

Conclusion

The following quote from the Arcadia (MI) Wind Study Group conveys our similar position:

> *Our communities are at a crossroads. We are working to inform members of our community about the critical choices presented by industrial wind power. Contrary to what wind developers would have you believe, this massive project is not inevitable. Our townships do not have an obligation to permit so many wind turbines to mar our beautiful landscape. A few property owners cannot take from their neighbors. The law and the people are on our side. This fight is too important to lose. We will not get a second chance, and failure is not an option. Thank you for your consideration.*
>
> (http://arcadiawindstudygroup.org/needtoknow/)

Our group is not concerned with the elimination/exclusion of the wind farm. We are focused on achieving a "safe distance" from residential dwellings. If the wind farm is coming to our environment, then we want public policy which assures and guarantees that the wind turbines will be safe for our health and homes and maintain our current quality of life. The next Zoning Board meeting is on Tuesday, Sept. 6, 2011 at 7:30 P.M. at the Merritt Township Office in Munger, MI. We are hoping to have the Merritt Township Board move on one of our proposals for the safety of its residents.

For personal testimonials on the daily life of living in the footprint of a wind turbine farm constructed by NextEra in DeKalb, Illinois visit: http://lifewithdekalbturbines.blogspot.com/

This document is the property of representatives for the group "Merritt Township Residents for Safe Distances." Editing, modifying, or altering this document in any way is strictly prohibited. (9-9-11)

Wind Turbine Information

Safe Distances

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Size of Wind Turbines

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- Driessen: Wind Down Wind Subsidies http://www.washingtontimes.com/news/2012/jun/6/wind-down-wind-subsidies/
- Do Alternative Energy Sources Displace Fossil Fuels? http://www.nature.com/nclimate/journal/v2/n6/extref/nclimate1451-s1.pdf
- Impacts of Wind Farms on Land Surface Temperatures http://www.nature.com/nclimate/journal/vaop/ncurrent/full/nclimate1505.html
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Merritt Township Public Hearing for Special Land Use Permit
February 21, 2012

Presentation of Annette DuRussel, Merritt Township Resident, Bay County, MI

Gentlemen, I am speaking to you tonight on behalf of the Merritt Township Residents for Safe Distances. And, I speak to you on behalf of the 452 residents (452 residents) who have signed our petition opposing the issuance of a Special Land Use Permit to NextEra in order to protect the current "quality of life" that we enjoy in our home town. We speak to you with ONE VOICE.

We want to begin tonight with a brief history. Just over two years ago, NextEra sent in representatives from Florida and Iowa for the purpose of planning and building an industrial wind turbine project in Merritt Township. At that time, Merritt Township residents asked WHY NextEra would be interested in this area since it is SO densely populated compared to other areas where NextEra has built. NextEra admitted that Merritt Township is one of the most densely populated areas that it has ever considered for an industrial-overlay. However, NextEra said that it felt this area could be financially profitable for its company, and the representative said it would be financially profitable for the Township as well. Two years later, the public has learned that Merritt Township will only receive about $1,000 per year, per turbine, over a 30-year average (the projected life of the wind farm). Merritt Township is being asked to carry the majority of the burden, yet, will receive an extremely small financial benefit.

NextEra also told Merritt Township that it is a "high wind zone" which is highly desirable by wind turbine companies. However, a map prepared by The MSU Land Policy Institute has revealed that Merritt Township's **wind power resource potential** is classified as "Marginal," essentially with a ranking of only 2 on a scale of 1 to 7, with a 7 being the highest wind power potential. If Merritt is not a "high wind zone" area like NextEra claims, then why would it select Merritt Township for its industrial turbine site? After speaking with a member of the Michigan Energy Committee, Merritt Township residents learned that the answer is that it is much cheaper for wind developers to build in Merritt Township than in clearly identified "high wind" areas in the State **north** of Bay County because of the **existing power grid infrastructure** that already exists in Merritt Township. Our township already has two sets of high voltage transmission-line towers and cabling that cross our small community. In fact, Merritt contains more power grid infrastructure than any other township our size in the State of Michigan. Therefore, NextEra will not have to spend as much of its own money to lay cabling and create new infrastructure. Based on this information, the public can now conclude that the real reason that NextEra comes to Merritt Township is NOT because we have the "best wind;" but because by building here, NextEra will gain the "best profits."

As the Board is faced with this historical decision tonight, you will encounter some proFIT-seekers who will try to tell you what your job is . . . First, some may try to convince you that your decision tonight should revolve around some temporary jobs that this project might create for their own personal benefit. However, this is not a "Jobs Bill," or a jobs decision. It is a zoning decision that will affect the residents for the rest of their lives on a daily basis.

Second, others will try to confuse you and convince you that you are obligated to permit wind energy developers, like NextEra, to establish industrial wind farms in your township anywhere they so choose. However, the State has left it up to the local units of government to establish its own wind zoning ordinances to regulate industrial wind turbine locations in each township. A State mandate does NOT exist concerning industrial wind turbine placement within townships. **In reality, only the energy companies have a mandate.** The energy companies' mandate is to have 10% renewable energy resources by 2015. However, our local utility companies, Bay City Electric Light and Power and Consumers Energy have already met their renewable quotas (or are on tract to meet them) without this turbine project. All of the electricity generated from this project will be sold to DTE in Detroit.

Third, some landowners will try to convince you that there is something wrong with you if you do not approve this Special Land Use Permit. They will call you biased and say that you are unworthy to serve on the Board. Don't listen to them. They don't understand that a Special Land Use Permit is discretionary, and that a Special Land Use Permit is **not a "right."**

Let's talk about "rights."—Some landowners who have signed leases with NextEra also like to talk about their "rights as landowners" to do whatever they want to with their property. They say that their rights will be violated if they are not allowed to have an industrial turbine on their land. However, nothing could be further from the truth . . . If having an industrial turbine on their property was indeed an actual "right"—Then, these landowners and NextEra would not have to be here tonight asking your approval. The reason they must ask permission is because the land is zoned agricultural; therefore, the land is not normally "expected" to have this type of industrialization placed upon it. The landowners KNEW their land was zoned agricultural when they bought it—it was NOT zoned "industrial." Therefore, the **right** to build industrial structures was never given to these landowners at any point.

Furthermore, IF the Board was to approve the Special Land Use Permit, essentially granting a "special right" to these landowners to have turbines, this could NOT be done without taking away the rights of other residents. The "rights" that would be taken away from other residents are:

- the "right" to enjoy the quiet, rural nature of our community
- the "right" to a good night's sleep
- the "right" to the scenic views currently unobstructed by industrial turbines
- the "right" to aerial spraying of farm fields
- the "right" to maintain current property values, etc. The list goes on and on.

There will be a ripple effect. Adding an industrial overlay to our rural community will come at a price of diminishing the "quality of life" of our residents who will be negatively affected by such a decision.

The Planning & Zoning Board does have the RIGHT to deny a Special Land Use Permit. Do not listen to those who will try to scare you into voting to approve this Permit. When a wind developer does NOT submit a complete application and criteria have NOT been met to protect the health, safety, welfare, and property values of residents, the Board has a legal right to deny such a permit.

The following are reasons to reject the special land use permit:

1. **Health, safety, and welfare of residents** should always be the primary factor in consideration of a "special use permit" for any township.
    - The MI Zoning Enabling Act states, for special land uses "the standards shall also insure that the land use or activity is consistent with the public health, safety, and welfare of the local unit of government."
    - At the NextEra Open House in Munger, NextEra provided a printed document (prepared by Berkeley National Lab) concerning the impact of wind turbines on residential property values in the United States. It was interesting to note that in this document ONLY 1% of the homes used in the study were located less than 3,000 ft. of a turbine. The other 99% of the study was for homes located beyond ½ mile—between 3,000 ft. and up to "greater than 5 miles" from a turbine! It must be understood by the Board that this wind project consisting of 9 turbines **will impact 104 homes** that are located in the "footprint" of the wind project—meaning 104 homes are located within 1 mile of a wind turbine for the benefit of 6 landowners. The 104 homes are located on roads as

follows: 3 on Colberg Rd., 5 on Farley Rd., 7 on Briggs Rd., 10 on Brown Rd., 11 on Cotter Rd., 12 on Kinney Rd., 15 on Markel Rd., 18 on Nolet Rd., and 23 on Munger Rd. One hundred four homes are located in Ground Zero.

- These 104 homes will be affected by wind turbine low frequency noise, which causes sleep disturbance at 45 decibels; ice throws that have been documented up to 1,600 feet; shadow flicker; visual obstruction, etc.

2. **Tuscola Bay Wind LLC's "Application for Special Use Permit" was INCOMPLETE**
   - The original application submitted at the Jan. 3, 2012 Planning & Zoning Board meeting did not contain a submittal date on the document. When a resident asked what the submittal date was, Spicer answered, "Dec. 30, 2011." This was one day past the due date of Dec. 29, 2011 that the township had set as the deadline for submittal. Furthermore, on the Special Hearing Notice mailed to residents, the submittal date was listed as Dec. 22, 2011. These are inconsistent dates; therefore, which is the legal submission date?
   - **Site Plan Copies Not Submitted as Required.** See Page 1 of the Application, "Completed Application must include all fees, a site plan application along with 10 full size copies and 1 reduced copy of site plan." The "official" site plan, submitted December 30, 2011 did NOT have 10 full size copies of the site plan included. Furthermore, at the January 3, 2012, Planning & Zoning Board Meeting, Spicer did not have 10 full size copies of the site plan for the members of the Board or the township office.
   - The application lacks ALL required federal, state, and local approvals and permits. On Page 2 and 3 of the Application, over half of the approvals and permits are not complete. A "Special Use Permit" should not be issued based on promises by Tuscola Bay Wind to get these approvals/permits "later." If there are "problems," the Township should know about these problems **before** a Special Use Permit is issued. For example, Tuscola Bay Wind submitted its application for a permit from the MDEQ requesting approval of 18 wind turbines (on Jan. 12 and Jan. 25, 2012) when it only requested 9 wind turbines on Jan. 3, 2012 from the Township.
   - The application contains a declaration page of insurance for NextEra; however, the application itself names the developer as Tuscola Bay Wind LLC. The application does not contain any declaration page of insurance for Tuscola Bay Wind LLC. Therefore, the application is incomplete with required insurance documentation.
   - The application also **does not contain the required legal descriptions of each leased parcel to be used in the project**. The ordinance has a requirement that all leased parcels being utilized in the project must be listed in the application; therefore, the application is incomplete.
   - **Overstatement of Sections Required for Project**: The application is also incomplete because there is not a clear determination of leased parcels that are to be included in this wind project. The Dec. 30, 2011 boundary map contained 30 sections of leased parcels instead of the 9 sections necessary for the project.
   - **Missing Leased Parcels**: Then, Merritt Township residents identified 8 leased parcels from the original Oct. 2011 map which were not on the Dec. 30, 2011 boundary map.
   - **More missing leased parcels**: Furthermore, the boundary map submitted Dec. 30, 2011, contained leased parcels not shown on the boundary map of Feb. 14, 2012, in the 9 remaining sections targeted by Tuscola Bay Wind.

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- **Leased parcels that need to be removed**: In the 9 remaining sections identified on the boundary map of Feb. 14, 2012, Tuscola Bay Wind is still including additional leased parcels that will not contain any wind towers or components necessary for this wind project. These additional leased parcels will need to be removed from the boundary map just as the 21 sections were removed on the new boundary map of Feb. 15, 2012. If these leased parcels are not removed from the boundary map, then these parcels will be vested into this project just as the 21 sections would have been vested into this project.
- In the application, Tuscola Bay Wind inaccurately identifies our township as **Gilford Township** on page 3 of the document in reference to "Promoting the intent and purpose of the zoning ordinance." Which begs the question, is Tuscola Bay Wind even referencing Merritt Township's ordinance?

If the Board WOULD choose to grant the special land use permit to Tuscola Bay Wind, the following are conditions that the residents request the Board write into the special land use permit to protect the **nonparticipating** landowners and **nonparticipating** residents within Merritt Township. The full text of these conditions has been submitted to the Board at the Jan. 3 and Feb. 7, 2012 Board meetings.

1. For nonparticipating residents, **prior to construction**, require a sound test of **current sound conditions,** by an independent third party selected by Merritt Township officials. Costs associated with the sound test must be paid by Tuscola Bay Wind.
2. Existing, available computer technology must be installed and operational (at the developer's expense) for any residential, non-participatory property where the potential for shadow flicker may occur; the technology will stop/turn-off the wind turbine when it is causing shadow flicker for the residential property.
3. Tuscola Bay Wind, at its own expense, must install and utilize the existing technology on each turbine which allows the night lights to be turned on only when approaching aircraft is detected. Thus, the wind turbines will not be continually lit throughout the entire nighttime hours but only when aircraft is within close proximity to the wind tower.
4. Tuscola Bay Wind will pay for testing of TV, internet, and radio reception for nonparticipating residents **prior to construction** and pay to correct degradation of TV, internet, and radio signals after construction.
5. If **decibel levels permissible under the ordinance are exceeded** on a nonparticipating residential property, the burden of proof will fall upon Tuscola Bay Wind LLC, not on the affected resident, and the developer must correct the problem to the satisfaction of the resident.
6. If **shadow flicker** and/or **low frequency vibration** occurs on a nonparticipating residential property, the burden of proof will fall upon Tuscola Bay Wind LLC, not on the affected resident, and the developer must correct the problem to the satisfaction of the resident.
7. Prior to any construction, Tuscola Bay Wind must provide the residents and the Merritt Township officials with peer-reviewed science which proves Tuscola Bay Wind's 1400 foot setback from homes is safe for the health, safety, and welfare of the residents.
8. Dust control standards must be maintained on job sites at all times during construction.
9. Any heavy equipment and machinery (including trucks) used in the construction process may not be operational on or near the job site prior to 7:00 A.M. and must leave the job site by 7:00

P.M. on Monday-Friday and on Saturday from 7:00 A.M. to 3:00 P.M. Construction is not allowed on Sundays under any circumstances.

10. Merritt Township officials must create a system of disciplinary action outlining violations and fines for noncompliance with the special land use permit conditions.

As you know, your Board is faced with a decision that will forever affect the "quality of life" for residents in Merritt Township. According to the State Representative's Office and the State Senator's Office, the reason that decisions like these are left at the local level is because local zoning and land-use decisions are best decided by those who actually live in the township themselves. There is the thought that if you live here, you will take care of your own. You will take care of the health, safety and welfare of your own people better than anyone else would. The residents of Merritt Township are hopeful that you will hear our "voice." The quiet, rural, agricultural nature of this area is what makes it appealing to all residents who make Munger their home town. An industrial over-lay will forever change the history, character, and attractiveness of this area. Please consider the "quality of life" that we currently enjoy that money cannot buy—It is the reason why we choose to move here, live here, and stay here.

Finally, we submit 3 more petitions tonight with an additional 20 signatures for a final total of 452 signatures. Thank you for allowing us the time to present this evening.

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CUSTOMER DRIVEN. BUSINESS MINDED.

DEPARTMENT OF LICENSING & REGULATORY AFFAIRS
MICHIGAN PUBLIC SERVICE COMMISSION
JOHN D. QUACKENBUSH, CHAIRMAN

STATE OF MICHIGAN

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MICHIGAN ENERGY OFFICE
STEVE BAKKAL, DIRECTOR

Readying Michigan to Make Good Energy Decisions

Michigan Energy Public Forum Statement Card

If you wish to speak today, please complete the following:

Spoke before

Name: Kevon Mavis

Affiliation (if any): IICUSA

Phone: _____

Email: Kevon@KevonMavis.com

Topics you wish to address today:

a. X Renewable Energy Portfolio Standards

b. ___ Energy Optimization / Efficiency Standards

c. ___ Electric Choice

d. ___ Other Additional Energy Topic

(Please specify): _____

Please prioritize and focus your comments to afford as many as possible, the opportunity to speak. The amount of time allowed for each speaker will be dependent upon the number of people requesting to speak. Please prepare for the time limit for each speaker to be in the 2 – 5 minute range.

Please leave a copy of any written or electronic materials at the welcome center.

You are encouraged to submit written feedback at www.michigan.gov/energy.

Good afternoon. Thank you to Commissioner Quackenbush and Director Bakkal for the opportunity to share our perspective on energy policy. My name is Kevon Martis and I am the director of the Interstate Informed Citizen's Coalition of Blissfield, MI. We are a non-profit dedicated to promoting science based energy policy instead of policy promoted by special interests. We are funded by tiny donations from across the state. We are a statewide coalition and are strongly bi-partisan. I estimate that roughly 40% of our supporters are self-described liberal environmentalists and 60% free market Republicans. And together we have come to one conclusion: wind is an ineffective means to produce cheap, abundant and reliable power; and, among all possible methods for reducing fossil fuel emissions, is among the least economical means to do so.

On that second point, how do we know? Simple: If you listen to the people speaking in support of wind energy today they will tell you that wind mandates create jobs, increase tax base, promotes economic development and is inexorably getting cheaper all the time. And they would love for us to argue those points because they know the answer to the only question that really matter is devastating to their cause, namely: Is wind the cheapest means of reducing CO2 emissions? If it was, you can be certain they would lead with that answer at every opportunity. But they never do. Anywhere. Because it isn't even close.

In so many ways this debate about whether wind can live up to the claims of it well-heeled boosters comes down to reliable sources versus sources with a bias. Fortunately for my cause, the truth will always out and from the most interesting places:

Maybe James Hansen, climate change activist has it right:

> "Suggesting that renewables will let us phase rapidly off fossil fuels in the United States, China, India, or the world as a whole is almost the equivalent of believing in the Easter Bunny and Tooth Fairy." Yes, *that* James Hansen

Or how about AWEA board member, German utility grid operator and wind developer E. On Energy, the same firm that operates the Wildcat I wind plant in Indiana from which Holland MI bought their cheap PPA:

> "Wind energy is only able to replace traditional power stations to a limited extent. Their dependence on the prevailing wind conditions means that wind power has a limited load factor even when technically available.... Consequently, traditional power stations with capacities equal to 90% of the installed wind power capacity must be permanently online [and burning fuel] in order to guarantee power supply at all times"
>
> http://www.nerc.com/docs/pc/ivgtf/EON_Netz_Windreport2005_eng.pdf

But my favorite case of "golly how the truth will out" is from an Obama Whitehouse briefing memo dated 10/25/2010 where Carol Browner, Ron Klain and Larry summers submitted this document in the Appendix:

(Read Appendix)

There you have it-from impeccable sources. James Hansen, AWEA board member E. ON and even the Obama administration concede that wind energy produces electricity at well above market price and replaces very little fossil fuel generation. Worse, its carbon reduction costs are 6 times the US government's estimates of true value- and are wholly dependent upon taxpayer subsidies.

1.8 Billion in Thurs to ~~[illegible]~~ create 200 MW Generation

If Governor Snyder is serious about having a "no regrets" energy policy, the let us be determined to once again base our energy policy upon real science and sound economics, not child-like faith in fairy tales.

Kevon Martis
Director
www.iiccusa.org

1.8 Billion spent in thurs to create a system of turbine & wires that function as a 200 MW generation & retire coal plants

~~[illegible]~~ 1.8 Billion in CCGT would permanently close 19% of DTE's coal fleet

Every dollar spent on wind generation could deliver 5X - 10X the emission benefit if spent on CCGT & slash emissions

Appendix: Shepherds Flat Loan Guarantee

The Shepherds Flat loan guarantee illustrates some of the economic and public policy issues raised by OMB and Treasury. Shepherds Flat is an 845-megawatt wind farm proposed for Oregon. This $1.9 billion project would consist of 338 GE wind turbines manufactured in South Carolina and Florida and, upon completion; it would represent the largest wind farm in the country. The sponsor's equity is about 11% of the project costs, and would generate an estimated return on equity of 30%.

- Double dipping: The total government subsidies are about $1.2 billion.

Subsidy Type	Approximate Amount (millions)
Federal 1603 grant (equal to 30% investment tax credit)	$500
State tax credits	$18
Accelerated depreciation on Federal and State taxes	$200
Value of loan guarantee	$300
Premium paid for power from state renewable electricity standard	$220
Total	$1,238

- Skin in the game: The government would provide a significant subsidy (65+%), while the sponsor would provide little skin in the game (equity about 10%).

- Non-incremental investment: This project would likely move without the loan guarantee. The economics are favorable for wind investment given tax credits and state renewable energy standards. GE signaled through Hill staff that it considered going to the private market for financing out of frustration with the review process. The return on equity is high (30%) because of tax credits, grants, and selling power at above-market rates, which suggests that the alternative of private financing would not make the project financially non-viable.

- Carbon reduction benefits: If this wind power displaced power generated from sources with the average California carbon intensity, it would result in about 18 million fewer tons of CO2 emissions through 2033. Carbon reductions would have to be valued at nearly $130 per ton CO2 for the climate benefits to equal the subsidies (more than 6 times the primary estimate used by the government in evaluating rules).

BRIEFING MEMO

THE WHITE HOUSE
Washington

October 25, 2010

MEMORANDUM FOR THE PRESIDENT

FROM: CAROL BROWNER
RON KLAIN
LARRY SUMMERS

SUBJECT: Renewable Energy Loan Guarantees and Grants

Your advisors seek your direction on implementing the energy loan guarantee program. Three near-term risks characterize this program: rescission of non-obligated funds; criticism from Hill supporters and stakeholders for slow implementation; and making commitments to projects that would have happened anyway and thus fail to advance your clean energy agenda. In considering these risks, the Department of Energy supports a process that would limit OMB and Treasury review. OMB and Treasury support the establishment of clear policy principles for project review, recognizing that this may pose a risk that some program funds may not be obligated by the program's September 30, 2011 sunset date. We also believe you should consider working with Congress to reprogram loan guarantee funds for an extension of the Recovery Act's renewable grant program during the lame duck tax extenders debate. An expanded EDB, including Secretary Chu, will provide an opportunity to discuss the options described below with you tomorrow.

DISCUSSION

Background

The Recovery Act created two new programs to promote deployment of renewable power: the 1705 energy loan guarantee program and the 1603 grant in lieu of tax credit program.

1705 Energy Loan Guarantee Program: The Recovery Act appropriated about $6 billion to enable the government to pay for the credit subsidies associated with loan guarantees for renewable energy (and related) projects. The credit subsidy can be thought of as the premium that must be paid for the insurance the government provides in guaranteeing the loan for a project. This program was intended to address concerns about tightening credit markets for renewable projects. It represents a modification of the existing 1703 loan guarantee program, which supports innovative technologies and covers renewables, nuclear, and advanced fossil. To date, the 1703 program has not received appropriations for credit

Estimated Benefits of 1705 and 1603 to Renewables Developers: The combined effect of 1603 and 1705 lowers the cost of a new wind farm by about 55% and solar technologies by about half relative to a no-subsidy case (see appendix table 1). Renewables' intermittency problem limits the deployment of these technologies, which could be remedied by installing back-up capacity (likely increases the cost by 2 to 4¢/kWh). Past experience with the wind tax credit suggests that the 1603 grant and the associated tax credits could have a significant impact on new wind capacity. Appendix figure 1 shows (in shaded regions) the halt to new investment during the three times the wind tax credit expired since 1999.

Loan Guarantee Pipeline and Process: After receiving an application, DOE conducts extensive due diligence work on the technological, financial, credit, legal, contractual, environmental, and operational aspects of each project. This due diligence can take months to complete and often results in significant changes to the original transaction structure to mitigate identified risks. In addition to negotiating with the project sponsors, DOE also engages in a back-and-forth with OMB and Treasury, in particular after the deal package has been submitted for review. OMB review of DOE projects has averaged 28 calendar days since September 2009, and 17 business days for the 1 closing and 3 conditional commitments DOE has transmitted between August 1 and October 15 of this year. DOE notes that the back and forth consumes a significant amount of staff time, thereby making it challenging to move several transactions forward simultaneously. Policy review by Treasury and the White House has occasionally extended the amount of time a project is under review beyond the time taken by OMB to score a credit subsidy. Last week, DOE conducted an interagency preview of five projects, with the expectation that most of these could reach the conditional commitment stage within the next 4-8 weeks under the current review system. DOE currently has 35 projects in due diligence, and expects a significant number of new applications when two project solicitations close in the next few weeks. Since loan guarantee funds can only be obligated at closing, conditional commitments will need to occur in the first quarter of 2011 in order to close by September 30, 2011.

Legislative Implications

The Administration's approach to the renewable loan guarantee program and grants has implications for legislative activity, including the FY2011 appropriations (House mark is $0, Senate mark is $380 million for energy loan guarantee credit subsidies); the tax extenders bill in which some Members would like to extend the 1603 grant; and the FY2012 budget.

Risks Characterizing the Loan Guarantee Program

Rescission Risk: The 1705 loan guarantee program has been scaled back to about $2.5 billion after reprogramming for Cash-for-Clunkers (May 2009) and the state aid package (August 2010). There has been recent interest in rescinding unobligated Recovery Act balances to pay for other programs. DOE has obligated about 2.5% of the $2.5 billion in the 1705 program appropriations. An additional 9 projects have received 1705 conditional commitments, and if DOE closes these deals, the total obligations would be about $500 - $900 million.

and possible rejection. It is important to recognize that under such an approach, there is a risk that not all of the 1705 appropriation of $2.5 billion will be obligated by the program's sunset of September 30, 2011.

Pros

- Ensures the economic integrity of government support for renewables.

Cons

- Exposes the program to rescission risk through September 30, 2011.
- Some Members of Congress may criticize this effort to limit the application of the loan guarantee program. The White House will bear this criticism.

Option 3: Reprogram 1705 Funds for an Extension of 1603 Grant Program

The 1603 grant program expires on December 31, although the associated tax credits that could be converted into grants under this program do not sunset until December 31, 2012. A 2-year extension of the 1603 grant program through the sunset of the associated tax credits has a $2.5 billion tax score. The Administration could work with Congress during the lame duck on the tax extenders bill to reprogram the 1705 funds to pay for the 1603 extension. As a variant of this option, the funds could be reprogrammed to support other clean energy priorities, such as the 48C clean energy manufacturing tax credit.

Pros

- Moves funds to the 1603 program that has been much more effective in promoting renewable energy, and likely to have a more significant impact on renewable energy investment in 2011 and 2012.
- Reduces economic risks and the rescission risks identified above.

Cons

- Sen. Bingaman, who views 1705 as "his program," would strongly oppose.
- Could signal the failure of a Recovery Act program that has been featured prominently by the Administration.
- The reprogramming effort entails the risk that Congress accepts the 1705 rescission but fails to deliver the 1603 extension.

Option 4: Streamline and Accelerate OMB / Treasury Reviews with Project Prioritization

OVP supports an option that falls in possible middle ground between options 1 and 2. This approach would create an expedited deal review process, while not doing away with Treasury and OMB reviews altogether. One option to be explored would be to assign higher credit subsidy scores in order to reach faster agreement on the government's risk tolerance and to more quickly utilize the $2.5 billion in appropriated funds. In addition, this approach could prioritize deals with more favorable policy characteristics (e.g., deals with lower total government subsidies). This option would prevent the holding of the loan guarantee programs to a more rigorous policy standard in awarding stimulus funds than other Recovery Act programs. The focus would be on spending *all* remaining funds while maintaining the necessary risk avoidance and *prioritizing* policy issues where possible.

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Energy Office

MICHIGAN ECONOMIC DEVELOPMENT CORPORATION
MICHIGAN ENERGY OFFICE
STEVE BAKKAL, DIRECTOR

Readying Michigan to Make Good Energy Decisions

Michigan Energy Public Forum Statement Card

If you wish to speak today, please complete the following:

Name: Sara Bonnette

Affiliation (if any): _____

Phone: 989-892-7309

Email: sara.bonnette@sbcglobal.net

Topics you wish to address today:

a. ___ Renewable Energy Portfolio Standards

b. ✓ Energy Optimization / Efficiency Standards

c. ___ Electric Choice

d. ___ Other Additional Energy Topic

(Please specify): _____

Please prioritize and focus your comments to afford as many as possible, the opportunity to speak. The amount of time allowed for each speaker will be dependent upon the number of people requesting to speak. Please prepare for the time limit for each speaker to be in the 2 – 5 minute range.

Please leave a copy of any written or electronic materials at the welcome center.

You are encouraged to submit written feedback at www.michigan.gov/energy.

Clean Energy Forum Comment
March 4, 2013
by
Sara Bonnette (I'm a former aquatic biologist who left work to stay home w/ my 2 sons in Bay City)

Thank you for letting me comment on this important issue. There is enough scientific evidence now to know that we must scale back on our use of fossil fuels. Energy use is not on the average person's radar but this topic is one of the most important our society can tackle.

What actions can we take now? Make science a priority in our schools. There is a terrible lack of scientific literacy out there. But I guarantee there will be no denying climate disruption if our scientific literacy improves. We will need young people to have the awareness and scientific aptitude to tackle energy issues in the future.

We also need to
Expand public transportation. Get off ~~your~~ our rear and walk or ride a bike for some of ~~your~~ our errands or walk ~~your~~ our child to school.

I don't support any one type of renewable energy.
Energy efficiency is key: take advantage of rebates and low-cost options to reduce energy use. Our family benefitted from a new furnace rebate and free devices from our utility to save on water in our home.

Although I understand the greens to get people who live next door to a wind farm

Increase Michigan's storage capacity for electricity generated from wind and solar. I just have to add — I live 1½ miles from the coal plant in Hampton Twp. & in the summer, you hear a fairly constant hum of the turbines — wind is not the only energy source that makes noise. Natural gas will play a part in our energy mix but we must protect our water quality and quantity. We must make sure that we understand what fracking will do to our air and water. The long-term consequences of fracking are unknown.

Oil has been federally subsidized for a long time. Addressing climate change should be the new "race to the moon". We should be encouraging innovation and progress to make better strides in renewable energy, including offshore wind & geothermal & improving energy efficiency

But you and I know it comes down to dollars and cents. If there is a buck to be made on dirty fuels than to heck with the long-term. We humans can adapt to small, barely noticeable changes in our environment: just turn up the air conditioning a little more, heating bill a little nicer in winter. But if we look and listen to the natural world a little more, we can see a picture that should get our attention. Twenty-seven of the 38 bird species for which we have adequate long-term records have expanded their ranges predominantly in a northward direction. There is some evidence to suggest that novel species, including pests and pathogens, may be more adept at adjusting to changing climatic conditions, allowing them to have more success than native species. Just as coal-miners heeded the caged canary, we must heed the signs we are now seeing in God's creation and we must listen to our conscience that is telling us that we are taking too much and leaving the future worse off. I want to be able to tell my two boys that we are tackling these issues now so that they will not have a more difficult time doing it down the road.

I hope the Governor will take positive action that will address our energy and climate issues now, in a way that will improve our children's future. The scientific data is there. Please listen to it and make the change away from fossil fuels now.

CLIMATE CHANGE IN THE GREAT LAKES REGION

GLISA
GREAT LAKES INTEGRATED SCIENCES + ASSESSMENTS

There is a high level of scientific certainty that the climate has changed in significant ways in recent decodes and thot it will continue to change in the future. This is a summary of the potential changes and impacts of climate in the Great Lakes region from the best research available across many scientific disciplines.

Temperature

- Average temperatures increased by 2.3°F (1.3°C) from 1968 to 2002 in the Great Lakes region.
- By 2050, an average air temperature increase of 1.8 to 5.4°F (1 to 3°C) is projected.
- By 2100, an average air temperature increase of 3.6 to 11.2 °F (2 to 6.2°C) is projected.
- Winter temperatures will likely experience a greater increase than the summer months.

Precipitation

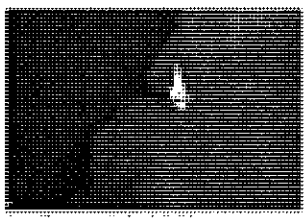
- Projections of future precipitation vary widely.
- Annual average precipitation will likely increase or remain nearly stable.
- Winter and spring precipitation may increase more significantly.
- Warmer temperatures will lead to less precipitation falling as snow, and more falling as rain.
- Lake-effect precipitation may increase in some areas.

Extreme Weather Events

- The frequency and intensity of severe storms has increased, and current models suggest that this trend will continue as the effects of climate change become more pronounced.
- More severe storms may have a negative economic impact due to resulting damages and increased costs of preparation, clean up, and business disruption.

Water Quality and Stormwater Management

- Increased risk of droughts, severe storms, and flooding events may increase the risk of erosion, sewage overflow, lead to more interference with transportation, and more flood damage.
- Future changes in land use could have a far greater impact on water quality than climate change. The coupling of climate change and land use change could therefore result in even stronger effects in some areas.



Milwaukee in a sewage overflow plume. Photo: Milwaukee Journal Sentinel

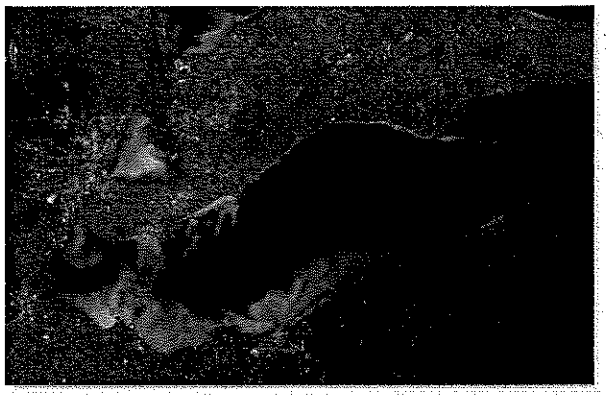
Ice and snow cover on Lake Superior. Photo courtesy of NASA.

Snow and Ice Cover

- Since 1975, the number of days with land snow cover has decreased by 5 days per decade, and the average snow depth has decreased by 1.7 cm per decade.
- From 1973 to 2010, annual average ice coverage on the Great Lakes declined by 71%.
- Snow and ice levels on the Great Lakes and on land will likely continue to decrease.
- Reduced lake freezing will result in more exposed water that could increase lake-effect precipitation.
- Earlier spring warming may decrease the length of the snow season and cause precipitation in some lake-effect events to fall as rain rather than snow.

Lake Temperature and Stratification

- Lake temperatures have been increasing faster than surrounding air temperatures.
- Both inland lakes and the Great Lakes will likely experience longer warm seasons.
- Warmer water surface temperatures may increase the stratification of the lakes, decrease vertical mixing in the spring-winter, and lead to more low-oxygen, "dead zones" and toxic algal blooms.



Lake Erie algal bloom, Oct. 20, 2011. Photo courtesy of NASA.

Fish and Wildlife

- Coldwater fish populations will likely decline in population as warmwater fish populations become more abundant.
- Overall biomass productivity in lakes and waterways could be reduced by lake stratification and increased frequency of hypoxic conditions.
- In general, many animal species may need to migrate north to adapt to rising temperatures, and increased evaporation rates may decrease total wetland area in the region, both of which may lead to additional stresses on some species.

Forests

- Climate change will likely have mixed effects on forests that vary based on the species involved and other factors.
- With increasing atmospheric CO2, forest productivity will likely increase until other impacts of climate change, such as increased risks of drought, forest fire, and invasive species present additional stressors to forests.
- As temperatures rise, the distribution and composition of tree species will likely shift northward.

Lake Levels

- Water levels in the Great Lakes have been decreasing since a record high was reached in 1980.
- Lake levels are rising and falling a month earlier than during the 19th century.
- Other factors, such as land use and lake regulations also affect lake level, however, and it is still unclear how much of the recent trend in lake levels may be attributed to climate change.
- Future projections of lake levels for the Great Lakes vary, though most indicate a greater decline in lake levels with increasing greenhouse gas emissions.

Water Availability

- Overall, the Great Lakes region is expected to become drier due to increasing temperatures and evaporation rates.
- More frequent droughts could affect soil moisture, surface waters, and groundwater supply.
- The seasonal distribution of water availability will likely change. Warmer temperatures may lead to more winter rain and earlier peak streamflows.

Agriculture

- The growing season will likely lengthen and positively impact some crop yields.
- An increased frequency and intensity of severe weather, increased flooding and drought risks, as well as more pests and pathogens will likely negatively impact crop yields.
- Water availability and quality will likely pose challenges for agriculture.

Energy and Industry

- Drier summers may lead to reduced hydroelectric output during periods of peak usage.
- Reduced water availability may interfere with some industrial operations.
- Warmer temperatures and more frequent heat waves will likely increase electricity demands, particularly in urban areas and during the summer months.

Transportation

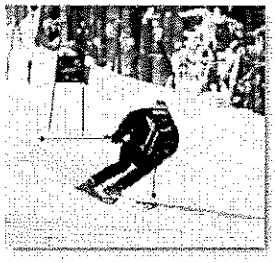
- With increasing temperatures, damage to paved surfaces due to expanding and softening pavement is more likely.
- The most significant impact on roadways will likely be the increased risk of flood damage.
- Shipping lanes will likely be open earlier and longer due to reduced ice cover on the Great Lakes.
- Lower lake levels may lead to decreased depth of navigation channels and a reduction in the maximum loads carried by vessels.

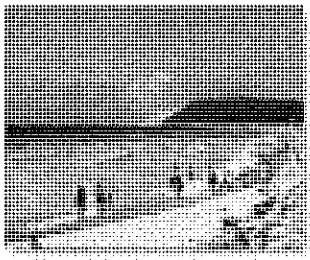
Public Health

- Increased risk of heat waves and increased humidity may increase the number of heat-related deaths and illnesses.
- Increased frequency of flooding events may lead to watershed contamination, while warmer surface waters could mobilize pollutants in sediment and contaminate fish.
- Diseases such as West Nile virus and Lyme disease may become more widespread since carrier insects will be more likely to survive milder winters.

Tourism and Recreation

- Winter recreation and tourism are likely to suffer due to reduced snow cover.
- Many species of fish important to recreation are likely to decline while the populations of some warmwater species may grow.
- Increased lake contamination and decreasing lake levels may lead to less desirable shorelines, but increasing summer temperatures and a longer summer season, may increase demand for beaches and some summer activities.
- Winter tourism and recreation may decline as summer tourism grows.





Winter tourism and recreation may decline as summer tourism grows. Photos courtesy of Shanty Creek Resorts and the National Park Service.

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GOVERNOR

MICHIGAN ECONOMIC DEVELOPMENT CORPORATION
MICHIGAN ENERGY OFFICE
STEVE BAKKAL, DIRECTOR

Michigan Energy Public Forum Statement Card

If you wish to speak today, please complete the following:

Name: Mike Schuette

Affiliation (if any): Communication Workers of America CWA

Phone: 248-333-2347

Email: Mschuette@cwa-union.org

Topics you wish to address today:

a. ✓ **Renewable Energy Portfolio Standards**

b. ✓ **Energy Optimization / Efficiency Standards**

c. ___ **Electric Choice**

d. ___ **Other Additional Energy Topic**

(Please specify): _____

Requested time to speak: ✓ **< 5 minutes** ____ **5 minutes**

Please leave a copy of any written or electronic materials at the welcome center.

Testimony of Mike Schulte – CWA

March 4, 2013 I would like to thank Governor Snyder for putting on these forums.

Thank Commissioner Quackenbush and Director Bakkal

(Intro Self and what inspired you to testify today) [illegible] + Tens of thousands of Referees

- Responding to the question: "What is Michigan's long-term potential for more wind, solar, hydro, biomass, landfill gas and other renewables source," Michigan is making strides expanding clean energy investments, including solar and wind energy, due in large part to the smart policies and investments we've made over the past few years developing and manufacturing renewable energy sources.

- Renewable energy is paying dividends for the economy and environment.

- As someone who cares about a better future for our state's economy and environment for my own and for future generations, a forward-thinking approach to Michigan's energy future must include renewable electricity goals and maintaining and expanding clean energy investments that have already opened the door to make Michigan a powerhouse in the renewable energy and renewable energy manufacturing sectors.

- Here in Michigan, both wind energy and solar energy are growing sectors that we can't afford to let other nations dominate.

States

* We also can no longer afford to send $1.2 Bill of our state dollars ~~to other st~~ purchasing energy from Neighboring State. Who therefore have recognized the need to increase renew standard

Wind Industry

- Today, the wind industry in Michigan shows tremendous potential for growth. According to the American Wind Energy Association, wind energy powers approximately 130,000 homes in Michigan and directly and indirectly supports 4,000-5,000 jobs in our state.

- We have far from utilized all of our wind energy capacity though. According to a resource assessment from the National Renewable Energy Lab, Michigan's wind resource could provide 160 percent of the state's current electricity needs.

- Putting wind energy to work can help meet our renewable energy goals as well as our economic goals of creating more jobs.

- According to the Natural Resources Defense Council, at one wind farm 1,079 direct jobs are created by dozens of companies throughout the multi-year development, manufacturing, construction and maintenance phases of a wind farm. These jobs aren't just created on the actual wind farm site — they're created throughout the sizable wind farm "ecosystem" — the chain of activities that, over time, comprise the many steps of building a wind farm.

- Wind industry related manufacturing has continued to expand its presence in the state also.

- According to the American Wind Energy Association, many Michigan companies have already begun supplying to the wind industry. At least 31 facilities in Michigan are currently manufacturing components for the wind energy industry.

- According to the American Wind Energy Association the wind industry across the country has potential to grow from the current 75,000 jobs to over 100,000 jobs in four years and continue toward supporting 500,000 jobs by 2030. Michigan stands to gain from this growth.

- Just seven years ago, only 25 percent of wind turbines installed in the U.S. were built here. Now, 60 percent of every wind turbine installed in America is made in America. We can do the same thing with solar and other renewable energy types.

- Offshore wind energy especially, represents a huge untapped resource that stands to generate clean electricity and increased manufacturing jobs. The Great Lakes are a tremendous benefit for tourism and shipping; they also are a tremendous opportunity for generating energy.

Solar Industry NATIONAL RESOURCES DEFENSE COUNCIL

- According to NRDC, between 2003 and 2010, the solar industry was one of the fastest growing segments of Michigan's economy, increasing at a rate of 15.8 percent each year.[13] Today, 121 companies in Michigan manufacture components for the solar market, employing 6,300 workers.

- At the end of 2009, Michigan had 1,041 kilowatt's worth of installed solar photovoltaic systems. There's still room for growth, however. Researchers estimate the state's total solar resource potential is 3,500 gigawatts.[15]

Policy Recommendations

- We can grow wind and solar even faster if we lead the charge in innovation and keep good 21st century jobs for American workers.

- We need to double down on the industries of the 21st century that will build a cleaner, more energy efficient and more competitive American economy. Clean energy industries are creating more good jobs and represent a second chance for the millions of Americans who are still searching for these good jobs that can support their families.

- Apart from federal policies such as the Recovery Act that helped level the global playing field, state incentives and policies must help support these industries.

- Initiatives that continue to promote the development of clean energy, renewable energy should continue to be a priority.

- Raising support and awareness about the importance of renewable energy sources such as wind and solar will be a lifeline to the budding renewable energy industries and the ~~other~~ jobs they have created and will continue to create.

Again I would like to THANK Governor Snyder
Commissioner Quakenbush
+ Director Steve Bakkal
For THIS opportunity

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Readying Michigan to Make Good Energy Decisions

Michigan Energy Public Forum Statement Card

If you wish to speak today, please complete the following: Needs to leave by 3/3:30pm

Name: Yvonne Bushey

Affiliation (if any): Citizens For Wind Energy CFWE

Phone: 989-856-2623

Email: YYbushey@comcast.net

Topics you wish to address today:

a. X **Renewable Energy Portfolio Standards**

b. ___ **Energy Optimization / Efficiency Standards**

c. ___ **Electric Choice**

d. ___ **Other Additional Energy Topic**

(Please specify): _____

Requested time to speak: X **< 5 minutes** ____ **5 minutes**

Please leave a copy of any written or electronic materials at the welcome center.

Yvonne Bushey
Citizens for Wind Energy
Energy Forum #3, Delta College, Bay City
March 4, 2013

Good afternoon. My name is Yvonne Bushey. I am a Huron County resident and a member of an organization called Citizens for Wind Energy.

I would like to thank Governor Rick Snyder, MPSC Chairman John Quackenbush, Michigan Energy Office Director Steve Bakkal and their staffs for putting together this forum. We believe it is the best approach to tackle such an important issue and support it wholeheartedly.

A number of my neighbors and other Huron County citizens banded together in 2010 as the development of wind farms in our county was just beginning. We came together as a counterweight to others in the county who were opposed to wind development of any kind. We joined together to support the well-considered, responsible development of wind energy resources in our county because we believed that harnessing our wind had the potential to produce a number of important benefits for our community: such as:

- Greater local tax revenues that would benefit our local schools, libraries, veterans programs, senior citizens, public transportation and other essential services;
- The possibility to attract manufacturers of wind turbine components and related supplies; and
- An increase in local employment associated with building the wind farms and the related infrastructure.

Yes, these benefits are now realized as wind farms have been developed and operating and more are in the planning and developing stage in our county.

I am aware that many alternative energy supporters have attended the first two Energy Forums, urging you to adopt policies to significantly increase Michigan's renewable portfolio standard. I am aware that some persons do not support the development of wind energy. The vast majority of our residents do support and accept wind energy development.

Wind turbines are technological marvels. They are making Michigan's electric generation mix cleaner. They also change the look, feel and character of the communities that host them as has all progress in our environment, such as new industries, electricity lines, communication towers, corn dryers, and expressways, etc.

We have been fortunate in Huron County to work with a number of very responsible, considerate wind developers, including DTE Energy, and Consumers Energy.

I encourage you to recommend a policy that encourages the thoughtful expansion of Michigan's wind portfolio. We would like to see a policy that encourages wind development at a pace that balances the cost of development, the benefits to the electric generation mix and local concerns.

My husband and I are 4th generation farmers, have grandchildren now wishing to farm in a healthy environment.

Thank you, Chairman Quackenbush and Director Bakkal for this opportunity to offer my views and those of the CWE group on this very important matter.

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Readying Michigan to Make Good Energy Decisions

Michigan Energy Public Forum Statement Card

If you wish to speak today, please complete the following:

Name: Mark Polega

Affiliation (if any): Mid Michigan Community Action

Phone: 989-386-0859

Email: MaPolega@MMCAA.org

Topics you wish to address today:

a. ___ **Renewable Energy Portfolio Standards**

b. X **Energy Optimization / Efficiency Standards**

c. ___ **Electric Choice**

d. ___ **Other Additional Energy Topic**

(Please specify): _____

Requested time to speak: X **< 5 minutes** ___ **5 minutes**

Please leave a copy of any written or electronic materials at the welcome center.

Mark Polega
Grants and Communications Director
Mid Michigan Community Action Agency
Energy Forum #3, Delta College
March 4, 2013

Good afternoon. My name is Mark Polega and I am the Grants and Communications Director for Mid Michigan Community Action Agency. We serve low and moderate-low income individuals and families across six counties – Bay, Clare, Gladwin, Mecosta, Midland and Osceola.

I want to thank you for this opportunity to present our perspectives about our state's energy policy. We applaud this initiative because we think it is vitally important for policy makers to consider this topic from the perspective of the men, women and families that we serve.

Our agency was founded in 1966 to serve families in need of emergency assistance , financial literacy and budget management; securing safe, affordable housing; early childhood development and senior programs; energy efficiency services; health/nutrition education and food access.

We are one of 30 agencies statewide covering all 83 counties. It is important to acknowledge that there is no "typical" community action agency (CAA). No two agencies are exactly alike because each is governed by the leadership and specific needs of its local community. Our common goal is to enable our clients to become self-sufficient—to provide the hand-up. We do this by assessing a customer's situation as a complete picture to identify barriers to self-sufficiency and then providing applicable services or connecting them with other community resources.

In Fiscal Year 2012 our agency provided services to 18,755 people including over 6,000 kids and over 5,100 seniors.

While we have many programs, Weatherization Assistance is an important highlight as it helps save energy in the home, makes homes healthier and more affordable allowing low-income families to pay their energy bills more easily.

Weatherization Assistance workers are experienced, well trained and providing high quality services that follow DOE and State of Michigan standards.

Over the past three years, Mid Michigan Community Action has weatherized 1,726 households. At present 224 families are on the wait list—with hundreds more on a wait list just to receive an application. **The need for assistance for low-income households remains great.**

Despite the impact and success of the Weatherization Assistance Program, funding allocations are unstable:

As ARRA funds go, the remaining DOE funding for home weatherization is diminishing causing a two-sided decrease in overall availability. 2013 DOE WAP funding reduced 66% from pre-ARRA levels and a 95% cut from the annual spending level under ARRA; despite the fact that Weatherization has only reached approximately 20% of US eligible low-income households.

(Reported in the "Low-Income Weatherization: Stimulus-Funded Program Shines But Storm Clouds are on the Horizon by National Consumer Law Center – November 2012)

LIHEAP funding in 2013 designate up to 15% of the funds go for weatherization, yet the funds are not yet allocated to agencies resulting in homes not being weatherized. LIHEAP is an important funding source since it can be used for repairing roofs, etc., which decreases the number of homes that must be walked away from and/or declined service.

Energy Optimization (EO) funding has been an excellent funding resource to help leverage weatherization dollars and extend the number of households that can be served. However, without DOE or LIHEAP money, the numbers of homes that can be assisted are reduced even with EO money is available since it is only a leveraging fund. Some of the EO programs have offered special programs outside of the weatherization assistance program that has provided needed refrigerators, furnace tune-ups and replacement.

In its review of 2011 Energy Optimization performance, the Michigan Public Service Commission said it quote:

"continues to view the Energy Optimization provisions of PA 295 as essential to Michigan's overall energy policy. The Commission believes that EO programs are a critically important component of efforts to improve the state's economy, and is confident that the state's EO programs will continue to improve the competitive position of Michigan businesses and the financial standing of its residents."

We couldn't agree more.

A year later, in its review of 2012's Energy Optimization programs, the Commission said it had

"seen many successes since first being implemented due to continued strong efforts by utilities and their EO providers and implementation allies. This year, Michigan was ranked among the most improved states in the nation with regard to energy efficiency. The successful implementation of the Energy Optimization program was the largest factor in the ranking by the American Council for an Energy-Efficient Economy (ACEEE)."

In our view, any energy policy adopted by policymakers needs to build on these successes.

Certainly we acknowledge that concerns have been voiced about energy costs. We, too, are mindful of those concerns because energy costs have a profound impact on our clients. But any future energy policy must work for all Michiganders, not just those whose large volume of energy use and usage profile is most appealing to non-utility energy providers.

Thank you once again, Chairman Quackenbush and Director Bakkal for this opportunity to participate in this effort.

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If you wish to speak today, please complete the following:

Name: Tarot Spencer

Affiliation (if any): _____

Phone: 810-639-4598

Email: Tarotmig@centurytel.net

Topics you wish to address today:

a. ___ **Renewable Energy Portfolio Standards**

b. ___ **Energy Optimization / Efficiency Standards**

c. X **Electric Choice**

d. ___ **Other Additional Energy Topic**

(Please specify): _____

Requested time to speak: ____ **< 5 minutes** X **5 minutes**

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HYDRO ELECTRIC POWER FOR THE FUTURE OF MICHIGAN

Tarot Denger, P O 3194, Montrose, MI, 48457

This idea was originally conceived as a way to provide the city of Flint with both a secure source of drinking water and a clean renewable source of electricity to help bolster its growth and ensure a prosperous future, without building a pipeline from Lake Huron. While the drinking water portion of the idea did not gain traction and the pipeline is slated to be built, the hydro-electric portion of the plan offers real potential to Michigan's future development as a hub for industry, hence jobs, while maintaining the allure of recreational, outdoor natural beauty:

I think the idea of using the Flint River as a source for drinking water is the best idea. The filtration plant is already there and about ready to use. One issue that was mentioned in the Jan 23, 2012 article in the Flint Journal is the condition of the Holloway, Kearsley and Hamilton dams. While it will cost to upgrade them, this also presents an opportunity for Flint to convert these dams to generate hydro-electric power. Since this is green energy, funding could be obtained through Federal or state green energy initiative grants. To save money and build community talent, Kettering University students could be used for design work, and U of M Flint students in Public Administration classes could help with the grant writing and government issues in a sort of intern program. The dam at Western Road, for one, is perfectly suited to hydro-electric generation as it empties into a deep ravine to the west of the dam. Any property that private owners would need to give up to make this project work could be traded with other property in the city that the city owns due to back taxes or whatever. Then not only would Flint have a good source of drinking water, but a cheap source of reliable, renewable energy which would attract investment in business and residency.

Extrapolating this type of thinking, one third of the state's rivers could be used for hydroelectric generation, leaving the rest as natural rivers. For example, the Secord and Sanford dams on the Tittabawassee River are necessary both for flood control and recreational purposes. These dams will be in place a long time, and contribute to a better standard of living (flood control) and recreational use, why not also have them generate electricity? The Bond Falls flowage in the Upper Peninsula is another example, along with the Holloway and Kearsley dams. Further, smaller flood control dams, such as the Hamilton dam (downtown Flint) or those at Frankenmuth and Corunna, could be adapted to generate at least some of the electrical need for those communities.

I do not advocate a large scale project of building whole new dams throughout Michigan's river system. I am simply advocating upgrading, strengthening and modifying those dams that currently exist to give an added benefit of clean renewable electricity to our state, utilizing a resource, the natural flow of water, most states do not have. Using a limited number of rivers as industrial/generation rivers, would leave the majority of rivers in their natural state. This would help Michigan grow through the wise use of her natural resources while helping to preserve the attraction of her natural beauty.

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If you wish to speak today, please complete the following:

Name: ERIC MARTIS

Affiliation (if any): I.I.C.C.

Phone: _____

Email: _____

Topics you wish to address today:

a. X **Renewable Energy Portfolio Standards**

b. X **Energy Optimization / Efficiency Standards**

c. X **Electric Choice**

d. ___ **Other Additional Energy Topic**

(Please specify): _____

Please prioritize and focus your comments to afford as many as possible, the opportunity to speak. The amount of time allowed for each speaker will be dependent upon the number of people requesting to speak. Please prepare for the time limit for each speaker to be in the 2 – 5 minute range.

Please leave a copy of any written or electronic materials at the welcome center.

You are encouraged to submit written feedback at www.michigan.gov/energy.

WINDPOWER MONTHLY

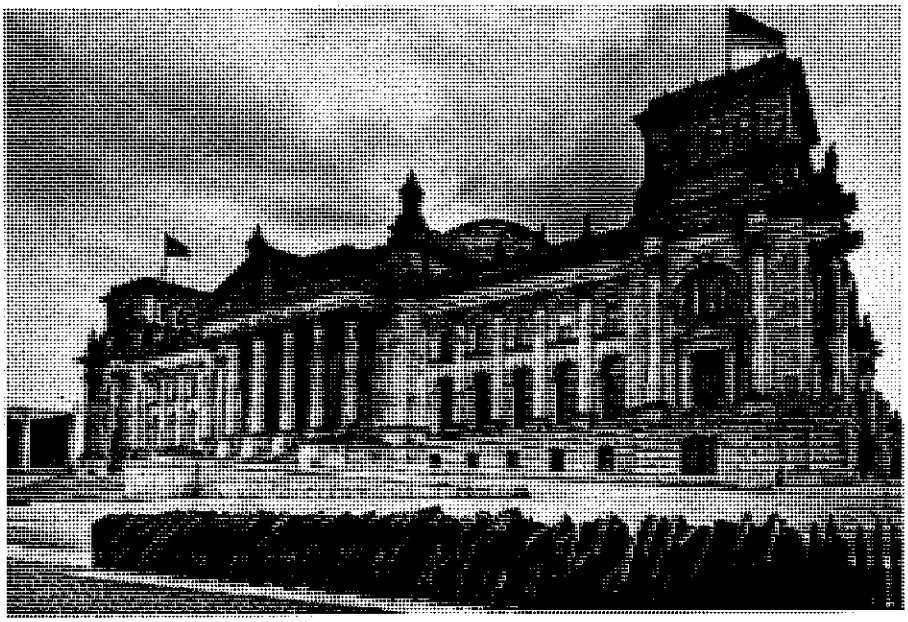
WEBCAST: Drive operational efficiency come rain or shine

GERMANY

German government looks to slash renewables funding

15 February 2013 by Sara Knight, Be the first to comment

GERMANY: A joint proposal to cut the costs of increasing Germany's renewable energy capacity has been presented by the federal economy and environment ministers.



If the measures are implemented, renewable energy association BEE fears a massive market collapse for investment in renewables.

The paper, which has been met with widespread criticism, includes:

- A one-off 1.5% decrease in renewables support payments in 2014 for wind and other renewables plants installed before August 2013.
- An initial five-month period without any support for all wind and renewables plants that are commissioned after 1 August 2013.

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FOR IMMEDIATE RELEASE

SEO/Birdlife issues warning

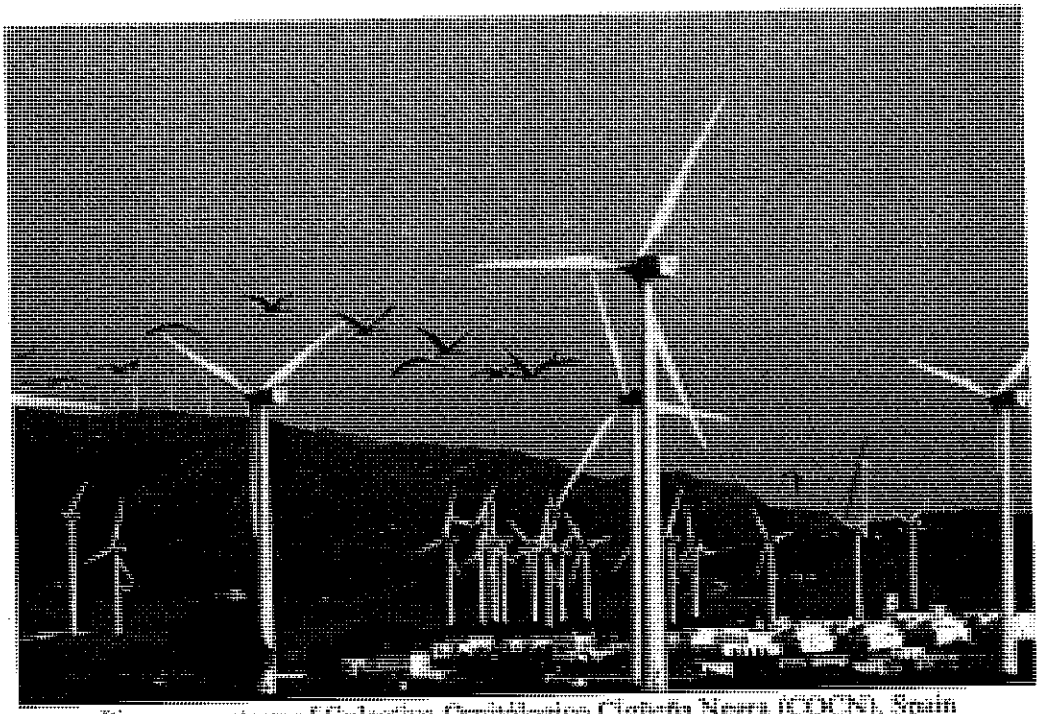
Spanish wind farms kill 6 to 18 million birds & bats a year

On 12 January 2012, at the First Scientific Congress on Wind Energy and Wildlife Conservation in Jerez de la Frontera, Spain, the Spanish Society of Ornithology (SEO/Birdlife) made public its estimate that, yearly, Spain's 18,000 wind turbines may be killing 6 to 18 million birds and bats (1). The average per turbine comes down to 333 – 1,000 deaths annually, which is a far cry from the 2 – 4 birds claimed by the American wind industry, or the 400,000 birds a year estimated by the American Bird Conservancy for the whole United States, which has about twice as many turbines as Spain.

Bats are included in the Birdlife estimate, comments Mark Duchamp, president of Save the Eagles International (STEI). "Therefore, supposing for example that wind farms would kill twice as many bats as they do birds, the figures would be: 111 - 333 birds per turbine per year, and 222 – 666 bats per turbine/year. The mortality figures that were recorded in Germany and Sweden in the early nineties are not unusual after all", he notes. Quoting from a California Energy Commission study: **"In a summary of avian impacts at wind turbines by Benner et al. (1993) bird deaths per turbine per year were as high as 309 in Germany and 895 in Sweden."** (2)

Duchamp has always maintained that earlier studies, made when bird mortality at windfarms wasn't such a hot potatoe, were more credible than recent ones. "It is a curious business where those consultants who find or predict the lowest mortality land all the contracts. This is what is being asked of them, and this is what they do. **This unethical conduct has already condemned the Tasmanian Wedge-tailed eagle to extinction (3), and more recently the Golden Eagle in the United States (4).** Another factor is the occultation of carcasses by windfarm employees, as may be seen in the SEO/Birdlife report." (5)

The report also stresses that even a small incremental mortality for bird species whose populations are not abundant may drive them to extinction. "This is what I have been claiming for years", laments Mark, who has been banned from ornithology forums as an unwelcomed messenger of bad news. "I am now vindicated, but that won't save the birds", he says.



Picture courtesy of Colectivo Ornitológico Cigüeña Negra (COCN), Spain

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THE WALL STREET JOURNAL.
WSJ.com

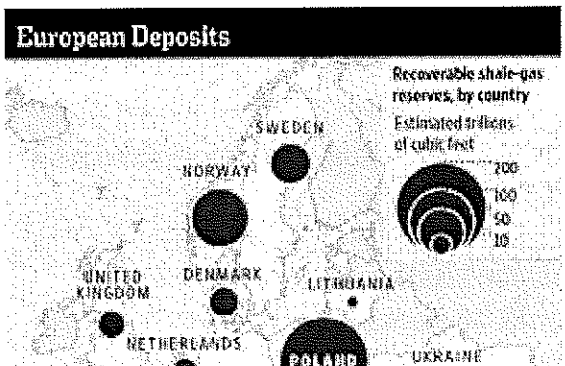
EUROPE NEWS | March 1, 2013, 2:33 p.m. ET

Germany Debates Fracking as Energy Costs Rise

By WILLIAM BOSTON

BERLIN—Germany is debating whether to allow hydraulic fracturing, a controversial drilling technique to extract natural gas from shale, amid concern that rising energy costs in the country could threaten its industrial backbone.

The German public is deeply suspicious of the drilling practice, commonly known as fracking. Many Germans worry that the process, which involves using a high-pressure mixture of water, sand and chemicals to break apart energy-rich rocks, could contaminate underground water supplies.



The Wall Street Journal

This week the government unveiled a proposal that it hopes can bridge the gap between pro-fracking advocates in industry and environmentally conscious voters. Through a change to existing laws, the government is proposing banning fracking near any water supply and in all national parks and conservation areas. Drilling anywhere else would be subject to approval based on an environmental-impact study.

The fracking debate comes as Germany is pursuing a radical restructuring of its energy sector. In the wake of the Fukushima nuclear disaster in Japan in 2011, Chancellor Angela Merkel abruptly declared that Germany would abandon nuclear power and transition to renewable energy sources such as wind and solar. As the use of nuclear power declines, Germany is filling the gap with a combination of renewable energy and coal-fired plants.

Yet Ms. Merkel's "energy revolution," as the shift away from nuclear has been dubbed, is having unexpected side effects.

from an outright ban on any fracking. The government's proposals are a compromise between the environment minister, who initially wanted to ban fracking, and the economy minister, who wants to allow it. Industry sees the compromise as a step that would allow for some testing and which could help determine whether fracking is harmful to the environment.

"Only at the end [of testing] will we be able to judge using all relevant criteria whether this makes sense—economically, environmentally, and regarding its acceptance by society," a spokesman for chemical and energy group BASF AG said. "To do that, we need the framework which is now being established."

Germany's powerful environmental lobby says the government's proposals don't go far enough and demand an outright ban. The opposition Green Party called the government's move a smoke screen. "It's like banning skiing in the Sahara," said Oliver Krischer, a Green Party member of parliament. "An environmental-impact study, which is also embraced by the gas industry, will do little."

Write to William Boston at william.boston@dowjones.com

A version of this article appeared March 2, 2013, on page A11 in the U.S. edition of The Wall Street Journal, with the headline: Germany Takes New Look at Fracking as Energy Bills Sour.

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WICKED LOCAL FALMOUTH
WITH NEWS FROM THE FALMOUTH BULLETIN

POLL: Falmouth Selectmen support removing wind turbines

More info soon in Feb. 6 print edition of The Bulletin

By Scott A. Giordano
THE BULLETIN
Posted Jan 31, 2013 @ 08:09 AM
Last update Feb 01, 2013 @ 09:44 PM

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TAKE OUR POLL: Falmouth Selectmen hear from public

TAKE OUR POLL: Falmouth Selectmen will hear from public on wind turbines

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Do you agree with the Falmouth Board of Selectmen's Jan. 30 decision to support dismantling and removing the town's wind turbines at the town's Wastewater Treatment Facility?

Yes, the decision is best to unify the community.

No, this will have a negative financial impact on the town.

Yes, because the voters will ultimately decide this themselves.

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FALMOUTH — The Falmouth Board of Selectmen voted Jan. 30 to support removing the town's industrial-sized turbines, in hopes to unify a divided community. Wind 1 and Wind 2, the turbines at the Falmouth Wastewater Treatment Facility, have divided Falmouth residents and public officials since they were first erected about two and one-half years ago.

"Typically government and good leaders think of the greater good of all. As a thoughtful person, I put all things into account. I have a fiduciary responsibility to this community, and not just a knee-jerk responsibility to a community. What we do ... we have to do in a thoughtful way so this community can continue to be a viable community," said Selectmen Chairman Kevin Murphy before the vote.

"The most important thing for this community, moving forward, is the fact that this is fracturing our community," he added. "What I hope to accomplish is to bring this community back together, bring us so we can live to fight another day. ... I will agree, and I will work, to be able to find a way to take down these turbines in a thoughtful process. My proposal would be that we put forth an article that would say we would go to the voters and [ask to] take down and dismantle the turbines."

Selectmen also voted to request the Massachusetts Clean Energy Center forgive the town's debt for renewable energy credits, and to send a delegation of state officials to request help with their debt for the purchase of Wind 1. In addition, they voted to draft language for a warrant article that will be presented for a vote at the Selectmen's Feb. 4 meeting - in time to have the issue go before voters in the town's April 9 special election and then proceed to the town's May general election.

According to analysis from Falmouth Town Manager Julian Suso, Murphy estimates removing the turbines would result in an average household tax increase of about $11 per year, unless they get financial assistance from the state. He urged selectmen to build consensus as they request specific help from the state. Selectwoman Mary Pat Flynn hopes to determine how much financial assistance the state will provide before voters are asked to decide the issue in May.

The selectmen's decision follows completion of a 53-page report from the Wind Turbines Options Analysis Process (WTOP) and a Jan. 23 public meeting in which Falmouth residents spoke overwhelmingly in favor of removing the turbines rather than pursue other WTOP options. Other options included full operation of the turbines, or curtailed operating hours and having the town buy and re-sell the homes of impacted neighbors who say they have suffered from serious sleep disturbances, adverse health effects, and depreciating values of their homes.

At the Jan. 30 meeting, Falmouth Assistant Town Manager Heather Harper presented three "kitchen style" rough drafts of warrant articles to address the multitude of options before the selectmen and the fiscal impact of each for the town and its taxpayers. One warrant article would appropriate money for specific debt obligations. Another would appropriate money for mitigation factors, including the acquisition of real estate and potential installation of solar panels. Another would appropriate money to supplement the 2014 operating budget.

Harper estimates that it would cost the town about $400,000 to dismantle the turbines with a best-case scenario of $600,000 for resale value. After she reviewed the options, selectmen shared their thoughts before voting to remove the turbines.

Reading from a prepared statement, Selectman David Braga said industrial-sized turbines don't belong in residential neighborhoods.

"We have an issue that has gone on for too long and it has divided our town. I want to be very positive and move forward to rectify this issue," Braga said. "I think it's time that we start building trust with the residents of Falmouth over this issue."

Selectman Doug Jones said he was inclined to agree with Braga but urged caution on how they proceed. Selectwoman Mary Pat Flynn suggested they further study the town manager's analysis and perhaps come back for a follow-up discussion on another day, but then supported her fellow selectmen in voting to remove the turbines.

During their Jan. 30 discussion, Murphy acknowledged the town had a "calamity of errors" with the wind turbines. "I don't think this is a depiction of wind power. I think we ended up with some bad machines," he said. "I don't think anyone intentionally did anything, thinking they were going to hurt or bother anybody."

At the meeting's start, Murphy thanked all the residents who participated in the open public

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DRIESSEN: Big Wind tax credit exterminates endangered species

Thousands of birds killed by wind turbines

By Paul Driessen

Saturday, December 22, 2012

The American Wind Energy Association wants its production tax credit (PTC) for wind electricity extended yet again. Congress should say no -- and terminate the PTC now.

Wind energy is expensive and unreliable. It does nothing to reduce carbon dioxide emissions. It is land- and raw-materials-intensive, parasitic and redundant. Whenever the wind is low or inconsistent, every megawatt of wind power must be supported by electricity generated by fossil-fuel plants. Even more damning, wind turbines disrupt wildlife habitats and butcher birds and bats that are vital to ecological diversity and agriculture.

The U.S. Fish and Wildlife Service (FWS) and American Bird Conservancy say wind turbines kill 440,000 bald and golden eagles, hawks, falcons, owls, cranes, egrets, geese and other birds every year in the United States, along with countless insect-eating bats.

New studies reveal that these appalling estimates are frightfully low and based on misleading or even fraudulent data. The horrific reality is that in the United States alone, "eco-friendly" wind turbines kill an estimated 13 million to 39 million birds and bats every year.

These shocking figures reflect the presence of more than 39,000 turbines in the United States, many located in habitats with large numbers of raptors, other birds and bats, says Mark Duchamp, president of Save the Eagles International. The estimates are based on a 2012 study by the Spanish Ornithological Society, which used data from 136 official turbine-monitoring studies in Spain, and is corroborated by a 1993 study of bird mortality from wind turbines in Germany and Sweden, Mr. Duchamp says.

Over the past 25 years, an estimated 2,300 golden eagles have been killed by turbines just at Altamont Pass, Calif. According to Save the Eagles International biologist Jim Wiegand, the subsidized slaughter "could now easily be over 500" golden eagles a year in our Western states, plus many bald eagles. Entire flocks of birds often get mowed down by turbine blades, whose tips move at 100 to 200 mph.

In an 86-square-mile area blanketed by the Altamont wind facility, no eagles have nested for more than 20 years even though the area is prime habitat, Mr. Wiegand says. Overall, there has been an 80 percent population decline for the golden eagle in Southern California, he notes.

Since wind turbines began proliferating, Oregon has had a 47 percent loss of raptors and Iowa has experienced a 42 percent decline in bird populations, according to FWS and Department of Natural Resources research.

After being nursed back from the brink of extinction, magnificent 5-foot-tall whooping cranes face annihilation because of thousands of turbines within their 200-mile-wide, 2,500-mile-long migration route, former FWS whooping crane coordinator Tom Stehn fears.

More than 200 endangered cranes have "gone missing" in recent years, and now FWS is delaying its 2012 "whooper" count until after Congress votes on the PTC. It also has changed its methods for counting turbine kills to ones Mr. Stehn calls "unacceptable and useless for species recovery management."

The new methods help hide turbine kills, according to Mr. Wiegand. The Interior Department has used

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BEFORE THE

PUBLIC SERVICE COMMISSION OF WISCONSIN

Application of Highland Wind Farm, LLC, for a Certificate of Public Convenience and Necessity To Construct a 102.5 Megawatt Wind Electric Generation Facility and Associated Electric Facilities, to be Located In the Towns of Forest and Cylon, St. Croix County, Wisconsin	Docket No. 2535-CE-100

Ex.-Clean Wisconsin-Hessler-6

Please enter the attached report titled "A Cooperative Measurement Survey and Analysis of Low Frequency and Infrasound at the Shirley Wind Farm in Brown County, Wisconsin" into the record as Ex.-Clean Wisconsin-Hessler-6.

1.0_Introduction

Clean Wisconsin is a nonprofit environmental advocacy organization that works to protect Wisconsin's air and water and to promote clean energy. As such, the organization is generally supportive of wind projects. Clean Wisconsin was retained by the Wisconsin Public Service Commission (PSC) to provide an independent review of a proposed wind farm called the Highlands Project to be located in St. Croix County, WI (WI PSC Docket 2535-CE-100). Clean Wisconsin in turn retained Hessler Associates, Inc. (HAI) to provide technical assistance.

During the course of the hearings, attorneys representing groups opposed to the Highlands project, presented witnesses that lived near or within the Shirley Wind project in Brown County, WI. The Shirley wind project is made up of eight Nordex100 wind turbines that is one of the turbine models being considered for the Highlands projects. These witnesses testified that they and their children have suffered severe adverse health effects to the point that they have abandoned their homes at Shirley. They attribute their problems to arrival of the wind turbines. David Hessler, while testifying for Clean Wisconsin, suggested a sound measurement survey be made at the Shirley project to investigate low frequency noise (LFN) and infrasound (0-20 Hz) in particular.

Partial funding was authorized by the PSC to conduct a survey at Shirley and permission for home entry was granted by the three homeowners. The proposed test plan called for the wind farm owner, Duke Energy, to cooperate fully in supplying operational data and by turning off the units for short intervals so the true ON/OFF impact of turbine emissions could be documented. Duke declined this request due to the cost burden of lost generation, and the homeowners withdrew their permission at the last moment because no invited experts on their behalf were available to attend the survey.

Clean Wisconsin, their consultants and attorneys for other groups all cooperated and persisted and the survey was rescheduled for December 4 thru 7, 2012. Four acoustical consulting firms would cooperate and jointly conduct and/or observe the survey. Channel Islands Acoustics (ChIA) has derived modest income while Hessler Associates has derived significant income from wind turbine development projects. Rand Acoustics is almost exclusively retained by opponents of wind projects. Schomer and Associates have worked about equally for both proponents and opponents of wind turbine projects. However, all of the firms are pro-wind if proper siting limits for noise are considered in the project design.

The measurement survey was conducted on schedule and this report is organized to include four Appendices A thru D where each firm submitted on their own letterhead a report summarizing their findings. Based on this body of work, a consensus is formed where possible to report or opine on the following:

- Measured LFN and infrasound documentation
- Observations of the five investigators on the perception of LFN and infrasound both outside and inside the three residences.
- Observations of the five investigators on any health effects suffered during and after the 3 to 4 day exposure.
- Recommendations for the existing Shirley project

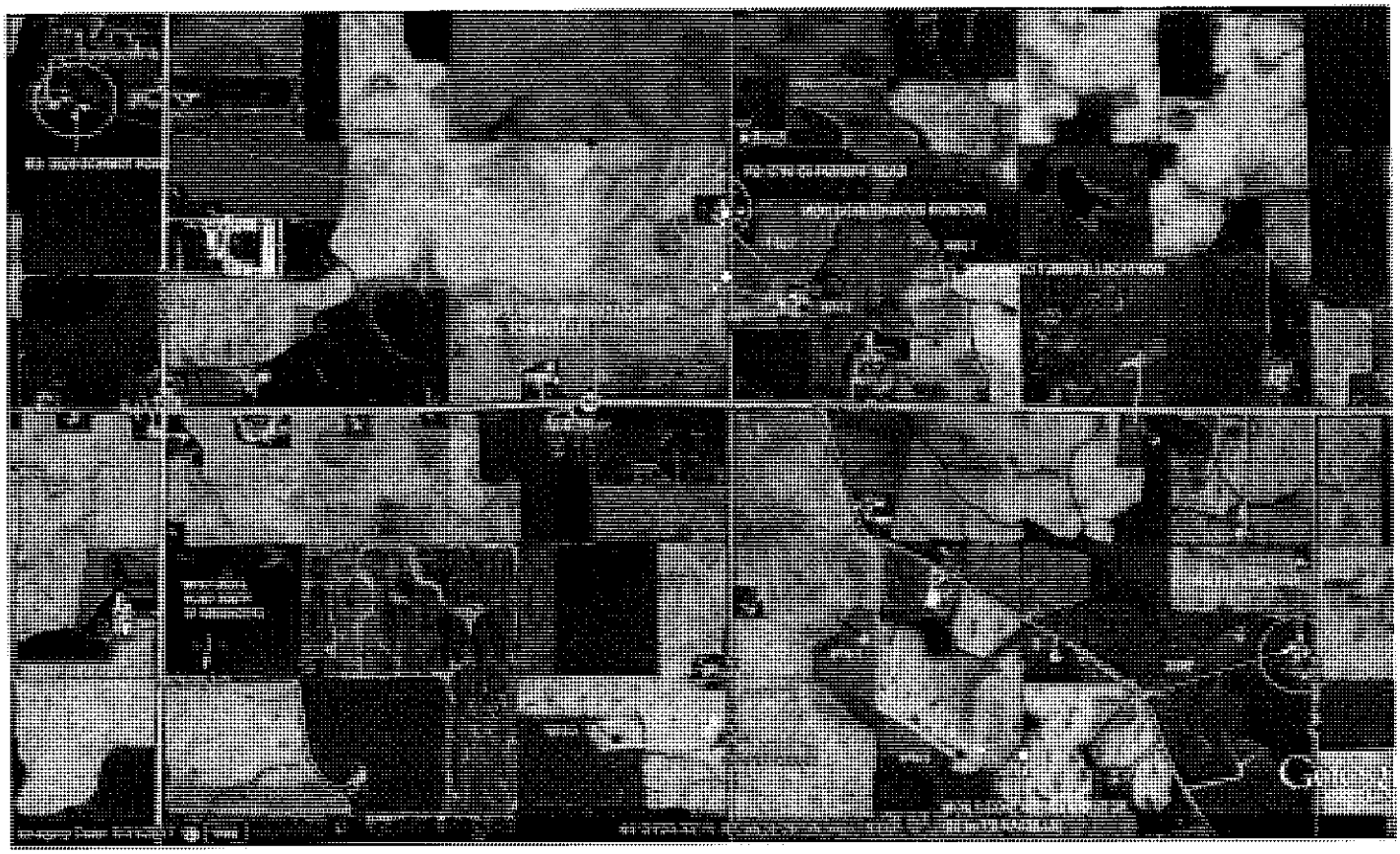


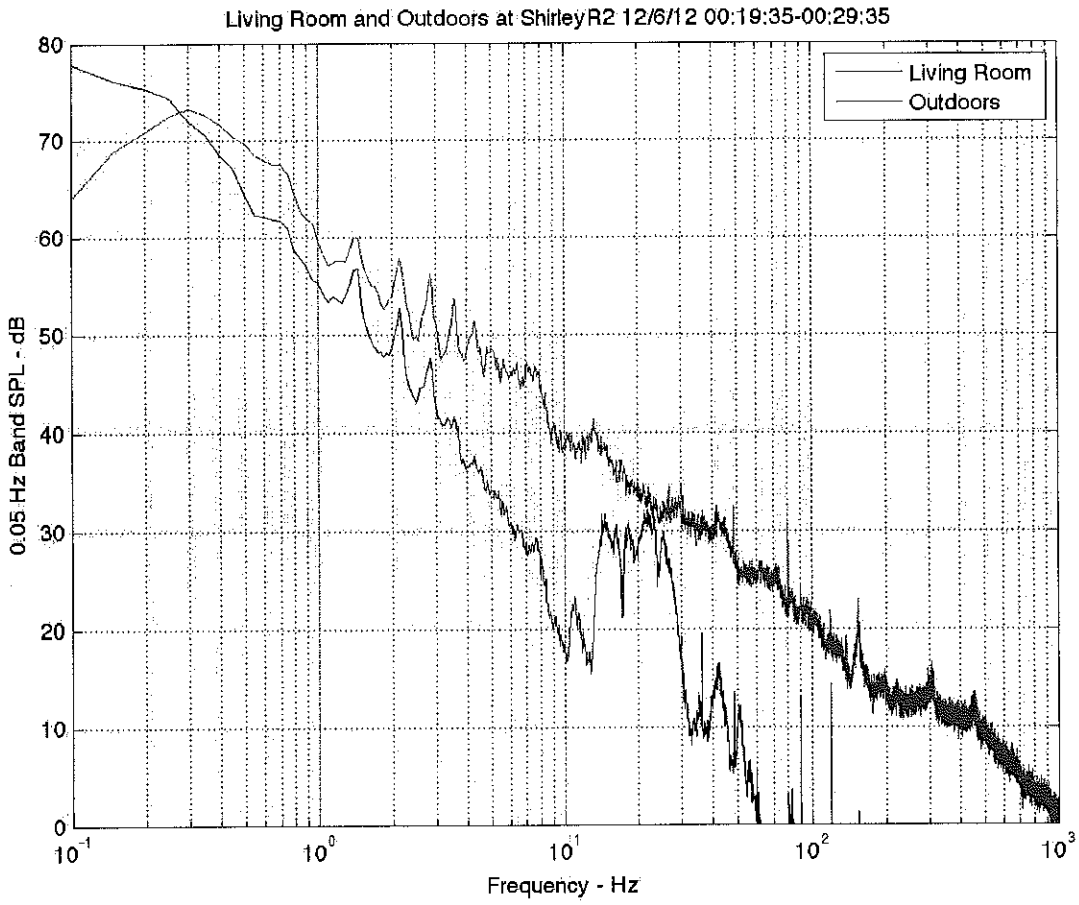
Figure 2.1: *Aerial view showing sound survey locations*

The four firms wish to thank and acknowledge the extraordinary cooperation given to us by the residence owners and various attorneys.

4.0_Conclusions

This cooperative effort has made a good start in quantifying low frequency and infrasound from wind turbines.

Unequivocal measurements at the closest residence R2 are detailed herein showing that wind turbine noise is present outside and inside the residence. Any mechanical device has a unique frequency spectrum, and a wind turbine is simply a very very large fan and the blade passing frequency is easily calculated by RPM/60 x the number of blades, and for this case; 14 RPM/60 x 3 = 0.7 Hz. The next six harmonics are 1.4, 2.1, 2.8, 3.5, 4.2 & 4.9 Hz and are clearly evident on the attached graph below. Note also there is higher infrasound and LFN inside the residence in the range of 15 to 30 Hz that is attributable to the natural flexibility of typical home construction walls. This higher frequency reduces in the basement where the propagation path is through the walls plus floor construction but the tones do not reduce appreciably.



Measurements at the other residences R1 and R3 do not show this same result because the increased distance reduced periodic turbine noise closer to the background and/or turbine loads at the time of these measurements resulted in reduced acoustical emission. Future testing should be sufficiently extensive to cover overlapping turbine conditions to determine the decay rate with distance for this ultra low frequency range, or the magnitude of measurable wind turbine noise with distance.

An important finding on this survey was that the cooperation of the wind farm operator is absolutely essential. Wind turbines must be measured both ON and OFF on request to obtain data under nearly identical wind and power conditions to quantify the wind turbine impact which could not be done due to Duke Energy's lack of cooperation.

We strongly recommend additional testing at Shirley. The multi-channel simultaneous data acquisition system is normally deployed within a mini-van and can be used to measure immissions at the three residences under the identical or near identical wind and power conditions. In addition, seismic accelerometer and dedicated ear-simulating microphones can be easily accommodated. And, ON/OFF measurements require the cooperation of the operator.

Since the problem may be devoid of audible noise, we also recommend a test as described by Schomer in Appendix D to develop a "Threshold of Perception" for wind turbine emissions.

Bruce Walker

George F. Hessler Jr.

David M. Hessler

Robert Rand

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Low Frequency Acoustic Measurements at Shirley Wind Park

Bruce Walker, Ph.D., INCE Bd. Cert.

OVERVIEW

Bruce Walker of Channel Islands Acoustics (ChIA) was requested by Hessler Associates to assist in defining low and infrasonic frequency (approximately 0.5 – 100 Hz) sounds at abandoned residences in the environs of Shirley Wind Park near DePere, WI. ChIA has been developing a measurement system that combines extended range microphones and recording equipment with mixed time domain and frequency domain signal processing in an effort to quantify sound levels and waveform properties of very low frequency periodic signals radiated by large wind turbines[i].

The Shirley Wind park consists of eight Nordex turbines with 85 meter hub height and 100 meter rotor diameter. These turbines are distributed over an approximately six square mile area in Brown County, WI as shown in Figure 1. The turbines are of similar in size to those investigated in Ref. 1.

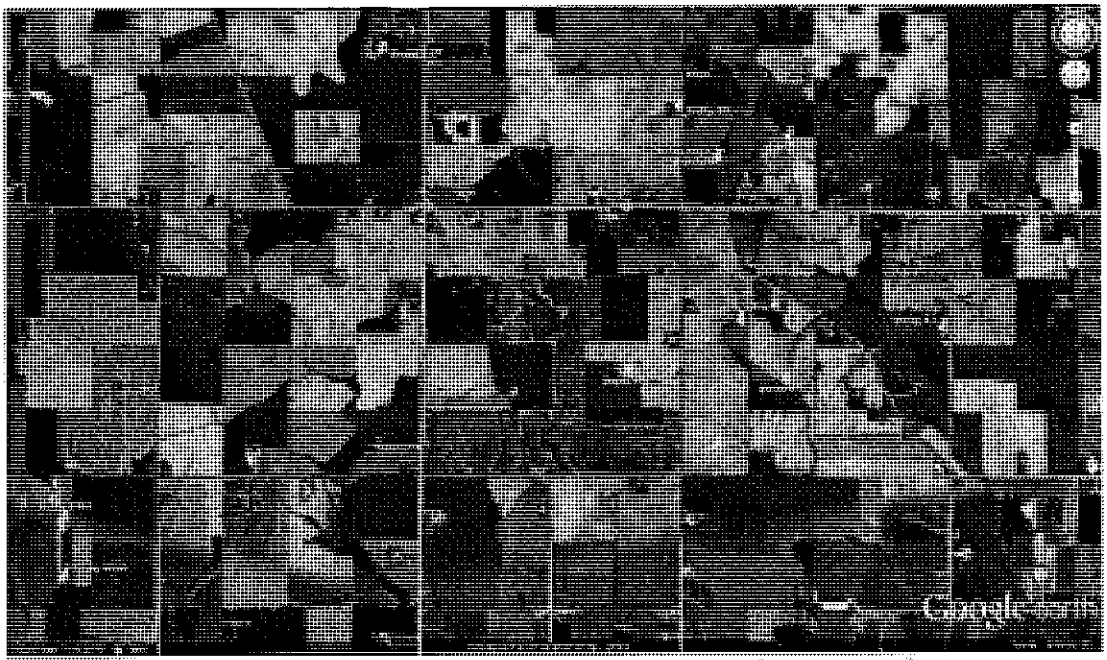

Figure 1. Environs of Shirley Wind Park, Showing Eight Turbines and Three Abandoned Residences Investigated in the Program

source. The **correlation coefficient** is the cross-correlation function divided by the product of the square roots of the auto-correlation at zero delay.

power spectral density function (PSD) – the average of the squared-magnitude of the frequency spectrum of a time-varying signal, divided by the nominal bandwidth (BW in Hz) of the spectral analysis. The unit is Pa-squared per Hz. Narrow band sound pressure levels in this report are computed in dB as 10 log(PSD x BW) + 94.

cross-PSD – the frequency-by-frequency average of the products of the spectra from two signals.

coherence function - a frequency-domain description of the relative commonality between two signals. It is determined as the frequency-by-frequency ratio of the cross-PSD to the product of the square roots of the two PSD's. If a spectral component in two signals results from a common source, the coherence is unity (1) and if the spectral component results from two statistically independent sources, the coherence is zero.

spectrograph – a display of amplitude as color or brightness vs frequency and time.

MEASUREMENT SYSTEM and DATA ACQUISITION

A basic list of the components in the measurement system are shown in Table **2.** Serial numbers and calibration certifications are available on request.

Table 2. Basic Components of ChIA Low-Frequency Acoustic Data Acquisition System

Item	Type	Number
Portable Acoustic Analyzer	B&K 2250	2
Low Frequency Microphone	B&K 4193	6
Microphone Preamp	B&K 2639	4
Signal Conditioning Amp	B&K NEXUS 2690-OS4	1
24 Bit Simultaneous ADC	DT9826-16	1
Laptop Computer	Acer	1
Calibrator	B&K 4231	1
Anemometer	NRG Cup & Resolver	1

As deployed in this program, the 4193 microphones with low-frequency extensions, 2639 preamplifiers and NEXUS signal conditioner were placed in three or four rooms of the residences, while a fifth 4193 and a 2250 analyzer was placed in a standard 3-1/2 inch hemisphere wind ball under an 18 inch foam secondary wind screen on a ground board approximately 50 ft from the residence in the direction of wind turbines. The sixth 4193 and second 2250 were held in reserve and ultimately deployed at R3 on December 7. Full system throughput calibration was run for all channels each day and after each equipment relocation.

Measurement data was collected with simultaneous in 10-minute blocks at sampling rate 24 kHz as shown in the Test Log, Table **3.** The signal conditioning amplifiers were set for range 0.1 Hz to 10 kHz. Amplifier sensitivities were set to allow sound pressures up to 10 Pa (114 dB) to be accepted without system overload. The output of the NRG cup anemometer/resolver was recorded on a seventh channel of the

Following this, the spectrum with the most distinct representation of turbine blade passage pulsation was identified. From the Blade Passage harmonic series noted for this spectrum, waveforms were synthesized assuming two sets of phase relationships. In the first, the harmonics were arranged as sine waves with zero phase. In the second, they were arranged as cosine waves with zero phase. The former produces a composite wave with maximum wavefront slope while the latter produces a composite wave with maximum peak-to-rms ratio (crest factor).

RESULTS EXAMPLES

The test produced a large compendium of testing results, which, it is hoped, can be correlated with turbine operating conditions from data yet to be received. Mean local wind speeds for all blocks are shown (meters per second) in Table **3**. Illustrative examples showing disparities among the three residences are shown in the following graphs. The full set of data is available for review.

Figure **2** shows a sample of raw data collected during windy conditions at Residence R2. Note that apparently wind-driven very low frequency pressure fluctuations are well synchronized and nearly equal in amplitude at four disparate locations within the home.

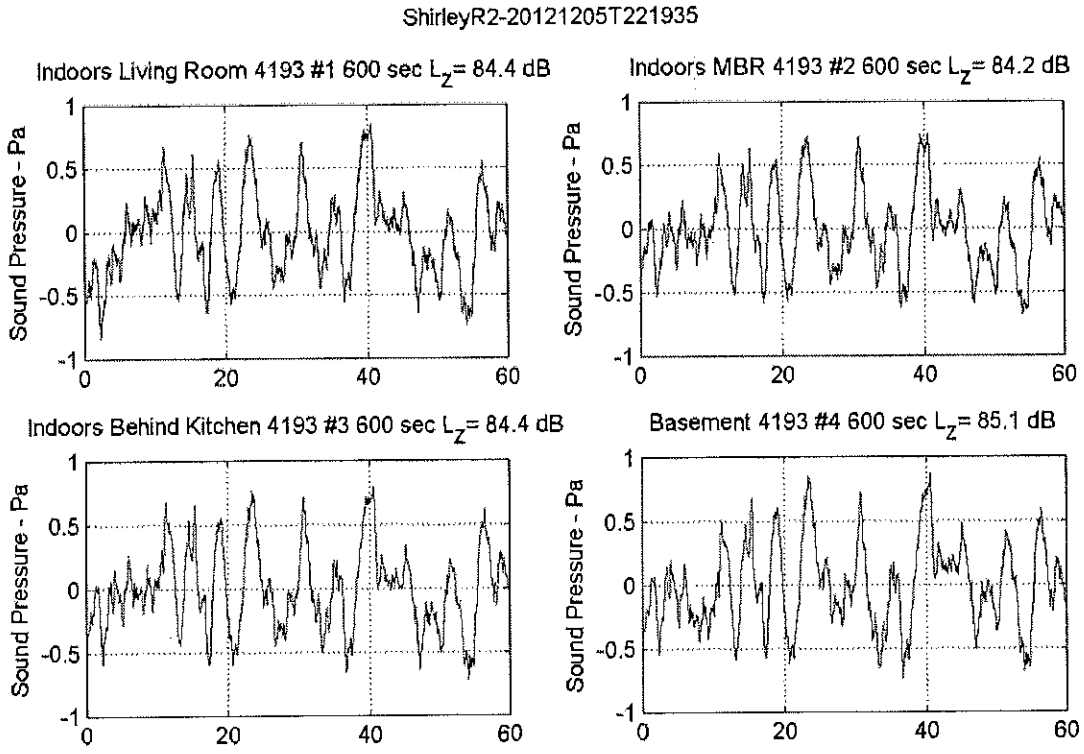

Figure 2. First Minute of Raw Data Collected at R2 On Dec 6 Starting 00:19:35. Note very low frequency fluctuations are nearly equal at four locations.

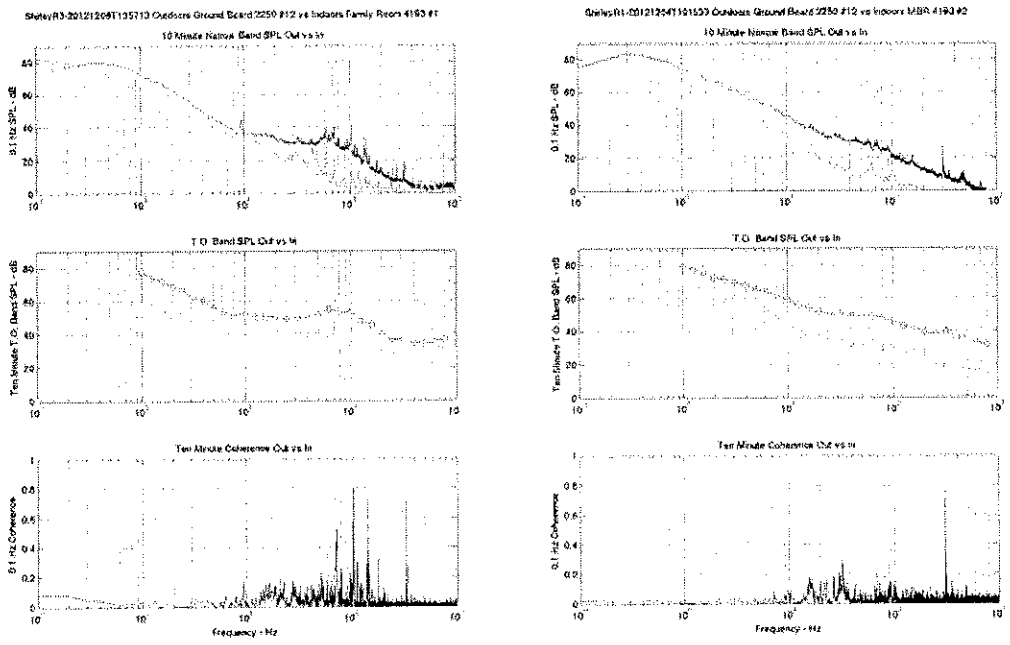

Figure 5. Low Frequency (0.1-1,000 Hz) Spectra and Coherence from Two Rooms in R3 measured 12/6/12 starting 15:57:13 showing differences in detail, poorly correlated low-order blade-pass harmonics and well correlated tones from passing vehicle exhausts. Red curve is measured outdoors between turbines and home.

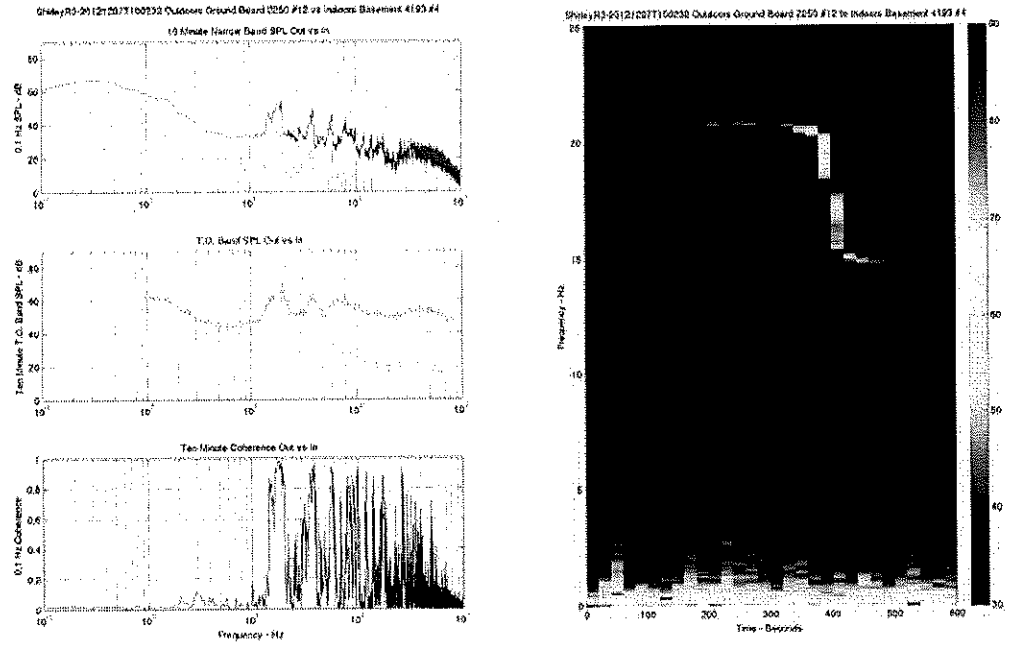

Figure 6. Low Frequency Spectra and Outdoor-Indoor Cross Spectrograph in Basement of R3 with Helicopter flyover. Note Doppler shift of rotor tone from 20.5 Hz on approach to 15 Hz receding. Also note high coherence of the helicopter rotor blade harmonics. Note very low coherence of turbine blade frequencies below 10 Hz, suggesting most of the infrasound is general atmospheric pressure fluctuation and wind force on the residence.

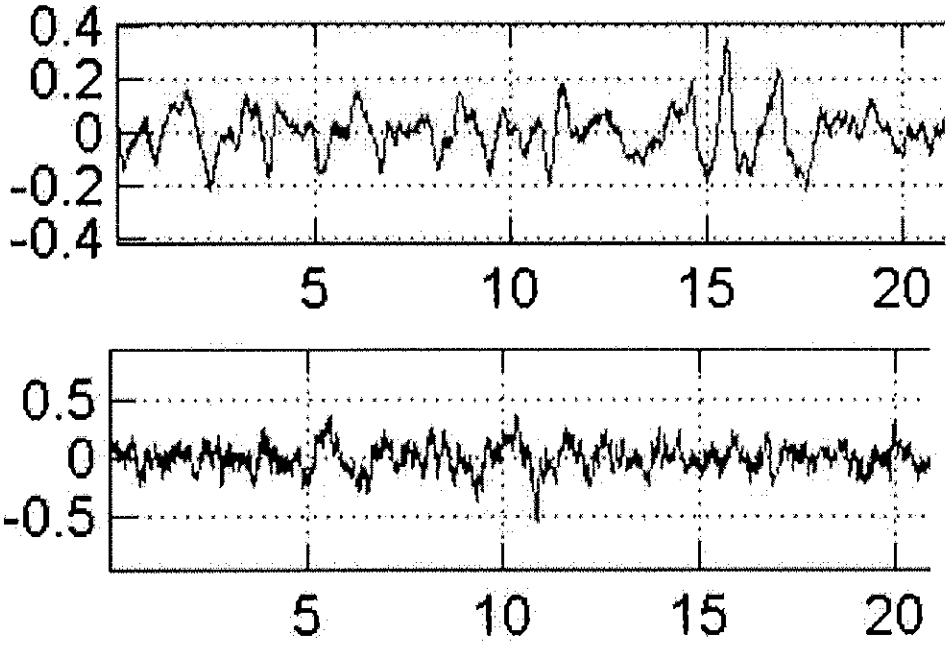

Figure 9. 0.5 Hz Phaseless High-Pass Filtered Waves Indoors (upper) and Outdoors at R2, Corresponding to Spectrum of Figure 7. Note repetitive waves indoors, similar to left-hand synthesized example. Note transient event indoors at 15.5 seconds unrelated to outside noise.

A summary of statistical sound levels for each test is shown in Table **4**. Note that the high frequency noise floor of the low-frequency microphones used indoors limits the A-weighted results to 29-30 dB minimum. The cells marked in red were affected by system overload or other problems and should be discounted. The cells marked in gold are for a seismic accelerometer mounted on the Kitchen island of R3 and are not calibrated except that 94 dB is approximately 1 m/sec^2. The cells marked in teal are taken on the front seat of the Mini-SUV parked outside R2. All others are normal measurements as shown in the Log, Table **3**.

CONCLUDING REMARKS

In an effort to determine acoustical conditions that could be linked to apparent intense reaction by some Shirley environs homeowners, simultaneous indoor and outdoor acoustic and local wind speed measurements were conducted sequentially at three disparate locations over a three-day period starting the evening of December 4, 2012. A very large compendium of raw and processed data was obtained, a small fraction of which is presented in this summary.

The apparent and tentative result indicates that at the second residence, located approximately 1,280 ft from the nearest turbine, blade-passage induced infrasound was correlated between outdoor and indoor locations and peak amplitudes of periodic waves composed of blade harmonics 0.7 to 5.6 Hz on the order 76 dB were detected both indoors and outdoors. Well correlated broadband low frequency noise at this nearest residence was also detected, with one-third octave band sound pressure levels approximately 50 dB in the frequency range 16-25 Hz. Both of these sounds are below normal hearing threshold; residents report being intensely affected without audibility.

At the other two residences, located approximately 3,300 and 7,100 ft from the nearest turbine, respectively, high levels of infrasound were detected indoors but the correlation with outdoor acoustic signals was not clear except at the 3,300 ft residence, where the broadband noise in the 20 Hz range was moderately correlated and produce one-third octave band level approximately 40 dB, which is well below normal hearing threshold. At the 7,100 ft residence, outdoor-to-indoor correlation was low except during motor vehicle passages or in particular a helicopter overflight. Again, residents report being intensely affected despite inaudibility and to be aware of turbine operation when the turbines are not visible.

The author is not qualified to make judgments regarding human response to normally subliminal sources of acoustic excitation. A detection test has been proposed by the consortium of investigators and put forth by Dr. Schomer. The author concurs that this is an important step in resolving a difficult issue.

An additional missing element in the program is ability to correlate acoustic test results with turbine operating conditions. Near-turbine acoustic monitors placed by HAI showed significant variability in near-field sound levels for turbines WTG6 and WTG8 over the course of the program, with an indication that turbine noise emissions may have decreased shortly before the team started and increased shortly after the team stopped measuring on some days. Review of turbine SCADA records will show turbine-height wind speeds and directions and turbine power output as well as times when turbine were parked for flicker suppression or other purposes. This will help determine the program for additional measurements and/or if scaling of measured levels would be appropriate.

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[i] B. Walker, Time Domain Analysis of Low Frequency Wind Turbine Noise, Low Frequency Noise 2012, Stratford Upon Avon, UK

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Appendix B to Report Number 122412-1

1. Introduction

Hessler Associates concentrated on acquiring data to define the low frequency issue at the Shirley site using four Norsonics Model N-140 ANSI Type 1 precision instruments (NOR140). These systems with the standard microphone and preamp are rated at an accuracy of +/- 1 dB from 5 Hz to 20,000 Hz. Two of the systems were used as continuous data loggers and the other two for relevant attended measurements. The systems were also calibrated against the extended frequency range system brought by Channel Islands Acoustics (ChIA).

2. Calibration

Two NOR140 units were set-up in the living room of residence R2 adjacent to the high performance ChIA microphone, which is rated accurate from 0.1 Hz to 20,000 Hz. The results of a 10-minute run between the three systems, along with a photograph of the set-up, are shown below. It is clear from the test that the NOR140 off-the-shelf unit can be used with confidence down to about 2 Hz; significantly better than its 5 Hz rating.

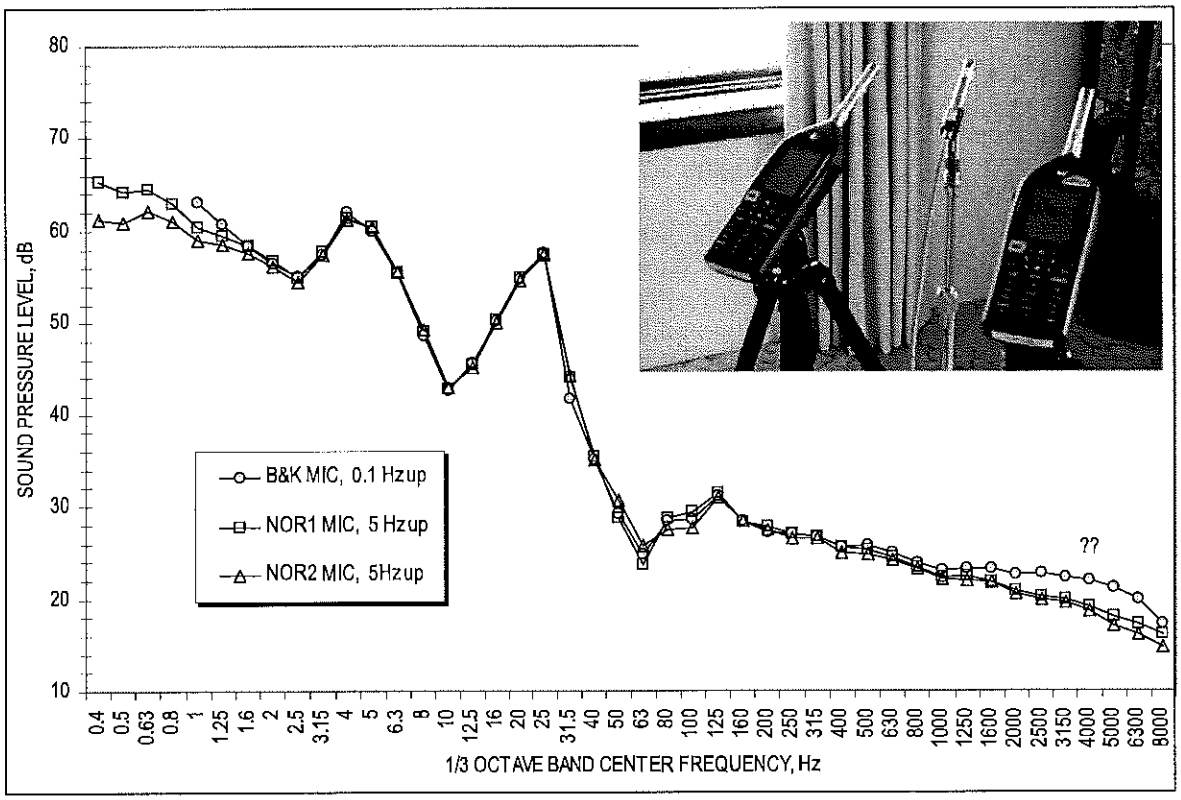
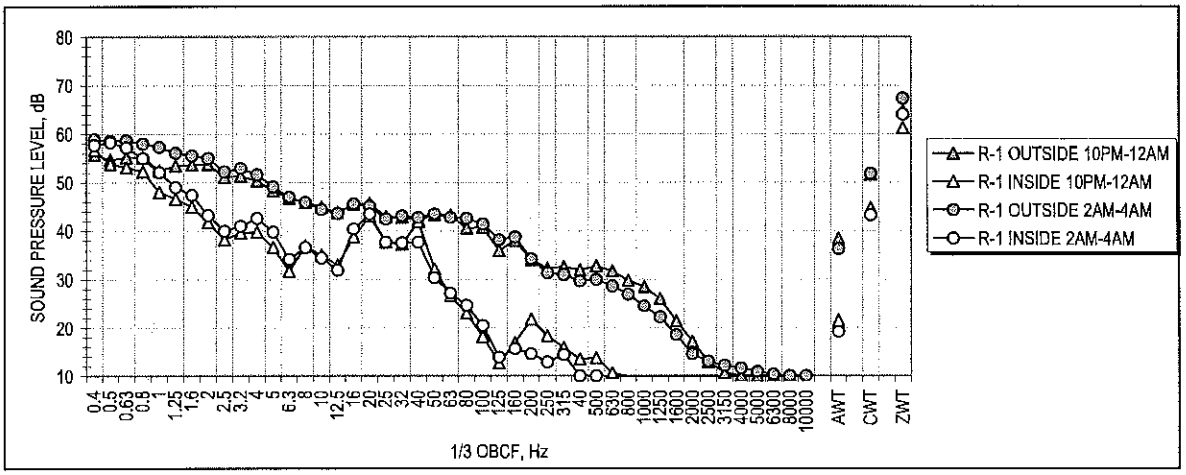
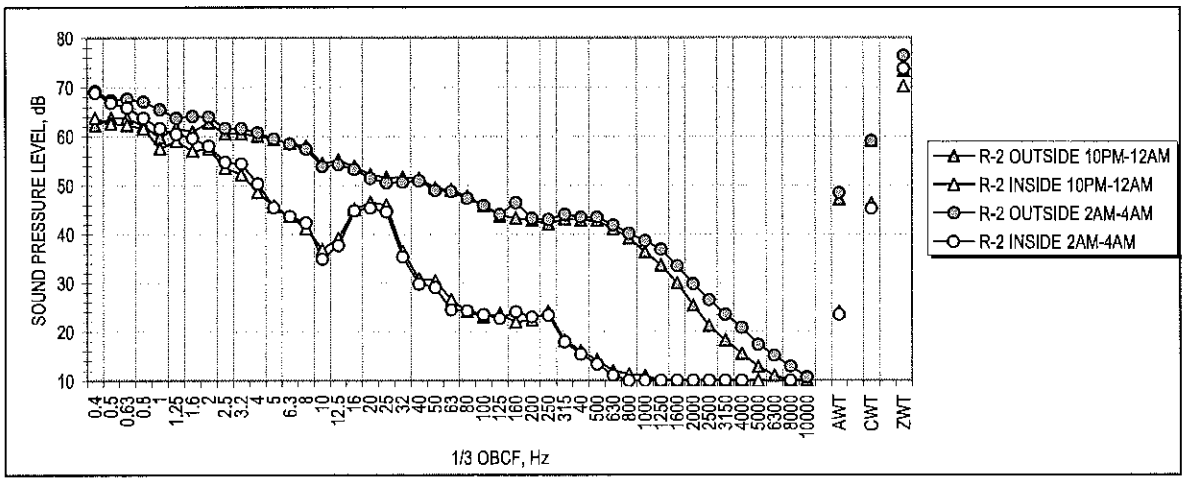


Figure 2.1 *Instrument Calibration Check Relative to High Performance ChIA System*

4. OUTDOOR/INDOOR Measurements

Measurements of the frequency spectra inside and outside of each of three residences on Wednesday night and early Thursday morning while the turbines were operating near full power are plotted below.





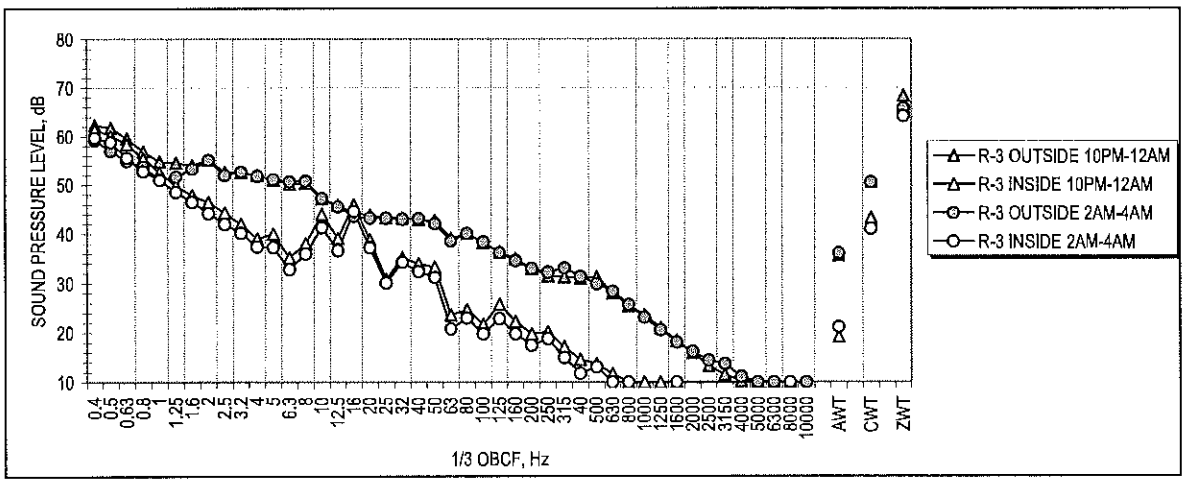


Figure 4.1 *Inside/Outside Sound Levels during Project Operation*

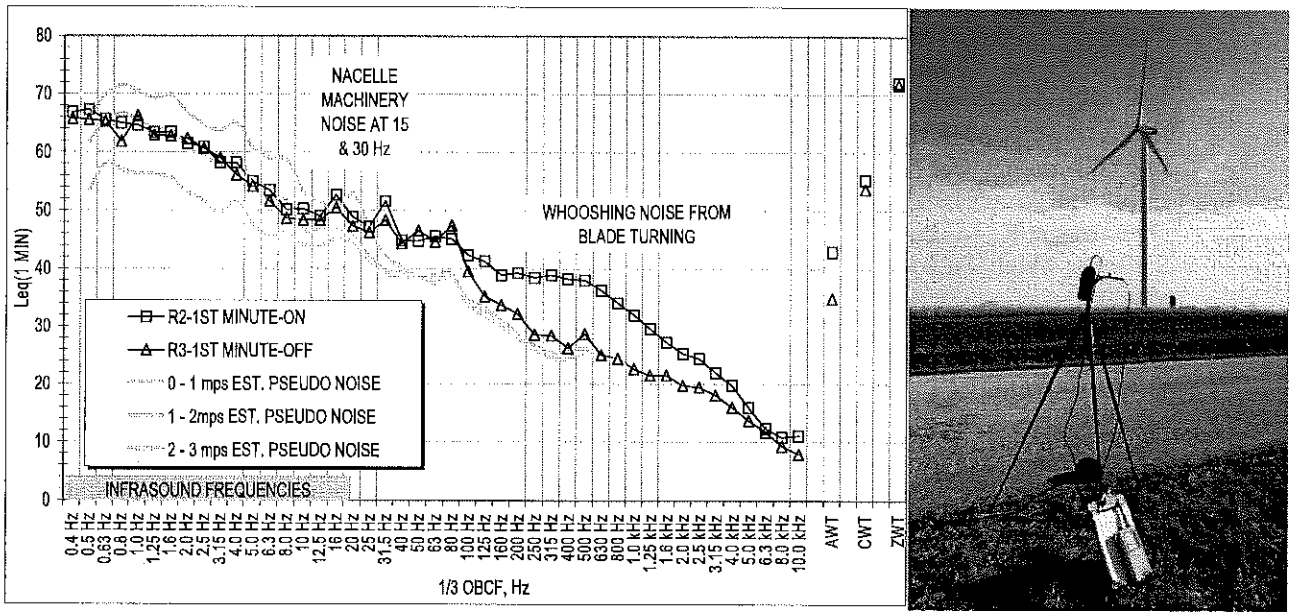


Figure 5.1 *On/Off Sound Levels Outdoors during Project Operation*

6. Proposed Method for Measuring Outdoor LFN in Wind

The experience above with on/off measurements outdoors can be combined with a finding made by Walker and Schomer that LFN inside a dwelling was quite uniform throughout all the rooms in the house, and not, as one might intuitively imagine, in the rooms facing the nearest turbine. This prompted them to measure the sound level inside of a vehicle, an SUV, and compare it to the levels measured inside the residence. It was found that the low frequency levels inside the car were similar to those inside the adjacent dwelling. Since an SUV is a closed, wind-free volume, it follows that the problem of obscuring pseudo could be eliminated with such measurements and accurate narrow band measurement of extreme low frequency sound could be measured inside of a car. The spectrum for a wind turbine shows up as a distinct pattern of peaks beginning at the blade passing frequency (about .5 to 1 Hz for modern wind turbines) with several following harmonic peaks that positively identify wind turbine low-frequency infrasound immissions. The beauty of the system sketched below in Figure 6.1 is that it is mobile and can be used at any public assess near or far from a wind farm.

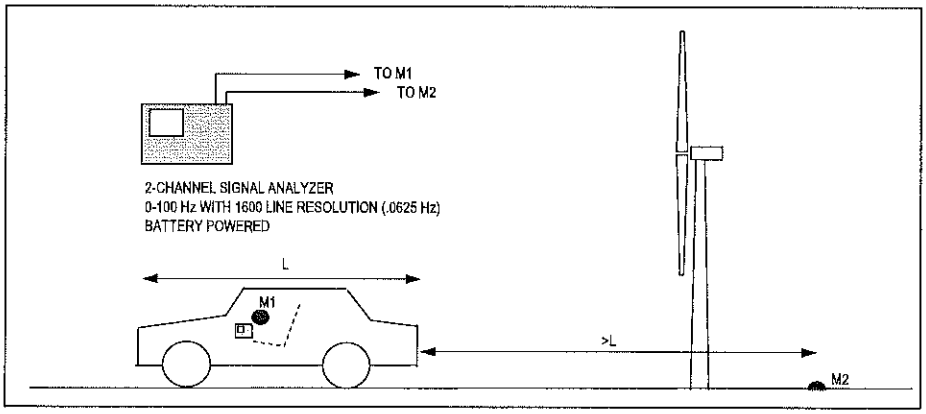


Figure 6.1
Schematic of Alternative, Mobile Measurement Technique for Low Frequency Sound Emissions from Wind Turbines

The study also showed that a wind turbine is indeed a unique source with ultra low frequency energy. The next figure plots the same R2 data above compared to a more commonly recognized low frequency noise source, an open cycle industrial gas turbine complex sited too close to homes. These two sources of electrical energy production, assuming the low end of the wind turbine measurement is actually due to the turbine rather than pseudo noise, have about the same A-weighted and Z-weighted overall sound levels.

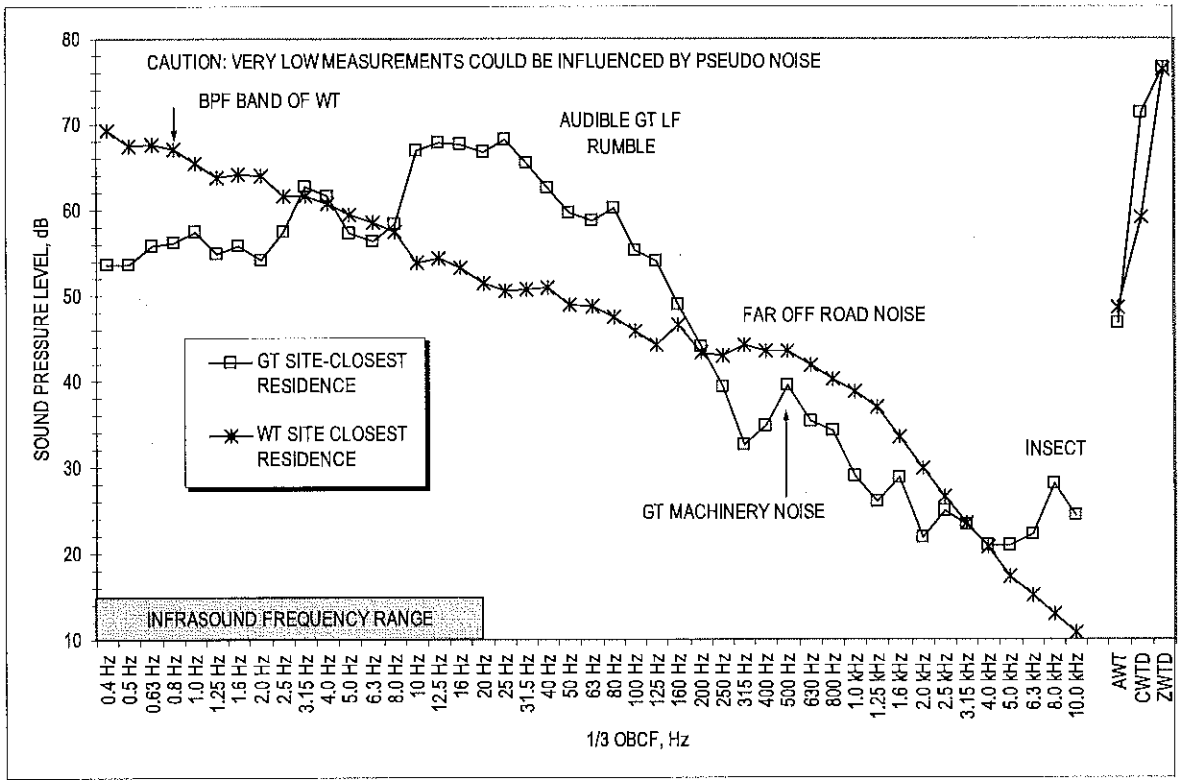


Figure 7.2 *As-Measured Wind Turbine Spectrum Compared to Gas Turbine Sound Level*

The C-weighted sound level is often used as a measure of low frequency noise; most commonly in gas turbine applications. If the C minus A level difference of a source is 15 to 20 dB, further investigation of the source is recommended by some test standards, since that apparent imbalance may be an indicator of excessive low frequency content in the sound. In this instance, the C-A level difference for the wind turbine is only 11 dB compared to 25 dB for the gas turbine, so this metric does not appear to work for wind turbines.

Schomer and Rand contend that the illness that is being reported may be a form of motion sickness associated with the body experiencing motion in approximately the same frequency range as wind turbine blade passing infrasound. However, this conjecture is based on a Navy study in which subjects were physically vibrated in flight simulators at amplitudes that may or may not be comparable to the situation at hand, whereas any such force from a distant wind turbine would need to be conducted through the air. One must make the leap that motion of the body in still air is the same as being still in air containing some level of infrasound. While potentially plausible this hypothesis needs to be verified.

APPENDIX C
by
RAND ACOUSTICS

effects reported by others living near wind turbines [1,2], Mr. Rand focused on acquiring neighbor reports on health impacts during and prior to testing and correlated those to data being acquired. The working assumption borne out by experience is that the human being is the best reporting instrument.

Correlation: When investigating community noise complaints, value can be derived from measurements and analysis primarily when they are highly correlated to neighbor reports. In simple terms: if a recording or analysis is made when the turbines are turning, and the neighbors are present and report feeling intolerable, tolerable, or not a problem, and report such details as headache, nausea, vomiting, dizziness, vertigo, or cloudy thinking, or the absence of health effects, the correlation to the neighbor reports provides very useful information for assessing the utility of those data. Without the neighbor reports, it is difficult to determine the significance of acoustic data. From details given in neighbor reports, the investigators can look for unusual or distinctive acoustic characteristics or differences to clarify what acoustical conditions correspond to the degree of health effects being reported.

Self-reports taken as valid: The team agreed prior to testing that neighbor reports would be useful. They also agreed that neighbor reports are sincere and truthful, not "claims" as often alleged by the wind industry. Neighbors considered and agreed to requests to be available during testing. Mr. Rand also agreed to note his condition during the testing, since unlike the other acousticians he is prone to seasickness and has also proved vulnerable to negative health effects when near large wind turbines.

Due to schedule constraints, Mr. Rand was unable to attend a preliminary meeting with the owners of the three homes during the midday on Tuesday, December 4. However he met with the owners during the evening of December 4 shortly after arriving, and observed and acquired owner health reports and noted his own health over the next three days.

2.1 Equipment

Equipment used by Mr. Rand included:

- Gras 40AN microphone
- Larson Davis Type 902 Preamplifier
- Larson Davis Type 824 Sound Level Meter
- M-Audio MicroTrackII 24-bit line-level audio recorder
- Bruel & Kjaer Type 4230 Acoustic Calibrator
- SoundDevices USBPre audio interface
- Infiltec Model INFRA-20 seismometer (acoustic pressure, 0.1 to 20 Hz)
- SpectraPlus 5.0 acoustic analysis software
- Amaseis helicorder datalogger software

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1 Robert W. Rand, Stephen E. Ambrose, Carmen M. E. Krogh, "Occupational Health and Industrial Wind Turbines: A Case Study", Bulletin of Science Technology Society October 2011 vol. 31 no. 5 359-362.
2 Ambrose, S. E., Rand, R. W., Krogh, C. M., "Falmouth, Massachusetts wind turbine infrasound and low frequency noise measurements", Proceedings of Inter-Noise 2012, New York, NY, August 19-22.

between. They said if the turbines are operating, it's intolerable. Mr. Rand observed neighbors unable to stay at the homes at times even under moderate wind conditions during the testing.

5.2 *Neighbors do not always hear the turbines. The neighbors indicated there is no real difference in wind compass direction on the negative health effects.* The house could be upwind, downwind or crosswind to the turbine; no difference.

5.3 *Neighbors retreated to the basement and gained partial relief from symptoms. Tested sound levels are the same everywhere in the home except less in the basement.* Lower sound levels in the basement matches the neighbor reports to Mr. Rand to the effect that, when the turbines are operating, it's about the same level of difficulty everywhere in the house, except the basement, where they would retreat to gain partial relief, until they either left or abandoned the home to get substantial relief. The neighbors reported that they felt a need to get outside when conditions were intolerable. Their reports are supported by and correlate to the ubiquitous presence of the acoustic energy inside in all locations, except in the basement where it is slightly less. The neighbors take to the basement or if that is not sufficient to gain relief, they leave the home.

5.5 *Acoustic energy outside was strongly coupled into the home at infrasonic frequencies when turbines operating in design range.* Neighbors reported feeling worst when turbines are turning compared to light-wind conditions with some or all turbines off when they report using words such as "tolerable". Coherence between outdoor and indoors time-series was high at infrasonic frequencies below 8 Hz when wind turbines operating compared to when wind turbines off or turning slowly in light winds.

5.6 *Neighbors reported being highly annoyed by the interior sound. Elevated acoustic energy was observed inside all three homes in the range of 10 to 40 Hz.* Room, house, wall and floor acoustic modes (resonant frequencies) are found in the 10 to 40 Hz range. The Nordex N100 has in-flow turbulence noise at a peak frequency of 9 to 14 Hz depending on rotational speed, which might be involved in exciting resonant frequencies in walls and floors. More analysis and/or survey work appears needed to determine the extent of the problem. Mr. Rand was able to discern panel excitation in R3 where the owner reported feeling pressure on his ears as he moved toward the southerly wall of the sitting area in the open-area. Two wind turbines operating at a distance were faintly audible in R3 and detectable with ear to wall. Dr. Walker and Mr. Rand discussed the sensation, examined the walls, and made measurements of the home room dimensions for a future check of room modes against acoustic recordings.

5.7 *Neighbors reported that at a distance of 3-1/2 miles, they could find relief when turbines were operating.* Outdoor average sound levels at the nearest home R2, a distance of 1100 feet, were measured at approximately 48 dBA. Assuming 6 dB per doubling of distance for the A-weighted sound level, a probable A-weighted sound level at 3-1/2 miles is 48-20log(1100/18480) or, 48-23 or, 25 dBA. Measured infrasonic unweighted average levels outdoors were approximately 73 dB at 0.3 Hz at 1100 feet. Assuming 3 dB per doubling of

5.7 *Negative health effects were experienced.* During testing Mr. Rand experienced again [4] some of the adverse health effects reported by the neighbors. In effect, Mr. Rand "peer-reviewed" the neighbors by staying in two of the homes for extended periods of time overnight to experience what they are reporting. Mr. Rand slept in R1 the night of December 4th to assess the effects on sleep, and worked at R2 much of the second night (to 5:30 am) to assess audibility and effects while awake. Wind turbine sound levels were faintly detectable with interior sound levels in the range of 18-20 dBA. Note: Although he had arrived the previous night feeling good, on awakening on December 5 Mr. Rand felt nauseous (very unusual). To summarize, Mr. Rand encountered unusual negative health effects during the testing period when near the operating wind turbines, including, at various times:

- Nausea
- Headache
- Dizziness

Symptoms persisted after the testing for about a week, relieved by rest away from the site. The other investigators do not get seasick and did not report the same negative health effects.

Implications

A nauseogenic factor is present. Naval, aviation and other research has established human sensitivity to motion producing nausea. While mechanism for motion sickness is not well understood, "theories all describe the cause of motion sickness via the same proposition: that the vestibular apparatus within the inner ear provides the brain with information about self motion that does not match the sensations of motion generated by visual or kinesthetic (proprioceptive) systems, or what is expected from previous experience". The range of motion nauseogenicity has been measured at 0.1 to 0.7 Hz and with a maximum nauseogenic potential at 0.2 Hz [5][6] (see Figure 1). The Nordex N100 has a rotational rate of 0.16 to 0.25 Hz and a nominal blade passage rate of 0.5 to 0.7 Hz (three times the rotational rate). A hypothesis is suggested based on the limited, preliminary research correlating acceleration and nauseogenicity: *Nauseogenicity is present at Shirley due to acceleration on inner ear from modulated, impulsive acoustic pressure at rotation and/or blade passage rates.*

Note: Wind turbines produce periodic acoustic pressure modulations at the rotation rate (per blade) and blade passage rate (per turbine), due to changes in wind speed and turbulence as blades are rotated top to bottom, and as they pass the tower where a pressure blow zone changes local wind speed. Pressure modulations at BPF with strong rates of change were documented by Dr. Walker (see Dr. Walkers report and the main report, conclusions).

---

4 Nausea/dizziness/headache (very unusual) experienced at three other wind turbine sites including Falmouth, MA, April 2011 (Vestas V82); Hardscrabble, NY, August, 2012 (Gamesa G90-2MW); Vader Piet, Aruba, October, 2012 (Vestas V90-3MW).

5 Samson C. Stevens and Michael G. Parsons, Effects of Motion at Sea on Crew Performance: A Survey. Marine Technology, Vol. 39, No. 1, January 2002, pp. 29–47.

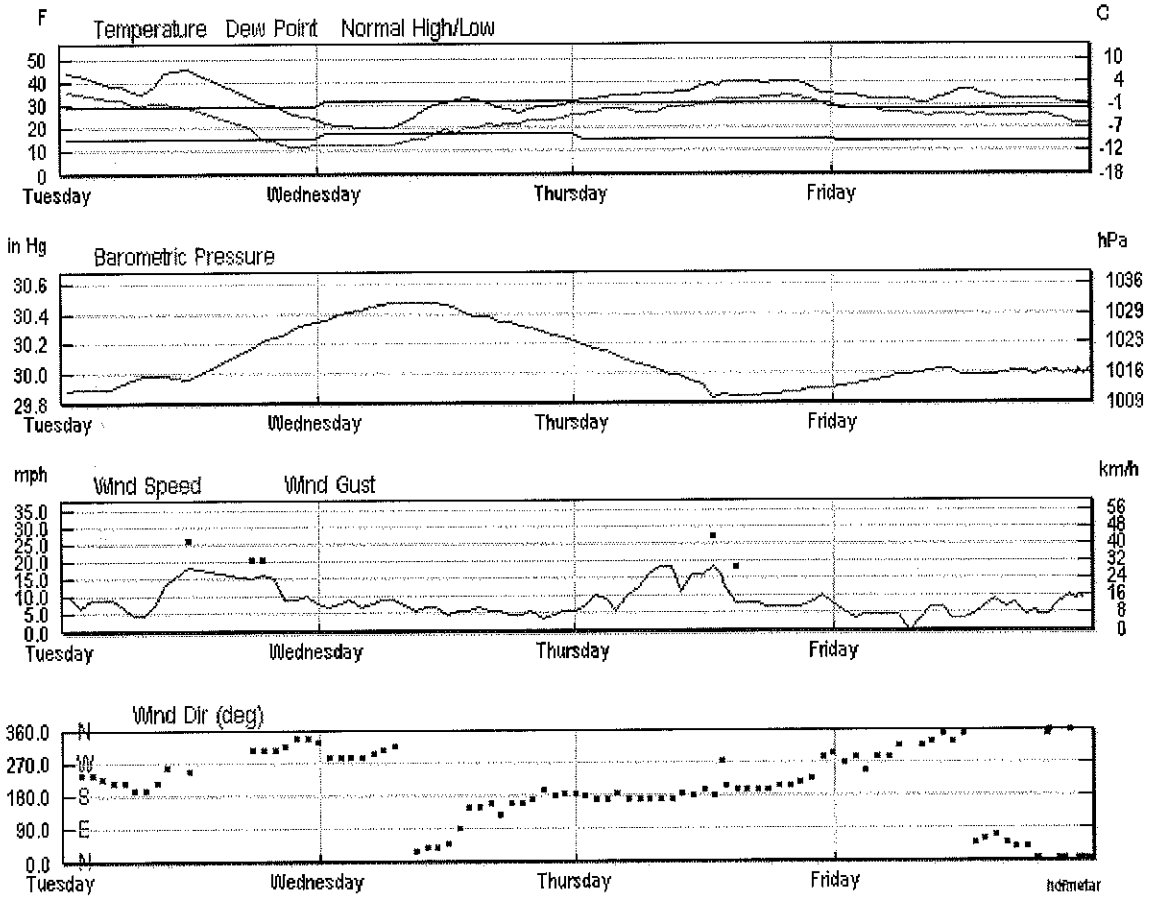
6 Golding JF, Mueller AG, Gresty MA., A motion sickness maximum around the 0.2 Hz frequency range of horizontal translational oscillation. Aviat Space Environ Med. 2001 Mar;72(3):188-92.

Conclusions

Nauseogenicity is a factor at Shirley. Acceleration of the inner ear is suggested due to extremely low-frequency pulsations at the rotation and blade pass rates that occur in or near the frequencies of highest potential for nauseogenicity and, are coupled strongly into the homes now abandoned. More research at Shirley is recommended to understand nauseogenicity from wind turbine operations, to properly design and site large industrial wind turbines (over 1 MW) near residential areas to prevent the severe health effects. More work is needed to establish what infrasonic levels are consistent with relief for the neighbors.

Medical research and measurement is urgently needed to be field coordinated along with infrasonic acoustic and vibration testing. The correlations to nauseogenicity at the 2.5MW power rating and size suggest worsening effects as larger, slower-rotating wind turbines are sited near people.

Figure 3. Weather conditions during investigations, December 4-7, 2012.



Weather source: KGRB Green Bay, WI. December 4-7, 2012
http://www.wunderground.com/history/airport/KGRB/2012/12/4/CustomHistory.html?dayend=7&monthend=12&yearend=2012&req_city=NA&req_state=NA&req_statename=NA&MR=1

Table 2. Neighbor field notes.

				Enz and Ashley
Name:		Darren Ashley	Location:	Homes
Date	Time	What you were feeling	Wind direction	# turbines on
4-Dec	12-1 pm	Tight chest, slight starting ear pain/pressure	west	4-6
4-Dec	2:30-3:30	Ears burning, more burning as on more turbine starts up	west	4-6
4-Dec	8:45 PM	Ears burning, especially strong sensation as I approached west window in Enz house	west/northwest	6 I think
5-Dec	am	Traveled from Denmark home to Schmidt home, mild ear pain in and outside of home, and while traveling	southeast	on and off
5-Dec	3-4:30 pm	At Schmidt home, in basement, fixing furnace, mild ear pain, very anxious all day into evening.	southeast	6 of 8
5-Dec	9-9:45 pm	pain in middle of my chest at Enz house, could not sit in kitchen against north wall because of head pain/pressure, no strong sensation as I would approach window west windows	south/southeast	6 of 8
6-Dec	12-12:45 am	felt strong presence in cozy room at Schmidt house, better outside not nearly as anxious all day	south/southeast	8
6-Dec	12-12:45 am	I had a tight neck while sitting on couch at Schmidt house, waiting for test	south/southeast	8
6-Dec	11:30 AM	drove thru wind farm, no issues, no pain, no headache	south	ZERO
6-Dec	12:40-12:50 pm	Driving home from Schmidt home thru wind farm I had a splitting headache, which lessoned as got further away.	south	7
6-Dec	4:15 PM	Stood on Glenmore road, close to Shirley road, felt sicker and sicker through my body the longer I stayed	south/southwest	6?
6-Dec	4:25 PM	could feel pressure in cozy room at Schmidt house, not as strong as night before, but still detectable	Southwest	5
6-Dec	4:35 PM	While testing I stepped outside, two turbines at School rd were off, I could immediately feel pressure in my right ear as the two turbines started up, reported this to Rand. At Schmidt home	Southwest	2at School rd and 3 others

APPENDIX D
by
SCHOMER AND ASSOCIATES, INC.

between the outdoor ground plane microphone and the four indoor spaces listed above. First, we examine Figure 1. All of the four spaces exhibit coherence at 0.7 Hz, 1.4 Hz, 2.1 Hz, 2.8 Hz and 3.5 Hz, and in this range there is no coherence indicated except for these five frequencies. The basement continues, with coherence exhibited at 4.2 Hz, 4.9 Hz. 5.6 Hz, 6.3 Hz and 7 Hz. The coherence in the basement drops low from 10-18 Hz and is more or less random and low after 18 Hz. Figure 1b shows the coherence just for the frequency range from 10 Hz to 35 Hz, and essentially this figure exhibits random patterns with no correlation from one room to the next. For example, coherence with the microphone behind the kitchen is high from 10-14 Hz and the master bedroom is high from 12-14 Hz while the other two spaces exhibit low coherence, and again the master bedroom is high 28-35 Hz with the others being low, and the living room is high from 50-58 Hz with the other spaces low; no pattern. In contrast all four spaces are lock step together in their coherence with the outdoor microphone below about 4 Hz. Figure 2, another sample from Residence 2 shows much the same pattern. In this case, 0 .7 Hz, 1.4 Hz, 2.1 Hz clearly are evident for all four spaces. For some reason 2.8 Hz is much reduced for the living room but 3.5 Hz is evident for all four spaces. In terms of the basement a number of other peaks are evident up to about 8 Hz where the basement then falls low until about 18 Hz and is random thereafter. As with Figure 1, there is no pattern to the coherence function above about 8 Hz.

3. Residence 2, and indeed all three residences, exhibit classic wall resonances in about the 10-35 Hz range which are different for each room and exposure, so it is reasonable to suppose that the randomness in the 10-35 Hz region in the above ground rooms is the result of wall resonances. The basement, which has no common wall with the outside, exhibits generally the lowest coherence in the 10-35Hz region. Thus, I conclude that the only wind turbine related data evident in the measurements at Residence 2 are the very low frequencies ranging from the blade passage frequency of 0.7 Hz to up to about 7 Hz. This conclusion is consonant with the residents' reports that the effects were similar from one space to another but a little to somewhat improved in the basement, the effects were independent of the direction of the rotor and generally not related to audible sound.

4. Figure 4 shows the coherence as functions of both time and frequency, and it is clear that the basement shows the greatest coherence below 8Hz of the four spaces and the least coherence above 8Hz. This result further supports the conclusion that it is the very low frequencies that are important.

5. Figure 3 is for Residence 3 which was 7000 feet from the nearest turbine, in contrast to Residence 2 which was only 1100 feet from the nearest turbine. Even here with much reduced amplitude there seems to be several frequencies where the four spaces have peaks together beginning at 0.8 Hz. However, unlike Residence 2, the coherence functions for all four of the space move together from about 15 Hz to 70 Hz. The sound pressure level at the outdoor microphone and at each of the four indoor spaces shows every harmonic from what appears to be the first harmonic at 20 Hz through 200 Hz. To my thinking this was clearly a loud outdoor source with a fundamental frequency of just under 20 Hz. And indeed it was. I called Bruce and he told me it was a helicopter. (I was not present the last day)

6. Figure 5 shows the sound pressure level for first minute of the 10 minutes represented by Figure 1, above. This figure, which is sensitive to the lowest frequencies shows that at these very low frequencies the sound pressure level in all four spaces is quite similar. The small changes from different positions in the house also suggests that the house is small compared to the wavelength so that the insides of the house are acting like a closed cavity with uniform pressure throughout being driven by very low-frequency infrasound.

II) Implications of the measurements:

1. The measurements support the hypothesis developed in (I)that the primary frequencies are very low, in the range of several tenths of a Hertz up to several Hertz. The coherence analysis shows that only the very low frequencies appear throughout the house and are clearly related to the blade

measurements at Shirley have clearly shown that low frequency infrasound is clearly present and relevant. A-weighting is totally inadequate and inappropriate for description of this infrasound. In point of fact, the A-weighting, and also the C and Z-weightings for a Type 1 sound level meter have a lower tolerance limit of -4.5 dB in the 16 Hz one-third-octave band, a tolerance of minus infinity in the 12.5 Hz and 10 Hz one-third- octave bands, and are totally undefined below the 10 Hz one-third-octave band. Thus, the International Electro-technical Commission (IEC) standard needs to include both infrasonic measurements and a standard for the instrument by which they are measured.

V) The Tests We Should Perform

1. That the wind turbines make people sick is difficult to prove or disprove. However, the sensing of the turbines turning on or off is testable. Consider the two houses where there is no audible sound. Residents would arrive at the house with the wind turbines running for something like a 2-hour test. 5ometime during the first hour, the wind turbines might or might not be turned off. If turned off, it would be the residents task to sense this "turn off" within some reasonable time--say 1 hour. Correct responses (hits) would be sensing a "turn off" when the turbines were turned off, or sensing no change if they were not turned off. Incorrect responses (misses) would be failure to sense a turn off when the turbines were turned off, or "sensing" a turn off when the turbines were not turned off. Similar tests could be done starting with the turbines initially off.

2. It would be necessary to prevent the subjects from seeing the turbines or being influenced by one another. If everyone marked a silent response on their board or into their laptop at the same time; say every 5 minutes, then no one would be able to know another person's responses. Pure chance is 50/50, so a hit rate statistically significantly greater than 50/50, and/or a miss rate statistically significantly less than 50/50 would indicate that the residents were able to sense the wind turbines without the use of sight or sound.

3. Testing would take about 3 to 5 good days; days when the wind was such that the wind turbines were operating at a substantial fraction of full power. Up to 3 tests per day could be done, with 3-4 subjects in each of the two, or possibly 3, houses. Physical measurements would be made of the before and after conditions at each house simultaneously to correlate with the sensing tests. Each subject would be tested up to 5 times. Note: Testing multiple times per day presupposing that the subjects could tolerate such a rigorous testing schedule.

4. The testing would require at least 1 researcher at each house to take the physical measurements and one researcher to supervise the sensing test with one test "proctor" per test room. It would be necessary for the proctor to help the researcher performing the physical measurements during non-test hours with activities like calibration.

5. Conduct of this test clearly requires the assistance and cooperation of Duke Energy. This test can only be done if Duke Energy turns on and off the turbines from full power, as requested and for the length of time requested.

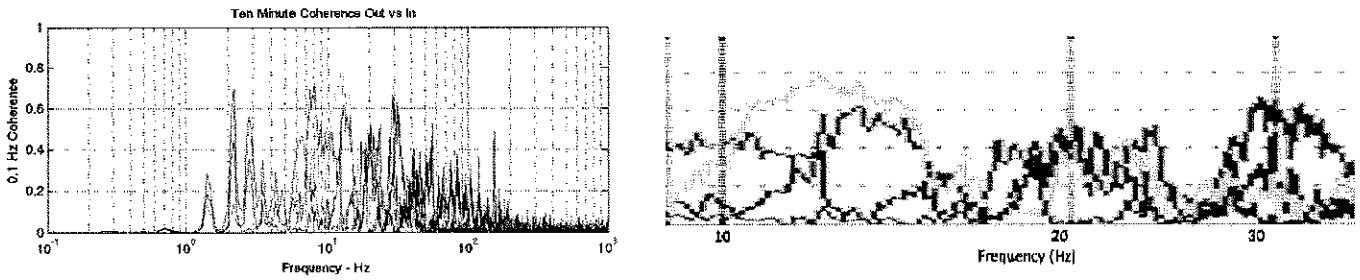


Figure 1a, b: R2-5T212420--coherence with outdoor-ground plane microphone; Living Room-Blue, Master Bed Room- Red, Behind Kitchen- Green, Basement-Purple, b is an expanded view from 9` Hz to 35 Hz

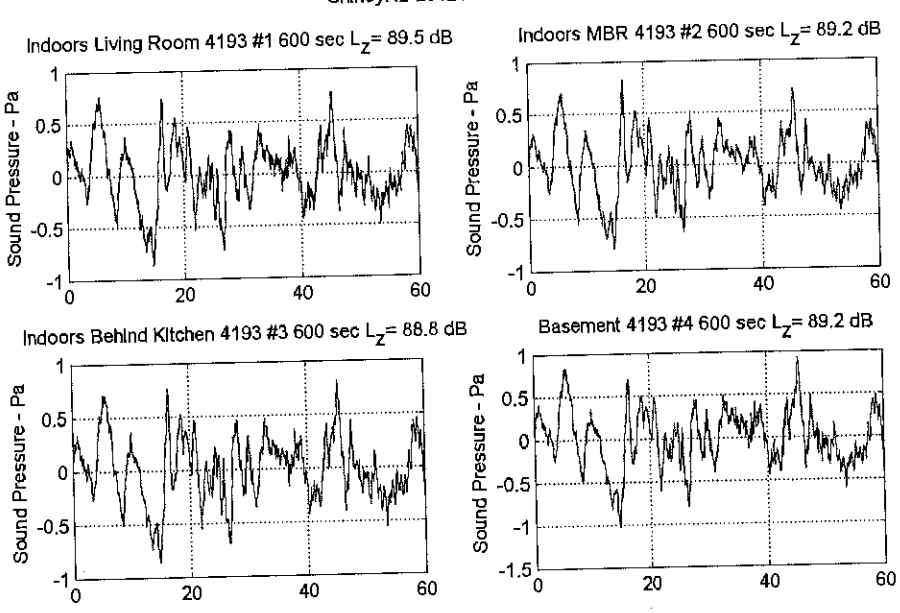


Figure 5- First of the ten minute period of 5T212420. Note that the SPL is very similar for all indoor locations.

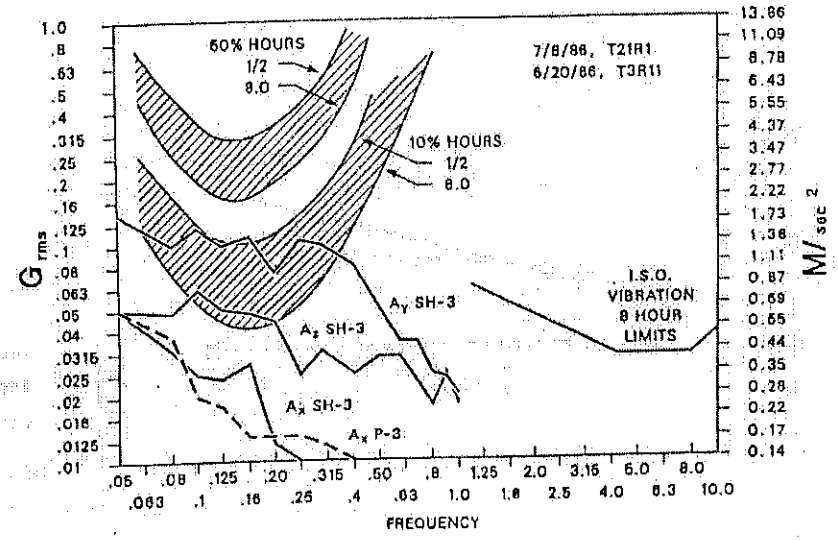


Figure 6.SH3 Sea King Nominal Run vs P-S Orion Nominal A_x

Figure 1 from "Motion Sickness Symptoms and Postural Changes Following Flights in Motion-Based Flight Trainers"

R.S. Kennedy, G.O. Allgood, B.W. Van Hoy, M.G. Lilienthal, **(1987).** " Motion Sickness Symptoms and Postural Changes Following Flights in Motion-Based Flight Trainers," Journal of Low Frequency Noise and Vibration, **6** (4), 147-154.

I Am

a

Victim of

PA295.

Governor Snyder: Please Help Us!

www.iiccusa.org

Hello

My name is Eric Martis and I am a member of the Interstate Informed Citizens Coalition, Inc.

Before I begin my comments, I would like to thank Governor Snyder for hosting these energy roundtables. I would also like to thank Mr Bakkal and Mr Quakenbush for being here today.

The documents I am ~~going to send in via email~~ FORWING IN TODAY are from all over the world. These document contain something that many here have never heard - the truth about the United States wind industry.

And as the information I am about to provide you will make clear, Michigan and the United States need to develop their own energy policy. Following the lead of European countries like Germany is just plain wrong.

Now, although the paid operatives of Michigan Energy, Michigan Jobs, MLUI, Sierra Club, MLCV, etc. have repeatedly said we should follow Germany's lead in the area of wind energy, that certainly doesn't seem to be the right path to me.

Here are some facts about energy policy in Germany:

(1) Germany is one of the of the biggest proponents of wind energy

(2) Germany is such a large proponent of wind energy that they are shutting down their nuclear plants and replacing them with coal plants.

(3) Germany's environmental and economic ministers are now proposing cuts to their subsidies to renewable energy because of the cost. They have proposed a cut of 20% in the onshore wind feed in tariffs. Also, onshore and offshore wind will be excluded from using the guaranteed feed in tariffs after July 2013

(4) Subsidies for energy producers in Germany are causing electricity prices for ordinary consumers and industry to rise. Germany's biggest industrial power consumers have seen electricity prices increase nearly 40% in the last 5 years.

(5) And to put the icing on the cake, for the first time in 25 years, despite all their wind energy, Germany's CO2 emissions actually increased. That is because their move towards intermittent renewables, while shutting down nuclear plants, forced Germany toward coal to fulfill their base load energy needs.

(6) This is the reality of wind energy in Germany.

I will now move on to some inconvenient truths about the wind energy industry in the US:

(1) Industrial wind has not replaced one coal plant in the US, despite the overly subsidized wind rush that has taken place in the nation.

(2) In Falmouth, Massachusetts, they are shutting down industrial wind turbines because of adverse effects on health on local residents.

(3) In light of the clear acknowledgement of issues in Falmouth, as well as recent studies at Shirley Wind in Wisconsin, it is evident that industrial Wind is adding to the negative health effects, rather than solving those created by fossil fuel energy generation.

(4) Industrial wind turbines kill millions of birds and bats each year.

(5) Many of the birds that are killed by industrial wind turbines are endangered or protected species, not your common sparrow.

(6) The lobbyist group American Wind Energy Associations board is filled with companies that are among the largest fossil fuel generators in the country, and are frequently the targets of environmental groups. For example, NextEra is the fourth largest fossil-fuel generator-in the US. BP, the famous gulf oil spill company, is also on the AWEA Board, not to mention the multinational E.On amongst others.

Despite E.On's position on AWEA's Board, it doesn't appear that they believe industrial wind

turbines are the solution to our energy problems. In fact, here is a quote from Eons website:

> Around 40 percent of the world's generated energy is produced from coal. Due to its large reserves, numerous supplier countries and relatively low fuel costs, coal will be significantly involved in this increase and thus will make an important contribution to safe and cost-effective energy.

And after hearing a quote like this, the question needs to be asked, "if industrial wind energy is so good for the environment, then why are there are no environmental groups on the AWEA board ?"

So in conclusion if this is truly a race in Michigan for the most environmentally friendly and cost effective ways to produce energy, then we should run away from the failing German model as fast as we can. And we must also run away from the industrial wind industry salesman who seek to tie us to fossil fuels forever. It is time to concentrate on science based energy policy, energy efficiency and less intrusive, more efficient items like rooftop solar.

Thank you

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Readying Michigan to Make Good Energy Decisions

Michigan Energy Public Forum Statement Card

If you wish to speak today, please complete the following:

Name: VICTOR LEABU

Affiliation (if any): GUPCA

Phone: 810-599-7741

Email: VLEABU@SBCGLOBAL.NET

Topics you wish to address today:

a. ___ **Renewable Energy Portfolio Standards**

b. ___ **Energy Optimization / Efficiency Standards**

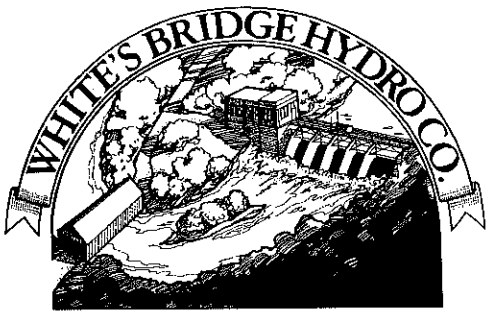
c. ___ **Electric Choice**

d. X **Other Additional Energy Topic**

(Please specify): HAMO-PUDDA CONTRACTS

Requested time to speak: X **< 5 minutes** ___ **5 minutes**

Please leave a copy of any written or electronic materials at the welcome center.



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March 4, 2013

Michigan Energy Public Forum

My name is Victor Leabu. I am a member of GLREA. I own and operate a small hydro electric dam on the Flat River in Ionia County, 25 miles northeast of Grand Rapids. We have generated approximately 3 million KWH of electricity per year since 1984.

We have one of the early PURPA contracts in Michigan. These contracts were based on "Avoided Costs". Part of the contract known as "Capacity Payment" was based on the cost of construction of a base load coal plant amortized over 32 years. This rate was fixed for the duration of the contract. The second component is the "Energy Payment Rate", based upon the operation and maintenance, including fuel costs, of 8 base load coal plants. This rate changes monthly.

The "Avoided Cost" contract was a key component in helping us to obtain financing for our project. A known rate for power generation is essential for small projects to obtain financing.

Most of the original PURPA contracts will be expiring in 3 to 5 years. It is crucial that any State energy policy provide an equitable way for these contracts to be renewed at sustainable rates.

If the State of Michigan wishes to encourage a broad base of renewal energy generation, a policy that provides a known rate for power sales is essential. Individuals, small companies, subdivisions, schools, and municipalities cannot compete with "Big Wind". It would seem that a new "Avoided Cost" approach, balancing current base load coal and gas generation costs with wind would be an equitable way to promote renewables in Michigan.

Sincerely,

Victor Leabu
President

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If you wish to speak today, please complete the following:

Needs to speak early (DID NOT SPEAK)

Name: Kathryn G. Light (LIGHTS)

Affiliation (if any): LTC - SVSS

Phone: 989 89 26749

Email: KZ Light@charter.net

Topics you wish to address today:

a. X Renewable Energy Portfolio Standards

b. ___ Energy Optimization / Efficiency Standards

c. ___ Electric Choice

d. ___ Other Additional Energy Topic

(Please specify): economics (short 2-3 min)

early please - can't stay

Please prioritize and focus your comments to afford as many as possible, the opportunity to speak. The amount of time allowed for each speaker will be dependent upon the number of people requesting to speak. Please prepare for the time limit for each speaker to be in the 2 – 5 minute range.

Please leave a copy of any written or electronic materials at the welcome center.

You are encouraged to submit written feedback at www.michigan.gov/energy.

Q. 10

What are the current and projected relative costs of existing + new builds for wind, Solar, hydro, biomass, landfill gas, coal, natural gas, nuclear + other sources? How would those differ if placed in another jurisdiction electrically tied to Mich.

Kathy Light
KZLight@charter.net

I THOUGHT I'D DROP YOU A HOLIDAY LION.

Mich currently gets just 3.9% of its electricity from renewable resources.

nearly 60% from coal — all of which is imported from other states. Mich. sends $1.7 Billion dollars a year — and the jobs it creates — to other states.

think of all the roads that would repair ~~starting with the street in front of my house to yours~~ —

Earthquakes = Ohio 11 in last 3 yrs.
Grayling Mi 2

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March 4, 2013

Steve Bakkal, Director
Michigan Energy Office
Michigan Economic Development Corporation
301 N. Washington Square
Lansing, MI 48909

Dear Mr. Bakkal,

Thank you and the Michigan Public Service Commission for holding a Michigan Energy Public Forum at Delta College. We appreciate the opportunity to submit comments at this Energy Listening Session.

Saginaw Future Inc. is a non-profit economic development organization, representing the County of Saginaw, City of Saginaw, fourteen local units of government and nearly 300 businesses in Saginaw County and the Great Lakes Bay Region. We have worked with our colleagues from Bay Future and Midland Tomorrow to grow the solar supply chain since 2008, bringing on a national site consultant firm to assist us. We have a copy of their final report for your records and we have implemented nearly all the recommendations including the development of a $7.5m, 231 acre Great Lakes Tech Park adjacent to Hemlock Semiconductor. We also developed a Guide to Installing Solar for your business and have copies of that document to submit to you as well.

Most recently, we have completed work with the Clean Energy Coalition to advance solar installations in our 11 county MEDC region. As the home of the global solar leader, Hemlock Semiconductor, and other firms in the solar industry, including the Dow Chemical Company, Dow Corning Corporation, Merrill Technologies Group, Mersen and others, the Great Lakes Bay Region is the epicenter for solar in Michigan.

We believe that if we want to attract solar businesses, we must embrace solar energy and encourage installations in Michigan. In 2012, under a grant from the MEDC, we partnered with the Clean Energy Coalition to drive down the costs of solar pv installations by evaluating permitting processes, solar zoning and ordinances and application processes across four municipalities. A set of recommendations and best practices was developed and recently, the Michigan Energy Office awarded a contract to implement the recommendations for these local governments to help create an encouraging climate for residents and business owners to install solar by simplifying permitting, zoning and inspection processes.

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We believe that reducing the complexity, cost and time involved in these processes in turn reduces the soft costs portion of solar installations, making solar more financially viable for customers. Streamlined processes also help increase local government efficiency and reduce municipal costs.

This year, the MEDC is providing the Great Lakes Bay Region with funding for an aggregation initiative designed to further lower the installed cost/watt for solar in the region. The project will identify, qualify and work with pre-aggregated groups (congregations, schools, businesses and large employers with multiple facilities) to structure aggregated purchasing programs. We will be working with our partners at Consumers Energy and DTE on net metering and will focus on promoting solar firms in the Great Lakes Bay Region and Michigan.

Having a balanced energy portfolio with affordable sources, such as coal, natural gas, wind and solar makes sense for Michigan, our businesses and residents. We encourage the Governor and Michigan Public Service Commission to include solar and other renewable energy sources in future energy plans.

Thank you for the opportunity to provide these comments.

Sincerely,

JoAnn Crary

JoAnn Crary, CEcD
President

Advancing Solar:

Great Lakes Bay Region

clean energy coalition

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bridging needs. advancing change.

This report was prepared by Clean Energy Coalition at the conclusion of a project made possible by the Great Lakes Bay Economic Development Partnership and funded by the Michigan Economic Development Corporation.

October 2012

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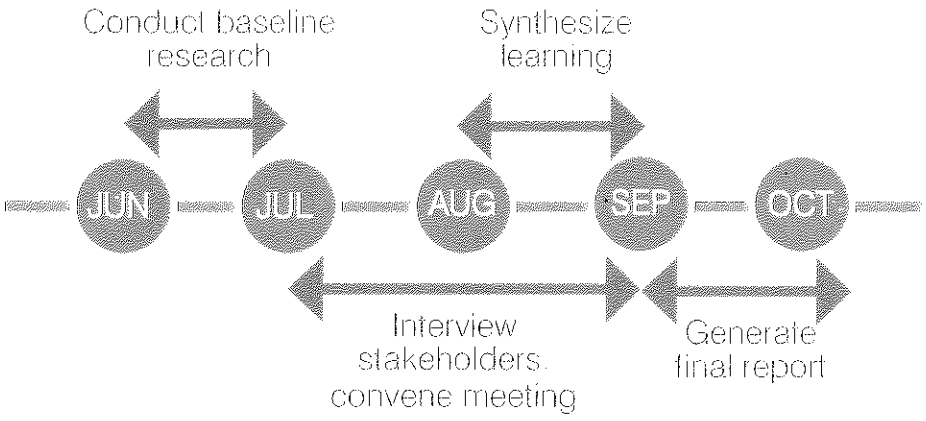
1. Introduction

1.1. Project Background

Clean Energy Coalition, in partnership with the Great Lakes Bay Economic Development Partnership (a collaborative of Saginaw Future, Bay Future, and Midland Tomorrow) has led a process to help drive down the costs and simultaneously spur solar photovoltaic (PV) installations across the Great Lakes Bay Region. This project has evaluated permitting processes, solar zoning and ordinances, and application processes across four municipalities in the region (City of Midland, City of Saginaw, Thomas Township, and Williams Township).

Working with a range of stakeholders in the region and across the State of Michigan, Clean Energy Coalition has developed recommendations to minimize existing barriers to and increase uptake of solar adoption in both the commercial and residential sectors. The project team gathered industry best practices, conducted a baseline evaluation of the four communities' current policies and practices, convened stakeholder groups to assess current barriers, and synthesized results, concluding with this report that details implementation recommendations.



1.2. Solar Barriers Background

Federal, state, and local policies are key to promoting widespread solar adoption. These policies create the environment in which customers, installers, municipal staff, and utility company staff engage and interact with each other. These policies also, in many cases, set financial parameters for solar projects in terms of determining permitting costs as well as outlining financial incentives.

While there are many factors at play, local jurisdictions can help create an encouraging climate for residents and business owners to install solar by simplifying permitting, zoning, and inspection processes. Reducing the complexity, cost, and time involved in these processes in turn reduces the "soft costs" portion of solar installations (costs that are separate from the PV hardware), making solar more financially viable for customers. Streamlined processes also help increase local government efficiency and reduce municipal costs.

The following areas of local government have been identified by national and international studies as areas that may contain barriers to the solar market, and are therefore the focus of this project:

- Permitting
- Inspections
- Fees
- Zoning

It is important that local governments understand the benefits of taking action in these areas now in order to improve efficiencies, encourage uptake of solar, and prevent future problems. The international consulting group AECOM estimates that solar permitting reform, in conjunction with incremental growth of the solar industry, would contribute an estimated $5.1 billion to the California economy between 2012 and 2020.

> *"Government permitting for residential solar installation accounts for approximately five to 20 percent of total installation cost (depending on the size and complexity of the solar installation), or approximately $2,500 per solar installation If local jurisdictions put into place a streamlined and uniform permitting system, total permitting costs are estimated to decrease by approximately 76 percent, to approximately $600 per solar installation."*[1]

1.3. Purpose of Project

Solar power is the fastest growing industry in the nation, and the number of installations nationwide has been growing consistently each year since 2000.[2] This increased demand, along with improvements in technology that have reduced materials costs, have caused the cost of installed solar PV to drop significantly in recent years, and the cost is projected to fall another 50 percent in the next three years alone.[3] There is no doubt that as this trend continues, more and more residents and business owners will install solar PV on their properties. Local governments will need to be ready with permitting, zoning, and inspection standards and processes that fairly and properly address the installation of solar PV.

While the project scope is focused primarily on the four municipalities in the Great Lakes Bay Region, from the outset the goal was to create something scalable that could be used across the entire region and state. The more standardization achieved through this effort, the easier it will be for solar PV installers to navigate local processes and work in a more efficient and cost-effective manner.

It should be noted that this project largely focuses on distributed solar ("rooftop solar") for residential and commercial installations, where the electricity generated is typically used on site. This report does not address wholesale distributed generation, or large-scale PV installations where the sole purpose is selling large amounts of electricity to a utility. This project also does not address solar thermal or solar hot water systems but rather focuses only on solar PV for electricity generation.

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[1] AECOM, *Economic and Fiscal Impact Analysis of Solar Permitting Reform.*
[2] Vote Solar, *Solar Growth Trends.* [online]
[3] Vote Solar, *Solar Cost Trends.* [online]

1.4. Great Lakes Bay Region

Four municipalities in the Great Lakes Bay Region of mid-Michigan were the focus of this project. All four communities fall within the Consumers Energy service territory for electricity and natural gas.

City of Midland

- Seat of Midland County
- Population: 41,863 (2010)
- Households: 17,597
- Med. household income: $48,843 (2010)
- Land area: 34 sq. miles
- Zoning: has own zoning

City of Saginaw

- Seat of Saginaw County
- Population: 51,508 (2010)
- Households: 19,843
- Med. household income: $27,051 (2010)
- Land area: 18 sq. miles
- Zoning: has own zoning

Thomas Township

- Located in Saginaw County
- Population: 11,877
- Households: 4,545
- Med. household income:
  - $52,536 (1999)
- Land area: 32 sq. miles
- Zoning: has own zoning

Williams Charter Township

- Located in Bay County
- Population: 4,492
- Households: 1,623
- Med. household income: $54,766 (1999)
- Land area: 34 sq miles
- Zoning: has own zoning

The stakeholders for this project included:

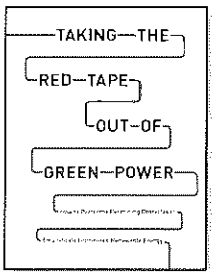
- Saginaw Future
- Bay Future
- Midland Tomorrow
- Michigan Economic Development Corporation
- Local government leaders, elected officials, and key staff
- Michigan Bureau of Construction and Codes
- Michigan Public Service Commission
- Consumers Energy
- Solar industry representatives, including both installers and suppliers
- Michigan Municipal League
- Great Lakes Renewable Energy Association
- Local solar suppliers and manufacturers

2. Research Summary

2.1. Research Overview

Clean Energy Coalition staff identified national and international reports and studies on improving access to solar at the local government level as background research for this project. (Appendix A contains a complete list of sources and reports.) While staff reviewed some private industry studies, the primary focus at this stage was on unbiased research and reports from nonprofit or government sources that looked at the specific role that local jurisdictions play in shaping the solar market.

Detailed summaries of these reports are included in Appendix B. Each report has a slightly different viewpoint, but certain themes were consistent in many if not all reports; these emerged as common recommendations that could be considered to be national best practices. For purposes of simplifying these results, Clean Energy Coalition created a matrix of best practices and tracked the themes that emerged most frequently from nine of the reports studied. Appendix C contains this matrix.



Taking the Red Tape out of Green Power

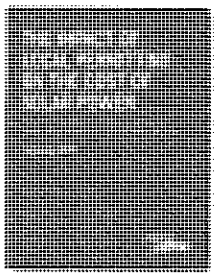
2.2. Best Practices

2.2.1. Permitting

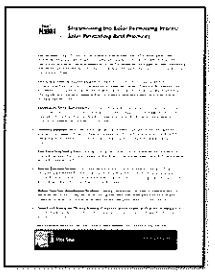
Nearly every report that has been published on solar permitting in the U.S. includes recommendations for regional or statewide collaboration on solar permitting in order to create common processes across jurisdictions. This makes it easier for contractors to work throughout a region and can also help to increase collaboration between municipalities. Standardization could also allow jurisdictions in a particular region to pool resources and even share inspection and plan-checking staff.[4] Many national reports also recommend consistent, flat permit fees that are not based on project valuation.

Solar Powering Your Community: A Guide for Local Governments

The timing of the permit review process, as well as inspection windows and the number of inspections related to each project, were also discussed in many reports. Where possible, electronic permit submission and notification is considered to be a best practice; several reports also recommended eliminating the need for multiple inspections. In terms of the timing associated with inspections, best practices suggest that an inspection should be completed within no more than three business days of the request.


The Impact of Local Permitting on the Cost of Solar Powe

The SunRun group estimates that multiple, unnecessary inspections can add over $200 to the cost of the residential solar permitting process when factoring in the time spent performing these inspections.[5] Several reports suggest that the number of inspections could be reduced, especially for relatively simple systems, such that a final inspection of the completed project is all that is required. SolarTech suggests that in many cases there are extraneous requirements that do not impact the safety or soundness of installations, and that removing these would not jeopardize the installations.[6]


Solar Permitting Best Practices

Several reports also suggest that providing solar-specific training for permitting staff would help reduce the total time associated with the permit process. Inexperienced staff can lead to unnecessary delays and extra

Expedited Permit Process for PV Systems

[4] U.S. Department of Energy, *Solar Powering Your Community: A Guide for Local Governments.*

[5] SunRun, Inc. *The Impact of Local Permitting on the Cost of Solar Power.*

[6] SolarTech, *'Top 10' List for Expedited Permitting.* [online]

steps that may not be necessary if more people were familiar with solar requirements.

Further time and money savings could be achieved by reducing inspection appointment windows. SunRun and other groups suggest that both installers and homeowners would benefit from receiving more specific estimates of when inspectors would be arriving, especially given that inspections tend to last only around 15 minutes.

> SunRun, a San Francisco-based residential solar leasing company, estimates that for residential PV installations, local permitting and inspection processes add $2,516, or $.50 per watt, to the cost of every installation.

While not mentioned in a majority of reports, the idea of creating an expedited process for similar small solar PV installations was addressed in a few of the reports considered in this project. Given that many residential systems would meet similar design criteria, the idea behind a permitting "fast-track" is that these projects would be unlikely to require extensive review.

In particular, there is widespread acceptance across the U.S. as well as endorsement from the solar industry for *Expedited Permit Process for PV Systems*, a report from the Solar America Board for Codes and Standards (Solar ABCs). Solar ABCs is a U.S. Department of Energy (DOE)-sponsored effort to reduce barriers to the adoption of solar and to stimulate growth of the industry.

The Solar ABCs report created a nationally standardized expedited permitting process for solar installations meeting established criteria, in this case projects that are small-scale, residential-sized (no more than 10-15 kW of output power), and with prescribed structural and electrical minimum requirements as detailed in the report.[7] Other reports, including from the group SolarTech, mention that contractors with reliable PV installation track records could also participate in a "fast-track" process, as municipal staff could have confidence that these installers were familiar with the permitting process and following requirements.

2.2.2. Planning and Zoning

Even before projects reach the permitting stage, it is important that a community's planning ordinances and zoning codes allow for solar installations. With proper planning and zoning, a community can position itself to encourage renewable energy and to be prepared as requests for solar increase.

Some of the reports reviewed for this project mention removing barriers to PV and ensuring that there are no restrictions to solar embedded within other regulations. The DOE Solar Communities report discusses "solar rights laws" at the state level that limit or prohibit restrictions on solar by neighborhood covenants and/or bylaws as well as local government ordinance.[8]

Communities should set the direction of solar in their policy documents, such as a master plan. Master plan language can promote the potential for solar energy use in the region, set goals for solar energy development, and provide solar-specific implementation strategies.

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[7] Solar America Board for Codes and Standards, *Expedited Permit Process for PV Systems*.

[8] U.S. Department of Energy, *Solar Powering Your Community: A Guide for Local Governments*.

While developing implementation strategies for a community-wide policy that embraces and encourages solar, communities will need to make decisions related to solar access, solar easements, and solar siting provisions (e.g., orienting developments to maximize solar input). In this policy development stage, it is important to recognize that different types of installations will require different zoning treatment. For example, installations that are on rooftops versus those that are ground mounted, or that are part of a large-scale solar farm, will have drastically different impacts on land use.

The American Planning Association (APA) has prepared a comprehensive information packet for communities interested in incorporating solar into master plans and zoning ordinances.[9] Among other resources, APA provides model ordinance language for solar access, siting, and general installation.

APA's information and other reports also highlight the fact that local jurisdictions can direct the types of solar usage and how they align with zoning districts through zoning ordinances. Given that small-scale rooftop or ground-mounted installations are typically found in residential and commercial districts, whereas solar farms usually only occur in agriculture or industrial districts, jurisdictions can detail the parameters of various installations to ensure that they fit appropriately with the surrounding land use.

2.2.3. Information Access

Access to information is a crucial aspect of jurisdictional solar support. Communities that have information available to the public in an easily digestible format make it easier for property owners and installers to understand the process of installing solar in their area. The Interstate Renewable Energy Council (IREC) report points to the "pre-application" stage, before the permitting process even begins, as a crucial point for sharing information with interested parties.[10] Their best practices include providing a checklist to guide installers and property owners through what is required for permitting or including all relevant information on an easy-to-locate website.

The Vote Solar Initiative echoes this suggestion and mentions the importance of having permit fee information and requirements available for advance review and preparation.[11] Vote Solar then goes further to propose compiling a national map of permitting practices; this would be useful not only for property owners to gather information on solar practices in a community but also for communities to see how permitting practices line up with those across their state or region.[12]

DOE's Solar America Communities report recommends a state energy office central web portal that educates and informs customers on the benefits of solar as another key point of information access.[13]

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[9] American Planning Association, *Planning and Zoning for Solar Energy*.

[10] IREC, *Sharing Success: Emerging Approaches to Efficient Rooftop Solar Permitting*.

[11] Vote Solar, *Solar Permitting Best Practices*. [online]

[12] Vote Solar, *Project Permit*. [online]

[13] U.S. Department of Energy, *Solar Powering Your Community: A Guide for Local Governments*.

3. Findings

3.1. Description of Data Gathering

3.1.1. Stakeholder Interviews

In order to assess current processes, Clean Energy Coalition staff conducted numerous stakeholder interviews, both over the phone and in person, with:

- Local officials at each of the four jurisdictions
- State government representatives
  - Michigan Public Service Commission
- PV installers
  - Midland Solar Applications
- Residential PV customers
- Interested parties
  - Great Lakes Renewable Energy Association
  - Michigan Municipal League
- Industry suppliers
  - Dow Solar
  - Dow Corning / Hemlock Semiconductor
- Inspectors
  - Detroit Electrical Industry Training Center
- Utility company staff
  - Consumers Energy Interconnection Department

The complete list of interviews requested, scheduled, and completed is available in Appendix D-1.

Two to three Clean Energy Coalition staff participated in each interview; as few as one or as many as four stakeholder representatives were interviewed at a time. While some questions and topics discussed were consistent across all audiences, questions were tailored to each interview. Interviewees were sent a list of draft questions in advance of the interviews in order to be prepared for the topics that would be discussed. (A copy of each set of interview questions can be found in Appendix D-2.)

All four jurisdictions had participated in the U.S. DOE SunShot Initiative - Market Transformation grant application submitted by Clean Energy Coalition in partnership with the Michigan Economic Development Corporation in September 2011. The goal of that grant was to reduce the soft costs of solar PV by developing and implementing regional best practices for the permitting and interconnection processes. Included in the proposal was a "market assessment" to better understand each jurisdiction's current practices related to permitting, interconnection, financing, planning/zoning, and net metering. Clean Energy Coalition verified and updated this information while conducting this research process. For the complete notes from each interview, please see Appendix D-3.

3.1.2. Stakeholder Meeting

On September 24th, the Clean Energy Coalition team met with stakeholders to discuss best practices and interview results and to solicit feedback on staff's preliminary recommendations. The meeting, which involved a presentation by Clean Energy Coalition followed by a small

group exercise, took place at Saginaw Valley State University and involved the following attendees:

Name	Organization
Thomas Bowes	Detroit Electrical JATC
JoAnn Crary	Saginaw Future
Chuck Cribley	EnerSafe, LLC
Luke Forrest	Michigan Municipal League
Sherri Heisler	Consumers Energy
Trevor Keyes	Bay Future, Inc.
Rich LaBombard	City of Saginaw
Greg LaMarr	Saginaw Future Inc.
Kari Napora	Phoenix Home Performance
Magen Samyn	Bay Future, Inc.
Barri Woods	City of Saginaw
Lindsey Zion	Saginaw Future
Steve Ellebracht	Midland Solar
Jamie Kidwell	MI Green Communities
Michael Langenburg	Midland Solar/solar customer
Scott Walker	Midland Tomorrow

For a copy of the meeting invitation as well as the full list of invitees and respondents, see Appendix E-1. The agenda, presentation, and handouts distributed at the meeting are provided in Appendix E-2. Michigan Municipal League co-hosted the event and provided a short presentation explaining the Michigan Green Communities Challenge at the conclusion of the breakout session discussion period.

The goal of the small group exercise was to determine applications for the best practices discussed at the start of the meeting and explore ways to help make solar installation processes more efficient. To achieve this goal, the breakout groups examined the roles of people and organizations involved in the process of a solar installation. The groups first looked at how the roles and processes are currently working and then discussed how to improve them. The roles that the groups discussed included:

Group	Primary Role
Planning commissions, boards, and councils	establish planning policies and zoning ordinances that relate to solar
Manufacturers and distributors	develop and distributing solar products.
Property owners and consumers	purchasing products, initiate and oversee projects, and initiate and/or complete permitting process
Permitting departments	administer permits
Installers	install solar products. May serve as liaison for customer with permitting and utilities
Inspectors	ensure accurate Installment along with protecting safety of customer and community and enabling project completion
Utilities	provide interconnection

In examining the roles, members of the groups were asked if any roles were missing, if the primary role descriptions seemed accurate, and what best practice activities should be applied to the roles.

Once the roles were further defined, participants were given separate pieces of paper for each role and were asked to organize the roles to represent how the solar installation process *currently* works, then reorganize the roles to show how the solar installation process *should* work more efficiently.

The results of this exercise revealed several important items:

1. **The stage must be set at the beginning.** Planning and zoning language for solar needs to be in place to set the direction for how solar should be handled within the community. This will help all others involved in the process more clearly understand what the parameters are for solar installations.
2. **Municipal information needs to be available and easily accessible.** Information from the municipalities on any solar-related zoning ordinances and their permitting process will alleviate many of the questions and delays involved in the solar installation process. One participant shared an example of a contractor claiming that solar installation was not allowed, causing confusion and delay with the project. Clear and easily accessible information on solar would have enabled the developer to quickly resolve or even prevent the issue from occurring.
3. **Utility interconnection information needs to be available and easily accessible.** There are some misconceptions and confusion about how the utility interconnection process operates. Easily accessible information from utility companies on this topic will help all those involved in the solar installation process have a more clear understanding of this from the start.

Following the meeting, Clean Energy Coalition followed up with stakeholders that could not attend the meeting to discuss the results and solicit feedback. This feedback was incorporated with the rest of the findings from the project.

3.2. Results

City staff in all four jurisdictions involved in this project noted that they have not seen many (if any) solar installations yet, although all welcome increased uptake of solar in the area. Many staff also noted, both in interviews as well as the stakeholder meeting, that commercial and residential installations are very different processes (in terms of permitting and inspection required as well as the way projects were implemented) that could not be streamlined in the same ways. Overall, there seemed to be an impression that there is not enough of a market for solar in Michigan, due in no small part to the lack of financial incentives to get past the upfront cost hurdles.

What also became evident in discussions with stakeholders, however, was that it is a misconception that permitting and zoning are creating barriers to solar, especially in this region. Permitting and zoning do not appear to be major problems at this time, although it is not entirely possible to gauge whether this is due to processes that function well or to a minimal volume of installations.

In terms of areas where local jurisdictions can actually influence the solar industry, permitting and zoning processes are critical. Even though current practices are not obviously problematic, there is still considerable room for improvement, as will be discussed throughout the remainder of this chapter. Municipalities are encouraged to find ways to improve to meet best practices, and Chapter 4 of this report provides specific suggestions for implementing recommendations.

The remainder of this chapter is organized by topic, based on the best practices identified from the research in Chapter 2. While some of the results vary by municipality, the findings of all municipalities are presented by topic, in the interest of continuing to think of promoting solar as a regional approach. This approach is also valuable for noticing consistencies and identifying areas where differing practices can be brought into alignment. The key below explains how each of the municipalities meet (or do not meet) best practices for each of the topics:

Key	
Meets best practices	✓
Does not meet best practices	×

As mentioned above, commercial projects can vary greatly from residential projects, especially when involving complex rooftop arrays on larger commercial facilities or large ground-mounted arrays sited on commercial property. While city staff acknowledged that streamlining the permitting process for residential projects could be possible, there was discussion that the specific nature of each commercial project would likely continue to require longer review processes or more detailed inspections.

This theme was echoed across most of the best practices reviewed for this project; some focused solely on small residential projects and outlined expedited processes only for systems that are traditionally small residential projects. The Solar ABCs report, for instance, discusses "residential-sized PV systems;"[14] the distinction between commercial and residential in this context relates to size, output, and complexity of installation rather than the type of facility on or near which the array is installed. Where community-specific findings were different between commercial (large or complex systems) and residential projects, they are referenced below; where not mentioned, the results are related to residential projects.

In addition to presenting findings gleaned from interviews and the stakeholder meeting, this section of the chapter also describes the process of installing a hypothetical 5 kW residential rooftop solar PV system (total cost approximately $25,000[15]) in each of the municipalities studied. Modeling a hypothetical installation helps portray the actual process encountered by a resident or installer interested in solar.

[14] Solar America Board for Codes and Standards, *Expedited Permit Process for PV Systems*.

[15] National best practices encourage expedited permitting processes for systems similar in size and cost to the hypothetical installation described here, although none of the municipalities studied currently have expedited processes in place.

3.2.1. Standard Permitting Practices

Best Practices: Permitting Practices	City of Midland	City of Saginaw	Thomas Twp.	Williams Charter Twp.
[illegible]	X	X	X	X
[illegible]	X	X	X	X

Permitting practices vary significantly among the four communities, and each currently uses its own series of applications that require the installer to provide different information. None of the communities have forms that are unique to solar installations, and instead require the applicant to submit building and/or electrical permits. To the average resident, it may not be clear which permits are necessary for a particular solar installation; for installers, the lack of consistency across nearby jurisdictions adds further layers of complexity to their work and to the installation process.

Hypothetical Installation[16]: Required Permits	City of Midland	City of Saginaw	Thomas Twp.	Williams Charter Twp.
Permits Required	electrical	building electrical	building electrical	electrical

Building Permits

City of Saginaw and Thomas Township require a building permit for roof-mounted PV arrays; City of Midland and Williams Charter Township[17] do not. Where building permits are required, two sets of plans each for the foundation floor, roof and wall section, building elevations, and site plan are also required. The City of Saginaw also requires a letter or drawing signed by the engineer to verify that the roof can support the additional load of the array.

Electrical Permits

All four jurisdictions require an electrical permit for PV installations. By state law, electrical plans are only required:

1. When the electrical system rating does not exceed 400 amps and the building is not over 3,500 square feet in area.
2. Work completed by a governmental subdivision or state agency costing less than $15,000.

Solar projects that do not fit into the above exemption are required to submit plans for all building types, and must be prepared by or under the direct supervision of an architect or engineer licensed pursuant to Act No. 299 of the Public Acts of 1980, as amended, and must include that architect's or engineer's signature and seal. While most residential PV installations would not fall under the criteria that require engineer-stamped electrical plans, some

[16] See description of hypothetical installation in Section 3.2 above.

[17] The building permit requirement for a rooftop array in Williams Charter Twp depends upon the condition of the roof on which the array is being installed.

commercial installations could require this extra step depending on the size and scope of the project.

Zoning Permits and Ground-Mounted PV

Ground-mounted solar PV installations require a zoning permit in addition to an electrical permit in the City of Saginaw.

A ground-mounted PV installation under 200 square feet is treated as an accessory structure in the City of Midland, which requires a zoning permit in addition to an electrical permit. A 5 kW ground-mounted array, for example, would likely be 500 square feet, in which case a zoning permit would not be required, but instead would need a standard building permit in addition to the electrical permit.

The same ground-mounted solar array in Thomas Township would only require a building permit.

In Williams Township, there are no zoning permits; electrical permits are required for all arrays but building permits would only be required if the structure was particularly large.

At the time of the stakeholder interviews, no municipality was utilizing Solar ABC templates; representatives from the City of Saginaw mentioned that they were working on streamlining their permitting processes but were not yet aware of this template. Although most of the attendees at the stakeholder meeting agreed that implementing these templates would be useful and relatively easy to do, in later conversation a representative from the City of Midland suggested that there did not yet seem to be a need to create a separate process for solar installations given there was such low demand.

Recommendations for implementing Solar ABCs and other permitting practice improvements are discussed in detail in Chapter 4.

3.2.2. Permitting Process: Fees, Timing

Fees

Best Practices: Permit Fees	City of Midland	City of Saginaw	Thomas Twp.	Williams Charter Twp.
[illegible]	N/A / ✓	✗ / ✓	✗ / ✓	N/A / ✓
[illegible]	✓	✗	✓	✓
[illegible]	✓	✓	✓	✓

The permitting process is significantly different in each of the four jurisdictions; each has a different set of fees as well as varying permit review and decision times. Numerous groups, including the U.S. DOE, Solar ABCs, Vote Solar, and the Sierra Club recommend that permitting fees should be no more than $300 for a residential installation, which is based on the Sierra Club's calculated cost of 2 to 4 hours of labor for experienced building department

staff members to process the permit and complete the inspection.[18] For more on the inspections process findings, see 3.2.3. below.

Hypothetical Installation[19]: Permit Fees	City of Midland	City of Saginaw	Thomas Twp.	Williams Charter Twp.
Building permit fee	N/A	$75	$135	N/A*
Electrical permit fee	$35	$60	$155	$90
Total permit costs	$35	$135	$290	$90

Depending on the type and size of project, fees can vary substantially in each jurisdiction. For example, in the City of Midland, a ground-mounted PV installation under 200 square feet is treated as an accessory structure, which requires a $20 zoning permit in addition to the cost of an electrical permit. A 5 kW ground-mounted array would likely be more than 200 square feet, in which case a zoning permit would not be required, but would instead require a standard building permit in addition to the electrical permit, which would be an additional $200. This difference in fee requirements means that a 5 kW system in City of Midland could vary in cost by $200 depending on where it is installed.

Timing

Best Practice: Timing	City of Midland	City of Saginaw	Thomas Twp.	Williams Charter Twp.
Decision in less than 3 business days	✓	✗	✓	✓

Research suggests that the window for permit application decisions for solar PV should be within three business days for simple residential installations.[20] Reducing the amount of time it takes for permit approval saves the installer time and helps keep the project moving.

Hypothetical Installation[21]: Timing	City of Midland	City of Saginaw	Thomas Twp.	Williams Charter Twp.
Permit review/decision time	Same day	1-2 weeks	1 day	Same day

With the exception of the City of Saginaw, the time it takes for these jurisdictions to process and approve basic residential permit application(s) is in line with best practices. It will be important for each of these jurisdictions to maintain this level of responsiveness, even as solar installations in the region increase.

Submission of Applications

Best Practice: Allow electronic permit submission/notification

Although each of the four communities have permitting forms available for download on their website, none offer permit submittal on their website or explicitly state that permits can be

[18] U.S. Department of Energy, *Solar Powering Your Community: A Guide for Local Governments.*

[19] See description of hypothetical installation in Section 3.2 above.

[20] Solar America Board for Codes and Standards, *Expedited Permit Process for PV Systems.*

[21] See description of hypothetical installation in Section 3.2 above.

submitted through email. Instead, all permits must be mailed in or delivered in person. See chapter 4 for recommendations related to permit applications.

Expedited Solar Permits

Best Practice: Fast-track application for contractors with reliable PV track records or projects of similar size or scope (i.e., simple residential)

While none of the communities offer any sort of expedited permit application process by installation size, there was some discussion during the interview with the City of Saginaw that applications from known installers were usually processed faster.

3.2.3. Inspections

Best Practice: Inspections	City of Midland	City of Saginaw	Thomas Twp.	Williams Charter Twp.
Requires only one final inspection	X	X	X	X

Research suggests that eliminating the requirement for in-process (or "double") inspections for basic residential PV installations saves both the inspector's time as well as the time of the resident or installer. According to SunRun, these extra inspections are unnecessary because any concerns about safety or roof penetrations can be addressed during the permit review process.[22] In both the City of Saginaw and Williams Charter Township, the large number of required inspections reduces the efficiency of the process.

Hypothetical Installation[23]: Number of Inspections	City of Midland	City of Saginaw	Thomas Twp.	Williams Charter Twp.
Building inspections	N/A	2 +	1	N/A
Electrical inspections	1-2	2 +	1	2
Total number of inspections	1-2	4 +	2	2

The time window given once an inspection is requested is an often-cited complaint in the inspection process. Although a specific inspection appointment time is preferred over a time window for inspection, the windows in each of the four communities are not excessively large. Inspections are typically scheduled within a 2-3 hour window, and they only need to be scheduled 1-3 days out.

3.2.4. Training

Best Practice: Train jurisdictions' permitting staff in solar

The need for inspector training was identified as an issue during stakeholder interviews and the stakeholder meeting. The lack of familiarity with how to approach the installation of solar can slow down the permitting process, which can make it more expensive for jurisdictions, installers, and customers. This issue may not be apparent at this time due to the low number of installations the communities are experiencing, but any increase in local installations might cause the problem to be more pronounced.

[22] SunRun, Inc., *The Impact of Local Permitting on the Cost of Solar Power.*

[23] See description of hypothetical installation in Section 3.2 above.

Some state incentive programs require solar PV installers to hold a certification from the North American Board of Certified Energy Practitioners (NABCEP). Although this is not a requirement in Michigan, some stakeholders voiced that they thought this certification requirement was extraneous and unnecessary, especially in the case of solar shingles (see the Technology discussion in section 3.3.) There was discussion that such certification may not truly reflect the credibility and experience of the installer. Other stakeholders felt that such certification programs would be useful, however, especially in terms of providing assurances for a relatively new industry in the state.

3.2.5. Information Access

Best Practices: Information Access	City of Midland	City of Saginaw	Thomas Twp.	Williams Charter Twp.
[illegible]	X	X	X	X
[illegible]	X	X	X	X

Local governments need to define a clear and specific solar permitting process, and make the process very clear on websites and printed material. None of the four jurisdictions have any permitting instructions specific to solar available online or in print materials. This issue is even more pronounced considering each jurisdiction's widely varying permitting procedures and requirements. The average person looking for permitting requirements for a solar installation would likely not know where to start and what permits are necessary. While some jurisdictions address the general permit guidelines, such as where to submit the permit, none offer a comprehensive overview of the solar installation permitting process. Appendix F includes copies of each jurisdiction's permit applications at the time this report was drafted.

As part of the review process for this project, Clean Energy Coalition staff performed a detailed evaluation of the information available online from each jurisdiction. In some cases, this turned out to be different than what was discussed during interviews with each municipality, which may be due in part to municipal staff not being familiar with solar installations that are still occurring only rarely. The following chart provides an overview of this detailed information review; city-specific notes are available in Appendix G.

Current Practices: Information Access	City of Midland	City of Saginaw	Thomas Twp.	Williams Charter Twp.
Reference solar installations on permit webpage	X	X	X	X
List which projects require which permit	X	X	X	X
Solar-specific language on permit forms	X	X	X	X
Building permit: fees listed	X	X	X	X
Building permit: details on submittal requirements (drawings / plans)	N/A	✓	✓	*

Electrical permit: fees listed	✓	✓	✓	✓
Details on solar-specific inspection process	X	X	X	X

*not included in the permit application itself, but available in a separate download.

Chapter 4 contains recommendations on what information should be provided by municipal websites, as well as examples of helpful solar sites.

3.2.6. Planning and Zoning

Best Practices: Planning and Zoning	City of Midland	City of Saginaw	Thomas Twp.	Williams Charter Twp.
[illegible]	✓	✓	✓	✓
[illegible]	✓	✓	✓	✓

The existing zoning ordinances of the four jurisdictions do not prohibit solar, but also do not contain much language that expressly encourages solar or that provides direction for all solar installation types. By not fully addressing solar in the zoning ordinance, jurisdictions are leaving the issue open to interpretation by others, which could lead to conflict between property owners or covenant-making bodies like homeowner associations and installations that do not appropriately fit within the principal land use. Thinking through the issue now and preparing guidance through the zoning ordinance will help to prevent these types of problems in the future.

The City of Saginaw's zoning ordinance encourages solar installation, allowing it to have an exception to their aesthetic compatibility requirements. Specifically, the ordinance states "the foregoing shall not be construed to prohibit innovative design concepts involving such matters as solar energy." Solar installments also have special height and projection/yard encroachment allowances. The height allowance permits solar installations to extend up to fifteen above maximum building heights. The projection/yard encroachment allowance permits to extend up to four feet into any required front or rear yard, and forty percent into any required side yard to a maximum of four feet.

Midland allows for "Solar Power Generating Facilities," a category that includes "all structures and mechanical installations necessary to obtain usable energy from the light of the sun." These facilities are allowed in their Business, Limited Commercial, Manufacturing, and Research (LCMR) and Industrial districts, suggesting that these areas are designated for large-scale solar operations. According to the interview performed through this project, Midland handles small-scale arrays like an accessory structure, similar to small wind energy systems in the other districts. This is not currently stated explicitly in the zoning ordinance, however.

Thomas Township provides a Solar Technology/Renewable Energy overlay zone in their agricultural district. The purpose of this overlay zone is to provide an environment where high-tech uses and functions can be located and allows for a campus-type environment.

3.3. Other Issues

As discussed previously, although permitting and zoning are widely cited as major barriers to the solar installation process, Clean Energy Coalition found that the market for solar in this region has not yet reached a point for this to be an issue for any of the four communities involved in this project. Instead, what almost every stakeholder involved in this project pointed to is the lack of a robust incentive program to drive the market, reduce costs, and bring the economies of scale that solar PV installers need to stay in business in Michigan. Other states that have enacted such incentives have, in turn, seen an increase of innovative financing programs, such as leasing options and power purchase agreements (third party ownership). Financing programs help bring solar to local communities by putting solar PV installations within financial reach of a wider range of residents and businesses. Other possible financing solutions are also discussed in Chapter 5.

While not the primary focus of this project, the following issues came up repeatedly in stakeholder interviews as well as the stakeholder meeting and merited brief discussion in this report.

3.3.1. Other Local Policy

Property Tax Assessment

Several stakeholders voiced concern about whether municipalities will consider solar installations an improvement on a house that would then mean it was assessed at a higher value. This type of assessment can serve as a deterrent, as taxes will increase for that property owner. Stakeholders suggest working with municipal staff to help keep taxes low for such improvements, but possibly highlighting the improvement through real estate associations that could place a higher value on the home at the time of sale and use energy efficiency and renewable energy as key selling points.

Customer Education and Awareness

Some solar PV installers interviewed expressed the need for customer education about solar technology, net metering, and local utility incentives. Installers stated that they have to spend too much time explaining the background and benefits to solar, as well as walking customers through the long-term financial benefits of solar PV. Installers felt that this is information that could be coming from another body, whether the jurisdiction, utility, or another organization. For more ideas on innovative ways to educate citizens about solar and increase customer demand through greater awareness, see section 4.1 as well as Chapter 5.

Technology Advancements

In the future, PV will not necessarily be restricted to solar panels and arrays, but instead could take the form of something that would not require the same installation process as the current technology. For example, Dow's solar shingle product is installed as a part of the roof itself instead of as an accessory structure. This type of product might then require a roofing permit instead of a building permit, and zoning restrictions would no longer be an issue. As technology advances, the local government's solar PV permitting process may need to change.

3.3.2. Utility-Level Policy

Numerous stakeholders interviewed cited issues with utility interconnection as a major hurdle when installing PV, noting that the process was slow and cumbersome for potential customers. Although these comments were heard throughout multiple stakeholder interviews,

representatives from the MPSC stated that they have not received many complaints about interconnection troubles from customers in the Great Lakes Bay Region.

The problems cited in regard to interconnection are somewhat of a moot point, according to some stakeholders, because the lack of attractive utility incentives is seen as the larger problem. Stakeholders believed that if Michigan's utilities offered a more robust incentive program that encouraged PV installations, the increased number of installations might make inefficiencies in the interconnection process more apparent.

Policy Promoted Solar

In 2011, Illinois passed SB 1652, which created a distributed generation "carve-out" within the state's renewable portfolio standard (RPS) by requiring 1% of renewable energy generated by investor-owned utilities to come from distributed generation, or customer-owned renewable energy, by the 2015-2016 compliance year. Half of the 1% requirement must come from systems under 25 kW. These terms and subsequent net metering advancements make Illinois' RPS much more friendly to solar. While the State of Michigan enacted an RPS in 2008, there is no similar carve-out for distributed generation or customer-owned renewable energy.

3.3.3. State-Level Legislation

Net Metering

There was discussion amongst stakeholders that Michigan's net metering rules as they are currently written in P.A. 295 discourage solar installation.[24] Under current policy, customers can only participate in "true" net metering for systems up to 20 kW; any excess power generated (net excess generation, or NEG) would be credited at the retail rate on the customer's next billing period. The legislation does not require annual account reconciliation, so NEG can be carried over indefinitely.

Most PV systems between 20 kW and 150 kW are eligible for "modified" net metering. In the case of "modified" net metering, NEG crediting is handled differently by Consumers Energy:

- The customer is billed for power supply energy components, including power supply recovery factor, on net customer consumption. The customer is billed for distribution components including the monthly system access charge, plus any applicable surcharges, securitization charges and securitization tax charges on metered inflow supplied by the company to the customer.
- The customer is credited for power supply energy components on net excess generation. The credit appears on the bill for the following billing period and is used to offset power supply charges on that bill. Net excess generation credit exceeding power supply charges is carried forward and applied to power supply charges in subsequent billing periods. Net excess generation credit is non-transferrable.

The MPSC concedes that these current modified net metering policies do not encourage installations over 20 kW. Consumers Energy's net metering brochure and guidelines can be found in Appendix H.

In addition to the NEG credit limitations, many customers find the net metering rules related to virtual net metering, which would allow for "community solar," to be confusing and unclear.

[24] State of Michigan, Public Act 295.

The MPSC itself is unclear as to whether virtual net metering is explicitly prohibited in P.A. 295. Expanding the current net metering rules to allow virtual net metering would benefit customers who want to access a shared PV installation that is not located on their property. The electricity generated by the shared installation is credited across multiple electric meters. For more on community solar policy, see the Vote Solar Initiative's policy toolkit for shared solar programs.[25]

4. Recommendations and Tools

This chapter compiles the best practices research, local analysis, and feedback from the stakeholder meeting to make specific recommendations to the four municipalities that will help improve permitting and zoning practices. Organized by topic, the recommendations include overall points that apply to all communities as well as specific recommendations for individual cities as applicable. Key materials such as template forms or sample documents are included in Appendices as referenced throughout the text.

While some of these recommendations require structural changes that may not be immediately possible, others suggest informational or procedural processes that could be more easily implemented in the short term.

One overarching recommendation that was echoed across all best practices research but found to be lacking during stakeholder interviews is a consistent, coordinated approach to solar across all jurisdictions in the Great Lakes Bay Region. Similar processes across multiple nearby jurisdictions enable installers to become familiar with permitting procedures and work through the installation process more quickly, which ultimately reduces costs. Where city-specific recommendations are mentioned below, it is with the intent of bringing all the municipalities studied in this project into alignment with similar processes.

4.1. Information Access

4.1.1. Provide ample information to help those interested in installing solar

Residents and businesses interested in installing solar PV need to be able to access the processes and requirements for doing so in each jurisdiction. This means having clear instructions displayed on municipal websites, as well as providing print materials that detail how solar installation works in that jurisdiction.

Providing brochures (see Appendix I) and hosting community informational forums are other options for disseminating information. When developing solar installation information materials or conducting educational events, the four jurisdictions might coordinate to reduce costs, provide consistent information, and establish a "solar supportive" identity for the region.

[25] Vote Solar, *Policy Toolkit for Community Shared Solar Programs*. [online]

The City of Denver's website provides residents with a detailed overview of the solar panel permitting process. Such information includes factors that might affect the project, required permits, fees, submittal process, and what needs to take place during the construction and/or installation. See Appendix J for Denver's website as well as examples of other detailed solar-specific municipal websites.

Making information available

The more information available to the public about installing solar in their area, the better. Here's a list of things to consider including:

1. Where to start?
    a. Zoning/code regulations
    b. Local solar PV contractors
    c. Process checklist
2. Rebates, financing, and incentives
3. Required permits
    a. Required supplemental documents to submit permits
    b. Links to download permit applications
    c. Instructions to submit permit applications
    d. Fees
4. Timeline for submittal process
5. Utility interconnection
    a. Link to Consumers Energy
6. Inspections
    a. When to call, what to expect

4.2. Permitting Process

4.2.1. Coordinate solar permitting procedures with neighboring jurisdictions

While each jurisdiction may need to retain its own fee structure, common and uniform information and permit language can help residents, businesses, developers, and installers have a clearer understanding of the local and regional expectations with regard to solar installation. This reduces confusion about the process and helps applicants be better prepared, and generally streamlines the process.

Currently, the municipalities studied in this project have a range of permitting requirements and forms that installers or customers must complete. This recommendation of creating a coordinated approach would mean agreeing on a similar process in each municipality, and where possible, agreeing on common forms or applications. It is crucial that adjacent communities hold visioning sessions to highlight applicable permitting processes and identify any zoning ordinances that may be problematic. As the participating municipalities begin to identify similarities and differences, they should develop consistent processes that streamline solar-related zoning and permitting.

Solar ABCs offer standard template materials for an expedited permitting process for small-scale residential and commercial PV systems, which are discussed in section 4.2.3. below. Some variation of these forms could be made applicable to other larger or more complex projects that may not be able to get through a permitting "fast track" but would still utilize common forms and follow similar procedures across jurisdictions.

4.2.2. Permitting process checklist

Creating a permitting process checklist is a proactive approach for the interested resident to track each step of the solar installation permitting process. Rather than allocating municipal staff time to acclimate installers and customers to the process, the checklist provides the prescriptive guidelines and requirements for each step throughout permitting.

See Appendix K for sample checklists from the City of Berkeley, California, and Boulder County, Colorado. The checklists should act as a reference and template to craft a similar checklist for municipalities within the Great Lakes Bay Region once a common procedure has been identified across all communities; in the short term, a city-specific checklist could be made available to help those residents interested in solar now.

4.2.3. Create expedited permitting process for "prescriptive" systems

Expediting small residential and commercial PV permit applications could make the permitting process more efficient for both the installer and the jurisdiction's permitting staff by reducing the amount of time spent approving simple, "prescriptive" installations. This expedited processing could apply to contractors that possess reliable solar installation track records and for installations that meet pre-set requirements of size and complexity. Instead of requiring separate building and electrical permits, for example, a municipality would only require the Solar ABCs template permit application for small installations under 15 kW[26]. To further ensure that proper procedures are being followed, the jurisdiction could require contractors to complete an approval process before being eligible to utilize the expedited system. See Appendix L for the Solar ABCs expedited permit application template.

4.2.4. Shorten permit review and decision time

In general, the municipalities studied in this project met recommended best practices for permit review and decision time; city staff interviewed felt that they were adequately meeting needs in this area. Recommendations are still provided on this topic, however, as it is possible that current procedures are sufficient simply because there are not many solar installations taking place right now. The need to streamline review and decision processes may only become apparent as installations increase. If it is possible to take action now, municipalities will be prepared should solar projects suddenly become more widespread.

There are several ways to help shorten review and decision time, including electronic permitting submission and notification options, provision of a solar permitting process checklist (see 4.2.2. above), training permitting and inspection staff on the specifics of solar installation, and fast-tracking certain applications via an expedited process (see 4.2.3. above).

Online permitting

As noted in section 3.2.2, best practices recommend allowing permit applications to be submitted online as another way to make the solar PV permitting process more accessible. Currently, none of the jurisdictions explicitly allows online permit submissions, and in at least one stakeholder interview there was discussion on the merits of requiring in-person permit submittal as problems with or errors on the application could be discussed or resolved immediately. While considered a best practice, therefore, this may not be appropriate for every jurisdiction. Furthermore it would be important to ensure that the jurisdiction's website contains all of the information and instructions necessary to submit a complete application in order to avoid application problems.

If a jurisdiction decides to enable online submittal, this could be implemented either via a direct email submittal to the permitting department, which requires little to no upfront

[26] See the Solar ABCs report for specific criteria for an installation to be eligible for expedited processing.

investment for the jurisdiction in terms of online infrastructure, or by creating an online submission portal.

This more comprehensive online submission option would involve creating the online infrastructure for qualified or registered contractors to submit a permit via a form on the municipality's website. This may also include a system for tracking a permit's status from submission to approval. This option would require an upfront investment, and would likely include creating the online infrastructure for all permits, not just specific to solar. See Miami-Dade County, Florida's E-permit application for more information: http://www.miamidade.gov/development/e-permitting.asp

Staff training

Staff training should provide municipal employees with a basic understanding of the solar industry, installation, permitting processes, and zoning requirements. This could be provided with a whole day or two-day session involving a local contractor (or contractors) experienced in solar PV installation, as well as a municipality that has successfully streamlined solar permitting processes, for the purposes of outlining the process as well as the successes and pitfalls.

The DOE recently announced a free online training program for building and electrical code officials who perform inspections for residential PV installations. The training program attempts to establish a consistent and streamlined PV inspection process in jurisdictions throughout the country. The Photovoltaic Online Training (PVOT) program's curriculum illustrates and focuses on the correct techniques for safe solar installations that comply with relevant building and electrical codes. It includes seven modules pertaining to subjects such as roof and ground-mounted PV arrays, electrical requirements, equipment ratings, and expedited permitting. More information is available here: http://www.sitnusa.org/trainer-resources/pv-online-training

Contractor training/education

An educated and informed contractor base would also contribute to reduced permit review times, as permit applications would likely contain fewer errors and could therefore be reviewed and processed faster. Establishing two-way communication between contractors, specifically solar installers, and the permitting department will contribute to streamlined processes for both parties. Establishing this training program might present an opportunity for economic development organizations like Saginaw Future, Bay Future, or Midland Tomorrow to partner with cities and/or surrounding townships and an organization involved in solar installation. The forum would include hands-on training of installation best practices for various uses as well as administrative guidance to complete the permitting process.

A subsequent outcome of a contractor training program would then be an "approved installers" list that jurisdictions could make available to members of the community that are interested in solar, as part of the solar information described in 4.1.1. above. Not only would this list help drive customers to local and/or qualified contractors, but also it would provide a level of assurance to customers that they will be working with contractors that are already familiar with a jurisdiction's permitting procedures.

4.2.5. Streamline the inspections process

The two primary ways to reduce the need for multiple inspections is to provide ample information to the public, as discussed above in 4.2.2, and to provide solar installation-specific training to code officials (see 4.2.4. above). Not all code officials have experience with solar installation techniques. Since code officials may be worried about approving incorrect installations, but do not have the necessary information or training to make a quick and sound assessment, the lack of familiarity can lead to multiple inspections and other project delays.

Several reports suggest eliminating rough-in and in-process inspections for both prescriptive installations that qualify for the expedited permitting process (see 4.2.3. above), as well as other larger, standard, rooftop installations on homes and businesses.[27,28] The combination of trained inspectors and permit applications that provide ample detail to ensure code compliance will result in an inspection process that is more efficient for both the jurisdiction and the installer.

Finally, jurisdictions can streamline the inspections further by reducing the appointment time windows given for inspections. Although most participating municipalities already have fairly short appointment windows, this practice should be continued/maintained while also looking for ways to help further reduce the window. Short inspection windows help installers complete projects in a more timely, cost-effective manner, further reducing the "soft costs" component of solar installation.

4.3. Planning and Zoning

4.3.1. Support area-wide solar installation through common planning document language

Creating a multi-jurisdictional solar advisory Committee or Task Force can facilitate a uniform Master Plan amendment to accommodate and guide future solar panel installation. Such a Committee or Task Force (ideally comprising members of the planning commission or respective staff) can review sample planning language to collaboratively determine what would work for the region. Planning for solar now, and on a regional basis, will attract greater market potential throughout the region by making the City of Saginaw and surrounding communities more adept and nimble in dealing with the rapidly advancing industry of renewable energy.

Solar PV model planning language

As noted above, master plans provide a basis and justification for land use regulation and help guide the development of the municipality. Therefore, it is advisable for the municipalities in the Great Lakes Bay Region to amend their respective master plans to include uniformity from one municipality or township to the other. Examples that provide language and potential tangible goals for the development of solar throughout the region are provided in Appendix M.

[27] Vote Solar, *Solar Permitting Best Practices*. [online]

[28] SunRun, Inc., *The Impact of Local Permitting on the Cost of Solar Power*.

4.3.2. Support area-wide solar installation through common zoning ordinance language

A multi-jurisdictional solar advisory Committee or Task Force should be tasked with the revision of sample zoning language to collaboratively determine which land uses are most suitable for solar related policy as it relates to the region as a whole.

Consistent and uniform zoning language can help residents, businesses, developers, and installers understand what is expected in the region; as with wind energy in other parts of the state (e.g., Gratiot County county-wide wind ordinance) these policies can also make the area more attractive to solar industry development. Further, because large projects can take years to develop and implement, and proposals for renewable energy projects are anticipated to increase in the upcoming years, it is important that the participating jurisdictions start addressing this topic now.

The zoning language itself should be supportive of solar by minimizing restrictive language (related to aesthetic concerns, for example) and encouraging large-scale solar installations in the jurisdiction (for instance, through appropriate land use designations). Regionally, several zoning ordinances with solar language examples exist. Homer Township in Midland County defines various forms of solar collection devices and outlines what types are allowed by right or by special use permit in each district. Thomas Township's zoning contains an agriculture zone overlay. While different, both the Homer and Thomas Township examples help encourage solar installation in their communities while providing direction on where and how the community would like solar installed. These two examples, in addition to APA's resources, can help the participating jurisdictions start the discussion on what planning and zoning language might suitable for the region. See Appendix N for model solar PV zoning language from the following municipalities in Michigan:

- Grosse Point Shores
- Homer Township
- Thomas Township

5. Conclusion and Next Steps

5.1. Conclusion

In terms of solar permitting, planning, and zoning, some of the current practices across City of Midland, City of Saginaw, Thomas Township, and Williams Charter Township are in line with industry best practices, while others are in need of significant improvement. Overall, there are enormous opportunities to unify local policies and practices across the region to simplify the community's access to solar. Having as much consistency as possible among all of the jurisdictions and setting an example for other local governments in the region and in the State is key.

While Clean Energy Coalition found that permitting and zoning practices are not a huge barrier to solar now, this should not be a reason not to take action to make improvements. If the region really desires to be a leader in solar and wants to connect its solar manufacturing base to local

demand for solar products, the public's ability to easily access information about solar policies and practices is critical.

Overall, Clean Energy Coalition believes the jurisdictions can work together to agree on a process going forward that all parties will find useful and beneficial; this will not only benefit each community individually but also the region – and the State – as a whole.

5.2. Next Steps

This report is intended to serve as a tool for the Great Lakes Bay Economic Development Partnership to work immediately with the four jurisdictions in the region to begin implementing common permitting practices and zoning language. It may be helpful to establish an ongoing Task Force or Stakeholder group to begin the implementation work and to ensure ongoing collaboration on this issue among the four jurisdictions. As determined appropriate, efforts can then be expanded to include other local jurisdictions in the region and ultimately to decide if the approach can be replicated on a statewide level through other key partnerships.

5.3. Looking Beyond Permitting and Zoning

While this report has focused predominantly on analyses and recommendations to create uniform and efficient processes among the Great Lakes Bay Region jurisdictions in order to reduce the soft costs of solar PV installations, additional work can be done in the region to drive the community's demand for solar. Ideally both efforts would be coupled together to drive solar uptake in the region as a means for spurring local economic development and connecting demand to the manufacturing side of the solar industry that already exists in the region. Clean Energy Coalition provides a list of sample measures that could be implemented to help drive regional demand below:

5.3.1. Promoting the market

Throughout the U.S., municipalities pursuing solar and other renewable energy retrofits are conducting face-to-face outreach with residents and business owners. Examples include the City of Boulder's partnership with the Colorado Green Building Guild or the City of Grand Rapid's "Five Factors" for considering solar panel installation workshops. Such workshops might include a Business and Residential Forum, for example. This might present an opportunity for economic development organizations like Saginaw Future, Bay Future, or Midland Tomorrow to partner with cities and/or surrounding townships to discuss the option of installing solar, while explaining the costs and benefits. Additionally, the forum should also detail the zoning changes and outline the permitting process, while showcasing reputable contractors.

Beyond growing the business of local solar installers, it is also important to find ways to support local solar manufacturing. One approach is the Local First strategy, which advocates for local business ownership. The Grand Rapids-based effort is guided by three core values - Sustainability, Collaboration, and Support, and believes that locally owned businesses are critical to growing a strong West Michigan economy and tax base; their efforts have played a key role in the resurgence of Grand Rapids' urban neighborhoods and the growth of West Michigan's entrepreneurial culture.[29] For a solar program, a Local First strategy could

[29] For more information on the Grand Rapids based Local First, please see: http://www.localfirst.com/about/.

encourage the use of local materials through leading companies such as Hemlock Semiconductor, SolarWorld, or Dow Solar, for example, as well as promoting a local balance of systems or support materials through local contractors and using local financing.

5.3.2. Incentivizing solar

One successful program for promoting solar to homeowners by bridging the information gap and tackling financial barriers is the Solarize program model. First launched as a grassroots effort in neighborhoods of Portland, Oregon, this program works through community groups to educate homeowners about the advantages of installing solar, partnering with a local installer (or installers) to utilize bulk purchase discounts of solar panels. The limited timeframe, simplified approach, and cost-reducing aspects of the program address three of the main obstacles in the current solar market. The Great Lakes Bay Economic Development Partnership could help engage a team of public and private sector partners to launch a Solarize program in this region, with a particular focus on promoting locally sourced solar materials.

5.3.3. Encouraging solar education

Regional representatives could work with local foundations, educators, and others to integrate solar education into the new STEM (Science, Technology, Engineering, and Math) Common Core Standards work currently taking place in the region. This effort would provide ready-made solar curriculum materials that could be woven into STEM curriculums, so that efforts to support and promote a STEM-ready workforce would also promote solar technology and expertise. See Appendix O for further background information on STEM and Common Core Standards.

5.3.4. Financing

The lack of financing has been identified by external audiences, as well as many of the stakeholders interviewed for this project, as a key barrier to the expansion of solar in Michigan. Many creative financial mechanisms are being implemented across the country; the following may represent possibilities for use across the Great Lakes Bay Region:

- PACE Model. Property Assessed Clean Energy (PACE), which was enabled by the State of Michigan in 2010, allows local jurisdictions to finance energy efficiency and renewable energy programs for commercial and industrial properties. The City of Ann Arbor launched the state's first PACE program in 2011; more information on this program as well as an explanation of how PACE works is available at http://www.a2energy.org/pace.

  Best practices from this program could be used to craft an "Advancing Solar PACE Program." For example, third-party sponsored funding could seed a revolving loan-loss reserve program to underwrite a financing program for solar installations in the region. Under such a program, the sponsored funding would be paid back to the third-party sponsor through a series of payments added on to the borrower's loan. As the borrower pays in to the revolving loan program, the sponsor would withdraw an equal amount.
- **Impact Investing**. Impact Investing[30] refers to investments made based on the practice of assessing not only the financial return on investment, but also the social and environmental impacts of the investment that happen in the course of the operations of the business and the consumption of the product or service which the business

[30] For information on Impact Investment Fund Managers, please see: http://www.impactassets.org/ia50/

creates. An Impact Investing initiative could be designed specifically to advance solar in Michigan, with the intention of generating measurable social and environmental impact alongside a financial return.

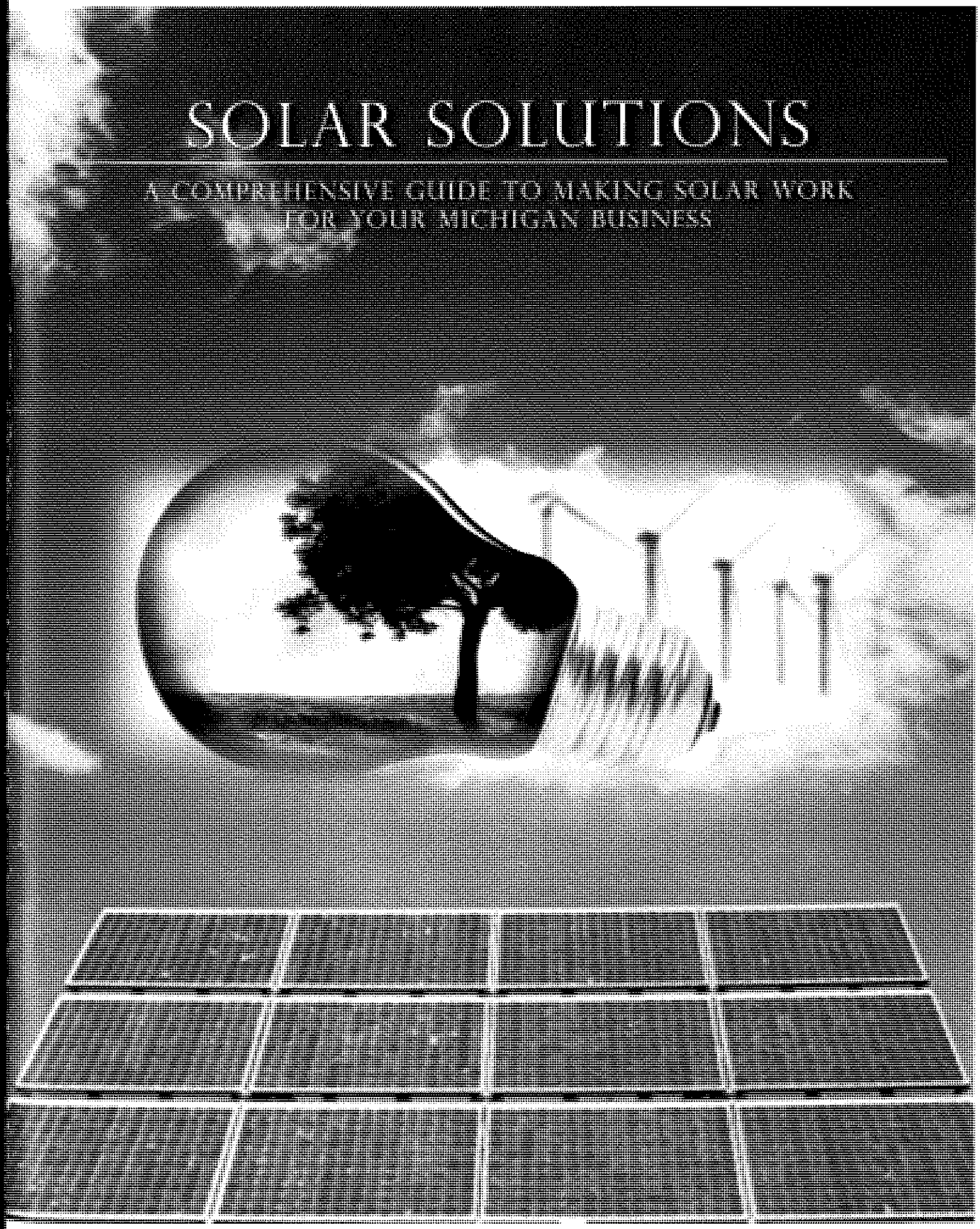
5.3.5. Utility and state policies

It may behoove the Great Lakes Bay Economic Development Partnership to engage in dialogue both with Consumers Energy and the MPSC to advocate for advancements in solar incentives and current net metering policies. While clearly these are larger and likely more complicated issues to tackle, Clean Energy Coalition believes making a logical case for their importance for solar advancement in the region would not go unnoticed coming directly from entities devoted to driving economic development in Michigan.

6. Appendices

SOLAR SOLUTIONS

A COMPREHENSIVE GUIDE TO MAKING SOLAR WORK FOR YOUR MICHIGAN BUSINESS



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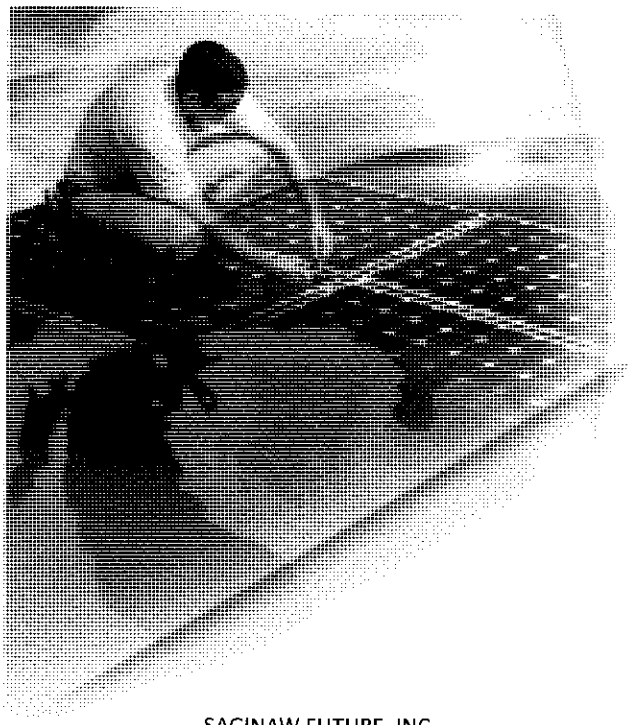

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Solar Solutions: How To Make Solar Work For Your Michigan Business was compiled and written by Lindsey Zion for the Great Lakes Bay Region Solar Alliance. Coinciding with the Great Lakes Bay Economic Development Partnership's mission, this guide provides Bay, Midland and Saginaw Counties with resources to help local businesses learn about and implement solar/ photovoltaic products within their facilities.

The Great Lakes Bay Region Alliance would like to thank the many people who have helped with the creation of this guide, with a special thanks to Veronica Horn and Chris Shirk of Dow Corning, Greg Bausch of Hemlock Semiconductor, as well as Harry Leaver of Saginaw Valley State University. Moreover, thank you to all those who provided research guidance and valuable information to make this guide meaningful for all those who will use it.

This document does not contain original work; rather it is a compilation of information gathered from expert sources on the various topics.

MI Great Lakes Bay solar ADVANTAGE

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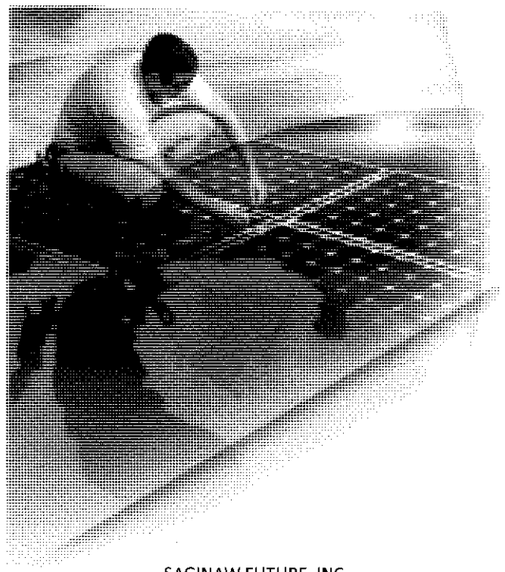

Solar Solutions: How To Make Solar Work For Your Michigan Business was compiled and written by Lindsey Zion for the Great Lakes Bay Region Solar Alliance. Coinciding with the Great Lakes Bay Economic Development Partnership's mission, this guide provides Bay, Midland and Saginaw Counties with resources to help local businesses learn about and implement solar/ photovoltaic products within their facilities.

The Great Lakes Bay Region Alliance would like to thank the many people who have helped with the creation of this guide, with a special thanks to Veronica Horn and Chris Shirk of Dow Corning, Greg Bausch of Hemlock Semiconductor, as well as Harry Leaver of Saginaw Valley State University. Moreover, thank you to all those who provided research guidance and valuable information to make this guide meaningful for all those who will use it.

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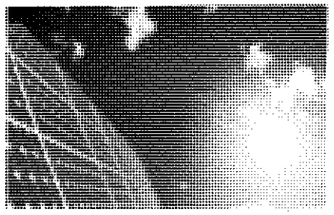
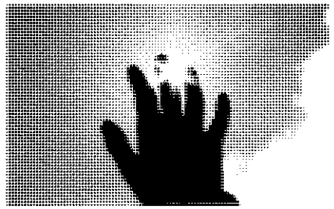
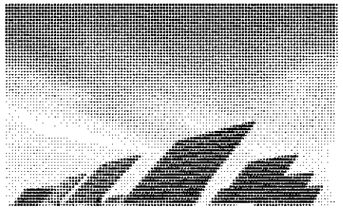
This document does not contain original work; rather it is a compilation of information gathered from expert sources on the various topics.

Mi Great Lakes Bay solar ADVANTAGE™

Executive Summary







The twenty-first century has ushered in an age of efficient "green" technologies into the energy industry. In recent decades, advances in photovoltaic technology have made solar energy an affordable option for businesses and the general public to use. However, even with these amazing technologies available at our fingertips, a relatively small number of business owners have put them into practice in their operations. The following guide, ***Solar Solutions: A Comprehensive Guide To Making Solar Work For Your Michigan Business,*** provides insight and background information on solar technologies available for end users.

This guide examines how to go about installing solar, specifically targeting small to medium sized business in the Great Lakes Bay Region. As the home of one of the world's key suppliers to the global solar market, two premier chemical and silicon technology companies that provide the latest technologies and processes across the photovoltaic value chain, and numerous other emerging players, the Great Lakes Bay Region is an excellent location to demonstrate and reap the benefits of solar technology. The partnering of private companies, academic institutions and government facilities equips this region with all intellectual and production-based resources needed to create an energy hub. The goal of this guide is to increase local awareness of the benefits that solar has to offer.

The following document will explain why solar is a suitable option for energy generation, what the fundamentals of a solar system are, the key components to consider when selecting solar products, what products are available, the legal requirements needed to implement a system, and who to contact to find more information on any one of the implementation steps. While we are aware that this guide does not cover all solar/PV products and energy efficient technologies in the market, it does serve as a solid foundation of information regarding the initial steps of solar implementation.

In summary, this guide presents a basic outline of key topics to consider when implementing solar solutions in the Great Lakes Bay Region. We stress that the instruction and information presented is variable depending on individual businesses preferences. Location, size, capital resources, and company goals will influence the selection and implementation of solar products. We hope that the contents of this guide are extensive enough for those in early stages solar system exploration, and specific enough to be of value to an experienced solar consumer.

SOLAR FUNDAMENTALS

SOLAR COMPONENTS TO CONSIDER

SOLAR IMPLEMENTATION PROCESS

SOLAR INCENTIVES

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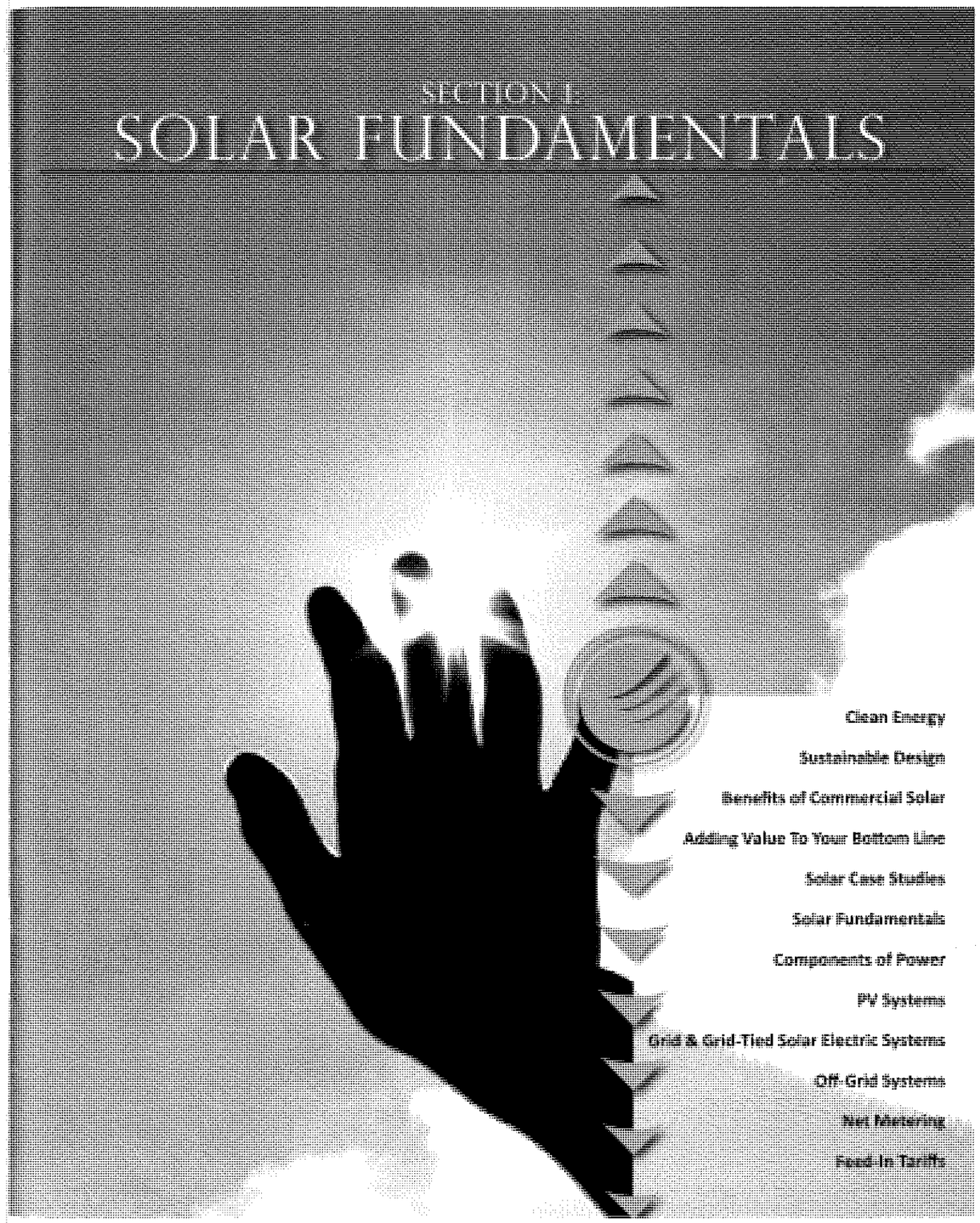
SECTION I

SOLAR FUNDAMENTALS



Clean Energy

Sustainable Design

Benefits of Commercial Solar

Adding Value To Your Bottom Line

Solar Case Studies

Solar Fundamentals

Components of Power

PV Systems

Grid & Grid-Tied Solar Electric Systems

Off-Grid Systems

Net Metering

Feed-In Tariffs

Clean Energy

Need & Opportunity

Driving the growth of green buildings is a growing environmental awareness, increased attention towards the bottom-line of building costs (energy savings), increasing costs of nonrenewable resources, a mushrooming of local incentives implemented to spur the growth of the green building industry, and an increasing awareness by businesses that greener workplaces attract talent. The most obvious and most cited benefit of green buildings lies in lower occupancy operating costs."

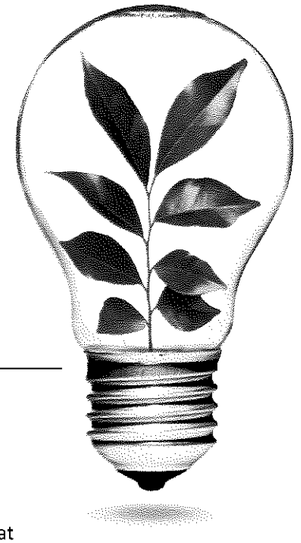
There is a growing consensus on the need for aggressive public and private action to deal with energy security, increasing energy costs and global climate change. In the U.S., buildings account for approximately 40% of total energy consumption and 40% of greenhouse gas emissions. About half of this is attributable to the commercial sector, and commercial building energy use is growing more rapidly than residential sector energy. Dramatic improvements in the energy performance of commercial buildings can reduce greenhouse gas (GHG) emissions more quickly and more cost-effectively than many other options – while helping reduce the impact of rising and increasingly volatile energy prices.[2]

Many stakeholders, including industry and professional associations, voluntary high-performance building organizations, codes and standards organizations, many leading utilities, state and local agencies, private building designers, developers, owners and operators, and equipment manufacturers have all recognized the need for more aggressive and effective action. [2]

Transforming the energy performance of commercial buildings requires a comprehensive and concerted industry effort, sufficient in scale to influence the more than $500B per year that the sector spends on new construction, renovation and energy. Achieving sector-wide transformation will require a focused, multi-year public/private initiative, including coordinated technology development, demonstration and deployment supported by major innovations in policy, financing, project design and delivery, and building energy management. [2]

"The most obvious & most cited benefit of green buildings lies in lower occupancy operating costs."

Why Green Technology Makes Good Business Sense



BENEFITS OF SUSTAINABLE DESIGN

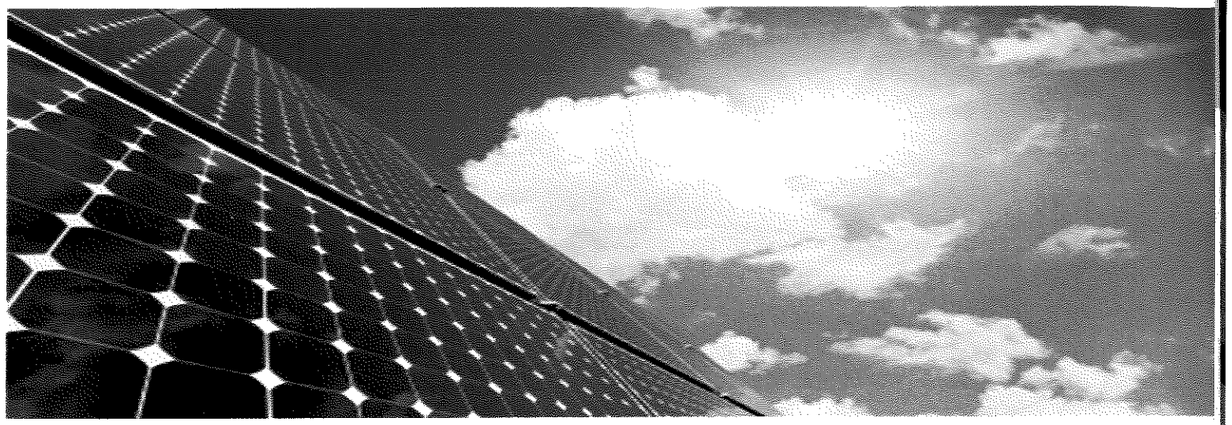
Importance of Sustainable Design

Buildings consume more than two-thirds of the total electricity consumed annually in the U.S. No matter what the source, using energy carries a burden. This burden can be from mining and extraction of fossil fuels, air pollutants released in the burning of these fuels, or the production and disposal of nuclear materials.[3]

Saving energy minimizes a wide range of environmental impacts and potential health risks. Sometimes the price is political. Our need for energy resources has caused political turmoil in the past, and ensuring continued access to these resources will long continue to carry strong economic consequences.[3]

Sustainable buildings have benefits far beyond reducing our national dependence on fossil fuels. Occupants of sustainable buildings are more productive, more creative, and in general, healthier. These benefits contribute to a firm's ability to attract and retain the caliber of employees required to better meet its mission.[3]

Benefits of Commercial Solar



CONTROL ENERGY COSTS WHILE REDUCING YOUR ENVIRONMENTAL FOOTPRINT

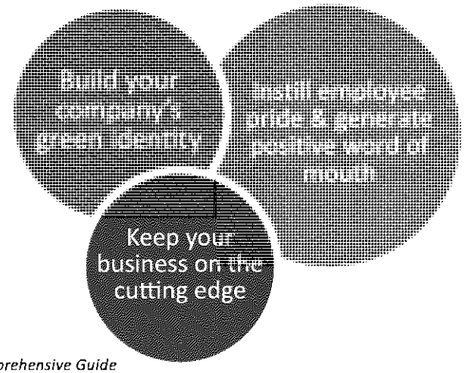
The benefits of a commercial solar system extend well beyond a reduction of your carbon footprint. A commercial solar system provides fixed cost energy pricing for your business via a clean, renewable, locally generated source. In as little as four years, your solar system can pay for itself through lucrative tax benefits available only to commercial customers.

SAVE MONEY ON ENERGY EXPENSES WITH INNOVATIVE FINANCING OPTIONS & POWERFUL TAX INCENTIVES

For many businesses, investing in solar energy makes serious financial sense. Your new solar energy system will:

Reduce or eliminate your electric bill
Provide a fast return on investment (about 4 years)
Dramatically reduce your tax liability
Provide long-term financial savings
Lower operating expenses

Keep in mind, a solar system can provide consistent renewable energy for over 30 years. With no moving parts, there is little to no maintenance required. Plus, your new solar energy system provides a great opportunity to build your green identity.



How Solar Energy Can Add *Real Value* To Your Bottom Line

PEAK SHAVING

Large buildings draw a lot of power. Beyond the amount your company pays for the energy it consumes it may also be subject to something called a "Peak Use Charge." This is because electricity is more expensive during hours of peak demand. So if your building uses a lot of power during this time -- typically during mid-day -- you're probably being dinged by a stiff surcharge. This amount can sometimes be higher than the charge for the actual energy consumed! Luckily, PV systems typically generate more power during the times of day when demand is the highest. This means that solar panels can effectively reduce the amount of electricity you purchase from the utility precisely when they are charging the most for it. People in the industry call this "peak shaving," or reducing a building's load during high-demand hours.[4]

PRICE LOCK-IN & PRICE HEDGING

This next important aspect of PV systems is related to, but not dependent on, peak-shaving. As previously discussed, retail electricity prices fluctuate relative to your electricity load. They also are prone to seasonal price fluctuations. PV systems can help to remove part of this price uncertainty and thus allow for improved forecasting of future energy costs. Power Purchase Agreements -- or PPAs -- provide a straightforward means of locking in consistently priced power while taking advantage of clean, low-carbon energy. PPAs are becoming increasingly popular among firms that want to source solar power. [4]

GETTING AHEAD OF THE REGULATORY CURVE

Point Carbon, a carbon-trading consultancy, released in 2008 poll numbers indicating that nearly 60 percent of respondents expect the United States to adopt some sort of binding commitment to reduce greenhouse gas emissions in the coming years. It's no longer a question of if the U.S. will apply a price to carbon emissions -- it's simply a question of when. Accordingly, many corporations are already building the prospect of carbon regulation into their strategic planning. While solar energy won't entirely eliminate your company's reliance on carbon-intensive fossil fuels, a well-planned PV installation can play an important role in shifting your company onto a less-carbon-intensive track of growth -- so that when regulators do throw the switch, you can hit the ground running. [4]

CORPORATE SOCIAL RESPONSIBILITY

It's clear that CSR is here to stay -- and the world will no doubt be a better place because of it. Solar energy clearly improves your company's environmental bottom line. Put simply, it is clean, carbon net-negative technology. What's more, solar energy has gained considerable prominence in recent years. Solar power not only offers the chance to contribute to responsible environmental stewardship, it represents a compelling -- and effective -- narrative with which to achieve your company's external communications goals. In brief, it's a win-win. [4]

DISTRIBUTED ENERGY

Distributed energy sources improve the quality and/or reliability of the electricity supply. They are "distributed" because they are placed at or near the point of energy consumption, unlike traditional "centralized" systems, where electricity is generated at a remotely located, large-scale power plant and then transmitted down power lines to the consumer. Distributed energy technologies are playing an increasingly important role in the nation's energy portfolio. They can be used to meet base load power, peaking power, backup power, remote power, power quality, as well as cooling and heating needs. Distributed energy also has the potential to mitigate congestion in transmission lines, reduce the impact of electricity price fluctuations, strengthen energy security, and provide greater stability to the electricity grid. [5]

LOW MAINTENANCE

Module Maintenance – Once you get your solar panels installed, you will find them fairly maintenance free. Most are rated for a 25 year lifetime, but continue to provide energy output beyond this timeframe. The maintenance associated with solar modules is easy. One potential issue is the accumulation of dirt and debris that can have an impact on the module's performance. Pollen, bird droppings, dirt, and dust can build up on solar panels. To ensure that a panel is performing optimally, it is often recommended to clean them at least two times a year. March/April when the rainy season has passed, and August/September, towards the end of summer.[10]

Inverter Maintenance – Inverter maintenance is also easy to do. Since there are no moving parts associated with the converter, upkeep is less complicated. Inverters typically have a lifetime of15 years or more, and as time goes by electronics will be getting smaller and cheaper for the end user. When evaluating the performance of the inverter you should inspect air duct and external cooling fans, ensure fans are operating, check wiring, and check the output of the inverter versus what the expected output should be. [11]

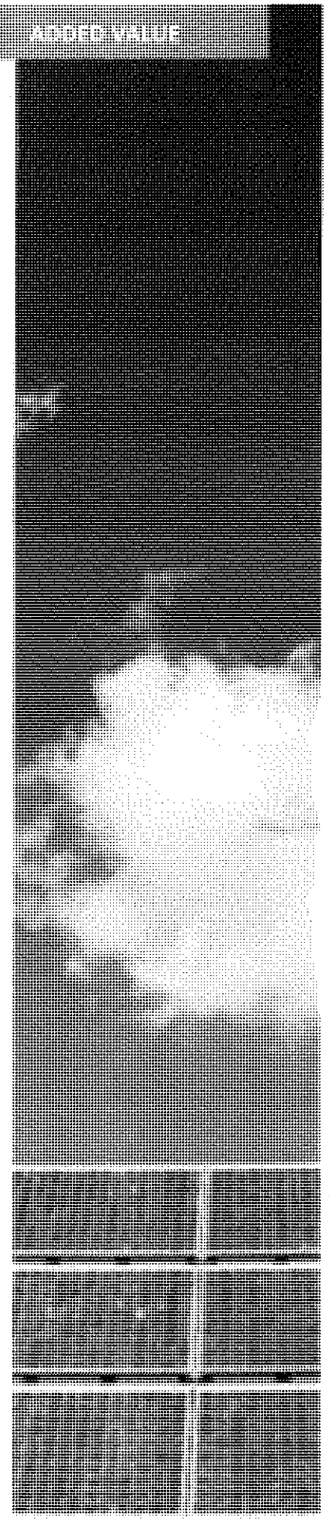
SCALABILITY

Solar is a power source that you can adjust in size over time. For example you may start your solar system with a single panel and add to it over time or implement a full array instantaneously.

MOBILITY

The past few years have seen the introduction of portable solar panels. They're reliable, convenient and offer the mobility that today's fast-moving society wants. The transportability of solar enables people in remote locations where there is not an electrical grid infrastructure receive power.

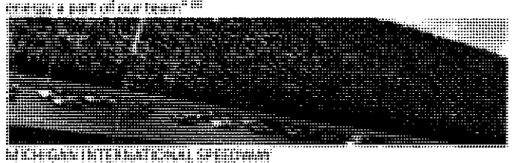
*See pay back period page.



DOW DIAMOND
Dow Diamond is believed to be the first Minor League stadium using solar power. Thanks to Dow Corning and Hemlock Semiconductor, the Dow Diamond scoreboard is powered by the solar panels located beyond the right field concourse. The 168 panels are connected to the stadium's main power grid and will generate power year-round. At peak performance, the panels will produce 28.56 kilowatt-hours of power. Through the course of a year, that amount of energy is equal to the electricity consumed by seven homes. [8]

When the panels were installed, Marie Eckstein, vice president and general manager of Advanced Technologies and Ventures at Dow Corning. Stated "We're delighted to offer this completely renewable energy source to the Michigan Baseball Foundation and the mid-Michigan community," "Mid-Michigan residents can be proud that many of the enabling technologies were developed or made right here in mid-Michigan." [8]

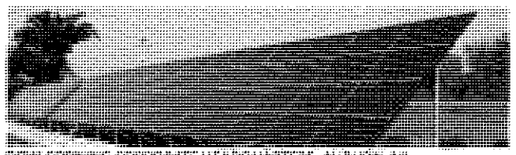
"This is a great example of applying a creative, innovative solution to address the need for renewable energy," said Paul Barbeau, president and general manager of the Great Lakes Loons. "We're pleased that Dow Diamond can be a showcase for the benefits of solar power, and happy Dow Corning and Hemlock Semiconductor are generously making solar energy a part of our team." [8]



[illegible]
The 2010 completion of the new suite and media center made the [illegible] track the first one on the NASCAR Sprint Cup Series circuit with an alternative energy source. The solar powered, 31-suite building and track media center is outfitted with approximately 8,000-square-feet of solar panels across the rooftop that captures 40 kilowatts of energy produced by the sun. (9)

The suite/media center also makes the racetrack one of the largest U.S. producers of green energy in American sports. Michigan International Speedway joins three other venues — AT&T Park in San Francisco, Staples Center in Los Angeles and US Airways Arena in Phoenix — as the country's energy leaders in major-league sports. "We hope Michigan International Speedway's actions can help show the nation that NASCAR and their fans are some of the country's most enthusiastic conservationists and can be a powerful leader in lowering energy consumption," track President Roger Curtis said. Solar energy saves money now and opens up our facility and our sport to non-traditional partners and unique business-to-business opportunities," track President Roger Curtis said. "It is the right thing to do and all companies today should take the necessary steps to lower their energy bills and minimize their energy footprints." (9)

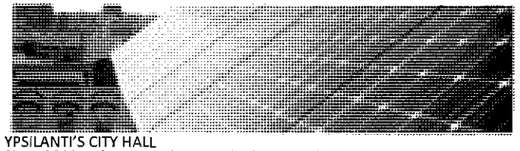
The solar panels from Uni-Solar in Auburn Hills, Mich., generate about 70,000 kilowatts per hour — enough energy to power 439 fluorescent light bulbs, 79 incandescent light bulbs, 175 laptop computers, 19 desktop computers and 26 refrigerators 24-hours a day. (9)



[illegible]
At the Dow Corning corporate center, the panels, made up of more than 9,700 solar cells, face south to take the best advantage of the sun. Travelers on U.S. 10 will see their backs. They form a backdrop to the new Solar Discovery Center, billed as an education facility. The 30 kilowatt hours of power from the panels is enough to power seven to 10 Michigan homes. "Our goal is that one day soon, a solar installation like this will be no more unique than a road being repaved or a house getting new windows," said Eric Peeters, global executive director of Dow Corning Solar Solutions. [8]

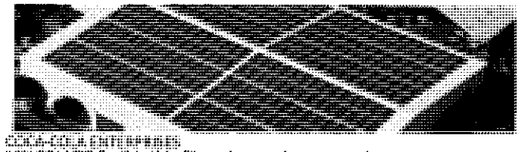
Combining these panels' output with output from panels at Dow Diamond, the Dow Corning Freeland Site, and at Hemlock Semiconductor, the companies contribute over 100 kilowatts to the energy grid. The solar cells in the Dow Corning array use polycrystalline silicon, an ultra-pure, rocklike substance that is a building block of the solar and semiconductor industries and is manufactured at Hemlock Semiconductor. Part of the new solar array has been coated with a new encapsulant developed locally by Dow Corning, the other part with a coating using the older, standard technology. The new coating is more transparent than older coatings, so it lets in more light, Peeters said. Because it uses silicone, it doesn't degrade over time from exposure to ultraviolet rays the way older coatings do. It's easier to produce, which means cost savings and less floor space in the manufacturing process. [8]

"It's easy for us to think of solar energy as some nebulous source of energy somewhere. But actually this is a technology that is real," said Chris Shirk, site manager of Dow Corning's Solar Solutions Application Center in Freeland, which conducts solar research and serves as a demonstration center for Dow Corning's technology. At the Discovery Center, one exhibit has panels that show components that make up solar panels, including a piece of polycrystalline silicon. Another display shows how energy travels from the sun through a solar panel, to an inverter that changes it from direct current to alternating current, and eventually to the energy grid and to a light bulb. [8]



YPSILANTI'S CITY HALL
Since 2009, solar power has supplied Ypsilanti's City Hall with on average 2.6 percent of its energy needs, a number that Dave Strenski hopes is a starting point. July and August both saw greater than 2 percent of city hall's power usage comes from solar, and it was actually at a higher percentage in April and May. Less overall power was used during the spring months because the demand for air conditioning was lower. The new solar panels, installed earlier this year in an awning on the south side of the building, were part of a grass roots project, Solar Ypsi. There haven't been any issues or problems yet with Ypsilanti's solar panels, and other municipalities have been contacting him to learn about the project and how it can be replicated. [10]

As part of the DTE SolarCurrents program, the city recently received a check for $5,900, not bad considering a state grant paid for the panels. He says that money will be reinvested in other green technology for the city. And down the road, those panels will hopefully save even more money: "It's good to do for the city, for its own economic benefit," he says. Solar Ypsi is still hoping to install solar panels on the bakery of the Ypsilanti Food Co-op later this month; the co-op already generates an impressive amount of solar energy. [10]

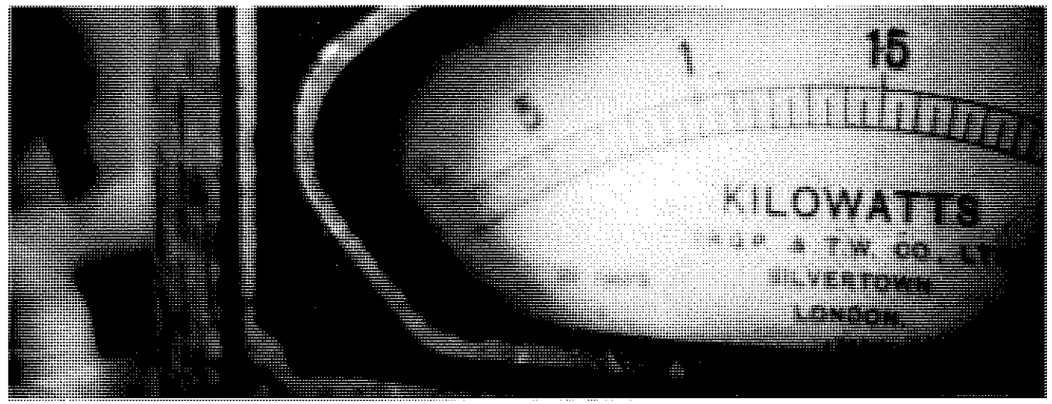


COCA-COLA ENTERPRISES
[illegible]
The new system combined 128-watt photovoltaic modules capable of producing 100 kilowatts of clean power from the sun daily, for every 28,000 square feet of roofing material installed. This capacity is critically important during peak hours when energy from public utility sources is particularly expensive. [11]

The 325 kilowatt solar roof at the Los Angeles production facility began generating electricity on February 13, 2004. By embracing the concept of green energy and implementing a solar roofing system, CCE stands to save millions in energy costs while significantly decreasing its CO2 emissions over the life of the system. [11]

Coca-Cola Enterprises new solar roof can produce 1,600 usable hours of electricity annually (equivalent to 67 days) with a cost savings of more than $60,000 per year. The new roof produces enough energy each day to power the average three-bedroom home for one year. CCE avoided the cost of a new roof and does not anticipate significant roof maintenance for another 25 years. [11]

Solar Fundamentals



Components of Power

WHAT IS A WATT?

A watt is a unit of power. One watt is the power resulting from an energy dissipation, conversion, or storage process. Energy in watt hours is the multiplication of power in watts and time in hours.

WHAT IS A KILOWATT?

The kilowatt hour is most commonly known as a billing unit for energy delivered to consumers by electric utilities

When you buy electricity they charge you by the kilowatt-hour (kWh). When you use 1000 watts for 1 hour, that's a kilowatt-hour. The prefix kilo means 1000, so a kilowatt is 1000 watts.

WHAT IS POWER?

Electrical power is the rate at which electrical energy is converted to another form. The common symbol for power is the uppercase letter P.

COMMON MISCONCEPTIONS

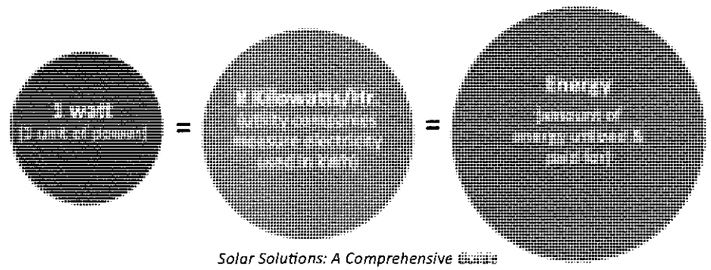
An electric bill terminology can be confusing. To determine the cost of electric use, utilities refer to the number of kilowatt-hours that are used. This is not a unit of power but a measure of the amount of energy that is used. [12]

The power capacity of a PV panel is rated in watts.

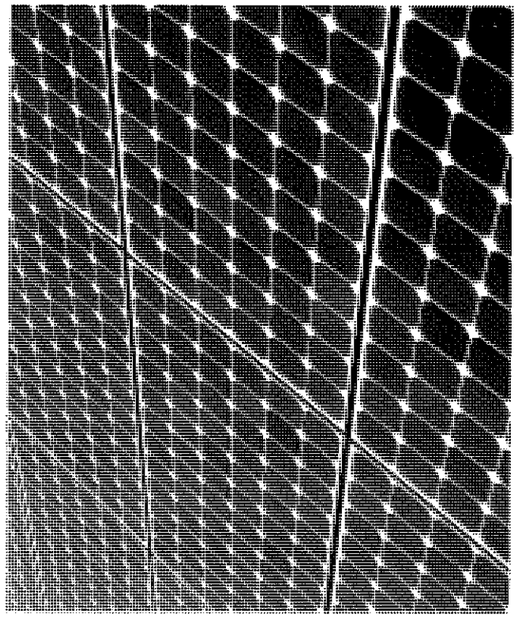
PV panels range in power capacity between 15 to +300 watts and have varying size options.

When many panels are linked together to form an array, the power capacity is often referred to in units of kilowatts (kw) or 1,000 watts.

For reference, a 1kW system under good sunlight has enough instantaneous power to run ten 100-watt light bulbs, or forty 25-watt Compact Florescent (CFL) bulbs.



Photovoltaic Systems



WHAT MAKES A PV SYSTEM?

A PV system includes panels, racking, inverters, wiring, and conduit. Batteries and charge controllers are required only if you will require back up power. Many people rely on the grid for this.

Typical panel efficiency for converting sunlight to usable power for your home is 13% - 18%.

Panels are warranted for 20 to 25 years. Inverters for 10 to 15 years.

Panels are designed to withstand hail, snow, and wind without incurring damage. System racking is designed to meet the wind zone ratings of specific neighborhoods.

There are two types of mounting systems: ground mounted and roof mounted.

Battery Life

When you use a bettery, how long is it going to last? For example, a 350ah battery could supply 17.5 continuous amps over 20 hours or 35 continuous amps for 10 hours. To quickly express the total watts potentially available in a 6 volt 360ah battery; 360ah times the nominal 6 volts equals 2160 watts or 2.16kWh (kilowatt-hours). Like solar panels, batteries are wired in series and/or parallel to increase voltage to the desired level and increase amp hours. [13]

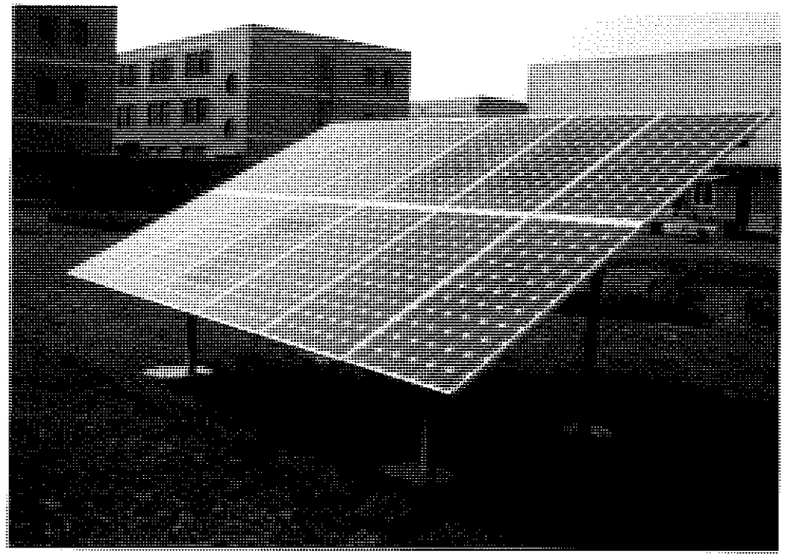
The battery should have sufficient amp hour capacity to supply needed power during the longest expected period of "no sun" or extremely cloudy conditions. A lead-acid battery should be sized at least 20% larger than this amount. If there is a source of back-up power, such as a standby generator along with a battery charger, the battery bank does not have to be sized for worst case weather conditions. [13]

The size of the battery bank required will depend on storage capacity required, maximum discharge rate, maximum charge rate, and the minimum temperature at which the batteries will be used. During planning, all of these factors are looked at, and the one requiring the largest capacity will dictate the battery size. [13]

What is a Photovoltaic System?

A photovoltaic system is a system which uses solar cells to convert light into electricity. A photovoltaic system consists of multiple components, including cells, mechanical and electrical connections and mountings and means of regulating and/or modifying the electrical output.

Grids & Grid Systems



OFF-GRID SYSTEMS

As the name implies, off-grid systems are not connected to the public utility grid and are often referred to as "stand-alone" systems. During the day, the electricity generated is used either by powering loads or to charge storage batteries. At night, power is supplied by the energy stored in the batteries. When the sun comes up the next day, the cycle begins again. [14]

Off-grid systems are typically found in remote homes, weather stations or radio sites and parks. Off-grid systems can also be used to supply electricity to vacation homes that are not connected to the utility grid. In developing countries, off-grid systems frequently represent the only solution to supplying remote villages with electricity. The demand for these types of systems is extremely large. To date, approximately two billion people worldwide still live without electricity in regions far away from public utility grids. [14]

What is a grid?

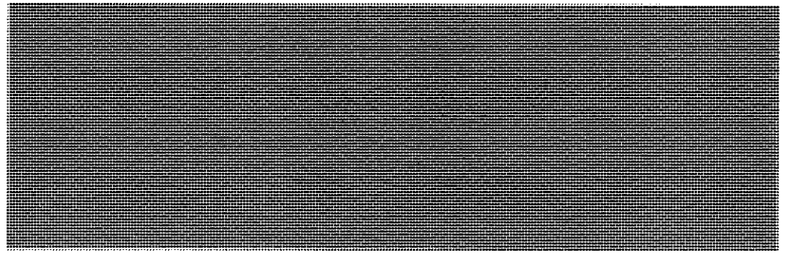
An electrical grid is an interconnected network for delivering electricity from suppliers to consumers. When referring to the power industry, grid is a term used for an electricity network which may support all or some of the following four distinct operations: (1) Electricity generation, (2) Electric power transmission, (3) Electricity distribution, and (4) Electricity control. [14]

Grid-Tied Photovoltaic (PV) systems have no batteries.

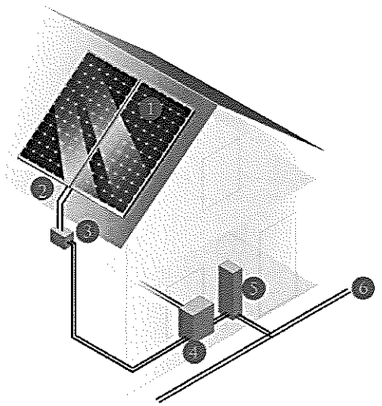
Your system automatically shuts down when the grid goes down so your system does not back-feed the grid and possibly electrocute a line worker. [14]

Being ***"grid-tied"*** means that you are interconnected with the grid, so you will always have power, even at night or on overcast days. [14]

Grid-tied systems allow you to spin your meter backwards. You will be credited at the retail rate for any power your system feeds onto the grid. At the end of the year, the utility will pay you for any excess kW hours at the wholesale rate. [14]



What is Net Metering?



1. FREE ENERGY FROM THE SUN IS COLLECTED BY SOLAR PANELS AS DC CURRENT.
2. WIRING PROVIDES A PATH FOR THE ELECTRICITY TO FLOW.
3. THE INVERTER CONVERTS DC CURRENT TO AC CURRENT THAT CAN BE USED IN A HOME OR BUSINESS.
4. POWER IS DISTRIBUTED AS NEEDED IN A HOME OR OFFICE THROUGH THE ELECTRICAL PANEL.
5. THE METER PROVIDES DATA ON HOW MUCH ENERGY IN KWH THAT IS CONSUMED OR SENT BACK TO THE UTILITY GRID.
6. THE UTILITY GRID AUTOMATICALLY PROVIDES ELECTRICITY WHEN THE DEMAND IS GREATER THAN THE POWER PRODUCED BY THE SOLAR SYSTEM.

Net metering programs serve as an important incentive for consumer investment in renewable energy generation. [16]

When a net metering customer's renewable generator is producing more power than is being consumed, the electric meter runs backward generating credits. When a net metering customer uses more power than is being produced, the meter runs forward normally. [16]

Net metering customers are charged only for the "net" power that they consume from the electricity service provider that has accumulated over a designated period or, if their renewable energy-generating systems make more electricity than is consumed, they may be credited or paid for the excess electricity contributed to the grid over that same period.

Without net metering, a second meter is usually installed to measure the electricity that flows back to the provider, with the provider purchasing the power at a rate much lower than the retail rate. [16]

BATTERY VS. COMMERCIAL ENERGY

In a Grid-connected system, the solar array is connected to the mains. Any surplus power is sold to the electricity company, and power is bought back from them when it is needed.

In a Stand-alone system, however, this is not possible. In this type of system the usual choice for energy storage is the lead-acid battery. The number and type of batteries is dependent on the amount of energy storage needed. [16]

AT WHAT RATE DOES THE ENERGY COMPANY BUY ENERGY BACK?

Michigan Renewable Portfolio Standard (RPS) compliance is based on Michigan Renewable Energy Credits (MIRECS; www.mirecs.org)

- One REC is created for every megawatt-hour (MWh) of renewable energy generated (1 MWh = 1,000 kWh)
- REC price will be market based. REC price estimates range from 1.5 to 7 cents per kWh

INTERCONNECTION & NET METERING:

What's the difference?

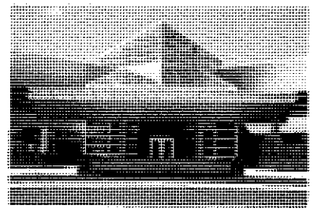
Interconnection-

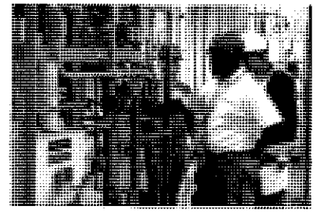
The technical rules for customers to "plug in" to the grid. [16]

Net Metering-

The billing arrangement by which customers realize savings from their systems, where 1-kWh generated by the customer has the exact same value as 1-kWh consumed by the customer. [16]

What is a Feed-In Tariff?





(Currently not relevant for Michigan)

A feed-in tariff is a term of art that means a guaranteed minimum price established by government policy paid by utilities to generators of electricity from renewable energy sources for a guaranteed minimum number of years.

FEED-IN TARIFFS

Utilities are required to purchase power at the feed-in tariff rate under government-designed contracts. FIT rates are frequently four times higher than the price paid by a utility for other purchased power. As such, they are designed to encourage the installation of non-utility-owned and noncommercial-scale renewable energy sources (RES) generation. They are distinguished from net metering inasmuch as net metering describes the practice where the generator uses the renewable energy source to provide its own electricity and only sells any surplus back to the grid. Under a FIT, the generator is required to sell all of the electricity produced back to the grid.

U.S. PILOTS

FLORIDA

In February of 2009 Gainesville Regional Utilities (GRU) announced that it had reached its first year solar PV reservation target with a groundbreaking feed-in tariff making it the first American city to have this type of solar incentive. Gainesville's program went live March 1st. During 2009 and 2010 all participants were guaranteed a solar PV tariff of $0.32/kWh for twenty years. The Gainesville muni's program has generated interest all across the state. The Sarasota Herald Tribune reports that an unusual alliance between a liberal Democrat and a conservative Republican are working on a statewide feed-in tariff policy. The Gainesville feed-in-tariff was so popular that the program was quickly full almost as soon as it started. In October 2008, when plans for the solar feed-in-tariff began, the utility district had 328 kW of installed solar power; by April 2010, it had 2,013 kW installed. That's more than six times more power, and it's still growing. Currently applications for 2011 have exceeded available program capacity. Therefore, an independent third-party selected 55 projects for inclusion by random drawing. GRU mailed all applicants a letter February 1 to let them know whether their project was selected. [18]

CALIFORNIA

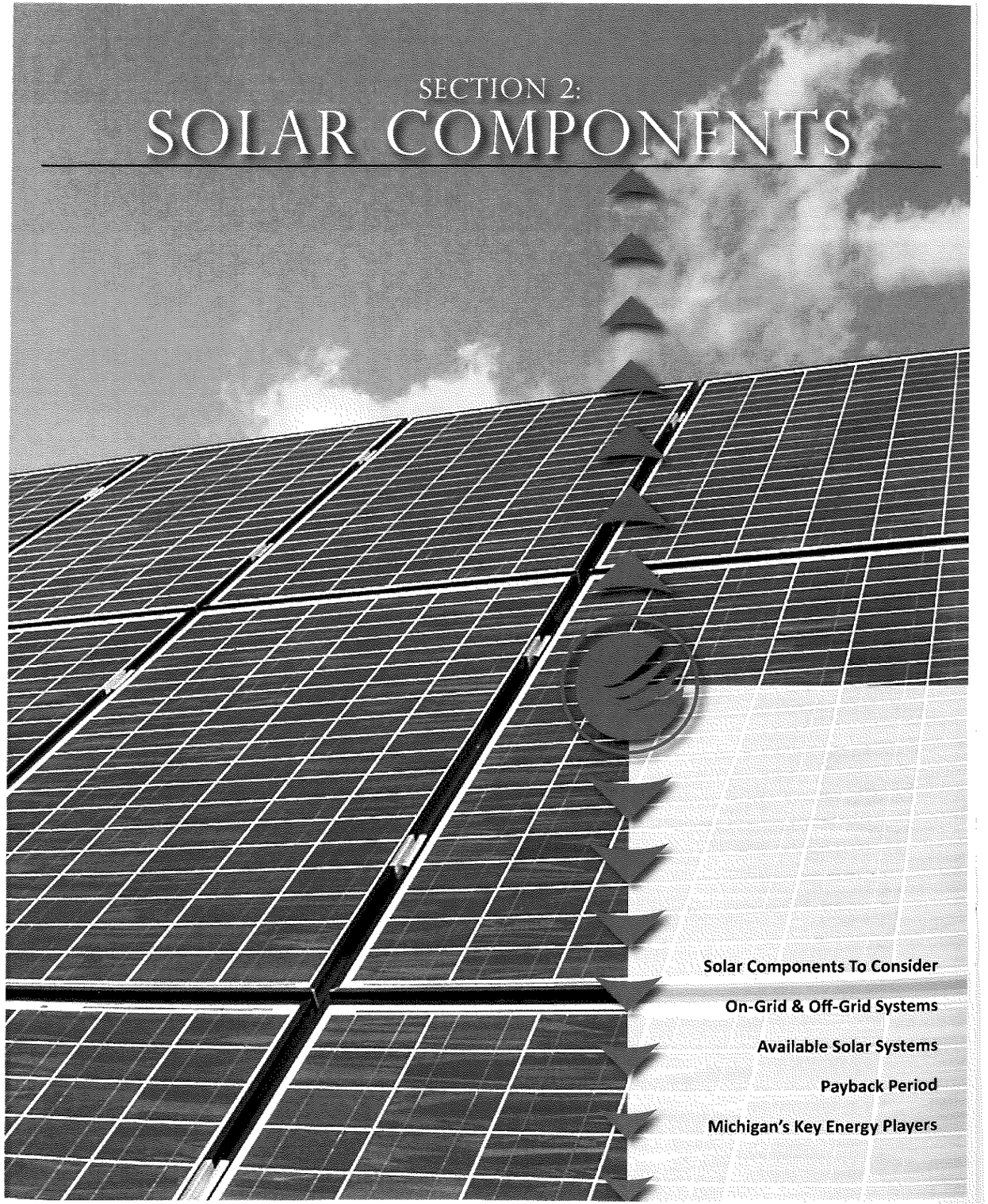
The California feed-in tariff allows eligible customer-generators to enter into 10-, 15- or 20-year standard contracts with their utilities to sell the electricity produced by small renewable energy systems -- up to 3 megawatts (MW) -- at time-differentiated market-based prices. The price paid will be based on the CPUC's market price referent (MPR) table, shown in CPUC Resolution E-4137. Time-of-use adjustments will be applied by each utility and will reflect the increased value of the electricity to the utility during peak periods and its lesser value during off-peak periods. A special, higher-level rate is provided for solar electricity generated between 8 a.m. and 6 p.m. All investor-owned utilities and publicly-owned utilities with 75,000 or more customers must make a standard feed-in tariff available to their customers. As the feed-in tariff is meant to help the utilities meet California's renewable portfolio standard (RPS), all green attributes associated with the energy, including renewable energy credits (RECs), and transfer to the utility with the sale. Any customer-generator who sells power to the utility under this tariff may not participate in other state incentive programs. The tariffs will be available until the combined statewide cumulative capacity of eligible generation installed equals 750 MW. [19]

TRAVERSE CITY, MICHIGAN

The Michigan Land Institute has proposed that Traverse City Light & Power implement a system of feed-in tariffs to wean the municipal utility from its dependence on coal. Traverse City Light & Power is a municipal utility serving the small town of 15,000 in the "little finger" of Michigan's Lower Peninsula. Traverse City is the largest town in a 14-country region. The utility is better known for installing one of the first, if not the first, municipally-owned, commercial-scale wind turbines in 1996. The utility has done little with renewable energy since that pioneering project. The report, 20-20 by 2020: a Clear Vision for Clean Energy Prosperity, among other recommendations, urges the utility's board to adopt feed-in tariffs to encourage locally-owned wind and solar energy. The Institute argues that feed-in tariffs, in contrast to tax subsidies, allows both non-profits and profit-making enterprises to participate. The Land Institute's proposal suggests that the utility use feed-in tariffs to install half of the planned renewable capacity additions, the equivalent of 3.3 MW of 50 kW commercial-scale of rooftop solar PV, and 15 MW from ten commercial-scale wind turbines. The wind and solar targets would provide 16% of the utility's supply in 2020. Landfill gas would complete the remainder of the Land Institute's 20% target for renewables by 2020.[20]

SECTION 2:

SOLAR COMPONENTS



Solar Components To Consider

On-Grid & Off-Grid Systems

Available Solar Systems

Payback Period

Michigan's Key Energy Players

Solar Components to Consider

Listed below are the key components and critical aspects of a solar system that an owner should be aware of. For a more complete listing of components and additianal information, please see the reference list at the end of the Solar Solutions Guide.

Technology

Remember: When deciding which type of PV Cell to implement, a cost-benefit analysis should be assessed for each type

Photovoltaic (PV) – production of a voltage by exposure to radiant energy (i.e. light)

3 types of solar cells:

Monocrystalline: cells are cut from a silicon ingot grown from a single large crystal of silicon. The most common material used in solar cells is single crystal silicon. Solar cells made from single crystal silicon are currently limited to about 25% efficiency because they are most sensitive to infrared light, and radiation in this region of the electromagnetic spectrum is relatively low in energy

Polycrystalline: cells are cut from an ingot made up of many smaller crystals. Polycrystalline ("many crystals") solar cells are made by a casting process in which molten silicon is poured into a mold and allowed to cool, then sliced into wafers. This process results in cells that are significantly cheaper to produce than single crystal cells. Efficiency is limited to less than 20% due to internal resistance at the boundaries of the silicon crystals.

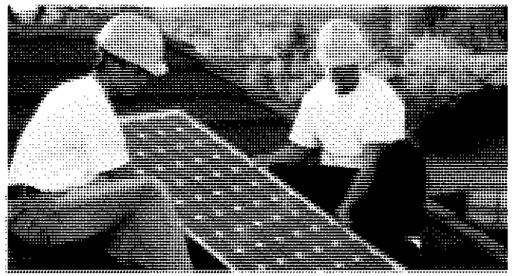
Thin-film solar cell: This type of solar cell can be applied as a thin film to low cost substrates such as glass or plastic. Thin film cells have a number of advantages, including easier deposition and assembly, the ability to be deposited on inexpensive substrates, the ease of mass production, and the high suitability to large applications. Since amorphous silicon cells have no crystal structure at all, their efficiencies are presently only about 10% due to significant internal energy losses.

Solar Thermal Energy – Or solar hot water, uses flat collector plates to harness the sun's energy to heat water for use in businesses, homes, and pools.[21]

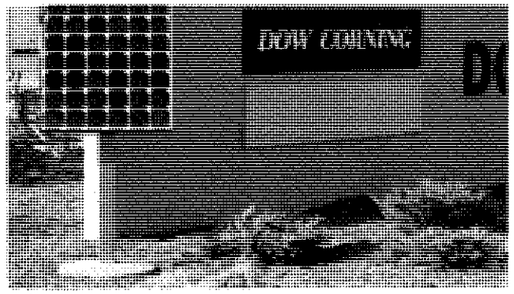
The installation and appearance are much like those of the PV panel, and the collectors are best installed facing south, under unobstructed sunlight. Unlike PV panels, solar thermal collectors do not convert sunlight to electricity, but transfer the energy directly to the water. Solar thermal systems displace the electricity or natural gas that would otherwise be required to heat water.[21]

BUILDING COMPONENTS

Roof
Installation of roof-mounted systems



Ground
Installation of ground-mounted systems



Pole
Installation of pole-mounted systems

Solar Panel Orientation
The angle of the solar array can be anywhere from your latitude plus 15 degrees to latitude minus 15 degrees for a yearly fixed mount position. Your latitude offers the best year-round position. By biasing the array "latitude plus 15 degrees" you will get slightly more sunlight intensity during winter months. A "latitude minus 15 degrees" will bias the array to summer months.

On-Grid vs. Off-Grid Systems

There are three combinations of solar power systems:

1. ON-GRID BATTERY SOLAR POWER SYSTEM

With an on-grid battery system, a back-up battery is included as part of the solar power system. Batteries can store excess energy generated by the solar panels, and even send the surplus electricity out to the grid. Of course, the system is connected to the electricity grid which is why it is called "on-grid." The solar panel system includes solar panels, a charge controller, battery, inverter, AC service entrance and AC subpanel, and a utility meter. [22]

2. ON-GRID SOLAR POWER SYSTEM WITHOUT BATTERY

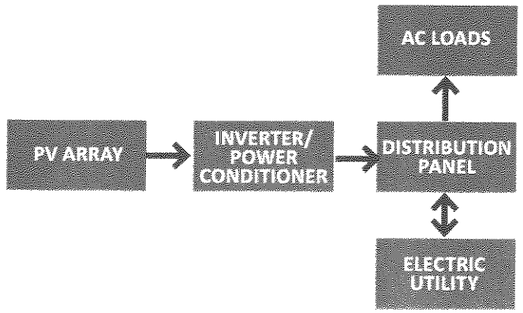
You can still stay on-grid without a battery, however. These solar power systems are the simplest and least expensive to set up. All that is included is the PV array, an inverter, AC service entrance and utility meter. Your system is connected to the grid, but there is no battery back-up. The obvious drawback is that when power goes out in your area, your solar power system will also shut down. [22]

3. OFF-GRID SOLAR POWER SYSTEM

Finally, there is the off-grid solar power system. There is no tie-in to the electricity grid. Batteries are required as part of the system in order to store excess energy. This system relies totally on personal solar panels, charge controller, batteries, and inverter to generate electricity. [22]

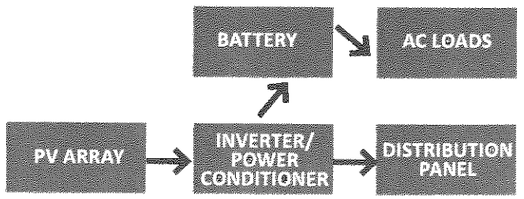
ON-GRID

PROS	CONS
Can draw on grid-based electricity when necessary	Dependent on utility company
More flexible	
Grid-tied solar contains no moving parts and will last 40+ years with no maintenance	



OFF-GRID

PROS	CONS
Provides an option for those who live in a remote area where there are no utilities available	100% reliant on renewable energy generated by off-grid installation
No electricity bills	Excess energy generated is not fed out to the utility to give you an energy credit
Freedom from rate hikes	Most off-grid systems include a back-up generator or batteries which can be very costly



Both systems can use batteries to store excess power. For grid-tied systems, batteries are backups during power cuts. For off-grid homes, they are an absolute necessity--at night, there is no sun to generate energy. Althought designing a PV System is entirely custom, a 10 KW System will be a good frame of reference for small commercial systems.

Solar Systems

CELLS

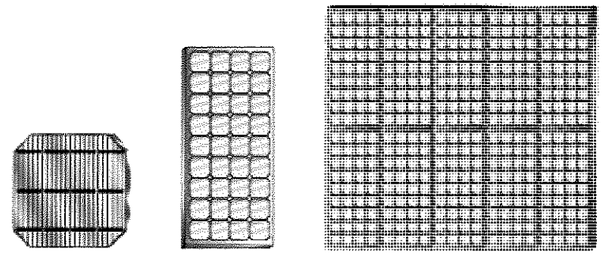
The building block of PV systems
Typically generate 2 - 4 watts of power

MODULES OR PANELS

Made up of multiple cells
A typical module costs around $2/watt

ARRAYS

Made up of multiple modules
Still need many other components to make this work
Typical systems cost about $5.50/watt today (without battery)



TYPES OF SOLAR SYSTEMS

Solar technologies are broadly characterized as either passive solar or active solar depending on the way they capture, convert and distribute solar energy. Active solar techniques include the use of photovoltaic panels and solar thermal collectors to harness the energy. Passive solar techniques include orienting a building to the Sun, selecting materials with favorable thermal mass or light dispersing properties, and designing spaces that naturally circulate air.

The term solar power system typically describes systems that convert sunlight into electricity (photovoltaics) or heat (solar thermal energy).

Photovoltaics:

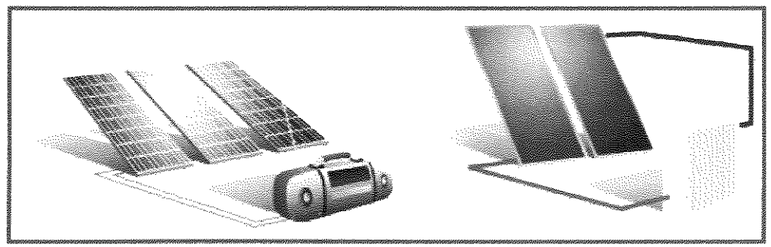
Photovoltaics and solar thermal energy are not in direct competition – quite the contrary: they ideally complement each other and can be combined well. Many specialized companies provide innovative solutions for this purpose.

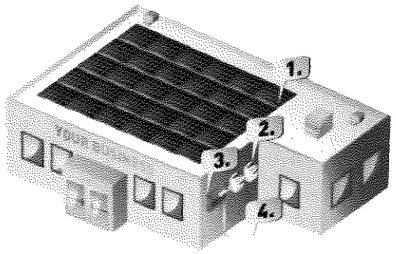
Solar Thermal Energy:

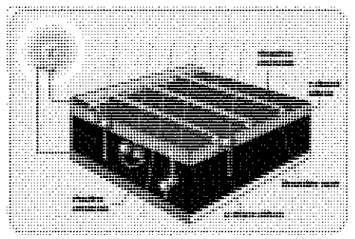
Focus the sun to create to create heat. This is done by boiling water or heating liquid metals.

- Use heated fluid to turn a turbine
- Generate electricity

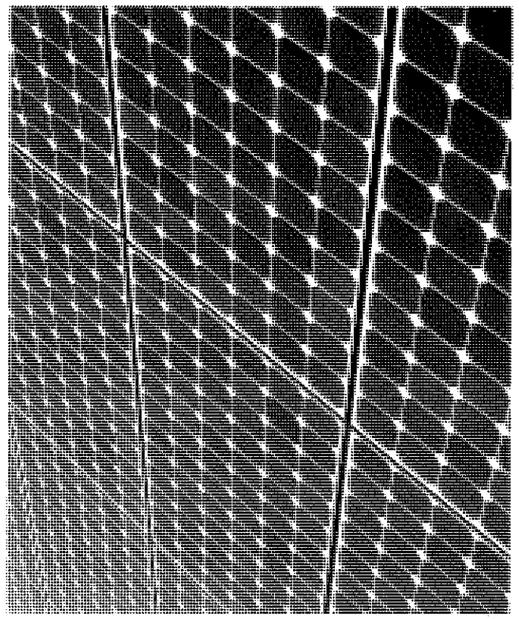
Saginaw, MI is situated at 43.31 degrees latitude and -83.99 degrees longitude. Solar systems installed in or neor Saginaw can expect to receive 4.18 solar exposure (measured in kWh per square meter per day) for each kW installed. This translates ta an annual yield of 1,224.89 kWh per installed kW, at a dollar value of $124.45/ $103.26 (Residential/Commercial) at the Michigan's average retail electricity charge.*

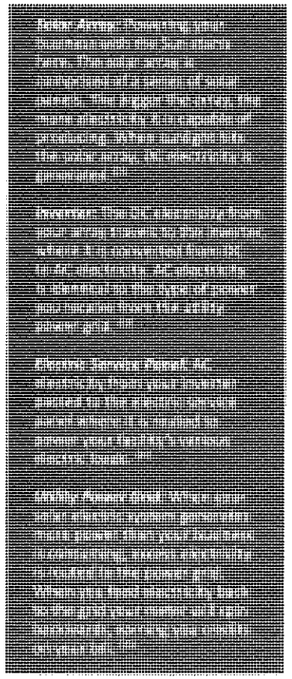






Photovoltaics





As solar power becomes increasingly popular, more and more solar panels can be seen on the roofs of homes and businesses alike. These solar panels employ one of the most environmentally friendly methods for producing electricity: "photovoltaic". The term photovoltaic, or PV, is used to describe something that creates electricity when exposed to sunlight. Solar panels, or PV modules, are made up of several solar cells. Each cell is comprised of materials which have photovoltaic properties.[15]

How It Works

Photovoltaic (PV) cells, which as the name implies (photo meaning "light" and voltaic meaning "electricity"), convert sunlight directly into electricity. A module is a group of cells connected electrically and packaged into a frame (more commonly known as a solar panel), which can then be grouped into larger solar arrays.

Photovoltaic cells are made of special materials called semiconductors such as silicon, which is currently used most commonly. Basically, when light strikes the cell, a certain portion of it is absorbed within the semiconductor material. This means that the energy of the absorbed light is transferred to the semiconductor. The energy knocks electrons loose, allowing them to flow freely. [15]

PV cells also all have one or more electric field that acts to force electrons freed by light absorption to flow in a certain direction. This flow of electrons is a current, and by placing metal contacts on the top and bottom of the PV cell, we can draw that current off for external use. This current, together with the cell's voltage (which is a result of its built-in electric field or fields), defines the power (or wattage) that the solar cell can produce. [15]

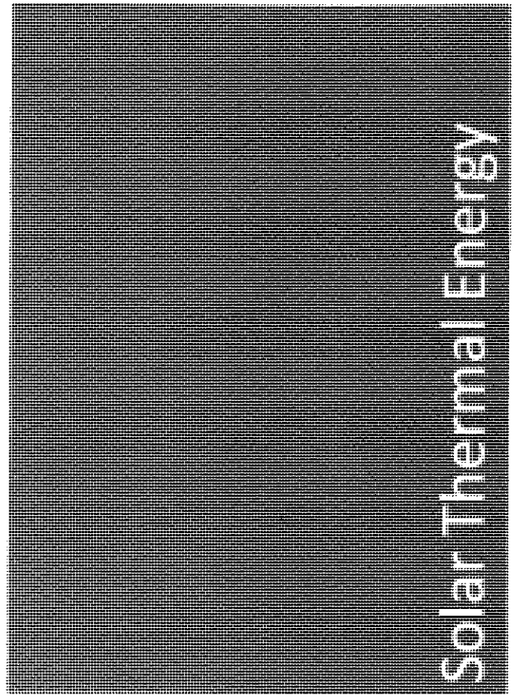
Photovoltaics Offer Great Benefits:

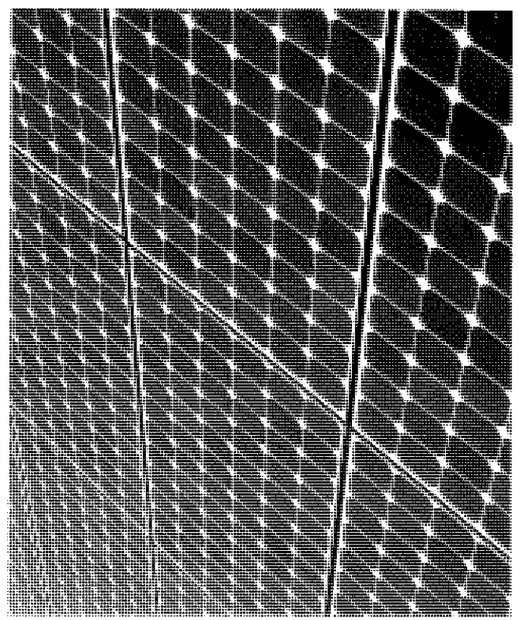
Simultaneously heating & cooling different parts of the same building

Photovoltaics Offer Great Savings:

Very competitive on initial costs and lower lifecycle costs than most HVAC systems. [15]

More Information
The International Ground-Source Heat Pump Association maintains an online database of accredited installers, trainers and certified geo-exchange designers at igshpa.okstate.edu/directory/directory.asp





There are many ways to get solar thermal systems to work and it is important to look into available options that will help to lower the costs of energy consumption needed to heat water or a space. There are two main types of thermal systems that use solar power and those are the passive and active systems. Passive systems allow the heat to be absorbed and are naturally distributed amongst the system while active system will use different means to power the collected heat through the system by using pumps or other devices. [23]

How It Works

In the simplest solar thermal application, a discrete solar collector gathers solar radiation to heat air or water for domestic, commercial or industrial use. The solar panel is usually a flat plate collector that consists of a metal box with a glass or plastic cover and a black absorber plate at the bottom. Absorber plates are usually painted with selective coatings that absorb and retain heat better than ordinary black paint. In locations with average available solar energy, flat plate collectors are sized at approximately 0.5 to 1 square foot per gallon of daily hot water use. Evacuated tube collectors have absorber plates that are metal strips running down the center of each tube. The solar collector is usually mounted on the roof and is connected to a circuit containing water with propylene glycol anti-freeze added, if necessary. The heated liquid flows around the circuit, either under the action of a pump to warm the main hot water tank, or by a thermo-syphoning action to warm a solar water storage tank that then feeds the hot water tank. [24]

Solar Thermal Electricity Generation (less relevant to Michigan)

Solar thermal energy can be collected at large scale and used to heat a transfer fluid that can then power a steam turbine to generate electricity. Although this process is mostly viable for locations with plentiful direct sunlight it is worth noting. Sunlight may be collected using huge mirror arrays focused on to a receiver at the top of a tower or, at the other extreme, may be based on the temperature gradient produced when sunlight impinges on a "solar pond" (a large salty lake) and heats the water at its base. [24]

Fulcrum Composites of Midland

Chris Edwards, owner of Fulcrum Composites of Midland, has a novel, high efficiency design. He uses something called "fuzzy focus" which focuses the sun in such a manner as to seriously increase overall efficiency while not increasing cost. Fulcrum has developed a solar thermal panel optimized for use in cold climates. Moreover, during the year 2010 they received a grant to develop a thermal storage system combined with solar thermal heating and waste heat recovery allowing energy to be accumulated throughout the year to be used when needed in winter. [24]

Thermal Energy Offers Great Savings:

In solar hot water systems, sunlight reduces the amount of electricity or gas required to heat your hot water supply, so it cuts your fuel bills. [24]

For more information, contact one of the following United States Solar Energy organizations in Michigan:

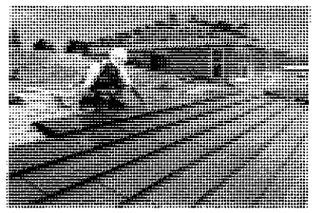
Solar Installers/Dealers

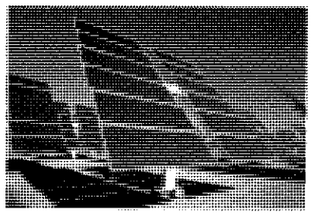
Backwoods to the Future
Basic Solar & Renewables LLC
Bauer Power
Currin Corporation
D&R Energy Services Inc
Event Horizion Solar & Wind
Michigan Solar & Wind Solutions
Solarworks in Michigan

Product Manufacturers

Ballard Power
SES Flexcharge USA
United Solar Associations
Great Lakes Renewable Energy Association

Payback Period





Solar powered systems demand a higher initial cost than common gas or electric systems, and most consumers choose conventional systems for that simple reason. However the payback of solar powered systems is relatively short in some cases. Solar options, namely solar hot water heaters, are environmental but also economical [25]

Paybacks & Types of Solar Applications

There are various types of solar powered systems, with different degrees of competitiveness and different paybacks. Solar Water Heaters are a competitive technology with paybacks around 5-6 years in many climate zones, while Solar Electric PV systems, even with high rebates and financial incentives, struggle to achieve such a quick payback.[25]

Payback, Climate, Prices & Other Variables

There are many possible variables determining the final payback of an investment in a solar system. Climate is important when calculating the payback of an investment in a solar system, all the more since it also determines the type of collectors, system, needs, etc. Similarly, you may find cheap and efficient solar hot water systems for around $1000-$2000, but more complex systems for colder regions (with pumps, heat exchangers, controls...) may cost you around $3,000-$4,000, or more... As to prices of solar electric photovoltaic solutions, they easily amount two or three times that values. [25]

Paybacks depend on prices, and on the type of system and the climate that are behind them. For more detailed information on prices, see visit: http://www.house-energy.com/Solar/Costs-Payback-Solar.htm

Payback Periods

You can recover your initial investment on solar power systems in a short period, or in a much longer one... As said before, all depends on the type of solar power system and also on issues as climate, installation, uses, etc. [25]

Below, we list some broad conclusions, based on average situations:

- The payback period for solar hot water systems can be relatively short. In very favorable cases (closely related to good climate conditions) 3 or 4 years paybacks are possible. Average paybacks of 5-6 years are also common.
- The payback period for PV solar electricity is much longer: more than 10-15 years in most cases, unless rebates and tax credits turns the investment more attractive.
- The payback for solar space heating is also larger than that of solar hot water systems, though all depends on the type of system. [25]

RETScreen International: Clean Energy Decision Support Centre

RETScreen Internaional is a financial and risk analysis software program that is free-of-charge at the RETScreen Internaional Clean Energy Decision Support Center Website: www.retscreen.net.[26]

The RETScreen International Clean Energy Decision Support Centre seeks to build the capacity of planners, decision-makers and industry to implement renewable energy, cogeneration and energy efficiency projects. This objective is achieved by: developing decision-making tools (i.e. RETScreen Software) that reduce the cost of pre-feasibility studies; disseminating knowledge to help people make better decisions; and by training people to better analyse the technical and financial viability of possible projects. [26]

The RETScreen Clean Energy Project Analysis Software is a unique decision support tool developed with the contribution of numerous experts from government, industry, and academia. The software, provided free-of-charge, can be used worldwide to evaluate the energy production and savings, costs, emission reductions, financial viability and risk for various types of Renewable-energy and Energy-efficient Technologies (RETs). The software (available in multiple languages) also includes product, project, hydrology and climate databases, a detailed user manual, and a case study based college/university-level training course, including an engineering e-textbook. [26]

Michigan Key Energy Players

Consumers Energy
Count on Us

DTE Energy®

Consumers Energy

Products & Services
- Energy Management
- Metering and Monitoring
- Power Quality
- Electric Construction & Maintenance

Join GREEN GENERATION SM and qualify for credits toward your LEED certification.[27]

Consumers Energy's Green Generation program has received the Green-e certification and qualifies for credits under the LEED (Leadership in Energy and Environmental Design) Green Building Rating System.® [27]

Existing or newly constructed buildings seeking LEED certification may qualify for credits by participating in Green Generation at levels specified under the appropriate LEED rating system. [27]

Existing buildings may qualify for credit by participating in Green Generation at a level that represents a minimum of 15% of the building's monthly electric consumption. Additional credits can be earned by increasing the level of commitment in Green Generation.

Newly constructed buildings may qualify for credit by entering into a two-year Green Generation participation agreement and subscribing to a level of participation that represents at least 35 percent of the estimated monthly electric consumption. [27]

For more information on the LEED certification, visit the U.S. Green Building Council's website. [27]

Consumers Energy Experimental Solar Program:

*At this time, the program is fully subscribed and not adding additional members. [27]

Participating customers may not enroll in net metering [27]

Limited to a total of 2 MW of solar PV, 500 kW reserved for residential customers [27]

Estimated $10 million program, out of ~$3.1 billion, 20-year spending on renewable energy [27]

Prices range from $0.65/kWh to $0.375/kWh
RECs belong to the utility
Contract term is up to 12 years [27]

Consumers Energy
green generation
Renewable Energy Program

Detroit Edison

SolarCurrents Pilot Program

Available to Detroit Edison retail net metering customers

Limited to 5 MW capacity; solar PV only; At least half reserved for residential customers [28]

Contract term of 20 years

Up-front payment of $2.40 per watt (estimated 25% of total system cost, including modest ROI) plus annual payments of 11¢/kWh for RECs (estimated ~25% of total system cost). [28]

Net metering program allows customer to receive an economic value of remaining 50% cost Estimated $25 million program, out of $2.2 billion total [28]

Customer Owned

Save up to half the installed cost of a solar PV system [28]

Cut your monthly electricity costs for the next 20 years [28]

Reduce your carbon footprint [28]

If you'd like to generate your own electricity using solar power, the SolarCurrents™ customer-owned program can make doing so much more affordable. [28]

Once you have purchased and installed your solar energy (photovoltaic) system, Detroit Edison will help offset your installation cost by an average of $22,000 (based on an average system size of 4.5 kW, over 20 years). The SolarCurrents program, combined with net metering, federal tax credits and local incentives could save you more than half the cost of your new photovoltaic system. [28]

In return, Detroit Edison will receive all rights to any Renewable Energy Credits (RECs) allocated to that renewable generation. [28]

Program Status:

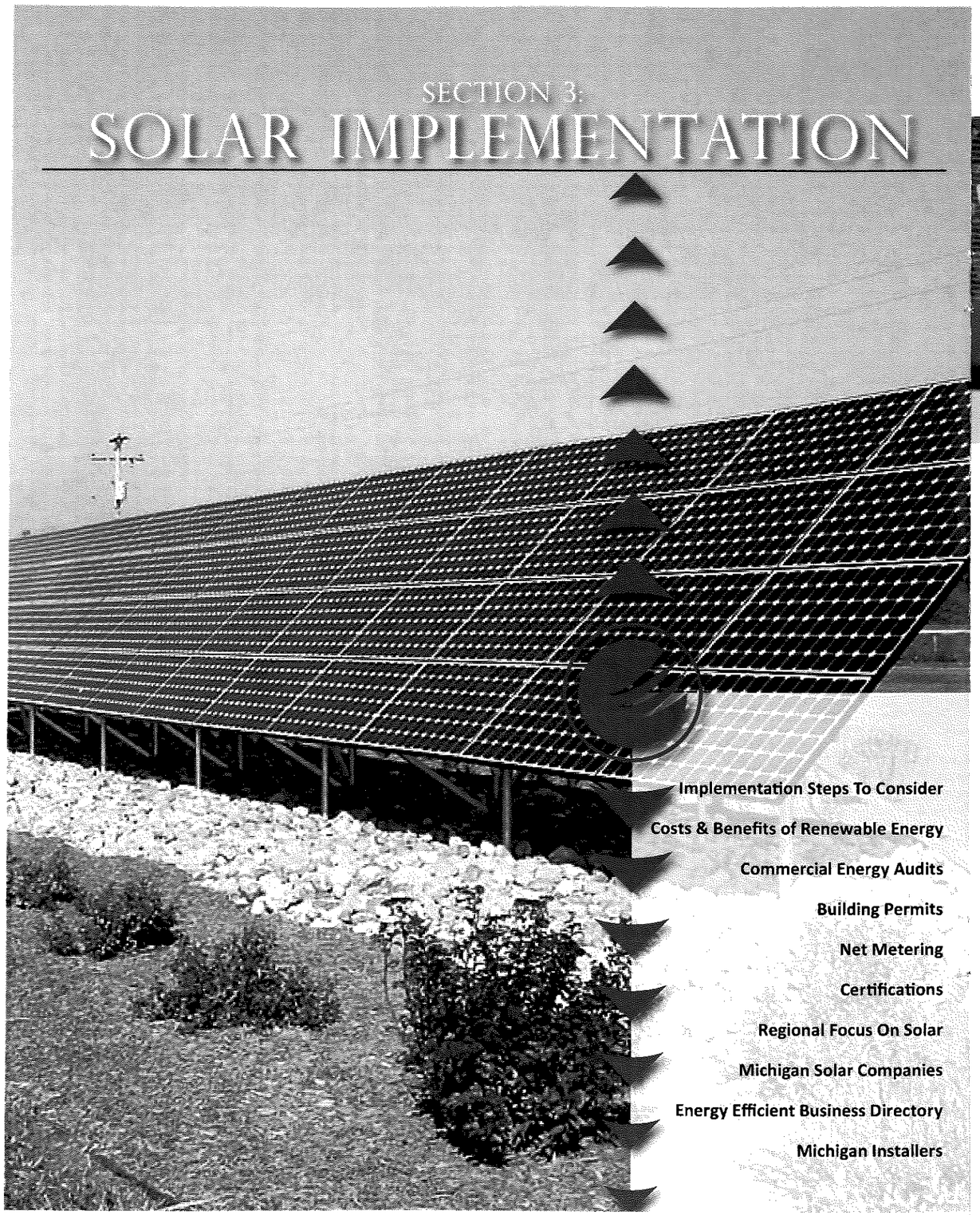
Applications are now being accepted for both residential and commercial installations. [28]

Completed installations: 145
Total kW installed (Max. 5MW): 678 kW
Funding remaining (Max. $25M): $22 M

SolarCurrents

SECTION 3:

SOLAR IMPLEMENTATION



Implementation Steps To Consider

Costs & Benefits of Renewable Energy

Commercial Energy Audits

Building Permits

Net Metering

Certifications

Regional Focus On Solar

Michigan Solar Companies

Energy Efficient Business Directory

Michigan Installers

The True Costs & Benefits of Renewable Energy

HOW GOOD IS RENEWABLE ENERGY?

Make your own assessments.

New web-based interactive Energy Calculators:

- http://www.getsolar.com/commercial.php
- http://www1.eere.energy.gov/calculators/buildings.html
- http://www.business.gov/manage/green-business/energy-efficiency/calculate-savings/energy-saving-calculator.html
- http://www.42u.com/efficiency/energy-efficiency-calculator.htm
- http://www.energystar.gov/index.cfm?c=comm_real_estate.building_upgrade_value_calculator

RECaBS

(Renewable Energy Costs & Benefits for Society)

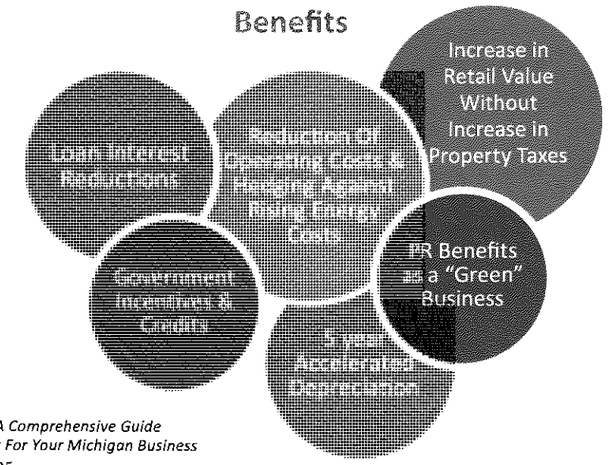
RECaBS is a project under the International Energy Agency's Implementing Agreement on Renewable Energy Technology Deployment (RETD). The aim of RECaBS is to estimate the costs and benefits of electricity from renewable energy sources compared to conventional technologies in a fully documented and transparent way. [33]

The new calculator enables anyone to make cost benefit analysis based on generally accepted values of calculation para-meters. It also allows the user to adjust key parameters to replace default values for comparison of different technologies. Data and documentation rely on internationally respected sources. [33]

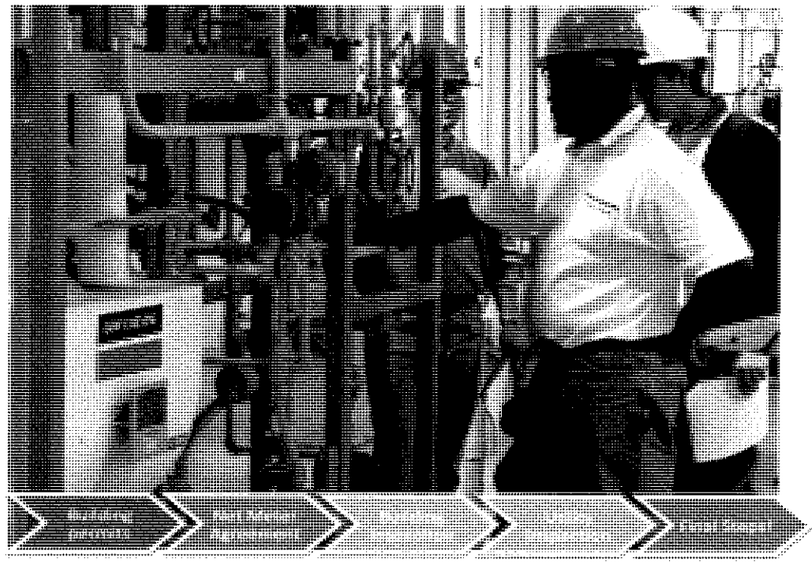
With the new tool, you can analyze various external costs and benefits at your own choice

- Environmental externalities (CO2 and other air pollutants)
- Grid integration (primarily extra costs to electrical infrastructure, power balancing costs and reduced capacity value for wind turbines and additional reserve capacity for nuclear power plants)
- Security of fuel supply (substitution of fuel imports with indigenous resources)
- Local benefits (primarily employment)

Thereby, the tool provides the basis for developing recommendations for international and national policies that could level the playing field for renewables by internalizing externalities in energy prices. [33]



Implementation Steps To Consider



AUDITORS IN OUR AREA:

AKT Peerless: Environmental & Energy Services
1693 Janes Avenue
Saginaw, Michigan 48607
(989) 754-9896

ENERGYCHECK INTERNATIONAL
Michigan Office
Dave Hollens
dave@energychik.com

Michigan Energy Audits, LLC.
6650 Maple
Clarkston, MI 48346
(248) 249-3775

MICHIGAN energy options
405 Grove Street
East Lansing, MI 48823
(517) 337-0422

William A. Kibbe & Associates, Inc.
1475 S. Washington Avenue
Saginaw, MI 48601
(989) 752-5002

Commercial energy audits

What is a Commercial Energy Audit?

A commercial building energy audit is a study of your building's energy using equipment. Building energy audits often also look at water consumption (even though that is not technically considered energy). An energy auditor comes out to your building and interviews facility managers, inspects lighting, air conditioning, heating and ventilation equipment, controls, air compressors, water consuming equipment, and anything else that is using energy. The auditor will develop a list of energy conservation measures (ECMs) that could reduce energy usage and costs in your building. Depending upon the level of building energy audit, the auditor will then quantify how much savings potential there is for each of these measures, and the costs associated with implementing them. Some measures will take decades to pay for themselves, while others will start paying for themselves within months.

Recommended Audits:

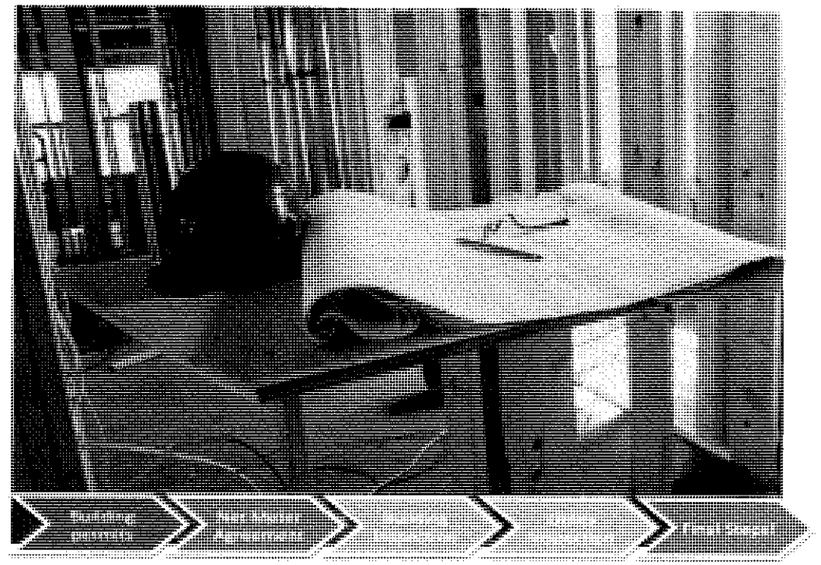
ASHRAE Level 1 – Walk Through Analysis

The ASHRAE Level 1 audit focuses on low-cost/no-cost energy conservation measures, and provides a list of higher cost energy conservation measures. In addition to tasks performed in the Overview Audit, ASHRAE Level 1 audits report how much in energy and energy costs can be saved from each energy conservation opportunity.

ASHRAE Level 2 – Energy Survey and Analysis

ASHRAE Level 2 audits will identify all appropriate energy conservation measures for a facility, and a financial analysis will be performed based on implementation costs, operating costs, and attainable savings. You will know for each energy conservation measure, the amount to be saved, the amount the measure will cost, and the amount of time it will take for the measure to pay for itself.

Implementation Steps To Consider



INTERCONNECTION PROCESS

1. **Select generator and project installer**
2. **Complete and submit interconnection application to electric utility with filing fee $75 for interconnection & $25 for net metering**
3. **Receive application approval from electric utility**
4. **Receive and review the Interconnection Agreement from electric utility**
5. **Install your project according to applicable codes and standards**
6. **Complete the local inspection**
7. **Utility meter installation, final inspection & testing, final approval from electric utility**
8. **Start generating your own electricity!**

Building Permits

Your installer will need to obtain various permits from your city or county building department before adding a renewable energy system. You will likely need to purchase a building permit, an electrical permit, or both to legally begin installation. [29]

Typically, your contractor or licensed installer will obtain these permits for you, rolling the price of the permits into the overall system price. Always make sure that permitting costs and responsibilities are addressed with your installer at the start of the process.

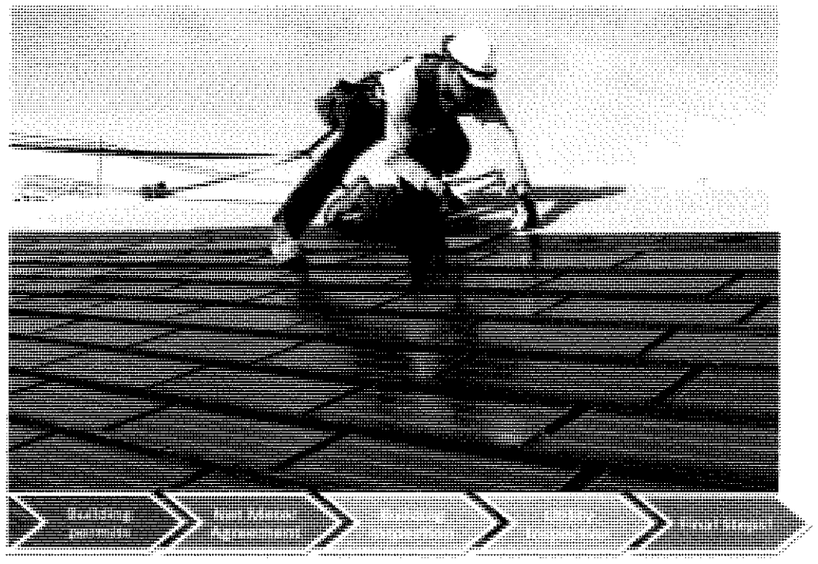
Whatever you do, don't short cut the building permit process. Remember, the building permit helps insure that the grid and your home are safe for everyone. [29]

Code requirements vary somewhat from one jurisdiction to the next. (Most PV-related electrical codes are based upon national electrical code standards.) [29]

If you are amongst the first in your community to install a renewable energy system you and your installer can speed the process along by working closely and cooperatively with your local building officials to help educate them about the technology and its characteristics. [29]

Contact your Homeowners' Association, if your community has a homeowners association (HOA), you will want to contact them to ensure you file the proper architecture request forms and obtain approvals. They cannot prevent you from installing a renewable energy system. [29]

Implementation Steps To Consider



To implement solar in your business you will have to follow a few guidelines. The Michigan Bureau of Construction Codes states that solar photovoltaic (PV) panel installations need to comply with the:

State of Michigan Building Code

State of Michigan Electrical Permit

Any local zoning permits that may exist

Michigan Permits & Licensing

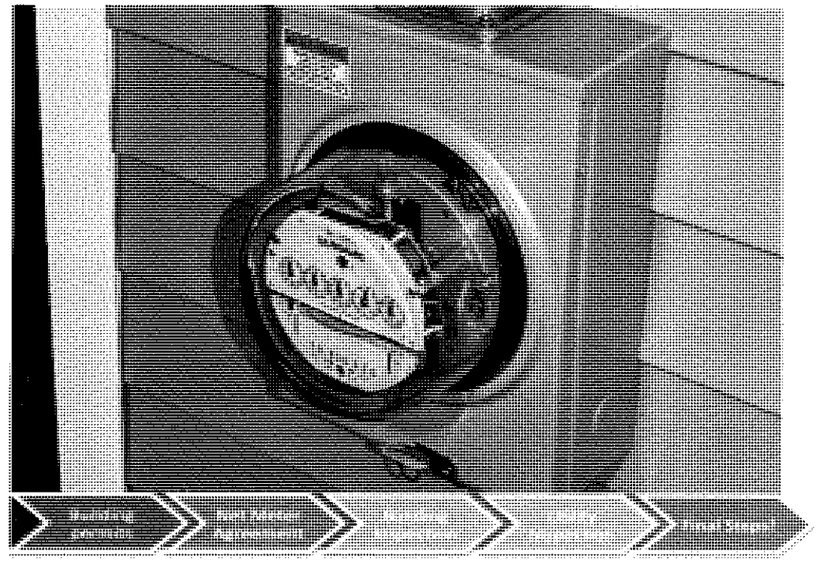
Solar PV panels are mounted either on a mast or directly to a building roof or exterior wall, or on ground mounted pedestals. Construction documents submitted for solar PV panels pursuant to construction permits need to show detailed information demonstrating structural stability for static loads - both vertical and lateral. The most critical load for the structural design of a solar PV panel is the wind load. [30]

Wind uplift and surface pressures need to be addressed by adequate anchorage to the structure or foundation system and must be shown in detail on the construction documents. [30]

If a solar PV panel is designed to be mounted directly to a building or structure, then the affected structural members shall be evaluated by the design professional in responsible charge of the project. Typically a building permit and electrical permit are required for installations of solar PV panels. The electrical information on the construction documents shall show connections to the electric utility grid and/or a private electrical system. [30]

Questions can be directed to the Plan Review Division at (517) 241-9328. Net Meter Agreement

Implementation Steps To Consider



To find further information and program details please visit the Consumers Energy website

http://www.consumersenergy.com/content.aspx?id=1800#WhatIs

Net Metering

The Net Metering Program is a way for customers who generate a part or all of their electricity using renewable resources to receive generation credits. [27]

How does the program work?

If you qualify for the program, your renewable generator must be sized not to exceed your annual electricity needs. For projects greater than 20kW, a meter will be installed to measure the output of your renewable generator. A separate meter will record the electric energy received from and placed back onto the electric grid. Consumers Energy will read the meters and bill you for energy supplied from the electric grid and give you credit for energy you generated on site, up to the amounts specified in the Net Metering tariff. If you generate more electricity than you use, you will be given net excess generation credits, which you may carry forward to future billing periods. [27]

Application Process

To initiate a request to participate in Consumers Energy's Net Metering Program, a customer shall submit a completed interconnection application, including an application fee of $75 and a completed Net Metering Program application, including an application fee of $25 to the company. The Net Metering Program application fee is refundable if the customer withdraws the application prior to commencing service under the Net Metering Program. [27]

How will I receive my generation credit?

You will receive a bill - just as you do now – for the electricity you use. When you have net excess generation, you will receive a credit toward your bill.. Any excess credit amount will be carried forward and applied to future billing periods. The credits do not expire, nor may they be redeemed for cash payment. If you purchase both electricity and natural gas from us, you will receive two bills per month as a participant in the Net Metering Program: one billing you for natural gas; the other for electricity. [27]

The program has 3 categories:

Category 1:
20 kilowatts (kW) and less

Category 2:
20-150 kW

Category 3:
150-550 kW

Implementation Steps To Consider

Building permits → Net Meter Agreement → Building Inspection → Utility Inspection → Final Steps!

LEED Certification

LEED = Leadership in Energy and Environmental Design

In short, LEED is a rating system for buildings, equivalent to a gas mileage rating for cars. Under LEED, buildings accumulate points for things such as saving energy, having accessible mass transit, and mitigating storm water runoff. Once the points are tallied, the building earns a LEED rating. The higher the tally, the more sustainable a building is.[32]

LEED is an internationally recognized green building certification system which provides third-party verification that a building or community was designed and built using strategies aimed at increasing performance, reducing waste, and improving quality of life.

The LEED rating systems, created by the U.S. Green Building Council (USGBC), are internationally accepted benchmarks for the design, construction, and operation of high performance green buildings. Since its inception in 1998, LEED has grown to encompass more than 20,000 projects in 50 U.S. states and 30 countries. LEED promotes a whole-building approach to sustainability by recognizing performance in five key areas of human and environmental health. The LEED rating and certification system is the industry's gold-standard for environmentally sustainable building and is recognized industry-wide by architects, engineers, developers, and other building professionals, many of which have been designated "LEED Accredited Professional."[32]

LEED quantifies a building's performance in the following categories:

Sustainable sites
Water efficiency
Energy and atmosphere
Materials and resources
Indoor environmental quality
Innovation in design and operations

Energy Star Certification

Buildings achieving a rating of 75 or higher and professionally verified to meet current indoor environment standards are eligible to apply for the ENERGY STAR. Display the ENERGY STAR plaque to convey superior performance to tenants, customers, and employees. Highlighting the ENERGY STAR qualified buildings in your portfolio sends a positive message to lenders, appraisers, owners, investors, and potential tenants or customers.[32]

How to Apply for the ENERGY STAR Label:

Determine if the building meets the eligibility requirements.

Login to Portfolio Manager and enter the required energy and building information.

Determine if the building achieves a rating of 75 or above.

Validate the Statement of Energy Performance (SEP) and Data Checklist by having a Licensed Professional sign and stamp the SEP and sign the Data Checklist.

Read and understand the ENERGY STAR Identity Guidelines.

Mail the signed Letter of Agreement and signed and stamped Statement of Energy Performance (SEP) along with the signed Data Checklist to EPA (postmarked within 120 days of the SEP Period Ending Date).

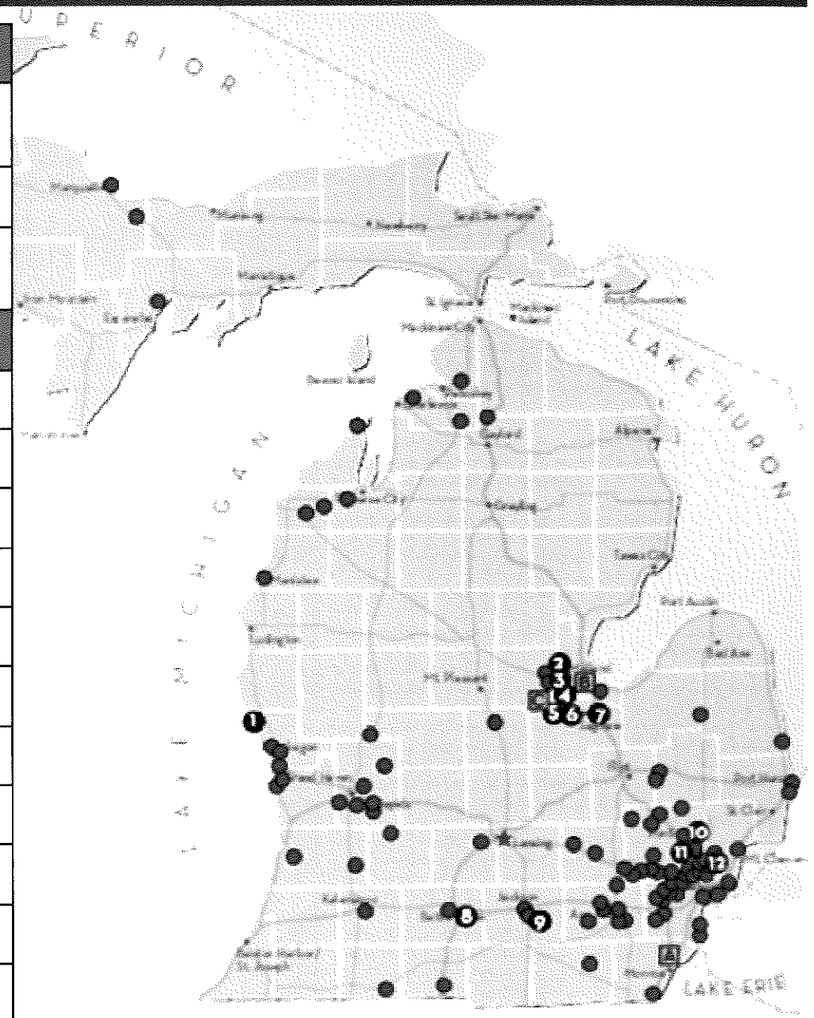
ENERGY STAR Label for Buildings
c/o The Cadmus Group, Inc.
1555 Wilson Boulevard, Suite 300
Arlington, VA 22209

For further information go to the ENERGY STAR website:

www.energystar.gov

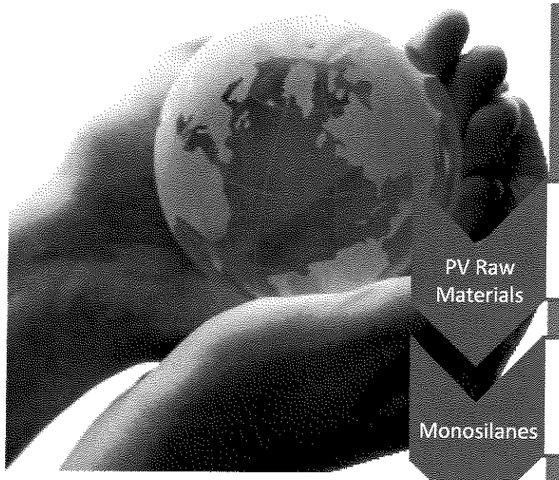
Regional Focus on Solar

Key Corporate Solar R&D Facilities	
A	Guardian Science and Technology Center
B	Dow Chemical Midland R&D Campus
C	Dow Corning Solar Solutions Application Center
Key Solar Companies	
1	PrimeStar Solar
2	EvergreenSolar
3	Dow Corning Corporation
4	The Dow Chemical Company
5	Global Watt
6	Suniva, Inc.
7	Hemlock Semiconductor Corporation
8	Patriot Solar Group
9	ADCO Products, Inc.
10	Guardian Industries Corporation
11	United Solar Ovonic
12	KUKA System Corporation North America



**Information and graphics provided by the Michigan Economic Development Corporation*

Regional Focus on Solar Technology



PV Raw Materials
- Hemlock Semiconductor Corporation

Monosilanes
- Dow Corning Corporation

Ingots, Wafers, Cells
- Evergreen Solar
- To Come - Suniva Inc.

Thin Films
- The Dow Chemical Company
- Dow Corning Corporation

Balance of Systems
- Variety of Local Businesses

Modules, Encapsulants
- Dow Corning Solar Solutions
- GlobalWatt Inc.

Our region possesses resources along the entire solar value chain, with companies that continually engineer & implement innovative solar products

The Great Lakes Bay Economic Development Partnership is focused on building a solar, photovoltaic cluster in Saginaw, Bay, and Midland counties. Made up of Saginaw Future Inc., Bay Future, Inc., and Midland Tomorrow the partnership attracts solar companies, assists local manufactures to diversify into solar, and promotes the deployment of solar energy. For more information contact us at info@migreatlakesbaysolar.com.

Michigan *Solar* Companies

COMPONENT SUPPLIERS / MANUFACTURERS
Adaptive Manufacturing Solutions
ADCO Products, Inc.*
Adobe Building Materials
Air Products and Chemicals, Inc.
American Green Energy Solution
AMPTECH, Inc.
Asahi Kasei Plastics North America, Inc.
Automation & Modular Components, Inc.
Bay City Light & Power
Bosch Rexroth Corporation
Burke E. Porter
Coffman Electrical Equipment Company
Cosma Engineering (Magna International)
CRESiT Energy
Dow Corning Corporation*
Dow Corning Solar Solutions Application Center
ESPEC North America
Evergreen Solar*
FANUC Robotics America, Inc.
FATA Automation, Inc.
Fronius USA
Fulcrum Composites, Inc.
Gexpro
GlobalWatt*
Grand Transformers, Inc.
Guardian Industries Corporation*
Gudel Lineartec, Inc.
Harlo Corporation
Hemlock Semiconductor Corporation*
HORIBA Instruments, Inc.
Integrity Design & Manufacturing, Inc.
Intricate Grinding & Machine Specialties, Inc.
IPR Sohner Plastic
Jan Watercraft Products
JENOPTIK Laser Technologies USA
k-Space Associates, Inc.
KUKA Systems Corporation North America*
Kulick Enterprises, Inc.
Linamar Corporation
Lotus International Company
LUMA Resources
MAG Industrial Automation Systems, LLC
Marelco Power Systems
Mersen USA
Michigan Industrial Controls, Inc.
Midbrook, Inc.
Miller Tool & Die Company
Nextek Power Systems, Inc.
Northwoods Energy Alternatives
Novi Precision Products, Inc.
ORT Tool & Die Corporation
Outbound Technologies, Inc.
Power Panel, Inc.
PrimeStar Solar*
Progressive Dynamics, Inc.
Promess, Inc.
Puritan Automation, Inc.
Ricardo Inc.
RMMP Testlab, Inc.
RoMan Manufacturing
RS Electronics
Seelye Equipment Specialists
SES Flexcharge USA
Solar Works in Michigan
Solar Works, LLC
SSOE Group
Stahlin Non-Metallic Enclosures
Superior Electric Motor Sales
The ABB Group
The Dow Chemical Company*
Tower Automotive
Turbo Spray Midwest
Uni-Solar
United Solar Ovonic
Vehma International of America, Inc.
W Industries
Wacker Chemical Corporation
Warnke Tool Industries, Inc.
Yazaki North America

INSTALLERS
Alternative Energy Solutions Integrated, Inc.
American EcoEnergy
Armstead Technologies, Inc.
Backwards to the Future Ltd.
Basic Solar & Renewables
Bauer Power, Inc.
BioGreen Technologies
B's Electric
Carbon Credit Environmental Services
Cascade Renewable Energy
Chambers Contracting & Renewable Energy
Contractor's Building Supply
CRESIT Energy
D&R Energy Services
ECO-Wind-Solar Solutions
Event Horizon Solar & Wind, LLC
FCB Solar
Freedom Power
Geo-Renew Systems, Inc.
Harmony Home Construction, LLC.
Homeland Builders of Michigan
Hot Watt Solar
J & J Services—Energy Specialists
J King Solar Technologies, LLC
Kravis Electric & Controls
LUMA Resources
Mechanical Energy Systems, Inc.
Michigan Solar & Wind Power Solutions
Michigan Solar Solutions, LLC
Mid Michigan Solar
Motor City Electric
Newkirk Electric Associates, Inc.
Orisol Energy
Patriot Solar Group
Power Distribution Center
Power Panel, Inc.
Renewable Energy Solutions
RLS Energy
Skyline Electrical Contracting
Solar Control Systems
Solar Dimensions
Solar First
Solar Specialists
SPM Windpower
Sun Services Inc.
Sundu Solar Sales & Service
Sunsiaray, Inc.
SUR Energy Systems
Sustainable Systems Inc.
TEMO Sunrooms
The Green Panel
Tom's Solar Heating Service
Top Line Electric, LLC
Turtle Island Wind & Solar
Vos Energy Concepts

SERVICES
ABB University
Adopt-A-Watt, Inc.
American Green Technology
Armstead Technologies, Inc.
Center for Sustainable Systems
Comau, Inc.
Davco Solar Corporation
Diversified Sales & Services
Dow Chemical Midland R&D Campus
Dow Corning Solar Solutions Application Center
Dynamic Engineering
Eaton Corporation
ESI Group
Guardian Science and Technology Center
JD Candler Roofing Company, Inc.
Kinetik Partners
Paradigm Energy Services
Robinson Cartage
Shepherd Advisors
Southern Exposure Renewable
The Renewable Energy Center
Walker Miller Energy Services

Michigan *Energy Efficient* Business Directory

ENERGY PROVIDERS

Ag Solutions, Inc.
Bay City Light & Power
BP Alternative Energy
Clipper Windpower
Crorey Biomass Gasifier Systems LLC
Consumers Energy
DTE Energy
ECO Heating
Environmental Alternatives Inc.
Lansing Board of Water and Light
Midland Energy, LLC
Noble Environmental Power
RLS Energy
Shadeplex
Spartan Renewable Energy, Inc.
Zeeland Board of Public Works

HOME IMPROVEMENT & BUILDING PRODUCTS

AIS Construction Equipment Corp.
Contractors Building Supply
Eagle Tech, Inc.
Eco Home Gear, LLC
Elzinga Green Houses
Fry Masonry Construction
Healthy Indoor Environments
O'Donnell Development, LLC
Plainwell Energy Doctor
R-Value Concrete Structures
Thorntree Commons, Inc.
WKU Solar Energy LLC

ENERGY EFFICIENT ARCHITECTS & DESIGNERS

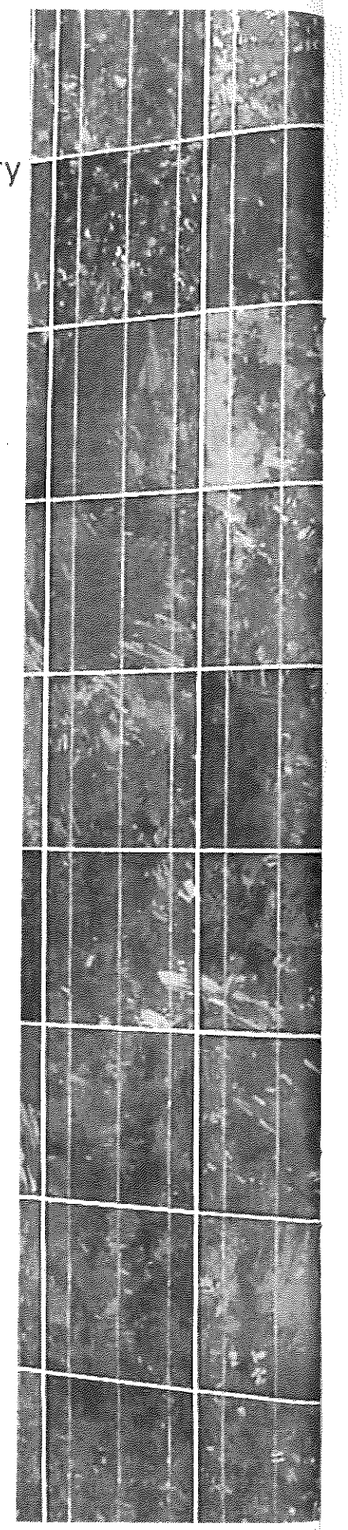
Ann Arbor architects Collaborative
Castles & Cabins
GMB Architects-Engineers
Hirschman Architects
Illumin Art
Image Design, LLC
Kelly-Tinker Architects
Metro Group Architects
Sun Structures Architects
Tri-Land Development Inc.
Patriot Solar group
ThermalTech Engineering

ENERGY EFFICIENT BUILDERS

Adobe Builders and Remodelers
Ambercrombie Construction
Barton Malow
Castles & Cabins
Cobblestone Homes
Decker Homes
Delivered Power Systems LLC
GreenLife Homes LLC
Heartland Builders, LLC
Howe Construction
JD Candler Roofing
Homeland Builders of Michigan LLC
Hybrid Homes LLC
Michigan Green Space
Platinum Development Corp.
Prud'homme, LLC
Shler Signature Home LLC
Rockford Construction
Sun Catcher Builders
VOS Energy Concepts
Vesta Building Industries

RENEWABLE ENERGY SUPPLIERS

The Alternative Energy Store
Alternative Energy Solutions of Michigan
ARKK Engineering
Complete Renewables
CRESIT LLC
Currin Corporation
Future Heat LLC
I.E. Hampton & Associates
IBERDROLA Renewables
Larmay
Lee Wind Energy
Menona Energy Great Lakes, Inc.
New Lifestyles Energy Products/ Fireplace Lifestyles
Orisol Energy US, Inc.
R.L. Deppmann Co.
Santoro Wind Harvester, Inc
Schoil Electric, LLC
Sleeping Bear Electric & Lighting
Solar Winds Power Systems
The Strouse Corp
Walker-Miller Energy Services, LLC
Wind4Power
Wolverine Power Systems



** All are members of the Great Lakes Renewable Energy Association*

The Green Panel

We offer a one-stop shop to engineer, furnish and install (EF&I) solar passive systems for tomorrow's energy demands. With our national network of engineers, installers and warehousing facilities, we dedicate 100% of our effort towards helping you implement and maintain your alternative/renewable energy initiatives.

719 East Grand River, Suite 100
Brighton, MI 48116
810.225.9932
info@thegreenpanel.com

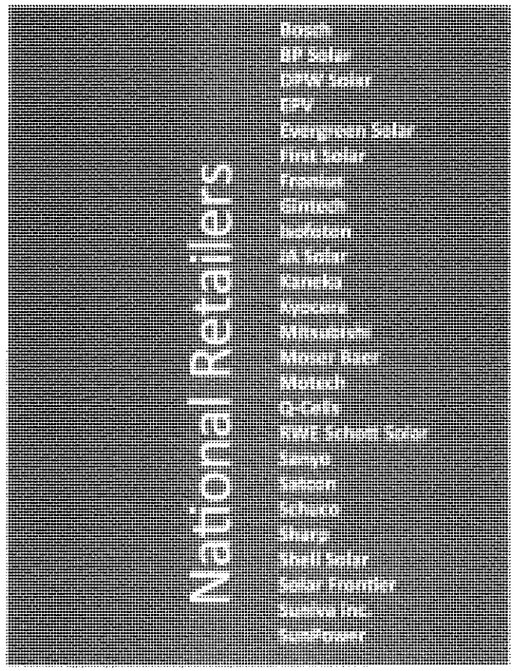
For a comprehensive and need-specific list of Michigan Energy Efficient Product & Service Businesses please visit the following websites:

http://energy.sourceguides.com/businesses/byGeo/US/byS/MI/MI.shtml
http://www.glrea.org/bizMemCategories/builders.html

Michigan Solar Installers

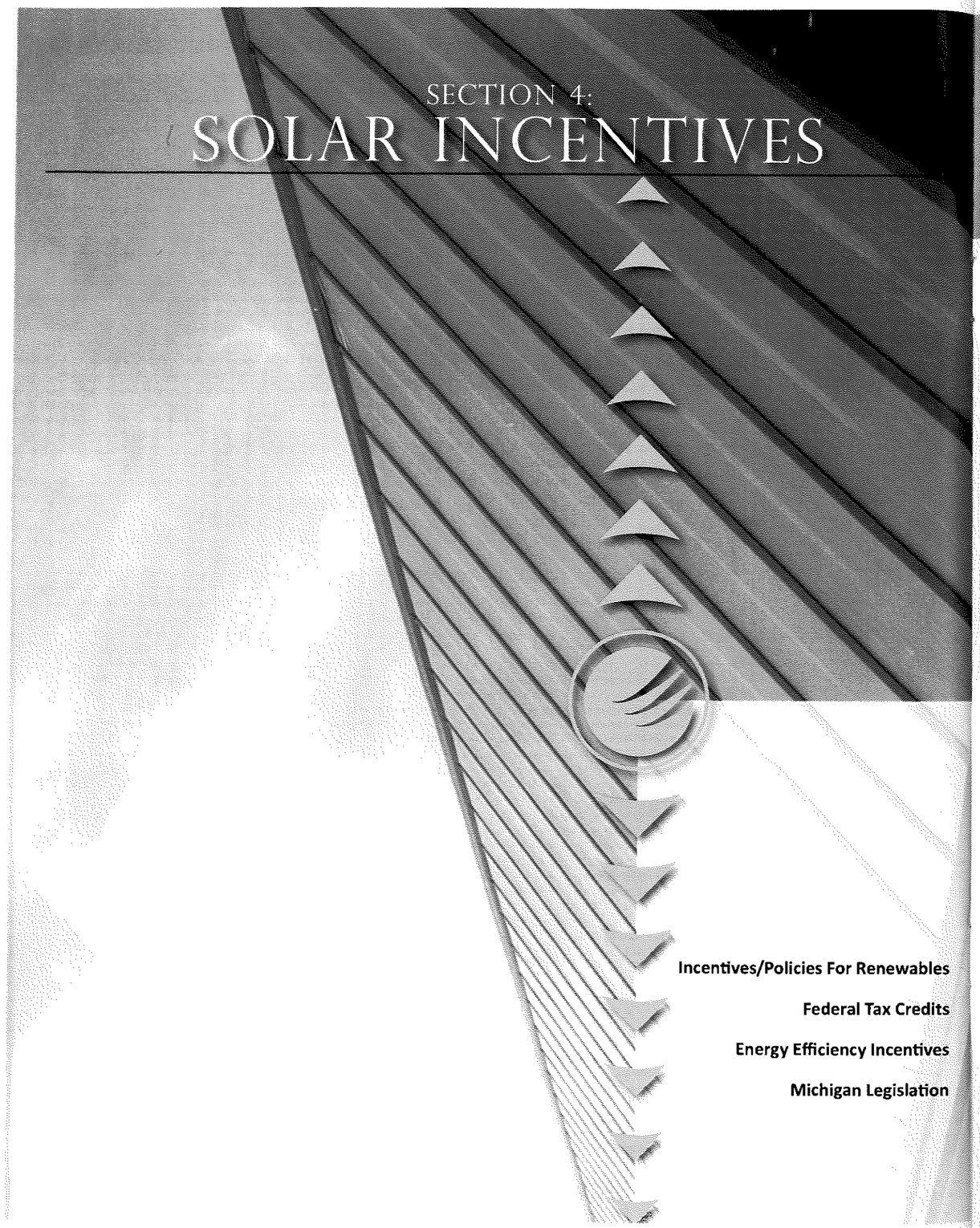
Basic Solar & Renewables - Hastings
Basic Solar & Renewalables LLC - Hastings
Bauer Power Inc. - Wayland
City Creations - Detroit
Contractors Building Supply Inc. - Copemish
Eco-Building Products - Traverse City
Event Horizon Solar & Wind - Middleville
Geo-Renew Systems Inc. - Holly
Great Lake Solar - Highland
Hartland Electric LLC - Hartland
Hot Watt Solar - Harrison Township
Largent Enterprises - Lansing
Mechanical Energy Systems, Inc. - Canton
MI Solar - Beverly Hills
Oak Electric - Waterford
Panoramic Electric - Traverse City
PDC - Brighton
Project 8 Industries Inc. - Jackson
Renewable Energy Solutions, LLC - Chelsea
Rummel Heating & Cooling, Inc. - Macomb
Sandel Solar & Engineering - Grand Haven
Self Reliant Energy - Fowlerville
Solar Specialists - Kingston
Solar Works - Tustin
Solar Works LLC - Whitmore Lake

UNI-SOLAR : The world's largest producer of flexible solar panels provides commercial products that you can implement today



SECTION 4:

SOLAR INCENTIVES



Incentives/Policies For Renewables

Federal Tax Credits

Energy Efficiency Incentives

Michigan Legislation

Federal Tax Credits

A tax deduction of up to $1.80 per square foot is available to owners or tenants (or designers, in the case of government-owned buildings) of new or existing commercial buildings that are constructed or reconstructed to save at least 50% of the heating, cooling, ventilation, water heating, and interior lighting energy cost of a building that meets ASHRAE Standard 90.1-2001. Only buildings covered by the scope of ASHRAE Standard 90.1-2001 are eligible. Partial deductions of $.60 per square foot can be taken for improvements to one of three building systems that reduce total heating, cooling, ventilation, water heating and interior lighting energy use by a certain percentage below ASHRAE 90.1-2001—the building envelope (10%), lighting (20%), or heating and cooling system (20%). An interim system-specific goal for lighting is provided directly in the legislation and is valid until the IRS issues a final regulation. The interim lighting provision allows prorated deductions from 30 cents to 60 cents per square foot for lighting systems as described below. [34]

These deductions are available for buildings or systems placed in service from Jan. 1, 2006 – Dec. 31, 2013

Additions to existing buildings or alterations to existing buildings can qualify for tax deductions in the new or retrofitted areas of the building only. The savings requirements are relative to a reference building that meets the minimum requirements of Standard 90.1-2001 and not relative to the performance of the existing building. [34]

Who is eligible for the incentives?

The person or organization that makes the expenditures for construction is generally the recipient of the allowed tax deductions. This is usually the building owner, but for some HVAC or lighting efficiency projects, it could be the tenant. For government-owned buildings, the deduction may be taken by the building or system designer. Click here for the complete IRS rules. [34]

What are the incentives & how do they work?

The builder (or designer in the case of publicly-owned buildings) can take the deduction in the year the property was placed in service. The building or system must be certified, with inspection and testing, as meeting the energy cost savings goal according to guidance issued by the IRS in consultation with the Department of Energy (a link to this guidance is provided below). [34]

Key provisions in the guidance include the following:

• Certifications must be done by "qualified individuals". Qualified individuals must be licensed engineers or contractors, not be "related" to the taxpayer taking the deduction (as defined by the IRS), and self-certify to the taxpayer that he or she has qualifications to provide the certification. [34]

• Certifications for energy savings shall be in accordance with the procedures in Appendix G of ASHRAE Standard 90.1-2004, supplemented with several provisions in the 2005 California Title 24 Nonresidential Alternative Calculation (ACM) Approval Manual. Generally calculations will be done by computer software. Software must be on a list of products approved by the U.S. Department of Energy. [34]

• The certification must include a field inspection of the building after the building is placed in service to confirm that the building has met the savings goals. Specific inspection and testing procedures have been developed by the National Renewable Energy Laboratory. [34]

http://www.nrel.gov/docs/fy07osti/40467.pdf

• Certifiers must also provide the building owner with an explanation and list of the energy efficiency features of the building and the projected annual energy costs. [34]

• For lighting systems, until the IRS issues a final rule, the law specifies that a deduction of $0.30 per square foot can be taken if the lighting system employs dual switching (ability to switch roughly half the lights off and still have fairly uniform light distribution) and reduces installed lighting power by at least 25% from values specified in specific cited tables in ASHRAE Standard 90.1-2001. As lighting power reductions climb from 25% to 40%, the deduction is increased proportionally, up to $0.60 for a 40% power reduction (plus the dual switching). This prorated credit does not apply to warehouse lighting. [34]

LightingTaxDeduction.org and AdvancedBuildings.net. [34]

What do I need to do to qualify?

Follow the guidance issued by IRS. For a taxpayer, they will need to know the square footage of the building (the IRS guidance explains how to calculate this), when the building was placed in service, and have a certification from a qualified individual stating which targets have been met (50% savings for three systems or 10% for the building envelope, 20% for lighting, or 20% for the heating and cooling system). There are no special forms to apply for this deduction. [34]

http://www.efficientbuildings.org/about_the_provision.html#01

To access IRS guidance on qualifying commercial property go to the following website: http://energytaxincentives.org/general/irs_regs.php

For additional information on the commercial building tax deductions:

Commercial Building Tax Deduction Coalition
http://www.efficientbuildings.org/

IRS Sumary
http://www.irs.gov/publications/p553/ch02.html#d0e2102

Commercial Energy Efficiency Incentives

Business owners are eligible for a variety of federal tax incentives for improving building energy efficiency, implementing combined heat and power (CHP) systems, purchasing hybrid gasoline-electric vehicles, and installing onsite renewable generation, fuel cells, and microturbines. [34]

Commercial Buildings

Businesses can take a tax deduction for new or renovated buildings by reducing the energy costs associated with three components—lighting system; building envelope; and heating, cooling and water heating equipment. Buildings must meet the ASHRAE 90.1-2001 standard and be placed in service between January 1, 2006 and December 31, 2013 in order to be eligible. The deduction is available in two levels:

- Buildings that save 50% or more of projected annual energy costs across all three system components are eligible for a tax deduction of $1.80 per square foot. [34]
- Buildings that save a percentage of projected annual energy costs for one of the three components—building envelope (10% energy savings), lighting (20%), and heating & cooling (20%)—are eligible for a partial deduction of $0.60 per square foot. [34]

The organization that makes the expenditures is generally the recipient of the deduction, which can be taken in the year the building is placed in service. In the case of a public building, the designer may take the deduction. The building must be certified by a qualified individual (a licensed engineer or contractor) as meeting the energy cost savings goal. [34]

www.energytaxincentives.org/business/commercial_buildings.php

Combined Heat & Power (CHP)

Owners of CHP systems smaller than 50 MW may take advantage of a 10% investment tax credit for CHP property, applicable to only the first 15 MW of CHP property. Systems must be placed into service between October 3, 2008 and December 31, 2016. Only the original constructor or user of the CHP property may take the tax credit, in the year that the system becomes operational. To qualify, a CHP system must be 60% efficient (on a lower heating value basis), and produce at least 20% of its useful energy as electricity and at least another 20% as useful thermal energy. The efficiency requirement does not apply to CHP systems that use biomass for at least 90% of the system's energy source, but the credit will be reduced for less-efficient systems. The economic stimulus legislation also provides the option for businesses to take a grant from the U.S. Treasury Department during 2009 and 2010 in lieu of the investment tax credit. For more information on combined heat and power, see www.aceee.org/chp. [34]

www.energytaxincentives.org/business/chp.php

Commercial Vehicles

Buyers of heavy-duty hybrid vehicles can receive tax credits based on the weight class of the vehicle, its fuel economy relative to a comparable conventional vehicle, and the incremental cost. The vehicle must also meet a threshold value of "maximum available power," a measure of the percentage of total vehicle power available from the rechargeable energy storage system of the vehicle. Credits are available for heavy-duty vehicles placed in service from January 1, 2006 through December 31, 2009. [34]

The maximum credit available is: $3,000 for a vehicle weighing 8,501 to 14,000 pounds; $6,000 for a vehicle from 14,001 to 26,000 pounds; and $12,000 for a vehicle over 26,000 pounds. See www.aceee.org/transportation/ hdhybtaxcred.htm for details. As of March 2009, nine manufacturers had certified tax credits for at least one truck or bus model; credits thus far range from $3,000 to $12,000. Businesses are also eligible for passenger vehicle incentives. See www.energytaxincentives.org/consumers/vehicles.php for details. [34]

www.energytaxincentives.org/business/commercial_vehicles.php

On-site Renewables

Business owners can take advantage of several onsite renewable generation incentives. The incentives apply to solar and wind systems placed in service from January 1, 2006 until December 31, 2016 and to geothermal heat pump systems placed in service from October 3, 2008 until December 31, 2016. The incentives are worth 30% of the installed cost of the system. The economic stimulus legislation also provides the option for businesses to take a grant from the U.S. Treasury Department during 2009 and 2010 in lieu of the investment tax credit. [34]

www.energytaxincentives.org/business/renewables.php

Solar Systems

Qualifying equipment will use solar energy to (1) generate electricity, or heat/cool or provide hot water to a structure, or (2) illuminate the inside of a building by means of fiber-optic distributed sunlight (tube systems and passive solar are not eligible). [34]

www.seia.org

Solar Water Heating

Systems must be certified for performance by the Solar Rating Certification Corporation (SRCC) or a comparable entity endorsed by the state government in which the system is located. At least half of the energy used by the system to heat the water must be solar energy. Expenses for heating swimming pools or hot tubs are not eligible. [34]

Photovoltaic (PV) Systems

Systems must provide electricity for the residence, and must meet applicable fire and electrical code requirements. [34]

Small Wind Systems

Businesses that install wind turbines with not more than 100 kilowatts of nameplate capacity are eligible for the 30% investment tax credit. For more information see www.awea.org. [34]

Geothermal Systems

Qualified geothermal systems are ground source heat pumps with related equipment used to produce, distribute, or use energy derived from a geothermal source. Commercial customers can either get an investment tax credit of 10% of the installed cost, available through 2016. The ARRA legislation also provides the option of taking a grant in lieu of the credit, worth 10% of the installed costs for equipment placed in service during 2009 and 2010. For systems where electricity is produced by geothermal power, equipment qualifies for an incentive only up to, but not including, the electric transmission stage. [34]

Fuel Cells & Microturbines

The investment tax credits for these two systems are available for systems "placed in service" through December 31, 2016. Fuel cells generate electricity through a chemical process. They are somewhat similar to batteries, except they must be continuously fed with fuel. Microturbines are small power generation systems using a gas turbine engine. [34]

www.energytaxincentives.org/business/fuel_cells.php

Fuel Cells

Credits are for 30% of the cost, up to $3,000 per kW of power that can be produced. To qualify, systems must have an efficiency of at least 30% and must have a capacity of at least 0.5 kW. [34]

Microturbines

Credits are for 10% of the cost, up to $200 per kW of power that can be produced. To qualify, systems must have an efficiency of at least 26% and must have a capacity of 2,000 kW or less. [34]

This is an overview of federal-level commercial tax incentives. For more information on equipment specifications, pertinent IRS forms, and eligibility details, visit the TIAP site at www.energytaxincentives.org.

Michigan Legislation

Anchor Zone Tax Credits

Provides tax credits for anchor companies, those companies that attract or influence suppliers or customers to expand anywhere in Michigan. The size of those anchor zone tax credits are based on the number of jobs created and the amount of personal income taxes generated by those jobs. [35]

Anchor Zone Designation

A second incentive grants the anchor company a Michigan Business Tax credit incentive for up to 10 years for successfully encouraging a customer or supplier company to locate within a 10-mile radius of the anchor company's facility. The company entering the anchor zone must invest at least $1 million and create more than 10 full-time jobs. It can be a Michigan company adding a new location in Michigan, a business relocating to the state, or one expanding operations in Michigan as a result of doing business with the anchor company. [35]

The new anchor zone incentives are directed at companies, suppliers, and customers active in high-growth, high-technology industries targeted in the governor's 21st Century Jobs Fund initiative to diversify and strengthen Michigan's economy, particularly in the area of alternative energy. Other areas of growth include advanced manufacturing and materials, information technology, medical devices, and life sciences.[35]

Michigan Renewable Energy Portfolio Standard (RPS)

Mandates that 10 percent of the State of Michigan's energy come from renewable sources by 2015 [35]

Electricity Legislation

Regulatory reform was enacted that protects Michigan ratepayers and allows utility companies to build new electricity generation in Michigan, and a requirement that utilities meet an additional 5.5 percent of Michigan's annual electricity demands through energy efficiency by 2015. [35]

Income Tax Credit and Net Metering

An income tax credit has been enacted to offset a portion of ratepayers' investments in renewable energy for Michigan and a "net metering" law that allows customers to sell renewable electricity they produce at their homes or businesses to their utility companies. [35]

Brownfield PA 143 Tax Credit

Up to a ten percent credit on the Single Business Tax for eligible redevelopment investments on Brownfield properties. [35]

Energy Efficiency Grants

Funds for the implementation of energy efficiency projects using photovoltaics and other technologies available to businesses and public agencies from the Michigan Public Service Commission. [35]

High-Tech MEGA Tax Credit

Negotiated credit against the Single Business Tax for companies involved in advanced technologies such as: computing, biotechnology, lab testing for product development, engineering, electronic devices, etc. [35]

High-Wage MEGA Tax Credit

Negotiated credit against the Single Business Tax for companies conducting manufacturing, R&D, wholesale trade and paying 150 percent of the federal minimum wage. [35]

Obsolete Property Rehab. Act PA 146 Tax Abatement

Freezes the existing taxable value on a designated obsolete facility for up to 12 years to encourage building improvements [35]

PA 198 Tax Abatement

One to twelve-year abatement which reduces real and personal property taxes by 50 percent [35]

PA 328 Tax Abatement

Abatement includes all millage, state, and local taxes [35]

Photovoltaic Demonstration Project Grants

Michigan Energy Office of the Department of Labor and Economic Growth grants public agencies and nonprofits up to $50,000 for a limited number of photovoltaic projects each year. The grant pays up to 90 percent of PV equipment costs. [35]

Renaissance Zone

Waiver of local and state taxes; eligible sites. [35]

Rural MEGA

Negotiated tax credit [35]

Youth Apprentice Tax Credit

$2,000 tax credit per apprentice to registered employers who train young people. [35]

Contact Information

Where can I learn more about qualifying technologies and designs?

U.S. Department of Energy:

EERE information on Commercial Building tax incentives
http://www1.eere.energy.gov/buildings/tax_commercial.html

NREL Energy Savings Modeling and Inspection Guidelines for Commercial Building Federal Tax Deductions
http://www.nrel.gov/docs/fy07osti/40467.pdf

Qualified Software
http://www1.eere.energy.gov/buildings/qualified_software.html

For design advice on how to meet building savings goals:
- AdvanceBuildings.net
- U.S. Department of Energy
- Energy Design Resources (www.energydesignresources.com)

For information on qualifying lighting systems:
- LightingTaxDeduction.org
- AdvancedBuildings.net

MI Great Lakes Bay solar ADVANTAGE

Michigan Economic Development Corporation (MEDC)
300 N. Washington Square
Lansing, MI 48913
Phone: 1.888.522.0103
Email: MEDCservices@michigan.org
Web site: http://www.michiganadvantage.org

Great Lakes Bay Region
Economic Development Corporations

Saginaw Future Inc.
515 N. Washington Ave., 3rd Floor
Saginaw, MI 48607
Phone: 1.989.754.8222
Email: info@SaginawFuture.com
Web site: http://www.saginawfuture.com

Midland Tomorrow
300 Rodd Street, Suite 201
Midland, MI 48640
Phone: 1.989.839.0340
Email:questions@midlandtomorrow.org
Web site: http://www.midlandtomorrow.org

Bay Future Inc.
721 Washington Ave, Suite 309
Bay City, MI 48708
Phone: 1.989.892.1400
Email: questions@midlandtomorrow.org
Web site: http://www.bayfuture.com

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If you wish to speak today, please complete the following:

Name: ANDREAS TOCH

Affiliation (if any): _____

Phone: 989-692-5031

Email: ANDREASTOCH@CHARTER.NET

Topics you wish to address today:

a. ___ **Renewable Energy Portfolio Standards**

b. ✓ **Energy Optimization / Efficiency Standards**

c. ___ **Electric Choice**

d. ___ **Other Additional Energy Topic**

(Please specify): _____

Requested time to speak: ✓ **< 5 minutes** ___ **5 minutes**

Please leave a copy of any written or electronic materials at the welcome center.

Transcript of Paul Martel's address to the Michigan Energy Public Forum 04 MAR 13 at Delta College

My name is Paul Martel. I am a Registered Professional Engineer in the State of Michigan. I am Facilities Manager of CFI Medical Solutions in Fenton, MI.

CFI Medical Solutions is a Medical Device Manufacturer employing approximately 135 people. We operate out of four facilities and sell products to over 32 countries.

Electric energy is one of the major expenses for our business, as is probably typical of many small and medium sized businesses in the State. As illustrated earlier during today's forum, electric rates have increased substantially since 2008. In our case, a thirty to forty percent increase.

We believe this results from two factors. The first is the virtual monopoly status the two major public utilities currently hold. The second is the cost of the expensive alternative electric generation. I heard several speakers mention the apparent savings with renewable energy. CFI certainly has not enjoyed any of these savings!

To compete globally in the medical device market, we require competitive energy rates.

In conclusion, I advocate the State foster competitive electric energy through a Customer Choice Electric Program for residential, commercial and industrial consumers. Thank you.