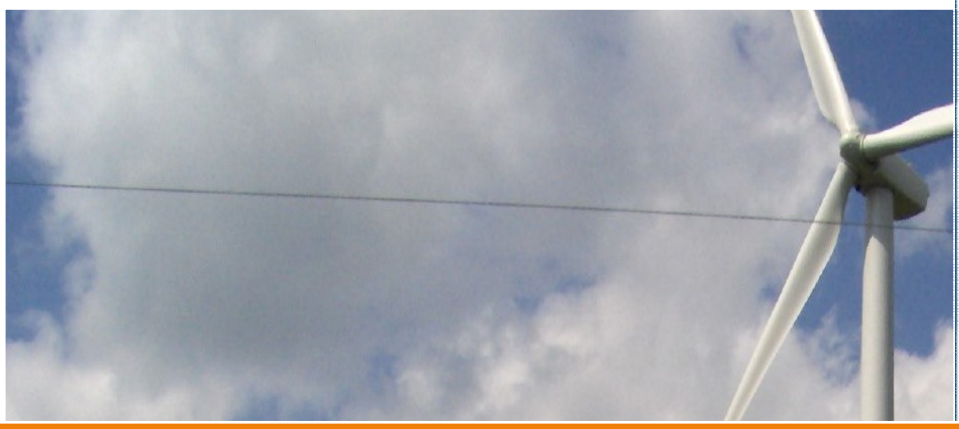


2009

WIND TURBINE IMPACT STUDY

APPRAISAL GROUP ONE

9/9/2009

WIND TURBINE IMPACT STUDY

DODGE & FOND DU LAC COUNTIES – WISCONSIN

Preliminary Draft - September 2009

This is a study of the impact that wind turbines have on residential property value. The wind turbines that are the focus of this study are the larger turbines being approximately 389ft tall and producing 1.0+ megawatts each, similar to the one pictured to the right.

The study has been broken into three component parts, each looking at the value impact of the wind turbines from a different perspective. The three parts are: (1) a literature study, which reviews and summarizes what has been published on this matter found in the general media; (2) an opinion survey, which was given to area Realtors to learn their opinions on the impact of wind turbines in their area; and, 3) sales studies, which compared vacant residential lot sales within the wind turbine farm area to comparable sales located outside of the turbine influence.

The sponsor for this study was the Calumet County Citizens for Responsible Energy (CCCRE) (Calumet County, Wisconsin), which contracted our firm, Appraisal Group One, to research the value impact that wind turbines have on property value. Appraisal Group One (AGO) protected against outside influence from CCCRE by having complete independence to the gathering of facts, data and other related material and the interpretation of this data to the purpose of this study. AGO chose the location of the study, the search parameters, the methodology used and the three-step approach to the study. AGO does not enter into any contract that would espouse any preconceived notion or have a bias as to the direction of the study and its findings. The purpose of the study was to investigate the value impacts of large wind turbines, the issues influencing these impacts and to report these findings on an impartial basis.

AGO is an appraisal company specializing in forensic appraisal, eminent domain, stigmatized properties and valuation research. This company is located in Oshkosh, Wisconsin,

and provides appraisal services throughout the State of Wisconsin. In addition, AGO provides forensic appraisal services, valuation consulting and research outside of the state. Recent projects were completed in Ohio, Indiana, Illinois and Michigan.

The geographic area of this study was focused in Dodge and Fond du Lac Counties. These two counties have three large wind farms. They are:

WE Energies - Blue Sky Green Field wind farm which has approximately 88 wind turbines and is located in the northeast section of Fond du Lac County, bordering Calumet County to the north.

Invenergy - Forward wind farm which has approximately 86 wind turbines and is located in southwest Fond du Lac County and northeast Dodge County.

Alliant - Cedar Ridge wind farm which has approximately 41 wind turbines and is located in the southeastern part of Fond du Lac County.

Of these three wind farms, only the WE Energies and Invenergy wind farms were used in the sales study since the Alliant – Cedar Ridge wind farm did not have enough viable sales within the turbine influence area to use as a base of comparison. The Realtor survey was limited to Fond du Lac and Dodge Counties, that being the area which had the three wind farms. The literature study was not limited geographically.

The balance of this report follows this introduction. The conclusions drawn at the end of each section are based on the data we collected and analyzed and are the sole possession of Appraisal Group One.

Submitted on September 9th, 2009, by:

Kurt C. Kielisch, ASA, IFAS, SR/WA, R/W-AC

President/ Senior Appraiser

Appraisal Group One

www.forensic-appraisal.com

WIND TURBINE IMPACT – REALTOR SURVEY

The purpose of the Realtor survey was to learn from the people who are on the first tier of the buying and selling of real estate what they thought of wind turbines and their impact to residential property value. This survey was designed to measure what type of impact (positive, negative or no impact) that wind turbines have on vacant residential land and improved property. The questions were designed to measure three different visual field proximity situations to wind turbines. These three were **bordering** proximity (defined as 600ft from the turbine), **close** proximity (defined as 1,000ft from the turbine) and **near** proximity (defined as ½ mile from the wind turbines). In all situations the wind turbines were visible from the property. Graphics and photographs were utilized to illustrate each question so the survey taker would have the same or similar understanding as others on each question. In addition to asking the Realtor about the type of impact they expected in each situation, the survey then asked them to estimate the percentage of the impact. Though it is understood that Realtors are salespeople and not appraisers, it is also true that they often have to estimate asking prices for their clients or act in the capacity of a buying agent for a client. Both situations demand an estimate of value and recognition of those factors that both benefit and detract from value.

The geographic area for selection of the survey participants was defined by the wind farm projects. These projects were in Fond du Lac and Dodge Counties, Wisconsin.

The Scope of Work (SOW) that was followed in the development, implementation and recording of this survey was as follows:

1. Outline the purpose of the questions and determine what is to be measured and what information is needed to have an informative survey free of any suggested bias.
2. Create a Beta version of the survey and have it tested by ten Realtors outside of the projected survey area.
3. Once the Beta testing and revisions were completed, then print the final version of the survey.
4. Realtor offices were presented with the survey and participants were offered a fee for taking the survey. (interestingly, some declined the fee.)
5. All surveys were given in person. No surveys were giving orally nor via the Internet.
6. Once the surveys were completed the survey presenter signed and dated the survey.
7. All surveys were reviewed for errors and those that were found in error, e.g. giving multiple answers to a question when only one was allowed, were then rejected and saved with the reason for its rejection.
8. The survey results were tabulated and presented in a spreadsheet format.

9. From the spreadsheet the results were presented graphically for ease of understanding.
10. A summary of the findings and a conclusion was then completed and included in this report.

Following is: (a) a copy of the survey that was hand delivered to each survey participant and (b) graphic presentation of the tabulated results from the survey.

Summary of Findings & Conclusion of Impact

The survey indicated that in all but two scenarios (those being Questions #8 and #9), over 60% the participants thought that the presence of the wind turbines had a negative impact on property value. This was true with vacant land and improved land. Where the group diverted from that opinion is when they were presented with a 10-20 acre hobby farm being in *close* and *near* proximity. In these cases 47% (close proximity) and 44% (near proximity) of the participants felt that the wind turbines caused a negative impact in property value.

The answers showed that *bordering* proximity showed the greatest loss of value at -43% for 1-5 acre vacant land and -39% for improved properties. Next in line was the *close* proximity showing a -36% value loss for 1-5 acre vacant land and -33% for improved property. Last in line was the *near* proximity, showing a -29% loss of value for a 1-5 acre vacant parcel and -24% loss in value for improved parcels. These losses show a close relationship between vacant land and improved land. This pattern was replicated regarding the *bordering* proximity for a hobby farm, whereas 70% believed it would be negatively impacted. Lastly, the opinions regarding the impact of the wind turbines due to placement, that being in front of the residence or behind the residence, showed that in both situations most participants believed there would a negative impact (74% said negative to the front placement and 71% said negative to the rear placement).

In conclusion, it can be observed that: (a) in all cases with a 1-5 acre residential property, whether vacant or improved, there will be a negative impact in property value; (b) with 1-5 acre properties the negative impact in property value in *bordering* proximity ranged from -39% to -43%; (c) with 1-5 acre properties the negative impact in property value in *close* proximity ranged from -33% to -36%; (d) with 1-5 acre properties the negative impact in property value in *near* proximity ranged from -24% to -29%; (e) in all cases the estimated loss of value between the vacant land and improved property was close, however the vacant land estimates were always higher by a few percentage points; (f) it appears that hobby farm use on larger parcels would have lesser sensitivity to the proximity of wind turbines than single family land use; and (g) placement either in front or at the rear of a residence has similar negative impacts.

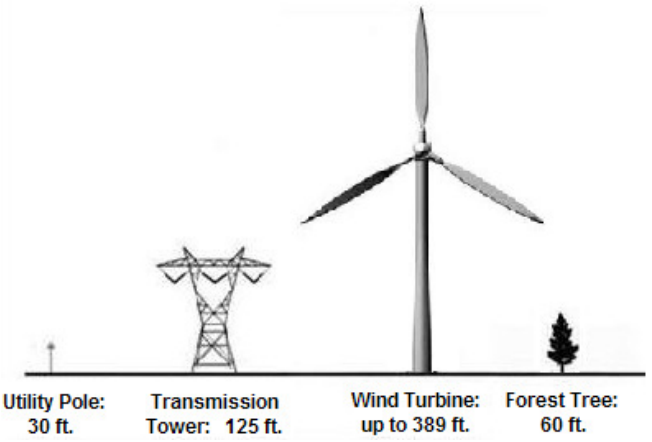
SAMPLE OF THE SURVEY
FOUND ON THE FOLLOWING PAGES

Wind Turbine Realtor Opinion Questionnaire

A. Purpose of the questionnaire

This questionnaire seeks to find the opinion of real estate sales professionals on whether an industrial-scale wind turbine near a residential property has an impact on its property value. The questionnaire specifically defines terms such as "wind turbine," "close proximity," "near proximity" and "outlying proximity."

Wind Turbine – for this questionnaire, a wind turbine is defined as a 1.5 MW industrial-scale wind turbine, approximately 389 feet tall from base to blade tip, at its highest point, with a blade diameter of approximately 252 feet. Such a wind turbine is pictured below, left. A comparison of the maximum height of industrial-scale turbines compared to other utilities and natural features is seen below, right.



Graphic: Impact of Wind Turbines on Market Value of Texas Rural Land. Derry T. Gardner of Gardner Appraisal Group, Inc. February 13, 2009. Original height of turbine altered for specific case

All dimensions to scale: 1 inch = 200 feet

Visual Field Proximity – for this questionnaire, "bordering proximity" is defined as 600 feet from turbine to residence, and easily seen from the subject property. "Close proximity" is defined as 1000 feet from turbine to residence, and readily seen. "Near proximity" is defined as ½ mile from turbine to residence, and seen in the distance. In the questionnaire you will see examples of each.

B. Please tell us about your real estate background: **(check all that apply)**

- Are you a Wisconsin licensed real estate sales person? ___ yes ___ no If yes, how long? ___yrs.
- Are you a Wisconsin licensed real estate broker? ___ yes ___ no If yes, how long? ___yrs.
- Are you a Wisconsin licensed/certified/general appraiser? ___ yes ___ no If yes, how long? ___yrs.
- Are you a Wisconsin assessor? ___ yes ___ no If yes, how long? ___yrs.
- Are you a land developer? ___ yes ___ no

C. What type of property have you listed or sold in the past? **(check all that apply)**

___ vacant land for residential use
___ vacant land for agricultural use
___ vacant land for recreational use
___ vacant land for commercial use
___ single-family residential
___ vacant land for residential developments
___ operative farm
___ hobby farm
___ recreational land
___ large tract rural land for any purpose
___ improved commercial

- In the last 5 years, have you listed a property from which one or more wind turbines were visible?
  ___ yes ___ no

  If yes, then please check the type of property **(check all that apply)**

  ___ residential improved
  ___ farm
  ___ residential development
  ___ large tract rural land for any purpose
  ___ vacant
  ___ recreational land
  ___ hobby farm
  ___ agricultural

- In the last 5 years, have you sold a property from which one or more wind turbines were visible?
  ___ yes ___ no

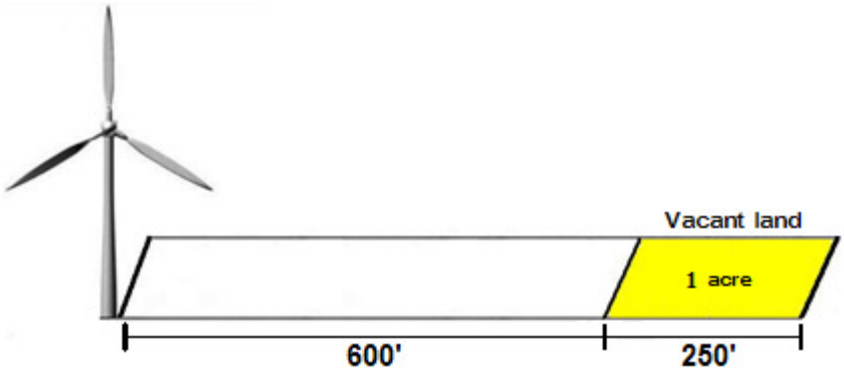
  If yes, then please check the type of property **(check all that apply)**

  ___ residential improved
  ___ farm
  ___ residential development
  ___ large tract rural land for any purpose
  ___ vacant
  ___ recreational land
  ___ hobby farm
  ___ agricultural

- Where do you reside?
  ___ City
  ___ Suburb
  ___ Rural

For this next set of questions, we are focusing on vacant residential land.

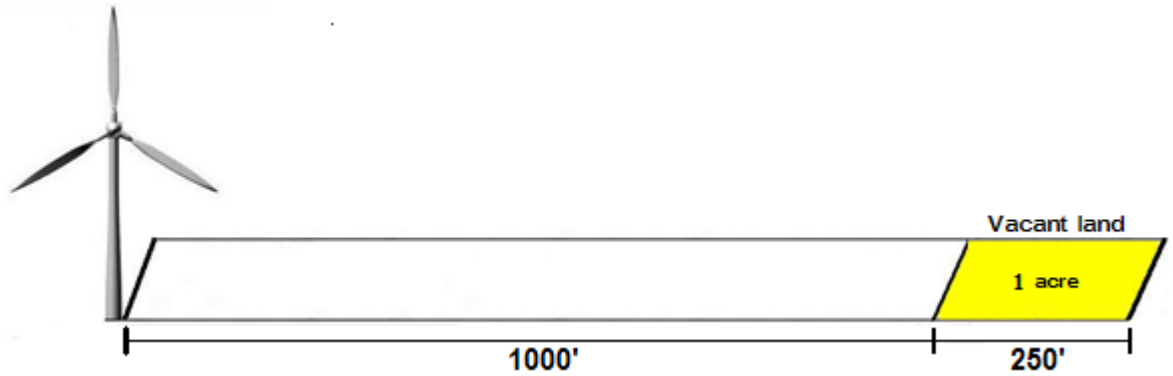
1. What is your opinion of the property value impact of wind turbines in **bordering proximity** to a 1-5 acre vacant residential lot? (see figure)
   i. Do you believe the property value of the parcel in this example would be:
      ____ Positively impacted
      ____Negatively impacted
      ____No impact



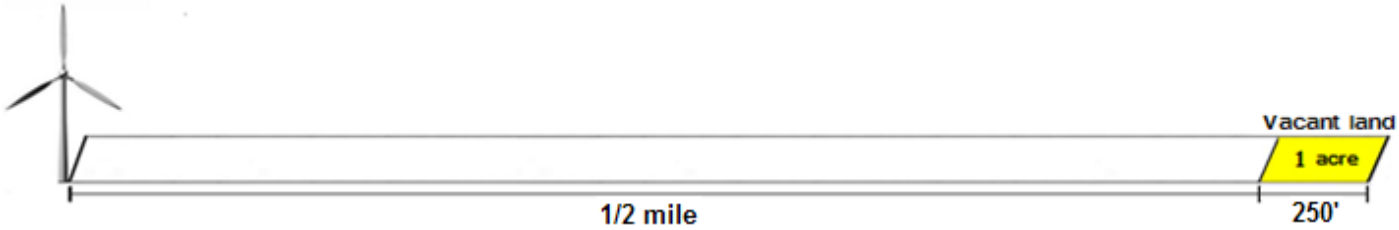
   ii. In your opinion, what would be the percentage of impact?
      ____ I would not know.
      ____ I would estimate a negative impact in the range of _____%
      ____ I would estimate a positive impact in the range of _____%

---

2. What is your opinion of the property value impact of wind turbines in **close proximity** to a 1-5 acre vacant residential lot? (see figure)
   i. Do you believe the property value of the parcel in this example would be:
      ____ Positively impacted
      ____ Negatively impacted
      ____ No impact
   ii. In your opinion, what would be the percentage of impact?
      ____ I would not know.
      ____ I would estimate a negative impact in the range of _____%
      ____ I would estimate a positive impact in the range of _____%

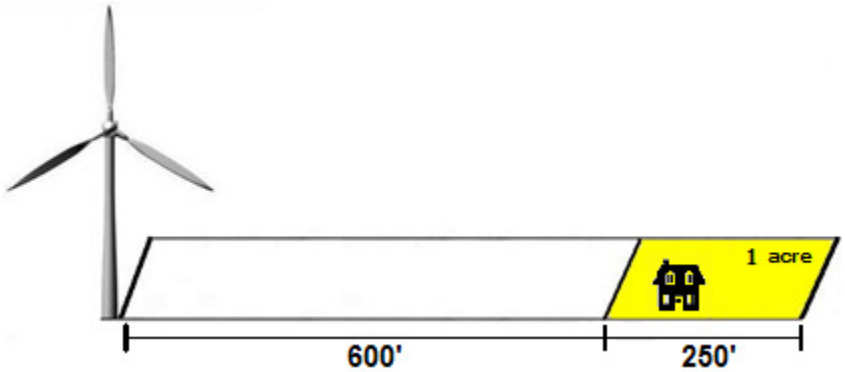


3. What is your opinion of the property value impact of wind turbines in **near proximity** to a 1-5 acre <u>vacant residential</u> lot? (see figure)
    i. Do you believe the property value of the parcel in this example would be
        ____ Positively impacted
        ____ Negatively impacted
        ____ No impact
    ii. In your opinion, what would be the percentage of impact?
        ____ I would not know.
        ____ I would estimate a negative impact in the range of _____%
        ____ I would estimate a positive impact in the range of _____%

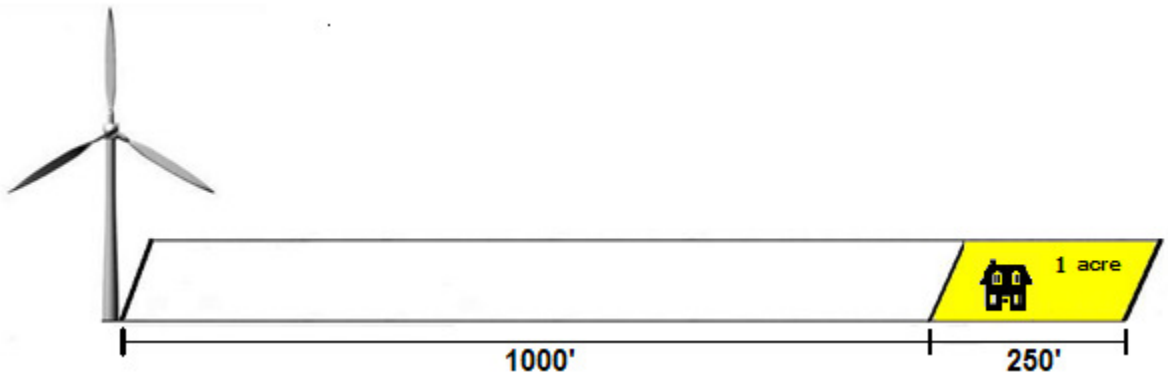


<u>For this next set of questions, we are focusing on **improved** residential land.</u> "Improved" means there is a residence on the property.

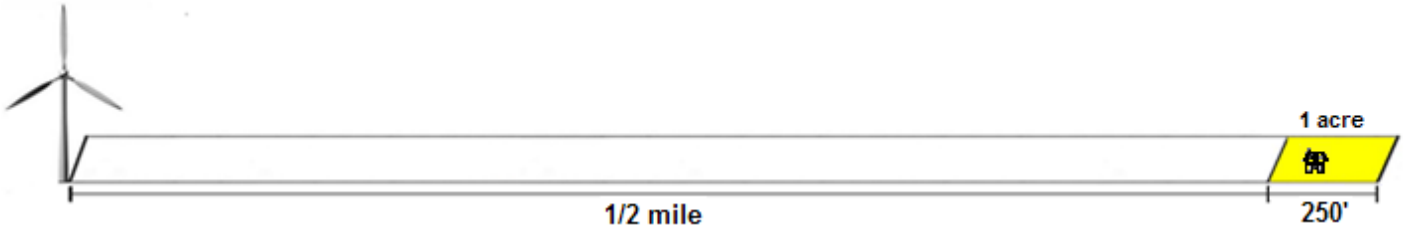
4. What is your opinion of the property value impact of wind turbines in **bordering proximity** to a 1-5 acre <u>improved</u> <u>residential</u> property? (see figure)
    i. Do you believe the property value of the parcel in this example would be
        ____ Positively impacted
        ____ Negatively impacted
        ____ No impact
    ii. In your opinion, what would be the percentage of impact?
        ____ I would not know.
        ____ I would estimate a negative impact in the range of _____%
        ____ I would estimate a positive impact in the range of _____%



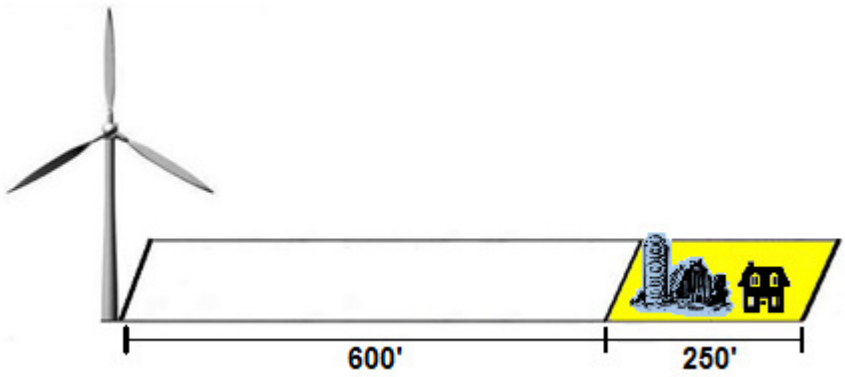
5. What is your opinion of the property value impact of wind turbines in **close proximity** to a 1-5 acre of <u>improved residential</u> property? (see figure)
    i. Do you believe the property value of the parcel in this example would be
        ____ Positively impacted
        ____ Negatively impacted
        ____ No impact
    ii. In your opinion, what would be the percentage of impact?
        ____ I would not know.
        ____ I would estimate a negative impact in the range of _____%
        ____ I would estimate a positive impact in the range of _____%



6. What is your opinion of the property value impact of wind turbines in **near proximity** to a 1-5 acre <u>improved residential</u> property? (see figure)
    i. Do you believe the property value of the parcel in this example would be
        ____ Positively impacted
        ____ Negatively impacted
        ____ No impact
    ii. In your opinion, what would be the percentage of impact?
        ____ I would not know.
        ____ I would estimate a negative impact in the range of _____%
        ____ I would estimate a positive impact in the range of _____%



7. Envision a hobby farm improved with a residence. It's 10-20 acres in size and has a wind turbine in **bordering proximity**. (see figure)
   i. Do you believe the property value of the parcel in this example would be
      ____ Positively impacted
      ____ Negatively impacted
      ____ No impact



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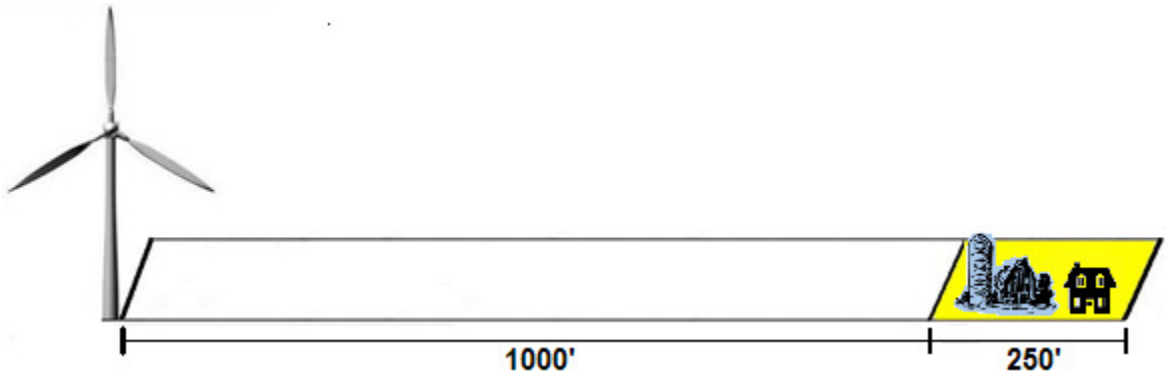
8. Envision a hobby farm improved with a residence. It's 10-20 acres in size and has a wind turbine in **close proximity**. (see figure)
   i. Do you believe the property value of the parcel in this example would be
      ____ Positively impacted
      ____ Negatively impacted
      ____ No impact



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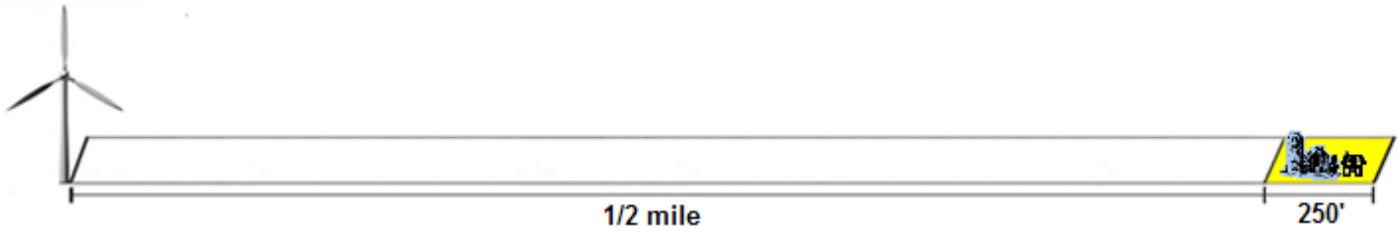
9. Envision a hobby farm improved with a residence. It's 10-20 acres in size and has a wind turbine in **near proximity**. (see example on next page)
   i. Do you believe the property value of the parcel in this example would be
      ____ Positively impacted
      ____ Negatively impacted
      ____ No impact



10. Assume that the wind turbine can be seen from the *front yard* of a 1-to-5 acre improved residential property as pictured below. Based on your professional experience would you say that this turbine would have:
    ___ A positive impact on the property value
    ___ A negative impact on the property value
    ___ No impact on the property value

11. Assume that the wind turbine can be seen from the *back yard* of a 1-to-5 acre improved residential property as pictured below. Based on your professional experience would you say that this turbine would have:
    ___ A positive impact on the property value
    ___ A negative impact on the property value
    ___ No impact on the property value.

Please feel free to include your own issues, comments or experiences (positive or negative) pertaining to wind turbines below:

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

Thank you for your help! Please date and sign below.

I have completed this questionnaire on ____/____/_____ signed _____

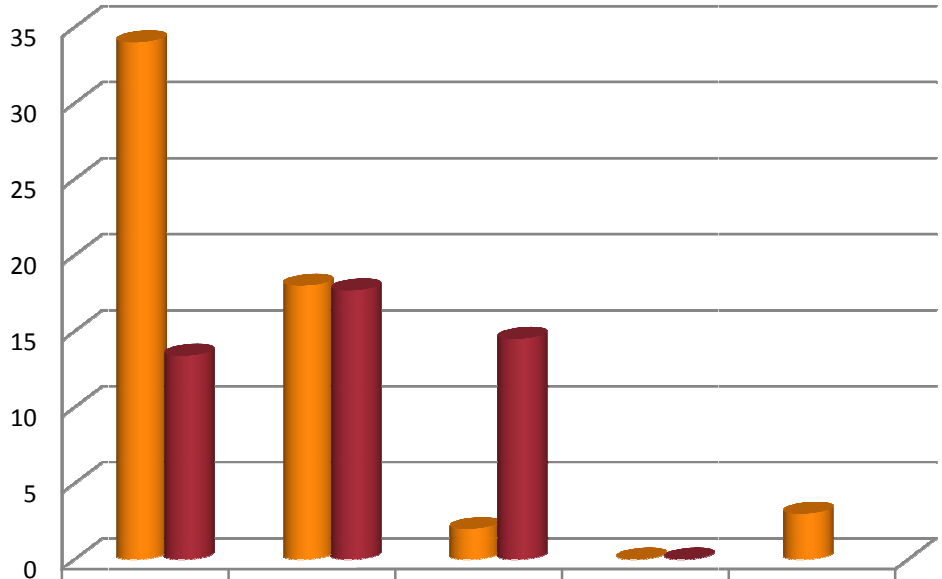
Name: _____
Company: _____
Address of company: _____
Contact phone number: _____

(To be filled out by interviewer)

This questionnaire was given by _____
on ____/____/_____
This questionnaire was given: ___ in person ___ by fax ___ by e-mail ___ by letter
If this questionnaire was given in person, at what location?
_____

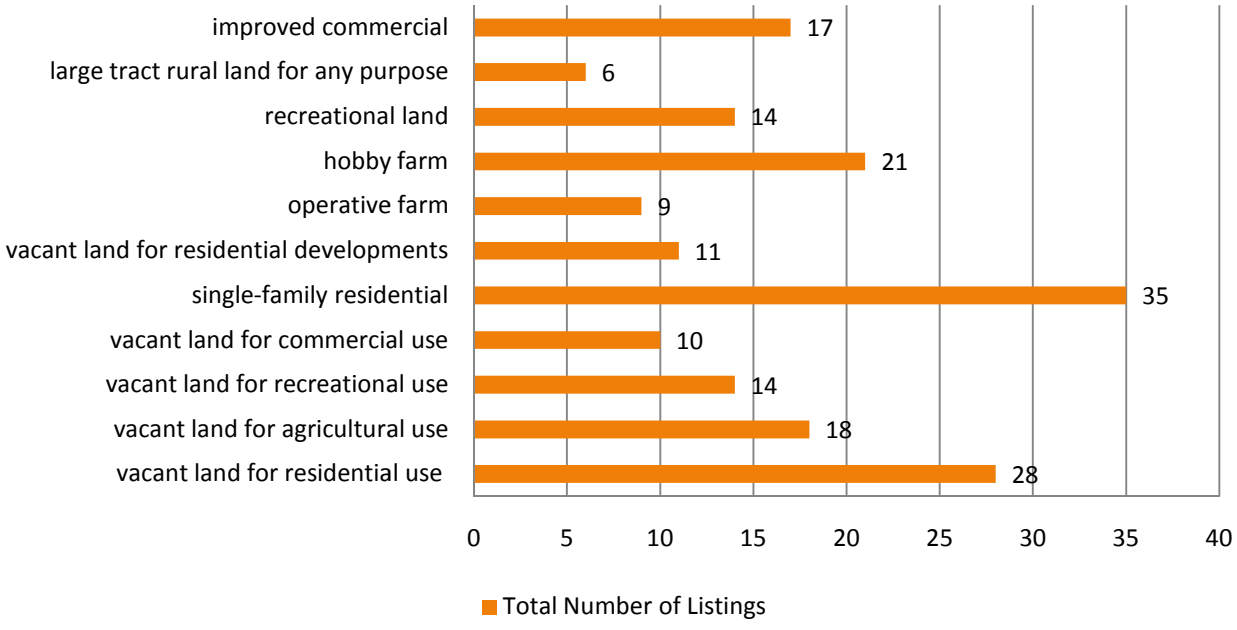
RESULTS FROM THE SURVEY IN GRAPHIC PRESENTATION FOUND ON THE FOLLOWING PAGES

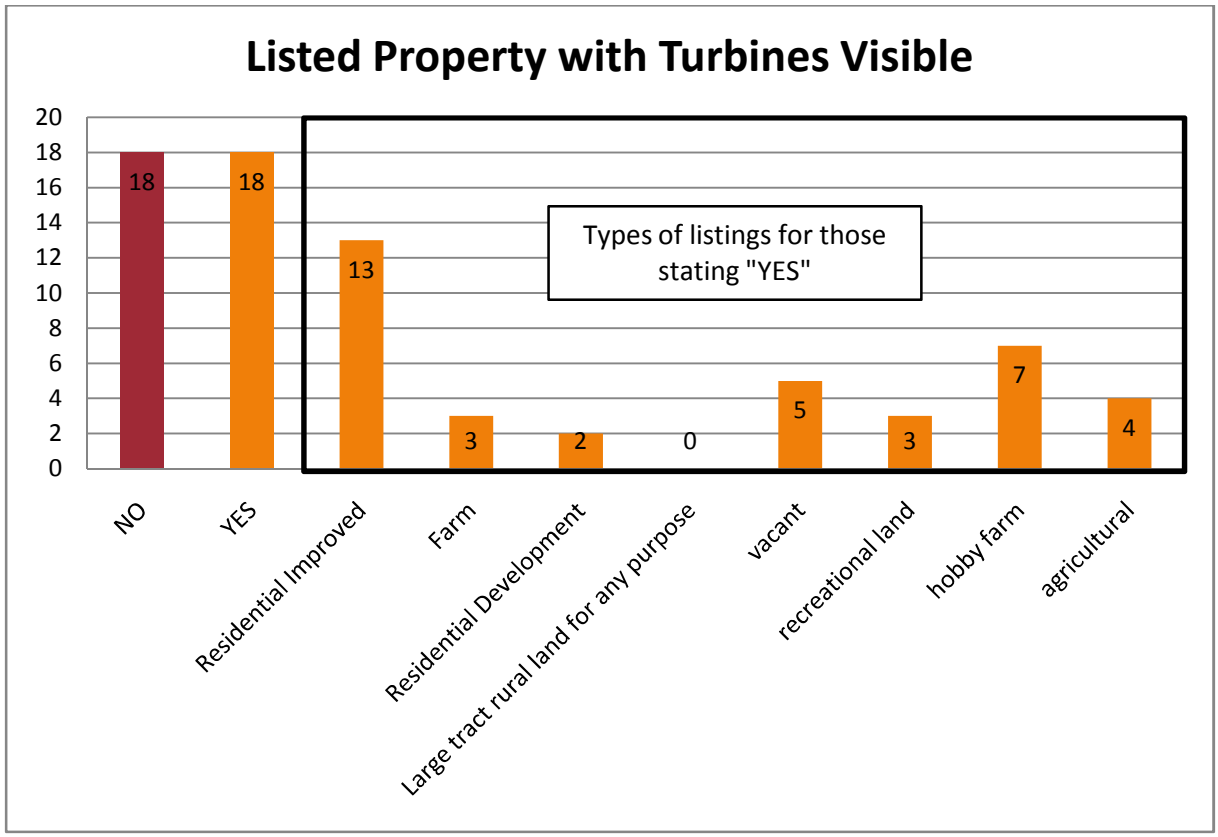
Real Estate Background

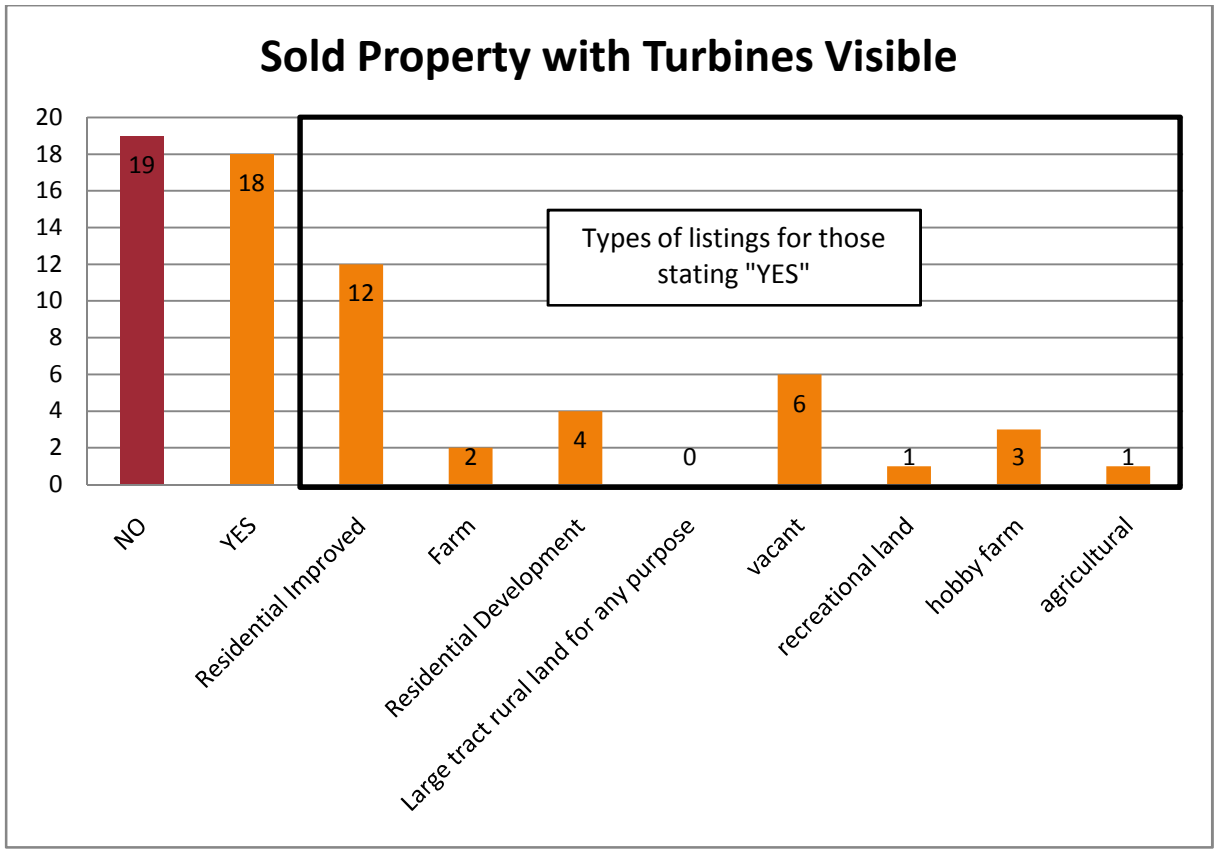


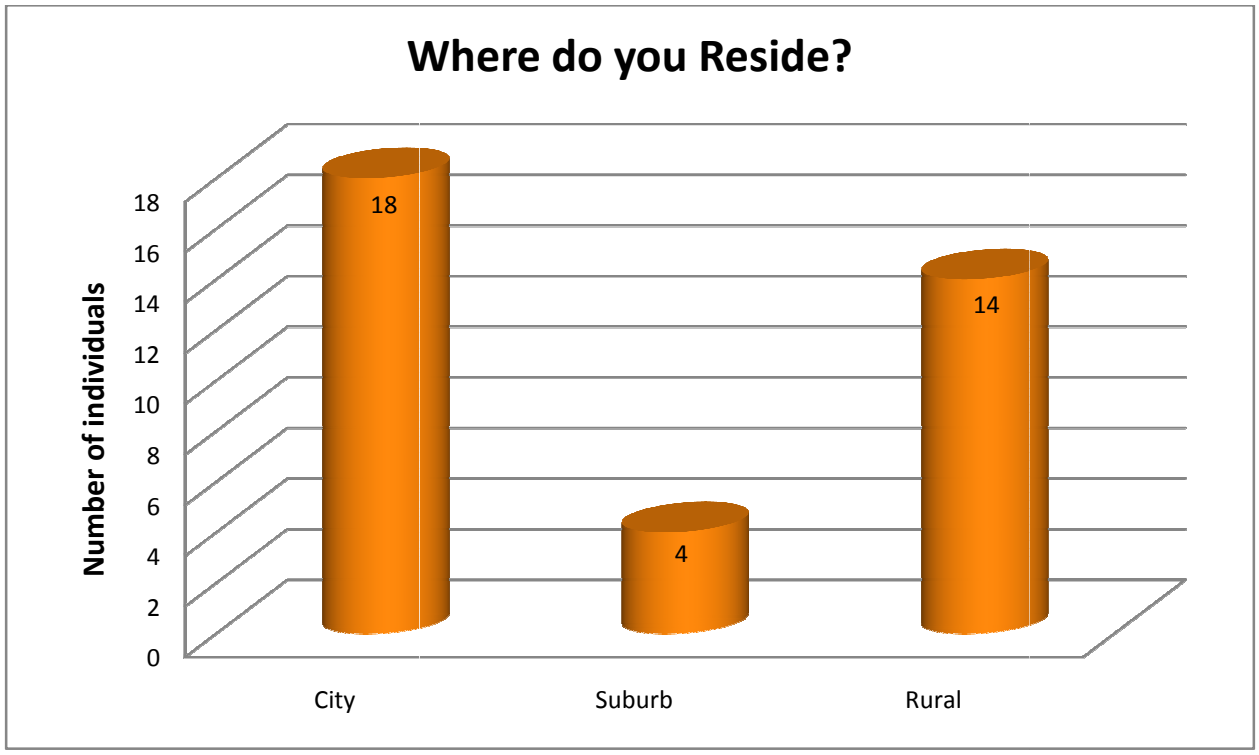
	Licensed Real estate salesperson	Licensed Real estate broker	Licensed/ Certified/ General Appraiser	Wisconsin Assessor	Land Developer
Number of Titles Represented	34	18	2	0	3
Average Years Experience	13.4	17.7	14.5	0.0	

Types of Listings Sold

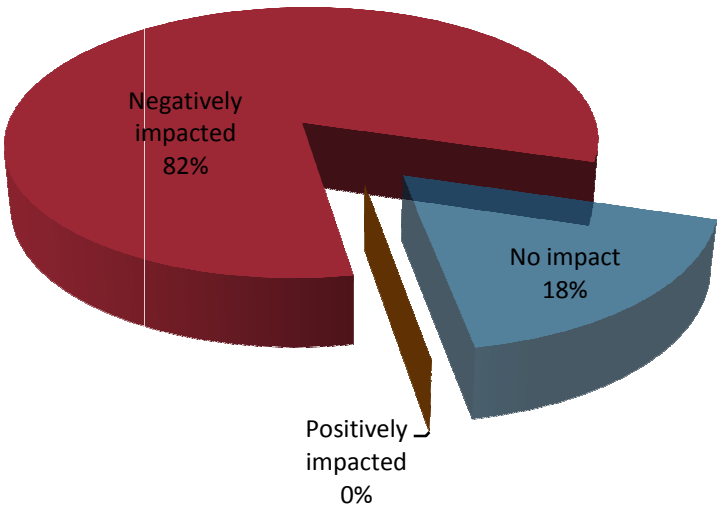



Listed Property with Turbines Visible
20
18
16
14
12
10
8
6
4
2
0
18
18
13
3
2
0
5
3
7
4
Types of listings for those stating "YES"
NO
YES
Residential Improved
Farm
Residential Development
Large tract rural land for any purpose
vacant
recreational land
hobby farm
agricultural

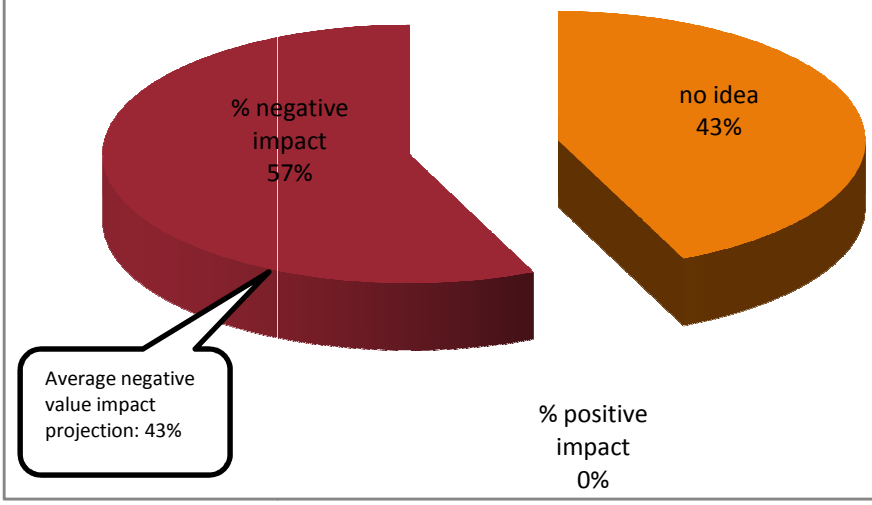

Sold Property with Turbines Visible
20
18
16
14
12
10
8
6
4
2
0
19
18
12
2
4
0
6
1
3
1
Types of listings for those stating "YES"
NO
YES
Residential Improved
Farm
Residential Development
Large tract rural land for any purpose
vacant
recreational land
hobby farm
agricultural


Where do you Reside?
Number of individuals
18
16
14
12
10
8
6
4
2
0
18
4
14
City
Suburb
Rural

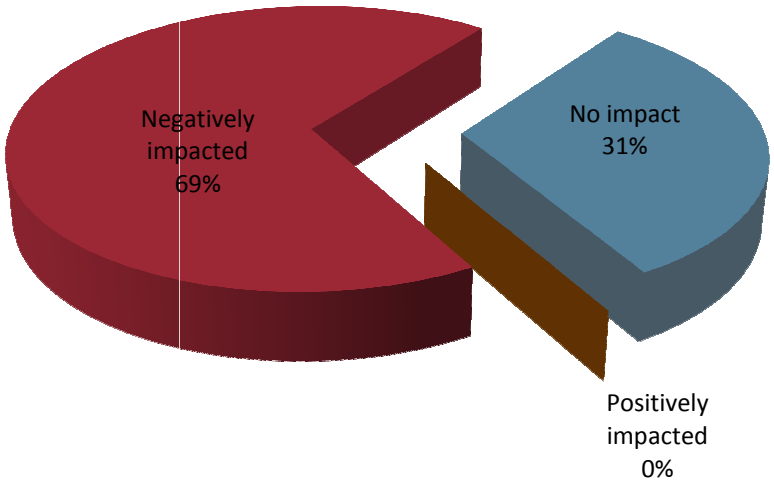
Question 1: What is your opinion of the property value impact of wind turbines in **bordering proximity** to a 1-5 acre <u>vacant residential</u> lot?



<u>Bordering proximity</u> to a 1-5 acre vacant residential lot:
Opinion of Percentage Impact

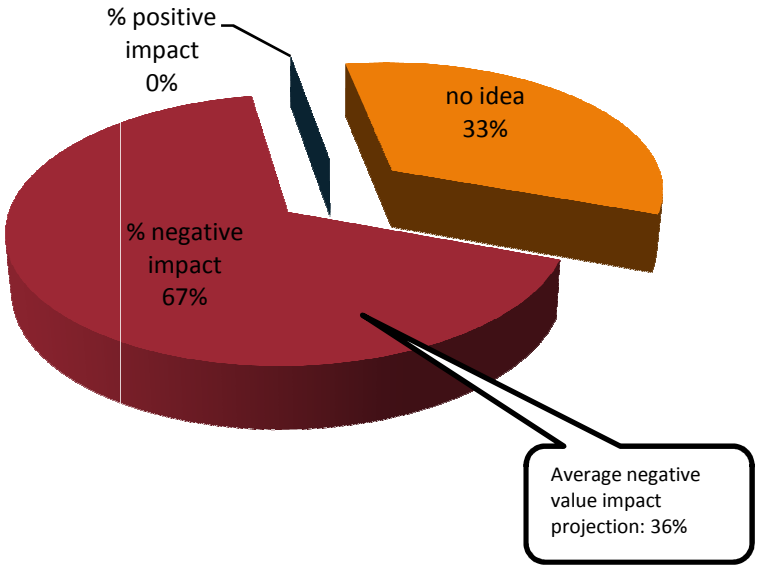


Question 2: What is your opinion of the property value impact of wind turbines in **close proximity** to a 1-5 acre <u>vacant residential</u> lot?

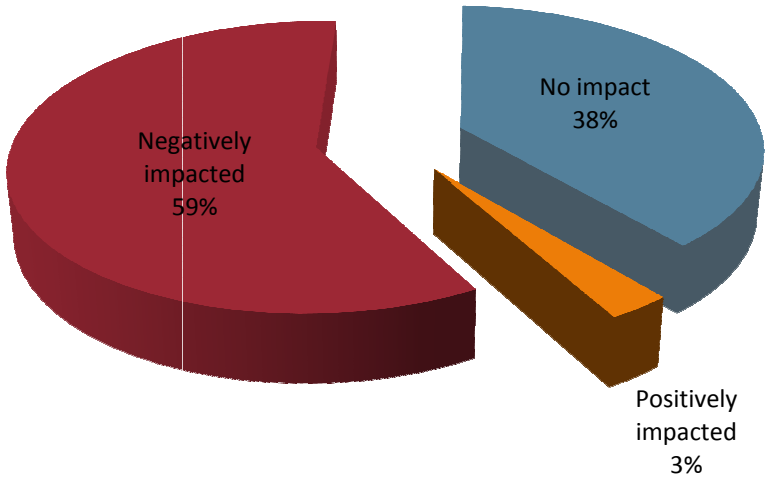


<u>Close proximity</u> to a 1-5 acre vacant residential lot:

Opinion of Percentage Impact

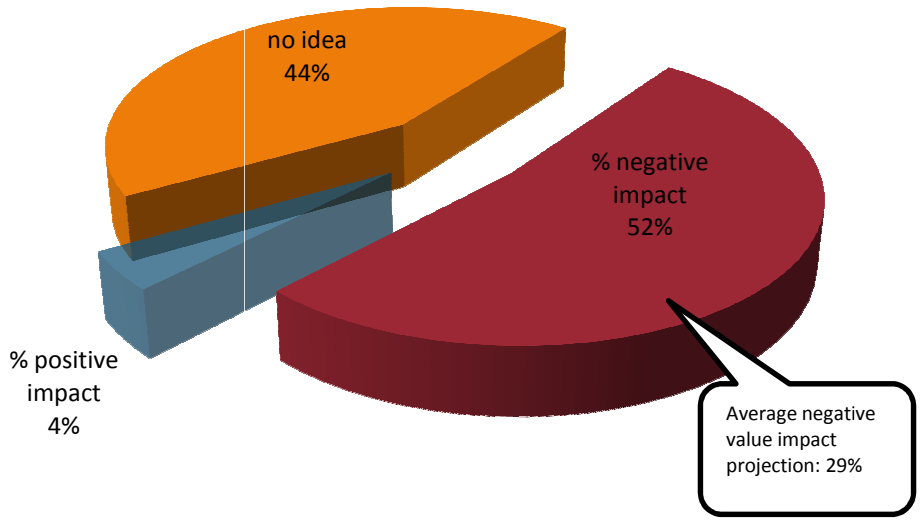


Question 3: What is your opinion of the property value impact of wind turbines in **near proximity** to a 1-5 acre <u>vacant residential</u> lot?

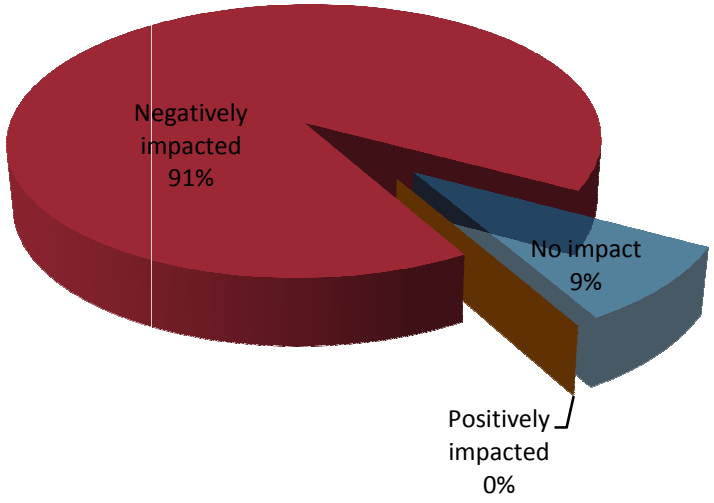


<u>Near proximity</u> to a 1-5 acre vacant residential lot:

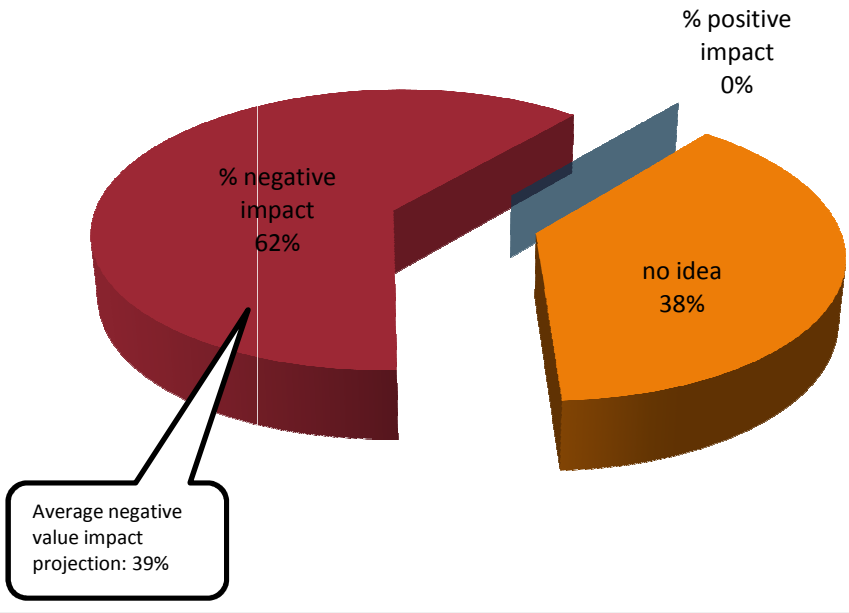
Opinion of Percentage Impact



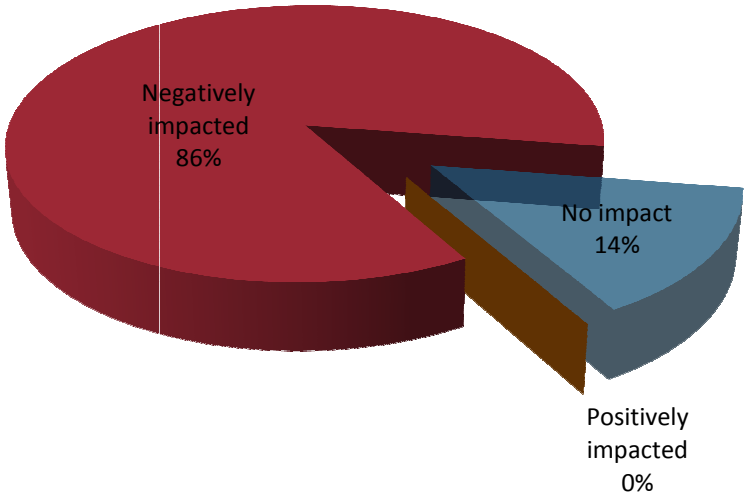
Question 4: What is your opinion of the property value impact of wind turbines in **bordering proximity** to a 1-5 acre <u>improved residential</u> lot?



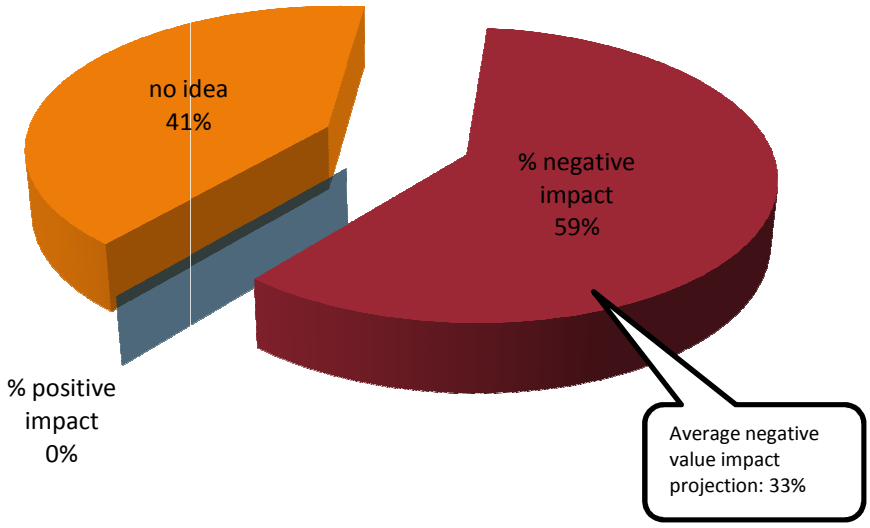
<u>Bordering proximity</u> to a 1-5 acre improved residential lot:
Opinion of Percentage Impact



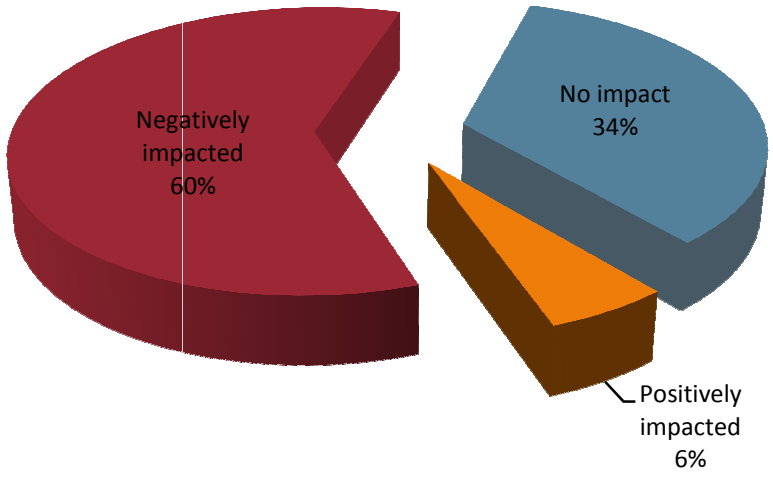
Question 5: What is your opinion of the property value impact of wind turbines in **close proximity** to a 1-5 acre <u>improved residential</u> lot?



<u>Close proximity</u> to a 1-5 acre improved residential lot:
Opinion of Percentage Impact

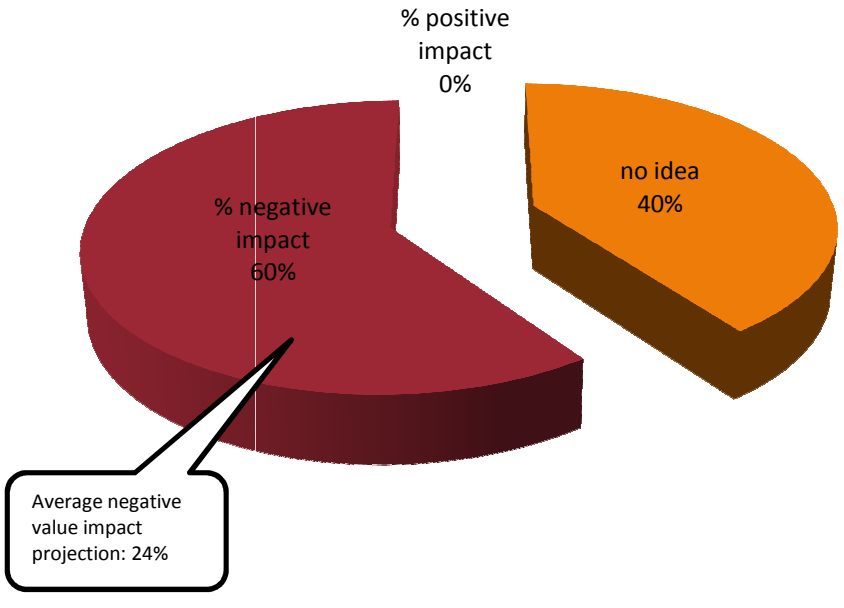


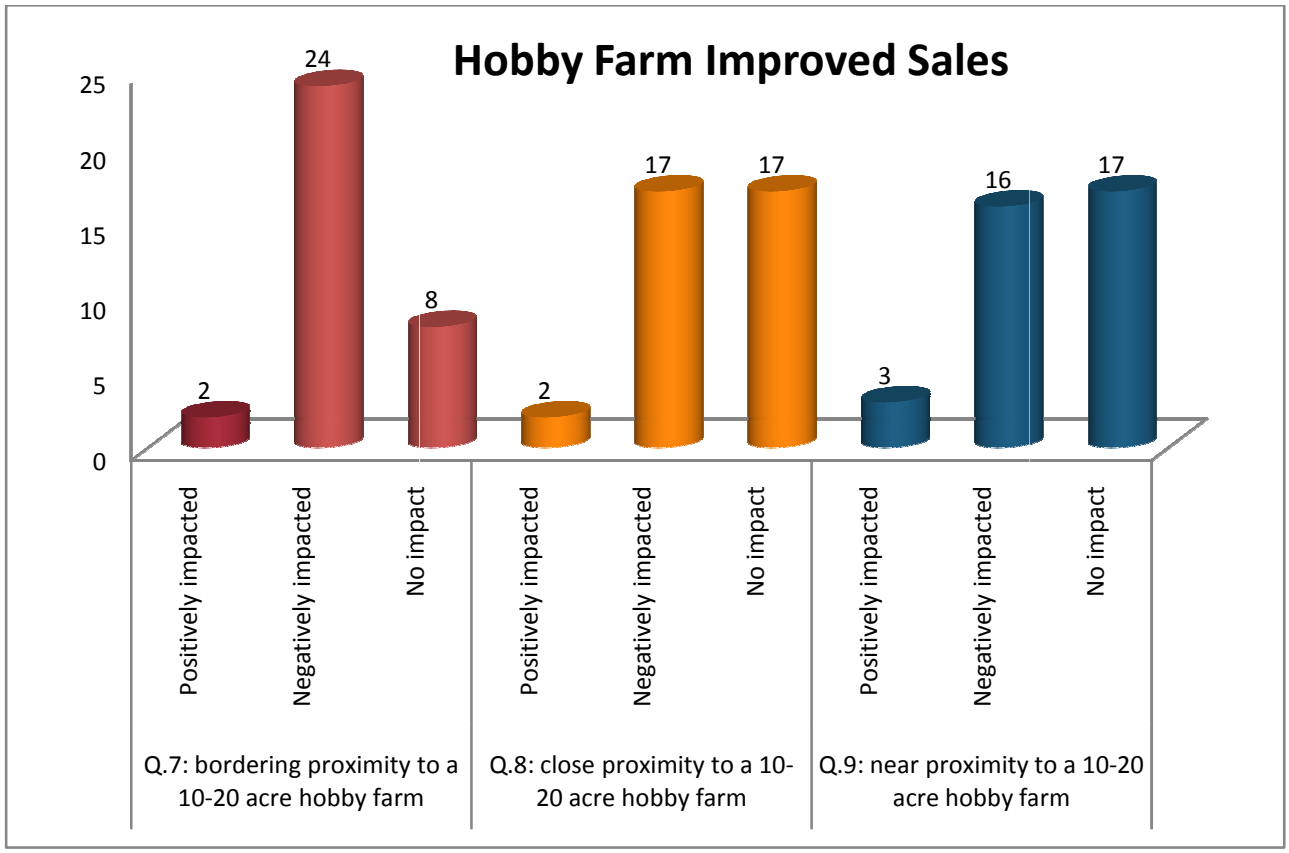
Question 6: What is your opinion of the property value impact of wind turbines in **near proximity** to a 1-5 acre <u>improved residential</u> lot?

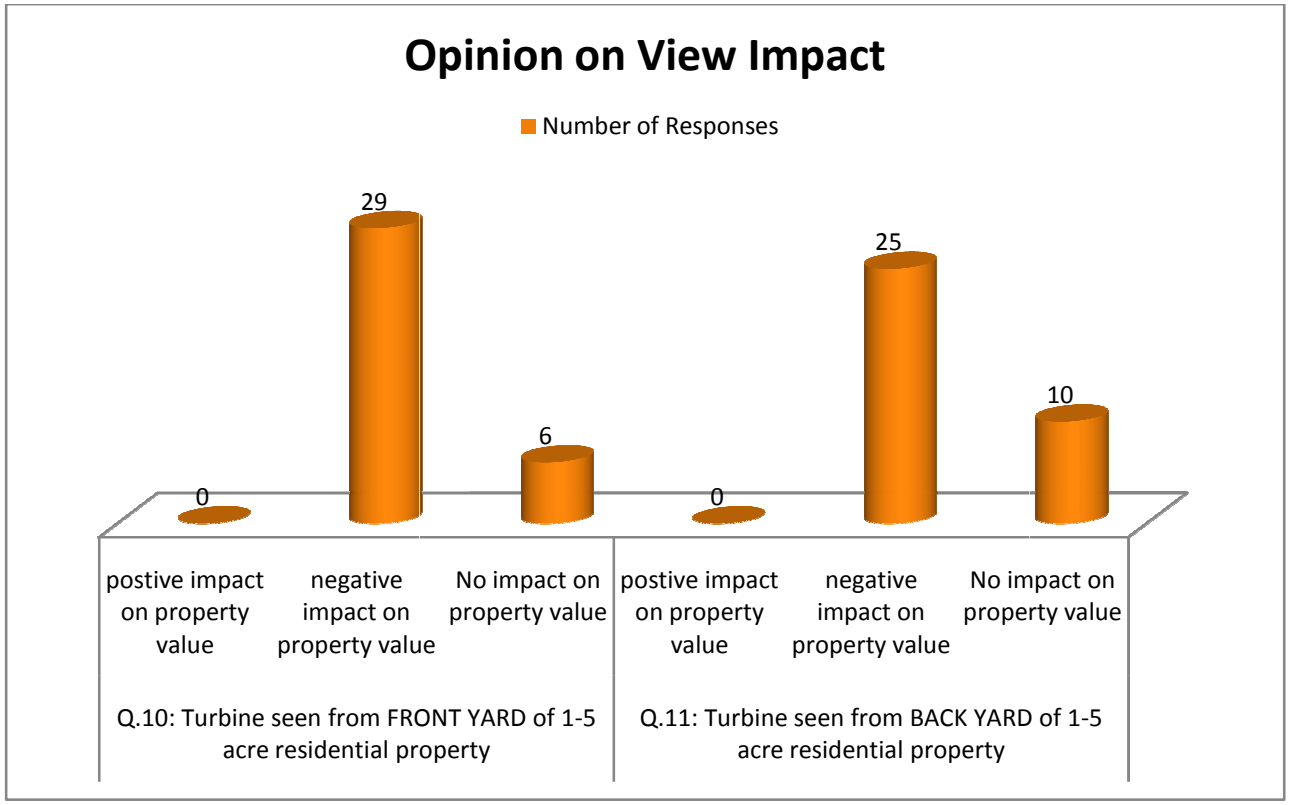


<u>Near proximity</u> to a 1-5 acre improved residential lot:

Opinion of Percentage Impact




Hobby Farm Improved Sales
25
20
15
10
5
0
2
24
8
2
17
17
3
16
17
Positively impacted
Negatively impacted
No impact
Positively impacted
Negatively impacted
No impact
Positively impacted
Negatively impacted
No impact
Q.7: bordering proximity to a 10-20 acre hobby farm
Q.8: close proximity to a 10-20 acre hobby farm
Q.9: near proximity to a 10-20 acre hobby farm


Opinion on View Impact
Number of Responses
0
29
6
0
25
10
postive impact on property value
negative impact on property value
No impact on property value
postive impact on property value
negative impact on property value
No impact on property value
Q.10: Turbine seen from FRONT YARD of 1-5 acre residential property
Q.11: Turbine seen from BACK YARD of 1-5 acre residential property

WIND TURBINE IMPACT - SALES STUDIES

The purpose of the wind turbine impact sales studies was to compare the residential land sales of properties located within the wind turbine farm area to comparable land sales located outside of the influence of the wind turbines. Being located outside of the influence meant that the wind turbines could not be seen from the property.

The Scope of Work (SOW) for this assignment was as follows:

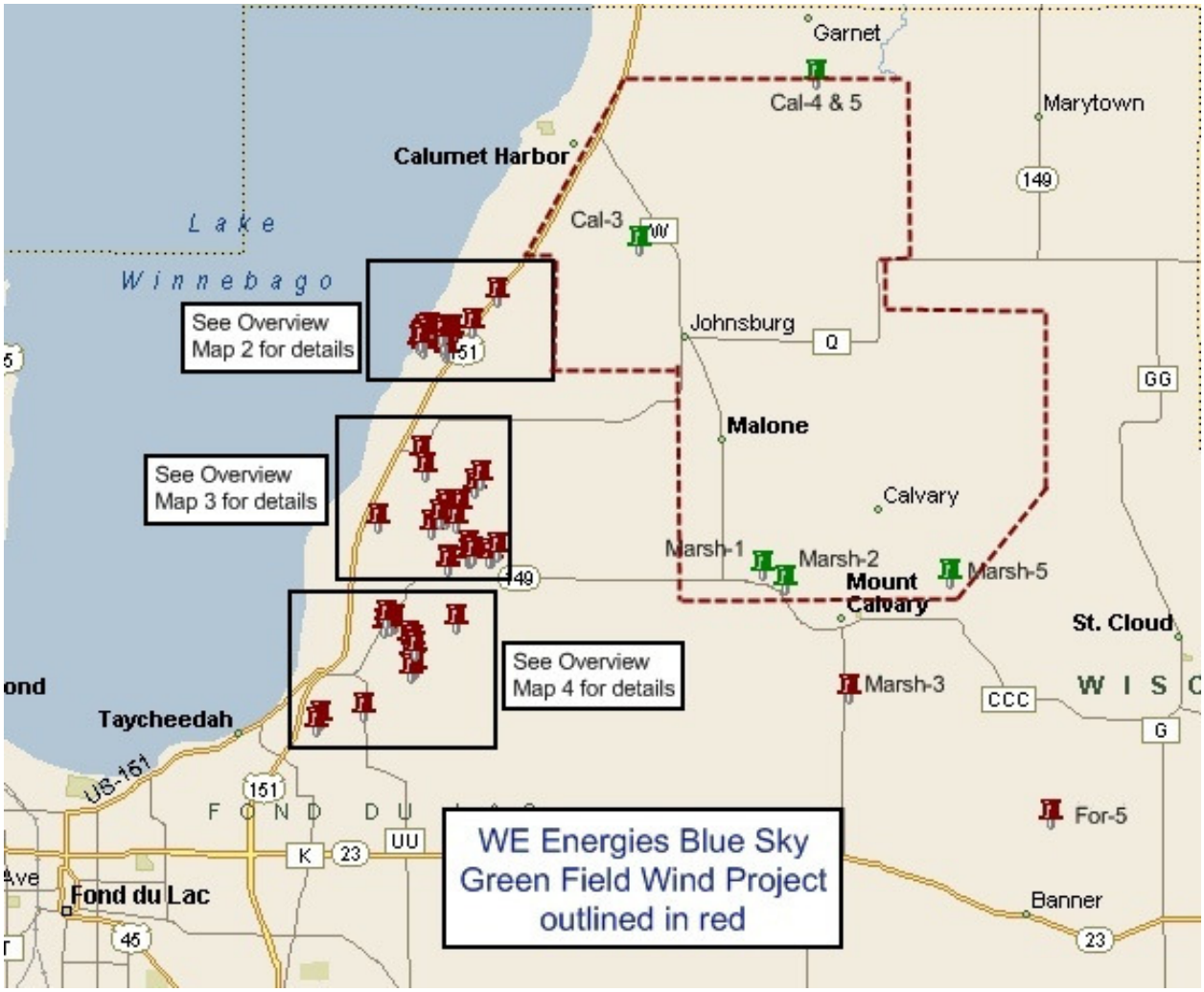
1) Obtain the wind farm maps from the wind farm developer.
2) Identify the wind turbine influence area using the wind farm maps, township maps, plat books and county maps.
3) Physically inspect the wind farm influence area.
4) Search for all residential vacant land sales in the wind farm influence area using the following parameters:
    a) 1-10 acre land size.
    b) January 1st, 2005 to May 31st, 2009, to keep the sales in the influence of the wind turbines either present or planned.
    c) Vacant land sales only.
    d) Residential land use only.
    e) Arm's length transactions that meet the legal definition of a Market Value transaction.
    f) Utilize REDI, MLS, court records, assessor records, county maps, Google maps, FEMA maps, and other sources as needed for property data of each sale.
5) Research and confirm all sales within the wind turbine influence and physically inspect all sales and locate the proximity of all nearby wind turbines.
6) Complete a sales info sheet on each sale.
7) Using the sales in #5, set forth the parameters for the comparable land sales located outside of the sphere of influence and follow steps #4 through #6.
8) Once all the sales are confirmed and the sales info sheets completed, complete a spreadsheet listing all land sales data.
9) Complete a market appreciation/depreciation time study for time adjustments.
10) Complete a "x, y" scatter chart plotting the land sales within the influence of the wind turbines vs. those outside of the influence after time adjustments are applied.
11) Plot regression lines of the two values using logarithmic functions.

12) Compare the values projected by the charts to identify and define any value difference between the land sales within vs. outside of the influence of the wind turbines.
13) Summarize and conclude the impact of wind turbines to property value.

The areas of study include the WE Energies - Blue Sky Green Field wind farm located in the northeast section of Fond du Lac County and the Invenergy - Forward wind farm located in southwest Fond du Lac County and northeast Dodge County. The sales studies and their conclusions follow.

WE Energies - Blue Sky Green Field Wind Farm Sales Study

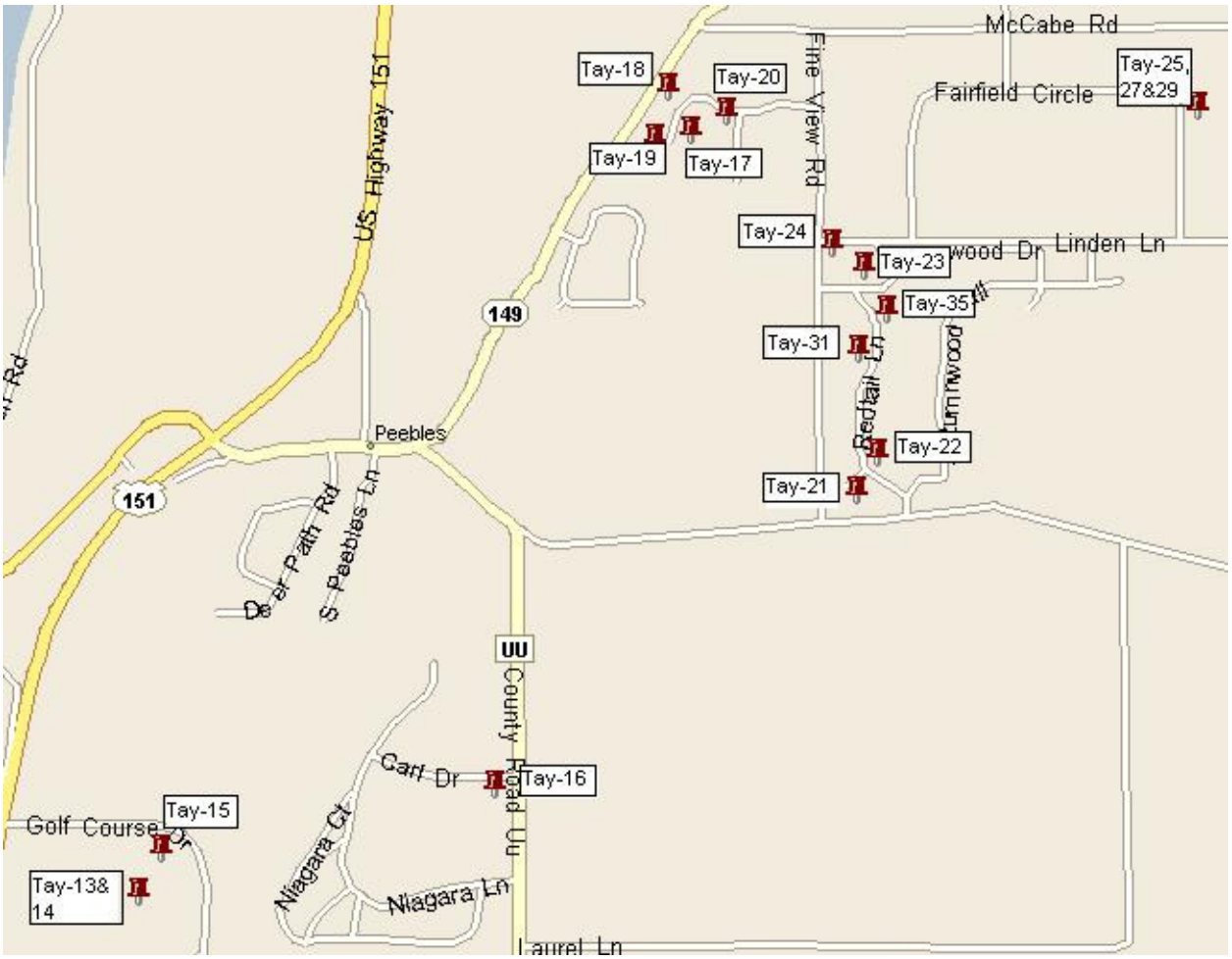
The area of study was the northeast section of Fond du Lac County bordered by Calumet County to the north, Lake Winnebago to the west and Sheboygan County to the east. The study included the townships of Calumet, Taycheedah and Marshfield. A total of 68 vacant residential land sales were utilized for this study. From that total, 6 land sales were in the influence of the wind turbines (within the wind farm parameters), and 62 sales were located outside of that sphere of influence. The sales map for this study is pictured below:



Overview Map #2

Overview Map #3

Overview Map #4



All of these sales were the placed in a spread sheet that appears on the next pages.

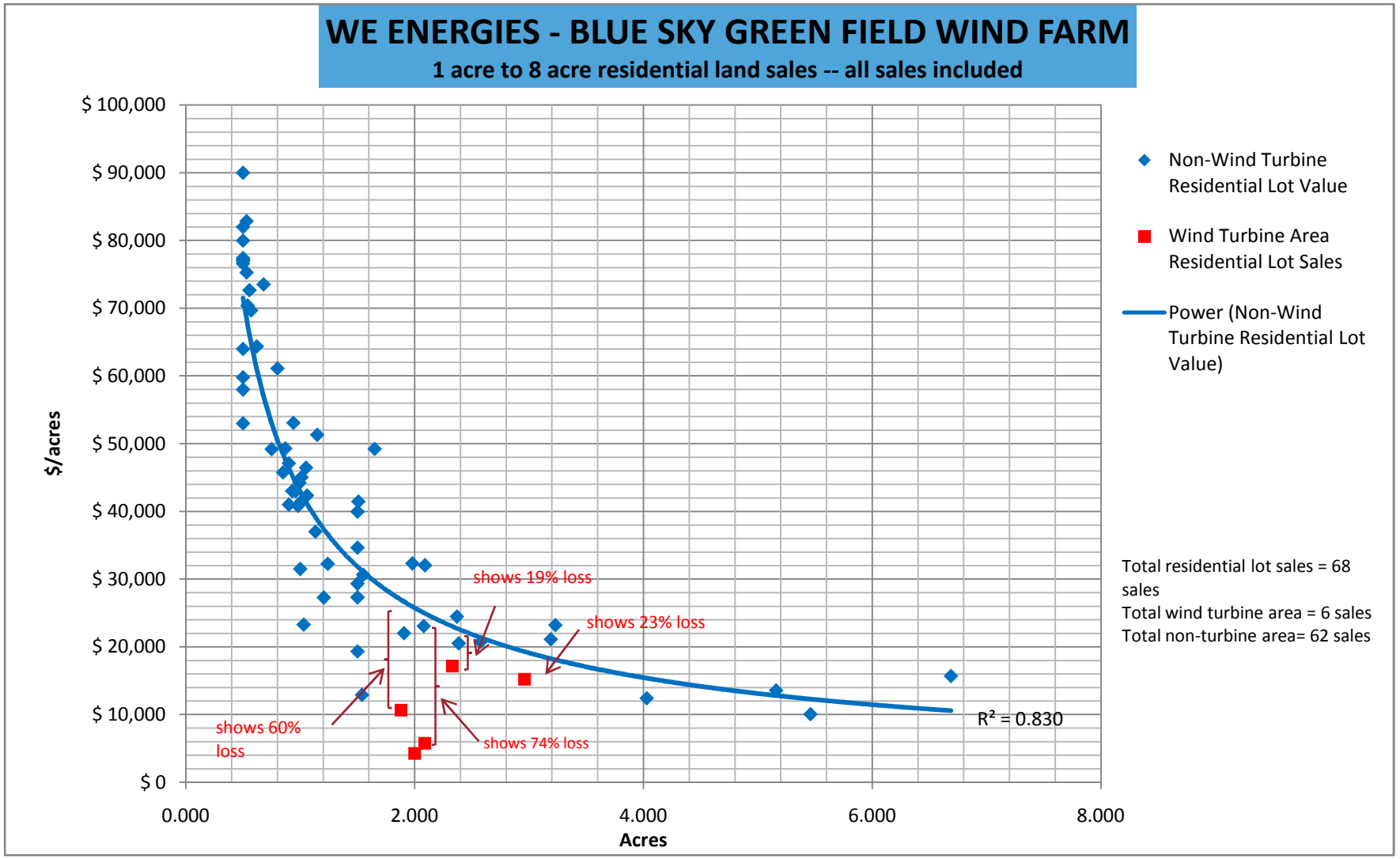
WE-ENERGIES BLUE SKY GREEN FIELD SPREADSHEET

Identifier	Subdv	Lot	Street #	Street name	resale?	Sale Amt	Sale Date	Doc #	lot size acres	adj Sale after time adj	$/ac
Cal-5	Rural	turbine	W2073	Cty Rd HHH	N	$ 8,500	3/31/2006	868997	2.000	$ 8,500	$ 4,250
Cal-4	Rural	turbine	W2079	Cty Rd HHH	N	$ 8,500	3/31/2006	868996	2.000	$ 8,500	$ 4,250
Cal-3	Rural			Schumacher Rd.	N	$ 12,000	2/12/2009	931211	2.088	$ 12,000	$ 5,747
Marsh-5	Rural	turbine	W1362	Basswood Rd.	N	$ 45,000	12/27/2007	908549	2.960	$ 45,000	$ 15,203
Marsh-2	Rural	turbine	W2209	Cty Rd W	N	$ 40,000	5/1/2009	871059	2.330	$ 40,000	$ 17,167
Marsh-1	Rural	turbine		Cty Rd W	N	$ 20,000	1/16/2008	909043	1.880	$ 20,000	$ 10,638
	Rural			Johnsburg Rd.	N	$ 53,500	6/10/2009	940604	2.578	$ 53,500	$ 20,753
Cal-2	Rural			State Hwy 151	N	$ 105,000	10/30/2006	883092	6.689	$ 105,000	$ 15,697
For-5	Rural		W879	Pleasant View Ct.	N	$ 24,000	2/4/2008	910007	1.030	$ 24,000	$ 23,301
Marsh-3	Rural			Cty Rd W	N	$ 19,900	10/20/2006	882217	1.540	$ 19,900	$ 12,922
Tay-13	Winward Estates	Lot 44	W4562	Aeolus Way	Y	$ 40,000	5/14/2009	938265	0.500	$ 40,000	$ 80,000
Tay-14	Winward Estates	Lot 44	W4562	Aeolus Way	N	$ 45,000	5/31/2007	895585	0.500	$ 45,000	$ 90,000
Tay-15	Winward Estates	Lot 68	N7346	Easterlies Dr.	N	$ 42,900	11/19/2008	926853	0.870	$ 42,900	$ 49,310
Tay-16	Niagara Estates	Lot 25		Carl Dr.	N	$ 70,000	9/15/2008	923533	5.160	$ 70,000	$ 13,566
Tay-17	Glacier Ridge	Lot 8		Jennie Lee Ct.	N	$ 64,000	5/1/2009	937263	1.980	$ 64,000	$ 32,323
Tay-18	Glacier Ridge	Lot 10 & 11		Jennie Lee Ct.	N	$ 75,000	9/6/2006	879445	3.230	$ 75,000	$ 23,220
Tay-19	Glacier Ridge	Lot 9	W4209	Jennie Lee Ct.	N	$ 67,000	6/12/2006	880888	2.090	$ 67,000	$ 32,057
Tay-20	Glacier Ridge	Lot 5		Jennie Lee Ct.	N	$ 81,250	10/4/2006	881308	1.650	$ 81,250	$ 49,242
Tay-21	Hawk's Landing	Lot 3	W4084	Redtail Ct.	N	$ 41,900	9/1/2006	879320	1.132	$ 41,900	$ 37,014
Tay-22	Hawk's Landing	Lot 88	N7611	Redtail Ln.	N	$ 40,400	5/1/2006	871526	0.556	$ 40,400	$ 72,662
Tay-23	Hawk's Landing	Lot 24		Thornwood Dr.	N	$ 39,900	5/9/2006	872462	0.620	$ 39,900	$ 64,355
Tay-24	Rural			Linden Dr.	N	$ 62,500	8/8/2008	920377	1.508	$ 62,500	$ 41,446
Tay-25	Rural			Fairlane Circle	Y	$ 52,000	5/7/2009	937834	1.501	$ 52,000	$ 34,644
Tay-26	Fisherman's Estates	Lot 32		Sturgeon St.	N	$ 40,000	8/30/2006	881378	0.930	$ 40,000	$ 43,011
Tay-27	Rural			Fairlane Circle	Y	$ 41,000	4/12/2007	892630	1.501	$ 41,000	$ 27,315

Tay-28	Fisherman's Estates	Lot 26		Sturgeon St.	N	$ 48,900	5/19/2006	872415	0.800		$ 48,900	$ 61,125
Tay-29	Rural			Fairlane Circle	N	$ 29,000	4/12/2007	892629	1.501		$ 29,000	$ 19,320
Tay-30	Fisherman's Estates	Lot 27		Sturgeon St.	N	$ 45,500	3/27/2006	869335	1.010		$ 45,500	$ 45,050
Tay-31	Hawk's Landing	Lot 14	N7694	Redtail Ln.	N	$ 43,900	8/24/2007	901256	0.993		$ 43,900	$ 44,209
Tay-32	Fisherman's Estates	Lot 28	W3867	Sturgeon St.	N	$ 50,000	11/26/2007	906314	4.030		$ 50,000	$ 12,407
Tay-33	Rural			Sunset Dr.	N	$ 44,900	4/20/2007	893004	1.060		$ 44,900	$ 42,358
Tay-34	Fisherman's Estates	Lot 23		Minnow Ln.	N	$ 41,272	5/11/2006	871911	0.960		$ 41,272	$ 42,992
Tay-35	Hawk's Landing	Lot 99	N7715	Redtail Ln.	N	$ 44,000	5/1/2006	883441	0.531		$ 44,000	$ 82,863
Tay-36	Fisherman's Estates	Lot 21		Minnow Ln.	N	$ 50,000	11/7/2006	884123	0.680		$ 50,000	$ 73,529
Tay-37	Sand Hill Ridge	Lot 23	W3766	Heron Ct.	N	$ 39,900	3/16/2006	868646	0.530		$ 39,900	$ 75,283
Tay-38	Fisherman's Estates	Lot 17		Perch Ln.	N	$ 48,800	3/15/2006	868611	1.050		$ 48,800	$ 46,476
Tay-39	Sand Hill Ridge	Outlot 2	N8192	Sand Hill Dr.	N	$ 49,900	3/27/2006	869045	0.940		$ 49,900	$ 53,085
Tay-40	Fisherman's Estates	Lot 16		Perch Ln.	N	$ 67,400	6/1/2007	895781	3.190		$ 67,400	$ 21,129
Tay-41	Rural		W3632	Schuster Ln.	N	$ 40,000	4/13/2006	869751	0.980		$ 40,000	$ 40,816
Tay-42	Fisherman's Estates	Lot 17	N9309	Perch Ln.	N	$ 47,500	4/18/2008	915162	1.550		$ 47,500	$ 30,645
Tay-43	Rural		W3677	Rosenthal Ct.	N	$ 32,900	6/28/2007	897596	1.206		$ 32,900	$ 27,280
Tay-44	Fisherman's Estates	Lot 10		Perch Ln.	N	$ 39,710	4/3/2006	869336	0.570		$ 39,710	$ 69,667
Tay-45	Rural		N3673	Rosenthal Ct.	N	$ 31,500	4/23/2007	893867	1.000		$ 31,500	$ 31,500
Tay-46	Fisherman's Estates	Lot 9	N9256	Perch Ln.	N	$ 41,000	5/15/2006	872274	0.500		$ 41,000	$ 82,000
Tay-47	Rural		N8424	Sunset Dr.	N	$ 41,900	4/6/2007	892075	1.010		$ 41,900	$ 41,485
Tay-48	Fisherman's Estates	Lot 7		Perch Ln.	N	$ 38,500	1/13/2006	934159	0.500		$ 38,500	$ 77,000
Tay-49	Rural			Sunset Dr.	N	$ 42,400	3/29/2007	893091	0.900		$ 42,400	$ 47,111
Tay-50	Fisherman's Estates	Lot 7	N9242	Perch Ln.	Y	$ 26,500	3/25/2009	934159	0.500		$ 26,500	$ 53,000
Tay-51	Rural		W3879	Somerset Ct.	N	$ 36,900	2/15/2007	889033	0.900		$ 36,900	$ 41,000
Tay-52	Fisherman's	Lot 5		Perch Ln.	N	$ 38,700	2/28/2006	867683	0.500		$ 38,700	$ 77,400

	Estates											
Tay-53	Rural		W3833	Somerset Ct.	N	$ 36,900	5/15/2006	872951	0.750		$ 36,900	$ 49,200
Tay-54	Fisherman's Estates	Lot 4		Perch Ln.	N	$ 38,610	3/28/2006	869334	0.500		$ 38,610	$ 77,220
Tay-55	Rural			Highland Dr.	N	$ 49,000	4/30/2007	893642	2.386		$ 49,000	$ 20,536
Tay-56	Fisherman's Estates	Lot 3		Perch Ln.	N	$ 38,500	1/13/2006	864806	0.500		$ 38,500	$ 77,000
Tay-57	Rural		N8168	Highland Dr.	N	$ 44,000	4/6/2007	892278	1.500		$ 44,000	$ 29,333
Tay-58	Fisherman's Estates	Lot 2		Perch Ln.	N	$ 38,300	4/28/2006	871249	0.500		$ 38,300	$ 76,600
Tay-59	Sand Hill Ridge	Lot 12	N8168	Sand Hill Dr.	N	$ 32,000	4/25/2008	915763	0.500		$ 32,000	$ 64,000
Tay-60	Fisherman's Estates	Lot 1		Perch Ln.	N	$ 38,000	4/25/2006	871250	0.540		$ 38,000	$ 70,370
Tay-61	Sand Hill Ridge	Lot 18	N8169	Sand Hill Dr.	N	$ 29,900	2/5/2008	910111	0.500		$ 29,900	$ 59,800
Tay-62	Fisherman's Estates	Lot 41		Sturgeon St.	N	$ 38,000	11/7/2006	884125	0.540		$ 38,000	$ 70,370
Tay-63	Sand Hill Ridge	Lot 17	N8179	Sand Hill Dr.	N	$ 29,000	11/30/2007	906665	0.500		$ 29,000	$ 58,000
Tay-64	Rural			Fisherman's Road	N	$ 42,000	6/3/2009	939982	1.907		$ 42,000	$ 22,024
Tay-65	Rural			Sunset Dr.	N	$ 38,900	6/2/2006	873344	0.850		$ 38,900	$ 45,765
Tay-66	Rural			Silica Rd.	N	$ 48,000	11/1/2007	905011	2.080		$ 48,000	$ 23,077
Tay-67	Rural		N8566	Cty Rd QQ	N	$ 55,000	1/22/2007	887591	5.461		$ 55,000	$ 10,071
Tay-68	Rural			Stoneridge Dr.	N	$ 60,000	5/15/2006	874032	1.501		$ 60,000	$ 39,973
Tay-69	Park Ridge	Lot 11		Park Ridge Dr.	N	$ 58,900	2/10/2006	865888	1.148		$ 58,900	$ 51,307
Tay-70	Rural		N8593	Lakeview Rd.	N	$ 58,000	8/15/2007	900674	2.370		$ 58,000	$ 24,473
Tay-71	Rural			Lakeview Rd.	N	$ 40,000	5/16/2007	894831	1.240		$ 40,000	$ 32,258

The spread sheet from above has been translated into a chart on the next page. This chart plots the land sales within the influence of the wind turbines in red and those sales outside of this influence in blue. The blue regression line plots the best fit of predicted values of the land value outside of the influenced area and then this line is compared to the six land sales lying within the wind farm. The difference in value is plotted and referenced in the graph.

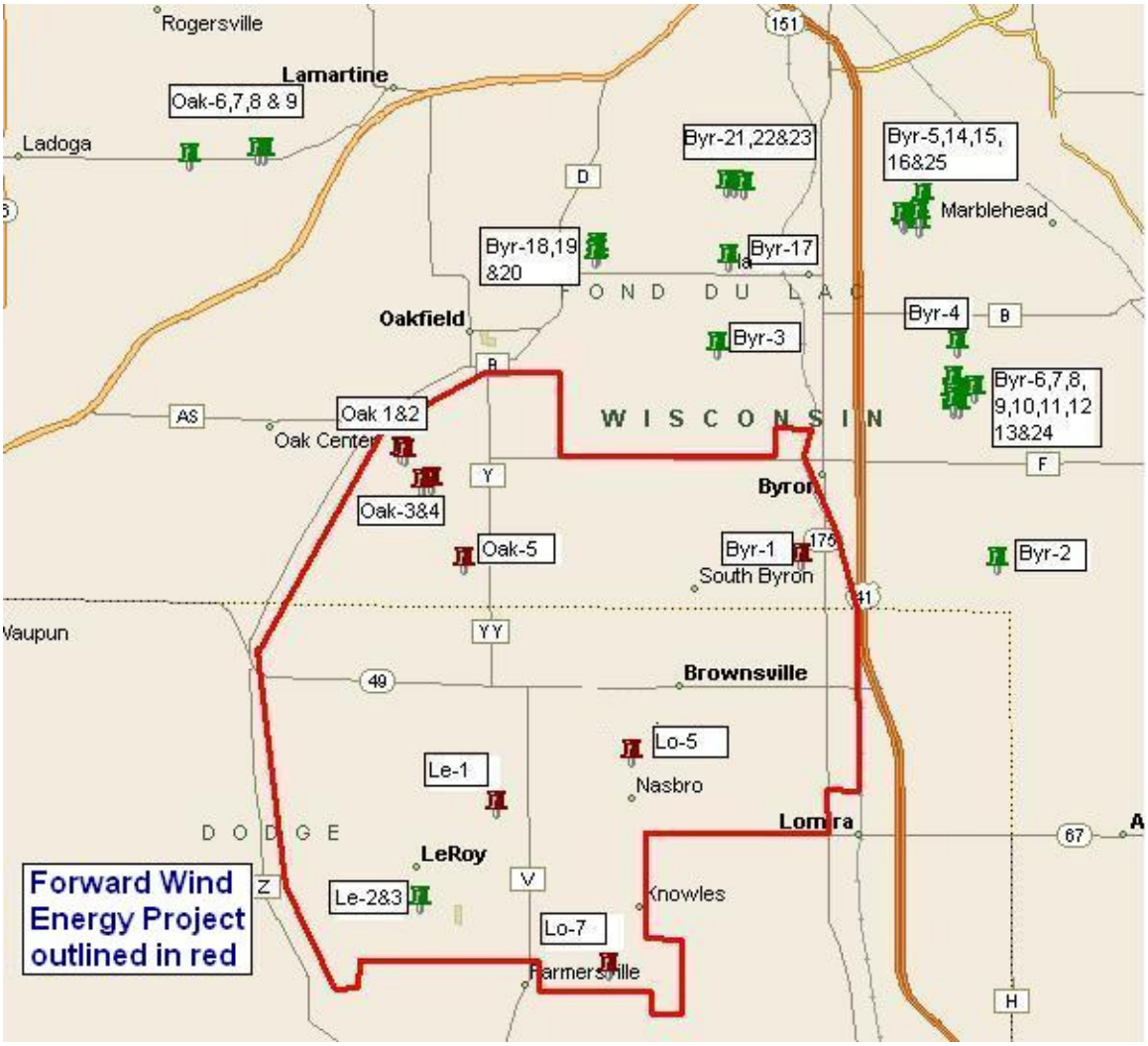

WE ENERGIES - BLUE SKY GREEN FIELD WIND FARM
1 acre to 8 acre residential land sales -- all sales included
$/acres
$ 100,000
$ 90,000
$ 80,000
$ 70,000
$ 60,000
$ 50,000
$ 40,000
$ 30,000
$ 20,000
$ 10,000
$ 0
0.000
2.000
4.000
6.000
8.000
Acres
Non-Wind Turbine Residential Lot Value
Wind Turbine Area Residential Lot Sales
Power (Non-Wind Turbine Residential Lot Value)
shows 19% loss
shows 23% loss
shows 60% loss
shows 74% loss
R² = 0.830
Total residential lot sales = 68 sales
Total wind turbine area = 6 sales
Total non-turbine area= 62 sales

SUMMARY & CONCLUSION

The sales study indicated three factors: (1) sales within the wind turbine influence area sold for less than those outside of this area; (2) there were substantially less sales available within the turbine influence area as compared to those sales outside of the influence area; and, (3) the impact of the wind turbines decreased the land values from -19% to -74%, with an average of -40%. Additionally, it can be said with a high rate of confidence that the impact of wind turbines on residential land sales is negative and creates a loss greater than -19% averaging -40%. It is logical to conclude that the factors that created the negative influence on vacant land are the same factors that will impact the improved property values. Therefore, it is not a leap of logic to conclude that the impact of wind turbines to improved property value would also be negative, most likely following the same pattern as the vacant land sales, that being greater than -19% averaging -40%.

Invenergy – Forward Wind Farm Sales Study

The area of study was the southwest section of Fond du Lac County and the northeast section of Dodge County being bordered by US Highway 41 to the east and Horicon Marsh to the west. The study included the townships of Oakfield and Byron in Fond du Lac County and Leroy and Lomira in Dodge County. A total of 34 vacant residential land sales were utilized for this study. From that total, 6 land sales were in the influence of the wind turbines (within the wind farm parameters) and 28 sales were located outside of that sphere of influence. The sales map for this study is pictured below:



All of these sales were the placed in a spread sheet that appears on the next pages.

INVENERGY – FORWARD WIND FARM SPREADSHEET

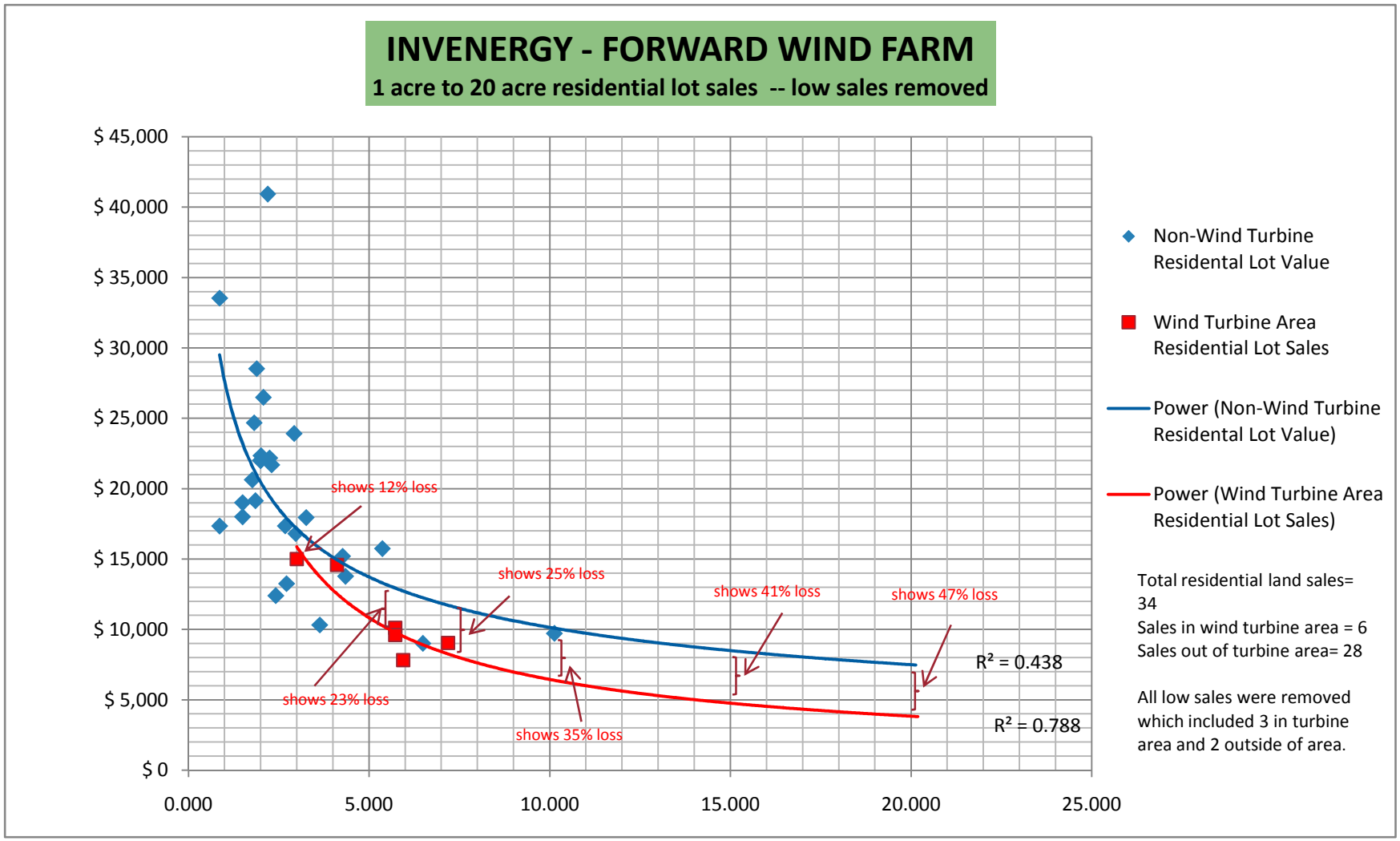
Salmon colored sales are within the wind turbine influence

Yellow colored sales are low sales both in and out of the turbine influence area removed from the chart analysis.

Identifier	Subdv	Lot	Street #	Street name	resale?	Sale Amt	Sale Date	Doc #	lot size in acres	adj Sale	$/ac
Byr-1	Rural			Cty Hwy Y	N	$ 46,500	5/29/2009	939508	5.947	$ 46,500	$ 7,819
Oak-2	Rural		W8162	Schoepke Rd.	N	$ 57,900	5/27/2005	848184	5.725	$ 57,900	$ 10,114
Lo-7	Rural		W2388	Farmersville Rd.	N	$ 60,000	8/5/2005	1051944	4.113	$ 60,000	$ 14,588
Oak-1	Rural		W8186	Schoepke Rd.	N	$ 55,000	6/15/2005	849179	5.724	$ 55,000	$ 9,609
Oak-5	Rural		W7810	Kinwood Rd.	N	$ 45,000	11/7/2005	860118	3.000	$ 45,000	$ 15,000
Lo-5	Rural			Rustic Rd.	N	$ 65,000	10/2/2007	1098197	7.188	$ 65,000	$ 9,043
Le-1	Rural		N11014	Dairy Rd.	N	$ 16,000	3/1/2005	1041761	4.000	$ 16,000	$ 4,000
Oak-3	Rural			Highland Rd.	N	$ 40,000	4/18/2006	870251	20.000	$ 40,000	$ 2,000
Oak-4	Rural			Highland Rd.	N	$ 30,000	4/18/2006	870206	15.000	$ 30,000	$ 2,000
Oak-6	Rural			Dehring Rd.	N	$ 30,000	8/14/2007	900404	5.000	$ 30,000	$ 6,000
Byr-17	Rural			Cty Hwy B	N	$ 38,700	1/18/2006	934701	5.719	$ 38,700	$ 6,767
Byr-10	Yellowstone Glen	Lot 10		Maple Ridge Dr.	N	$ 49,900	1/11/2008	909184	2.970	$ 49,900	$ 16,801
Byr-11	Yellowstone Glen	Lot 12		Maple Ridge Dr.	N	$ 49,900	9/7/2007	901728	2.250	$ 49,900	$ 22,178
Byr-12	Yellowstone Glen	Lot 9		Church Rd.	N	$ 64,900	12/19/2006	885873	4.270	$ 64,900	$ 15,199
Byr-13	Rural			Maple Lane	N	$ 35,500	12/3/2007	906831	1.855	$ 35,500	$ 19,137
Byr-14	Whispering Wind Estates	Lot 3	W5363	Abel Dr.	N	$ 36,500	12/20/2006	944576	1.770	$ 36,500	$ 20,621
Byr-15	Whispering Wind Estates	Lot 13		Abel Dr.	N	$ 89,900	4/20/2007	894055	2.197	$ 89,900	$ 40,919
Byr-16	Whispering Wind Estates	Lot 14		Bowe Ln.	N	$ 84,500	4/13/2007	892992	5.369	$ 84,500	$ 15,738
Byr-18	Rural		W7113	Briar Ct.	N	$ 50,000	1/3/2006	863679	2.306	$ 50,000	$ 21,683
Byr-19	Rural	Lot 4		Briar Ct.	N	$ 55,000	1/24/2007	887690	2.077	$ 55,000	$ 26,481

Byr-2	Rural		W5135	Cty. Rd. Y	N	$ 27,000	5/4/2006	871853	1.500	$ 27,000	$ 18,000
Byr-20	Rural	Lot 3		Briar Ct.	N	$ 58,500	6/28/2006	875130	3.260	$ 58,500	$ 17,945
Byr-21	Boda	Outlot 1		Lost Arrow Rd.	N	$ 58,500	11/23/2007	905816	6.492	$ 58,500	$ 9,011
Byr-22	Boda	Lot 3		Boda Lane	N	$ 30,000	8/31/2006	879134	2.420	$ 30,000	$ 12,397
Byr-23	Boda	Lot 6		Boda Lane	N	$ 28,500	3/14/2008	913416	1.500	$ 28,500	$ 19,000
Byr-24	Yellowstone Glen	Lot 18	W5143	Maple Ridge Dr.	N	$ 46,500	2/28/2006	867569	2.680	$ 46,500	$ 17,351
Byr-25	Whispering Wind Estates	Lot 19	W5384	Bowe Ln.	N	$ 70,000	12/28/2007	908457	2.927	$ 70,000	$ 23,915
Byr-3	Rural		N3866	Hickory Rd.	N	$ 36,000	7/11/2007	897417	2.717	$ 36,000	$ 13,250
Byr-4	Lonesome Oak		N3787	Shamrock Ct.	N	$ 37,500	6/28/2007	897801	3.636	$ 37,500	$ 10,314
Byr-5	Rural		W5326	Lost Arrow Rd.	N	$ 98,500	8/1/2008	920831	10.130	$ 98,500	$ 9,724
Byr-6	Yellowstone Glen	Lot 2	W5110	Maple Ridge Dr.	N	$ 44,900	3/29/2006	868808	1.820	$ 44,900	$ 24,670
Byr-7	Yellowstone Glen	Lot 17	W5133	Maple Ridge Dr.	N	$ 44,900	6/7/2006	873673	2.010	$ 44,900	$ 22,338
Byr-8	Yellowstone Glen	Lot 3		Maple Ridge Dr.	N	$ 53,900	11/12/2007	905595	1.890	$ 53,900	$ 28,519
Byr-9	Yellowstone Glen	Lot 8		Maple Ridge Dr.	N	$ 59,900	10/31/2007	907222	4.350	$ 59,900	$ 13,770
Le-2	Town		N10456	Cty. Rd. Y	N	$ 15,000	1/10/2005	1038920	0.865	$ 15,000	$ 17,341
Le-3	Town		N10456	Cty. Rd. Y	Y	$ 29,000	2/25/2005	1041336	0.865	$ 29,000	$ 33,526
Oak-7	Rural		W8870	Cty Hwy TC	N	$ 44,000	12/28/2007	908830	2.000	$ 44,000	$ 22,000
Oak-8	Rural			Cty Hwy TC	Y	$ 44,000	5/30/2008	917939	2.000	$ 44,000	$ 22,000
Oak-9	Rural			Cty Hwy TC	N	$ 44,000	5/29/2007	895852	2.000	$ 44,000	$ 22,000

The spreadsheet from above has been translated into a chart on the next page. This chart plots the land sales within the influence of the wind turbines in red and those sales outside of this influence in blue. The blue regression line plots the best fit of predicted values of the land value outside of the influenced area. The red regression line plots the best fit of predicted values of the land inside of the wind turbine influence. The difference in value between the two is plotted and referenced in the graph.


INVENERGY - FORWARD WIND FARM
1 acre to 20 acre residential lot sales -- low sales removed
$ 45,000
$ 40,000
$ 35,000
$ 30,000
$ 25,000
$ 20,000
$ 15,000
$ 10,000
$ 5,000
$ 0
0.000
5.000
10.000
15.000
20.000
25.000
shows 12% loss
shows 25% loss
shows 41% loss
shows 47% loss
shows 23% loss
shows 35% loss
R² = 0.438
R² = 0.788
Non-Wind Turbine Residental Lot Value
Wind Turbine Area Residential Lot Sales
Power (Non-Wind Turbine Residental Lot Value)
Power (Wind Turbine Area Residential Lot Sales)
Total residential land sales= 34
Sales in wind turbine area = 6
Sales out of turbine area= 28
All low sales were removed which included 3 in turbine area and 2 outside of area.

SUMMARY & CONCLUSION

The sales study indicated three factors: (1) sales within the wind turbine influence area sold for less than those outside of this area; (2) there were substantially fewer sales available within the turbine influence area as compared to those sales outside of the influence area; and, (3) the impact of the wind turbines decreased the land values from -12% to -47% with the average being -30%. Additionally, it can be said with a high rate of confidence that the impact of wind turbines on residential land sales is negative and creates a loss greater than -12%, averaging -30%. It is logical to conclude that the factors that created the negative influence on vacant land are the same factors that will impact the improved property values. Therefore, it is not a leap of logic to conclude that the impact of wind turbines on improved property value would also be negative, most likely following the same pattern as the vacant land sales, that being greater than -12% averaging -30%.

WIND TURBINE IMPACT – LITERATURE REVIEW

By Erik Kielisch

Introduction

The push for renewable energy is a global phenomenon. "Green" energy has swept the public consciousness, and wind farms are being promoted as a clean-air alternative to traditional energy sources.[1] The prevalent opinion is, "Wind is free. Why not harness it?" The wind industry claims wind turbines emit no greenhouse gases and produce electricity without using fossil fuels.[2] They also claim that the free nature of wind eliminates fuel cost uncertainty and stabilizes the overall price of electricity as compared to fossil-fueled power plants,[3] and thusly national security can be enhanced by diversifying and distributing such electricity generation resources.[4] Industry advocates claim wind energy development can create jobs, income and tax revenues – especially in rural communities where farmers can benefit from income opportunities through leasing.[5]

On the surface, it's an attractive option, but the reality is far less encouraging. Each industry claim has been widely contested by many, including several European countries the wind energy industry holds in high regard.

The focus on the ideals personified by wind power and the willful ignorance of its true costs and inefficiency has fast become a case of "symbolism over substance."[6] Though wind is free, harnessing it is not. Nor are wind farms benign, and the converting of blowing wind into electricity is anything but "green." As the following literature review summary will show, wind energy has many unresolved issues that warrant further investigation before committing the country's resources to its further development.

The Setting

When most Americans hear of wind farms, they think of the rustic water-pumping windmills found on turn-of-the-century farms or reruns of "Little House on the Prairie." These windmills are dwarfed by the turbines proposed and built worldwide. The most common height of a modern industrial-grade wind turbine used in wind farms is nearly 400 feet from base to blade tip. That's taller than the Statue of Liberty.[7] And the spinning diameter of the blades is wide enough to comfortably fit a Boeing 747.[8]

Though fossil fuels are a limited resource, the benefits of wind energy are equally limited. In their haste to promote renewable energy, many counties and states are approving wind farms with little research into how industrial-grade wind turbines impact the health of nearby residents, property values and the local economy.[9]

Health Issues

Many people living near operating wind turbines are reporting neurological and physiological disorders that are only resolved when the turbines are off or when the people leave the area. Common symptoms include sleeplessness, headaches, dizziness, unsteadiness and nausea, exhaustion, anxiety, anger, irritability and depression, problems concentrating and learning, and Tinnitus (ringing in the ears).[10] Symptoms can be experienced up to 1.2 miles away in rolling terrain; 1.5 miles away in valleys; and 1.9 miles away in mountainous regions.[11] These symptoms are being referred to as "Wind Tower Syndrome"[12] in the U.S., but they are the same symptoms of a proven ailment, Vibroacoustic Disease (VAD).[13]

In 2007, two Portuguese scientists found that the amount of infrasound and low frequency noise (LFN) generated by wind turbines is conducive to VAD.[14] Symptoms include: slight mood swings, indigestion, heartburn, mouth/throat infections, bronchitis, chest pain, definite mood swings, back pain, fatigue, skin infections (fungal, viral, and parasitic), inflammation of stomach lining, pain and blood in urine, conjunctivitis, allergies, psychiatric disturbances, hemorrhages (nasal, digestive, conjunctive mucosa) varicose veins, hemorrhoids, duodenal ulcers, spastic colitis, decrease in visual acuity, headaches, severe joint pain, intense muscular pain, and neurological disturbances.[15]

Though some may claim high frequency noise has no health effects, a study of before-and-after sound waveforms shows how overexposure to high frequencies can cause similar symptoms including: Tinnitus, headaches, sleeplessness, dangerously high blood pressure, heart palpitations, itching in the ears, eye watering, earaches and chest pressure.[16]

These symptoms can become so overwhelming that landowners have to leave their home to recover. In a case in Canada, four families had to abandon their homes near the wind farms – prompting the wind company to bury the turbines' collector line near the worst-hit homes. A collector line transports wind-generated electricity below ground within the turbine rows and above ground from the rows to the main substation.[17] The operator also installed an insulator between the neutral line and the grounding grid. It reduced the high frequencies, but didn't completely cure the situation.[18]

Most studies on the health impacts of wind turbines have been conducted in Canada and Europe – where turbines have long been operating. But in 2009, Minnesota's Department of Health released a study on the public health impact of wind turbines. They also found that wind turbines generate a broad spectrum of low-intensity (frequency) noise,[19] and houses do little to weaken LFNs.[20] Sleeplessness and headaches are the most common health and annoyance complaints associated with proximity to turbines.[21] LFN is typically a non-issue at more than a half mile, but differences in terrain or different wind conditions could cause the sound to reach further. Unlike LFN, shadow flicker can affect people outdoors and indoors. Minnesota's Department of Health recommended further testing to determine the LFN impact; evaluate potential impacts from shadow flicker and visibility; and estimate the cumulative noise impacts of all wind turbines.[22]

The noise produced from wind turbines is extremely complex, and it is the complexity of the noise and vibration which causes the disturbance.[23] A 2007 British study surveyed 39 residents already known to be suffering from problems they felt were due to their close

proximity to the turbines. On average, 75% of them reported fatigue, lack of sleep and headaches. Half reported stress and anxiety. And a quarter reported migraines, depression and Tinnitus.[24]

To counter health claims, the wind industry has quoted the World Health Organization's Community Noise Paper of 1995 which says, "There is no reliable evidence that infrasound below the hearing threshold produce physiological or psychological effects." However, the final WHO document of 1999 reversed that statement: "The evidence on low frequency noise is sufficiently strong to warrant immediate concern."[25]

According to Dr. Amanda Harry's 2007 study, "Wind Turbines, Noise and Health," people are affected by LFN because the human body is "in an extremely delicate state of equilibrium with the sonic environment and any profound disturbance of this system will have profound ramification to the individual."[26]

LFNs are mainly the result of the displacement of air by a blade and of turbulence at the blade surface.[27] LFN intensity changes with the wind and it can amplify audible, higher frequency sounds to create periodic sound. The effect is stronger at night – sometimes up to 15-18dBs higher – because of atmospheric differences. Multiple turbines can interact with each other to multiply the effect which will be greater for larger, more modern turbines.[28] LFNs contribute to the overall audible noise but they're mainly seismic – which is why people say they can "feel" the noise.[29]

Body vibration exposure at seemingly low frequencies from 1-20 Hz can have the following effects:[30]

- General feeling of discomfort 4-9 Hz
- Head symptoms 13-20 Hz
- Influence on speech 13-20 Hz
- Lump in throat 12-16 Hz
- Chest pains 5-7 Hz
- Abdominal pains 4-10 Hz
- Urge to urinate 10-18 Hz
- Influence on breathing 4-8 Hz

Over time, symptoms from LFN can have serious adverse physiological effects:[31]

- After 1-4 years: slight mood swings, indigestion, heartburn, mouth/throat infections, bronchitis.
- After 4-10 years: chest pain, definite mood swings, back pain, fatigue, skin infections, inflammation of stomach lining, pain and blood in urine, conjunctivitis, allergies.
- After 10 years: psychiatric disturbances, hemorrhages, varicose veins, hemorrhoids, duodenal ulcers, spastic colitis, blindness, headaches, severe joint pain, intense muscular pain, neurological disturbances.

One particular case in Nova Scotia, Canada has generated substantial press. The d'Entermont family home sits in the midst of a 17-turbine wind farm. Soon after the turbines began operating, the parents saw a noticeable shift in their six children's behavior. They started becoming more irritable, hearing ringing in the ears, lost concentration and developed high blood pressure. They had to move 30 miles away to resolve the health issues, and no one will buy their home.[32]

However, these symptoms don't affect everyone. Because wind is inconsistent, so too will be the noise (and thus health effects) caused by wind turbines.[33] As a result, the wind industry counters such health claims by relying on engineers and acoustics consultants who base their conclusions on engineering principles instead of on physiology like opposing audiologists and physicians who study the effect of sound and vibration on people.[34,35] Likewise, many environmentalists dismiss any health effects – claiming they're fictions fueled by not-in-my-backyard-ism.[36] However, experts in biomedical research have drawn different conclusions.[37]

The French National Academy of Medicine has warned that the harmful effects of sound related to wind turbines are insufficiently assessed. They consider wind turbines to be industrial installations and expect turbine operators to comply with specific regulations that address the harmful effects of sound particularly produced by these structures.[38]

This year, two families in Ontario, Canada had to move due to adverse health effects from nearby wind turbines. One of the displaced landowners said he started suffering from very high blood pressure, sore feet and irritability once the wind farm was online. Once he leaves the area, he quickly recovers. The wind company is paying for one of them to stay in a hotel while tests are being done on their property.[39]

In July of 2009, Sean Whittaker, vice president of policy for the Canadian Wind Energy Association said such health complaints are few. "There's no cause and effect relationship between audible sound produced by turbines and adverse health effects," Whittaker said. "…all research to date indicates that turbines do not produce infrasound at levels near enough to have impacts on humans."[40]

Elizabeth May, the former Executive Director of Sierra Club of Canada, vehemently defends wind energy but admits that literature studies show wind towers negatively affect human health. She makes a concession for better project siting – away from impacted citizens.[41]

But why do some suffer and others do not? Everyone's body is different. Some can be exposed to the flu and never catch it, while others succumb. Of three siblings with identical parentage, two may always be healthy and the third may suffer from extreme arthritis. The human body is complex and some are more resilient than others to outside influences.

Health Solutions

The international community recommends generous setbacks from wind farms in order to mitigate any potential health effects and loss to property values. The setbacks range from a minimal 1,500 foot setback[42] to 1½ miles away from any home, school or business.[43] Because

symptoms can be suffered up to a mile from a wind farm, one study suggests that turbines should be no closer than 1½ miles from a residence.[44] Others recommend an immediate and mandatory minimum buffer of 1¼ miles between a dwelling and an industrial wind turbine, and even more of a buffer between a dwelling and a wind turbine with greater than 2MW installed capacity.[45]

Other solutions include: filtering inverters at each turbine, burying all collector lines, filtering the power at the substation before going to the grid, and installing a proper neutral system to handle the high frequency return current.[46]

Wind Turbine Hazards

Wind turbines, like all machines, have weaknesses and are subject to accidents and failure. Inclement weather and strong gusts can snap off wind tower blades;[47] ice can build up on the blades, break and throw large ice chunks[48] and fling ice shards onto nearby homes[49,50] - potentially harming nearby residents;[51] turbulent wind can accelerate a blade's deterioration, weakening it to the point of breaking off and crashing into nearby homes;[52] high winds can also overpower its automatic braking system and result in structural failure; [53] automatic shut-down systems can malfunction, damaging the turbine to the point of collapse;[54] and gale force winds can shut down turbines and make them a safety concern. In one such case, British police cordoned off a 1,500 foot area around the wind farm for "safety precautions."[55] Other common problems include fires and blade disintegration caused by mechanical failures and lightning.[56]

In Europe, which has long had wind farms, they have seen an increase in turbine accidents, defects and needed repairs. A turbine's gearbox is expected to last 5 years and often quits before then. Due to the huge demand for turbines, manufacturers have no time to test their product before sending it into the field. And the demand has so strained manufacturing capabilities that the waiting list for replacement parts can sometimes top 18 months – leaving the turbine motionless in the meantime.[57]

Wind farms interfere with weather radar by sending false storm signals,[58] thus limiting the ability of people in surrounding areas to know if they should seek shelter or not. They also interfere with military radar, affecting military readiness.[59] And they may interfere with civilian radar,[60] making it dangerous to site turbines near airports or military installations.[61]

Despite the constant warning lights on top of each turbine, wind farms are dangerous to planes. A distance of 1,200 feet is still too close to an airport or landing strip because aircraft cannot turn fast enough to avoid the turbines. Also, turbines create a down draft – additional turbulence that pilots have to overcome in take offs and landing.[62]

In the 2007 *Burch v. Nedpower Mount Storm, LLC* decision, a West Virginia court found that wind farms can constitute a nuisance to nearby landowners. Even though the state's Public Service Commission approved the facility, the court ruled that such approval does not overrule the common law of nuisance.[63] Accepted causes of nuisance included noise, eyesore, flicker and strobe effect of light reflecting from blades, potential danger from broken blades, ice throws, and reduced property values.[64]

Conservation Concerns

Wind turbines have been found to adversely affect a wide variety of environmental, ecological, and scenic values.[65] Poor turbine sitings have led to bird and bat fatalities.[66] According to the American Bird Conservancy, wind towers kill 10,000 to 40,000 birds every year. However, this is still much lower than the 100 million window-related bird deaths each year.[67] Bat deaths, however, are killed three times as much as birds by wind turbines.[68] And many bats killed by turbines are most likely migrating for mating rituals. If such bats are killed then certain bat species are in danger of failing to repopulate.[69]

Aside from wildlife concerns, conservation groups are divided on wind energy. In North Carolina, environmentalists are fighting over siting issues. Some side with the wind companies and want to place wind turbines on mountain ridges for optimal winds. But other environmentalists want to keep them off the ridges in order to protect the mountains' natural beauty.[70]

According to the wind industry, the most damage to wildlife and plant-life happens during construction. After that, they say collision deaths are insignificant compared to the effects of other man-made structures, vehicles and pollution.[71] Turbine installation can also significantly affect natural drainage and ground water.[72]

The wind industry acknowledges is toxic or hazardous materials in the form of relatively small amounts of leaking lubricating oils, hydraulic and insulating fluids.[73] However, even small leakages of such materials can negatively impact ground water if left unchecked over time.[74] Fluid leaks not only drip directly downward, but they also fly off the tips of the spinning blades, thus spreading the contamination over a wider area.[75] On-site storage of new and used lubricants and cleaning fluids also constitutes a hazard.[76] To protect the public, the National Wind Coordinating Committee recommends setback requirements to provide "an adequate buffer" between wind generators and consistent public exposure and access.[77]

Property Values and Land Use

Wind industry advocates say little about a turbine's impact on property values. When they do address the issue, they deny that wind farms negatively impact property values. If they do admit impact, they say the only effect would be more time on the market.[78]

Mike Sagrillo, president of Sagrillo Power & Light Co. said that those who claim property value diminutions "pull myths out of thin air and persist in wild accusations despite being debunked."[79] To prove this point, wind industry advocates frequently refer to a 2004 study performed by the Renewable Energy Policy Project (REPP) – an organization dedicated to accelerating the use of renewable energy.

The REPP study, paid for by wind energy proponents, reviewed 25,000 assessment records of property sales within 5 miles of wind projects from 1998-2001 to determine if there was a negative effect on property values within the view shed of the wind farm projects. In 9

out of their 10 case studies, they found either no change in value or even an increase of value for those properties within the turbines' view shed.[80]

However, the conclusion that property values increased isn't verified.[81] They did not follow up with the property purchasers.[82] The REPP findings omit many necessary variables for analysis such as adjustments for a rising or falling market, number of days from listing to sale, residential property vs. rural property, effect of noise, flickering and shadows, distances of the homes from the turbines, and possible change in highest and best use due to the presence of the turbines.[83] By using assessment data, they measured mass property values, not individual property values, and assessments do not accurately reflect market value. The purpose of an assessment is to treat all property owners equally so the general tax burden is shared by all.

The REPP study also does not analyze whether or not the properties had a direct line of sight to the turbines, and the number of property transactions decreases the closer one approaches the wind farm. By only examining change in comparable property values over a three year period, the study weakens itself because, in most cases, the projects had been announced and debated long before the three-year window opened. As a result, any depressive effect on property values would have occurred prior to the start of the study.[84]

In contrast, others say close proximity to wind turbines can devalue a property 20-30%.[85] In analyzing potential impact to their township from a wind farm, the township of Centerville, Michigan disregarded the REPP study because of its flaws and bias in favor of wind energy.[86]

Industry advocates often liken wind turbines to other man-made structures like water towers.[87] But water towers don't move.[88] If they had no effect, then people would want to live near them. However, developers are balking at even building near wind turbines lest potential buyers of high-end homes be "spooked by the noise and visual distraction of the huge whirling fan blades."[89] In many cases there is a complete lack of interest in any homes near existing or planned wind farms. And when they do sell, they usually sell at less than current market value.[90]

At best, a wind turbine near a residential property can have no effect on the value and salability of the property. As one realtor explained, "Logically, as wind turbines produce constant audible noise over a large area, and as they intrude on the view shed, the only valid conclusion is that nearby residences are less valuable than they would be if there was no turbine nearby. Why would a buyer choose a house within sight and sound of a turbine, if a comparable house at the same price were available elsewhere, beyond the sight and sound of the turbine? It is totally counter-intuitive to suggest anything else."[91]

In the last couple years, Canadian assessors have begun to devalue homes that are at least 1,500 feet away from the nearest turbine. In Prince Edward Island, several residents near an industrial wind farm received up to a 10% lower property value due their proximity. The assessors considered the turbines as an industrial area and devalued nearby properties accordingly.[92]

As with other easements, some claim that the impact from windmills will diminish over time. However, studies from Europe show otherwise. In Germany, which has long had windmills, real estate agents report property value losses between 20-30% for properties in sight of wind farms.[93] And even though a minority may find windmills to be a nuisance,

property values can still drop $2,900 per turbine up to $16,000 for a property abutting 12 turbines.[94] Likewise, Scottish real estate agents found that a 41-turbine wind farm would result in $1 million in property value losses.[95]

Properties within wind farm areas may experience longer days on market. In his study, "Living with the Impact of Windmills," Real Estate broker Chris Luxemburger studied 600 sales over 3 years within proximity of a wind mill (interchangeable with "turbine") found that the days on market were more than double for properties within the windmill zone. Selling price was an average of $48,000 lower inside the zone than outside. And 11% of homes within the zone did not sell vs. 3% of homes outside the zone.[96]

Wind farms are normally built in rural locations. Therefore, apart from size, the main influences on value will often be the view, peace and serenity, and a rural environment. In many rural locations a wind farm will reduce the value of properties located nearby.[97] However, it has been observed in some rural farming areas that prices remained steady or even increased for those properties benefitting from the associated income stream from the turbine leases.[98] Many factors contribute to a loss in value, including: loss of a quality view, environmental noise pollution and the consequent health impact, shadow flicker and strobing light (which can have health repercussions). The further a dwelling is from wind turbines, the less impact they will have on property values and health.

In 2004, the township of Lincoln in Kewaunee, Wisconsin performed its own study and found that sales within one mile of the wind farm prior to installation were 104% of the assessed values. Properties selling after the wind farm installation in the same area were at 78% of the assessed value.[99] The UK has reported similar impacts up to a 20% loss in value from the presence of four 360-foot tall turbines 550 yards from a new home.[100]

In most cases, environmental noise pollution will influence the bulk of the property damages. In a well-populated rural area, the total financial damage on the community will substantially exceed the public interest that will be served from the wind farm.[101]

To counter claims of property value loss, the wind industry cites a 2006 study which shows no impact on property values from visibility of a constructed 20-turbine wind farm. The author, an environmental scientist graduate student, analyzed 280 arms-length residential home sales within 5 miles of the wind farm occurring between 1996 and 2005. He concludes that the lack of impact was due to wind farms "fitting the community's 'sense of place;'" payments "balanced" any adverse impacts; a well-respected landowner / proponent swayed others; and "possibly residents swapped local impacts for global benefits." However, the study does not include sales less than 4,000 feet from the windmills. It does not include any data on whether there were homes closer that did not sell. And of his 280 sales, only 43 had sold after the project started.[102]

The wind industry has referenced a 2007 British study of 919 home sales within 5 miles of a wind farm that found no impact from wind turbines on property value.[103] However, the turbines' maximum height was just over a third (124ft) of turbines being currently built. Additionally, the study omitted whether any of the sales could see the turbines. All distance zones and rural and town properties were combined together without differentiation. There was no before-and-after analysis of sale prices.[104] When interviewing general land agents, the study found 60% said that nearby wind farms would decrease property values in the view shed.

And 67% believed property value depreciation starts at the planning stages and lessen with time.[105]

In Kewaunee, Wisconsin, a 2007 study paid for by Invenergy, LLC – a wind farm developer – found no measurable difference in home values in the target areas close to the wind farms and the control areas outside of the wind farm vicinity. It found the same for a case study in Mendota, Illinois.[106]

However, even the possibility of a wind farm may have a more significant impact than the actual presence of one. In Michigan, a real estate agent lost a large vineyard sale because a proposed wind farm was seen as a detriment to potential buyers.[107] Wind farms in the UK are purposely avoiding populated areas in order to mitigate property value-based opposition.[108]

In 2006, concerned about the impact wind turbines may have on local property values, two members of the Centerville Township in Michigan conducted their own literature review of four available studies on the subject. The township committee concluded that the presence of wind turbine generators near residential houses causes property values to decline.[109] They concluded that the amount of negative impact is as high as $25,000 per property. In their words, "This is common sense, and there are no serious scholarly studies that support an opposite conclusion."

They found that large wind turbines can affect neighboring property values due to noise, health effects and visual impacts on residents. Some homes have been reported as "not salable" because of their proximity to wind turbines. Further impact on property values depends on location. These adverse impacts on property values may not exist in agricultural areas that have huge farms. If land is being sold as fertile farmland, then the presence (or absence) of a nearby wind turbine is probably irrelevant. If there is a chance that a future wind turbine might be placed on the property, a potential buyer might think the land was slightly more valuable.[110]

Though having a wind turbine on a property may create an income stream and thus increase a property's production value, it does not necessarily result in increased market value.[111] The wind turbine lessee incurs a higher property tax and receives annual rent for signing the lease/easement. The other landholders find their property values decreased, and they receive nothing.[112] Real Estate brokers in rural areas confirm that property values in wind farm areas are 10-30% less than similar properties outside of wind farm areas.[113]

View adds value to rural property. Take away the view, and you take away the value.[114] Homes with a turbine within 300 feet can suffer reduced property values of up to 10%. Noise, blinking lights, glare from the blades and vibrations all play a role in devaluation.[115] The value of a farmhouse may be affected by as much as 30% if it is in close proximity to a wind turbine.[116] In 2001 a British judge found that the noise, visual intrusion and flickering of a turbine a little over 1,800 feet away from a property negatively impacted local properties by 20%. According to the judge, "It is an incursion into the countryside. It ruins the peace."[117] Agents in Britain, Australia and the U.S.A. agree. They have found it nearly impossible to sell properties next to wind farms unless they discount it 20-30%.[118] "To me, it is absolute common sense that if you put up huge industrial structures in an exceptionally beautiful area, property prices are going to suffer," said British real estate agent, Kyle Blue.[119]

A 2004 realtor study around Nantucket Sound found that 49% of realtors expect property values to fall in proximity to a wind farm.[120] Two studies conducted in Nantucket, Massachusetts found that a 130-turbine offshore wind farm would drive enough visitors away to see a loss of up to 2,500 tourism-related jobs. They also found that inland property values would decline 4.6% while the waterfront properties suffer nearly 11% diminution for a total loss of $8 million in yearly tax revenue.[121]

In 2005, a successful Maryland realtor named Russell Bounds testified before the Maryland Public Service Commission as to the effect wind farms have on property values. In his experience he found that combining an area of natural beauty with industrial development like a wind farm will negatively impact its desirability. "It is not only devalued," Bounds said, "but the property may also be rendered unsaleable."[122]

Bounds further testified that property values up to a mile from the turbines will be negatively impacted. Beyond a mile the visual impact may still diminish property value. Closer to the turbines, the visual and the noise impact will substantially diminish special attributes of a property including scenic view, natural setting and peace and quiet. [123]

The impact of a wind turbine close to a property "takes a property of substantial value and takes away all of the characteristics that are the strengths of that property," Bounds said. "The visual impact takes away value. The noise takes away value. The property owners complain that the wind turbines take away value and there is no way for them to escape."[124]

In Maryland, a wind farm developer demonstrated the diminution of value when it bought two abutting properties to their wind farm and were unable to sell them for close to their purchase price. They bought one property for $104,447.50 and sold it for $65,000. They bought another property for $101,049.00 and shortly thereafter sold it for only $20,000.[125]

Studies have shown that fear of wind farms can negatively affect purchase prices. In his February 2009 study, "Impact of Wind Turbines on Market Value of Texas Rural Land," Appraiser Derry Gardner studied 350 acres of premium ranch land that were put on the market for $2.1 million. A prospective buyer agreed to the sale price but backed out when the seller disclosed a 27-turbine wind farm within a 1½ mile radius from the property. The seller discounted the land by 25%, but the buyer still declined to purchase. As of the study's publication, after two years on the market there has been little interest in the property despite its other positive characteristics.[126]

Independent studies have shown an average diminution of value up to -37% when the turbine is on the property; up to -26% average diminution for properties within 1,056 – 2,112 feet of a turbine; and up to -25% average diminution for properties within 1.8 miles of turbines. Properties can also suffer an additional 15-25% diminution in value due to infrastructure construction (clearing, blasting, digging, etc.), high voltage transmission power lines (HVTL) to transport generated electricity, substations, additional traffic for servicing turbines and HVTLs, and additional roads.[127]

Wind farms have the potential to impact local property values.[128] As the number of houses near to, or with a view of the installation increases, the likelihood of aesthetic or economic objections seems to increase.[129] To calm property owners, one township recommended that the wind farm developer provide property value assurances that are transferrable to subsequent owners of the wind facility.[130] Developers may wish to consider

compensating the community in some fashion that benefits even non-participants, such as impact payments to the township. Resulting benefits, such as reduced property taxes, may help to address concerns about inequities.[131]

Noise

Turbines make noise. The amount of noise can change with atmospheric conditions, wind speed, temperature, and terrain. Noise, particularly low frequency noise, travels not only seismically but also airborne over terrain. Hills and valleys can create a megaphone effect that can directionalize, combine and intensify the sounds of multiple turbines.[132,133] It can be noticeable for long distances in more remote areas with existing low ambient levels.[134] At the turbine's hub, the noise ranges from 100-105 dBA. People can differentiate sounds up to 3 dBA above background levels. [135]

The wind industry has said that the windy nature of rural locations often masks the quiet nature of modern turbines, even for "the very few individuals" located close enough to hear it.[136] However, turbine noise greatly affects people even a mile away, and low frequency noise can make people irritable.[137] Industry advocates say little, if anything, about infrasound or low frequency noise.

The environmental noise pollution from wind turbines built too close to dwellings causes serious discomfort and often health injury. Oftentimes those affected did not object to the construction, accepting the developer's assurances that noise would not be a problem.[138]

A common argument in support of wind turbines is that their noise is at lower sound pressure levels than highways and roadways. In contrast, a 2007 study found that noise annoyance associated with wind turbines hasn't decreased because the absolute noise level they create is less important than the character of the noise produced.[139] In other words, annoyance doesn't depend so much on the volume of sound created, it depends on what it actually sounds like. Wind turbines produce no constant tonality, making the creation of a noise standard challenging.[140]

The main issue appears to be low frequency sound waves. Two to three Hz can cause vomiting and other serious health issues. Twelve Hz can cause hallucinations.[141] Because of the deep foundations necessary to stabilize large wind turbines, LFN is transmitted down and throughout the contours of the land, often follows bedrock and even accelerates to emerge randomly miles from its origin.[142] Audible noises and LFN vibrations should be considered in siting along with the potential additional noise caused by broken machinery such as a failed bearing.[143]

Quality Of Life

To many, turbines are visually distracting, out of place and threaten residents' peace and quality of life.[144] Strobing light and shadows affect feelings of peace and solitude.[145]

Turbines generate flicker and shadows that can distract nearby motorists.[146] They also interfere with television signals, thus affecting the quality of life for nearby residents.[147]

Turbine-generated noise has an adverse impact on quality of life and may adversely impact the health of those living nearby. Research links noise to adverse health effects such as sleep deprivation and headaches. Sleep deprivation may lead to physiological effects such as a rise in cortisol levels – a sign of physiologic stress – as well as headaches, mood changes, and inability to concentrate. Initial research into the health impact of wind turbine noise (including the 'visual noise' of shadow flicker) reveals similar findings.[148]

Even proximity to small wind farms can have a serious impact on nearby residents. Concerned about the potential effects of a 22-turbine wind farm near their town, the township of Lincoln, Illinois surveyed its residents in 2001 and found that, on average, 42% were bothered by blade flicker and noise, had been awakened by turbine sound, and had TV reception problems. Nearby property owners also cited increased lightning activity, increased traffic hazards, annoyance at the tower's blinking lights, emergence of strange symptoms, and fears of EMFs. These tangible and intangible issues had an impact on the market value of nearby real estate. Reluctance to live near the turbines dramatically increased with proximity. For example, 41% of residents would not build or buy a home within 2 miles of the turbines. Within a half mile, 61% would not build or buy a home. And a quarter mile away from the turbines, 74% would not build or buy a home.[149] Wind farm developers said property values wouldn't suffer. But the town zoning administrator did his own empirical research and found that sales within 1 mile of the windmills prior to their construction were 104% the assessed value, and properties selling in the same area after construction were at 78%. Sales more than a mile away were at 105% the assessed value before and 87% after. They also found several properties have taken much longer than normal to sell.[150]

In New York, a landowner with a turbine on his property 2,000 feet from his house says the turbine rattles his windows, and he can hear some turbines a mile away in his house. The wind company said the turbine noise wouldn't exceed the sound of a refrigerator 900 feet away. He was joined by two other neighbors with similar complaints. They added that fellow neighbors in proximity to the turbines started experiencing seizures, anxiety attacks, learning disorders and other ailments once the turbines started running. Neither he nor the other leaseholders nor the town has received any promised compensation because the turbines are not selling into the grid. They were told the lights would be the softest available but they were instead much brighter than anticipated.[151]

Several case studies conducted by the wind industry show that landowners care little about nearby wind farms. In Oregon's Stateline Project, a 127-turbine farm covering 15 square miles in 2001 only sparked concerns over wildlife protection.[152] Southwest Minnesota has been building wind farms since 1995 ranging from 17 turbines to 143. Very few issues were raised during the review and permitting process and only after being built have issues emerged regarding poor television reception in proximity to the farms, additional noise generated by loose pieces of material within the blade at low speeds; cleanup of materials associated with turbine or blade modifications; complaints about aesthetic detriment; and bird health issues.[153]

In Highland County, Virginia, members of the rural mountain community fears that a proposed 19-turbine, 400-feet-tall-each project will blight their rural landscape and destroy the

area's scenic beauty. The wind farm developer claims the turbines can power 20k homes. Community response has been very negative. Residents are afraid the turbines will kill tourism – their only industry – and negatively impact property values.[154]

A proposed 67-tower wind farm near Delavan, Illinois sparked strong opinions among its affected community. Supporters say it will bring additional property tax revenue, jobs and clean energy. Its opponents say it will be an eyesore, a dangerous obstacle to crop dusters and would lower property values. An acoustical engineer from Michigan testified that the turbines would create noise that could affect nearby residents.[155]

In addition to landscape blight, many landowners are upset when the wind farms bring new transmission lines to transmit the wind energy to metro areas. But utilities are generally dismissive of such concerns. As the spokeswoman of Texas utility Oncor put it, "the importance of the transmission lines outweighs the aesthetic worries."[156]

In Europe, where wind farms have existed and operated for many years, many people do not want to be near them, especially in scenic areas.[157]

Wind Energy Production

Wind energy is gaining momentum in Wisconsin largely due to favorable geography, but it has its flaws. A typical coal-fired generating plant produces 500-600 megawatts of electricity per hour. Most wind turbines operate on average 30% of the time.[158] Invenergy, LLC forecast that their 133 turbines would generate 200 megawatts per hour.[159] However, the wind industry's average production percentages show that Invenergy's Forward Wind Farm in Fond du Lac and Dodge counties would generate 60 mWh (average).[160] In order to equal a fossil-fuel power plant, Invenergy would have to increase its farm 8 to 10 times its original size. A power plant typically covers a 40-acre footprint. Invenergy's wind farm covers a township. They would have to cover half a county to equal the output of one fossil-fueled power plant, and then only when the wind blows.

To make up the difference when the wind stops blowing, traditional power plants have to be constantly on (or "spinning") and generating reserve capacity equal to the maximum total power of wind turbines[161] – ready at any moment to be "ramped up" to stabilize the grid. This fluctuating backup system of spinning and ramping makes traditional power plants run inefficiently and increases fuel consumption (emissions). Keeping the necessary additional reserve capacity, and factoring in ramping up and down, will increase the fuel consumption (emissions) at least 8-10% compared with the steady operation of traditional power stations.[162]

Over 20 years of use in Europe, wind generated power has proven to be variable, unpredictable, uncontrollable and "routinely disappointing," according to UK energy expert, David White.[163]

In his 2007 study, "Calculating the Real Cost of Industrial Wind Power: An Information Update for Ontario Electricity Consumers," Keith Stirling, MA, summarized the Washington D.C.-based National Research Council of the National Academies 2007 report on the environmental impacts of wind energy projects. He summarizes their findings thusly, "Wind energy development will provide no reduction in emissions of sulfur and nitrogen oxides, the

pollutants responsible for acid rain and ground-level ozone. Regarding carbon dioxide, industrial wind turbines will offset national emissions by only 1.2-4.5% from the levels that otherwise would occur from electricity generation. [Most expert estimates are much lower however, usually around .0003%]. Wind power will not reduce carbon emissions of the U.S., but merely will slow the increase by a small amount."[164]

Even with generous government subsidies, wind energy is the highest cost option of available renewable energy sources.[165] It becomes more expensive to consumers once required backup and additional infrastructure are factored in. The high cost is caused by: A) the need to maintain backup generating reserve to cover times when the wind does not blow, B) the need to stabilize the grid when wind produces power that is not needed by current demand, and C) Government subsidization and tax benefits for the wind industry.[166]

Wind-power increases the complexity of the transmission and distribution system, and it is therefore inevitable that transmission losses [often estimated at 10%] will increase because of the additional miles of power lines required, both factors increasing costs.[167]

To help fund a new wind farm in Minnesota that will send its energy to Wisconsin, Alliant Energy proposes to raise electric and natural gas rates by 2010 – resulting in citizens having to pay nearly $9 more per month per household on their electric bill and $2.40 more per month per household on their gas bill. The farm will include 122 turbines, 400-feet tall each with 130-foot blades. As of July of 2009, Wisconsin citizen watchdog groups were criticizing Wisconsin's Public Service Commission's minimal review and questioning the project's need.[168]

In his introduction to his Environmentally Responsible Wind Power Act of 2005, U.S. Senator Lamar Alexander stated, "Wind produces puny amounts of high-cost unreliable power…Congress should not subsidize the destruction of the American landscape."[169]

To promote wind energy, many government entities have not factored in the real emissions impact of matching both demand and wind output simultaneously. As a result, many current policies incorrectly assume that CO2 emissions savings are guaranteed by the introduction of wind-power, and ignore wind power's difficulties and costs.[170]

Ireland's Electricity Supply Board published evidence in 2004 showing that as the level of wind capacity increases, the CO2 emissions increase with the variation of wind-power output.[171] Unlike natural gas or coal, wind energy cannot be physically stored on an industrial scale. Consequently, generation and demand have to be continuously balanced on the grid. Fossil-fuelled capacity operating as reserve and backup is required to accompany wind generation and stabilize supplies to the consumer.[172]

Operating gas turbines by ramping up and down generates more CO2 per kWh of electrical generation than if the gas turbines were operated on the normal planned load. Dependent on the weather forecasts, it may be possible to shut down some capacity for brief periods, but this may frequently be for only a matter of hours. Fuel is then wastefully consumed and CO2 emitted as the plant is started up again, without any power being generated, before it is returned to load-bearing grid service. Gas turbines are not made to handle frequent ramping and start-ups. This not only increases the CO2 emissions, but also causes otherwise avoidable wear and tear, and so shortens the periods between overhauls, thereby adding to maintenance costs and eventually resulting in a 15% increase in electricity cost.[173]

Merging wind-generated power into the power system is more complex than simply shutting down traditional power plants whenever the wind blows. The feed-in capacity can change frequently within a few hours.[174,175] And half of the time, wind power in-feed is less than two-thirds of its annual average.[176,177] Starting up and shutting down power plants may take minutes or hours, depending on the type of plant, while power may be needed in seconds. Unlike a conventional plant, wind output is not related to customer demand. Maximum wind production may occur during low customer demand periods, or at times of peak demand there may be little or no wind-generated power.

Canada knows all too well the irregular nature of wind. In Ontario, Canada they found that wind output changes have shown one distinct pattern: winds tend to be calm when consumers need electricity most. Northerners use the most electricity in summer – their weakest season for wind. Although winter is the strongest season, on the coldest days, when people use the most power, wind output tends to be poorest. Over the typical day, wind output peaks around midnight and bottoms out around 8 a.m., contrary to daily consumption.[178]

While Ontario's new wind generation has reduced fossil fuel generation when wind output is available, the wind production pattern – output falls during the early morning – has offset this benefit by lowering the fuel efficiency of the flexible fossil generators used for ramping, increasing air emissions per unit of production, and increasing maintenance costs.[179]

Ontario's 2006 Energy Probe reviewed a 2004 German study of their grid reliability and found that the proposed tripling of wind capacity in Germany by 2020 is alone driving a need for quintupling generation reserve requirements.[180] Wind power construction must be accompanied by almost equal construction of new conventional power plants, which will be used very nearly as much as if the wind turbines were not there.[181,182]

Germany hosts approximately 11,000 turbines which provide 4.7% of Germany's gross demand. Even then the electricity is sporadic because the wind blows when it likes, as it likes, and where it likes – which, unfortunately, is rarely in places where large quantities of power are required.[183] Likewise, the Danes, long held as a prime example of wind energy in action, reported in 2004 that increased development of wind turbines did not reduce their CO2 emissions.[184]

The increased use of wind power in Germany has resulted in uncontrollable fluctuations in generation due to the random character of wind power feed-in. This significantly increases the demands placed on the control balancing process and increases grid costs. Their massive increase of new wind farms in recent years has greatly increased their need for fossil-fueled reserve capacity. [185,186]

As wind power generating capacity increases, its ability to displace conventional sources decreases. Wind power is essentially adding surplus capacity rather than replacing conventional plants. One-third of the time, widespread wind power facilities in the U.K. (which boasts the best wind resource in Europe) would be producing at less than 14% of the turbines' capacity.[187,188]

Wind farms only provide electricity when the wind is strong enough but not too strong. As they suddenly provide electricity when the wind changes, the grid operator must match this changed supply of electricity to the existing demand. This is achieved by switching a power station to spinning standby mode so it can provide electricity when the wind changes again.

Spinning reserves provide no useful electricity and do not reduce emissions from power generation.[189]

Promoters of wind energy routinely overstate environmental benefits. They advocate that each kilowatt-hour (kWh) of electricity produced by a wind turbine displaces the same amount of fuel-use and emissions associated with a kWh of electricity produced by a fossil-fuel generating unit. However, the saving of CO2 emissions is not proportional to the amount of fossil-fueled power that it displaces. Necessary spinning reserve fossil-fired capacity emits more CO2/kWh than if the plant were optimized, thus offsetting much of the benefit of wind.[190] In addition to the assumption of kWh-per-kWh offsets, wind energy advocates often use outdated information about emissions when making their claims, not taking into account the difference made by newer, cleaner burning fossil fueled plants.[191]

The more wind power capacity is in the grid, the lower percentage of traditional generation it can replace. A wind farm of 24,000 turbines with a generating capability of 48,000 MW would replace just 2,000 MW of conventional generation, the equivalent to two medium-sized coal stations.[192]

The greater the distance between the source of generation and center of demand, the greater the losses during transmission. Currently these losses are estimated at 10-15%.[193] This is a problem since most wind turbines are in rural locations and far from the need.

Even at 10,000 turbines across the country, the UK will still not be able to supply 15% of its energy through wind turbines by 2020. Environmentalists say it's necessary to stop Global Warming while others point out how thousands of more wind turbines will blight their land.[194]

The high cost and low return of wind farms is acknowledged by the U.S. National Association of Attorney Generals. In a 2008 presentation, they concluded that, despite being "green" wind farms are a high-cost alternative with a large footprint but small power output.[195]

As we have seen from empirical research gleaned from a worldwide search, wind turbines produce very little electricity.[196] They have a high capital cost,[197] and poor capacity utilization.[198] Why, then, is wind-power the beneficiary of such extensive support if it is incapable of providing consistent power to replace traditional power plants, does not achieve the CO2 reductions required, and causes cost increases in backup, maintenance and transmission, while at the same time discouraging investment in clean, firm generation capacity?[199]

Wind Farms = Tax Havens

In light of the technical limitations of wind turbines, it makes sense to ask why wind farms remain so popular. Two factors seem to take precedence. Firstly, the U.S. government is requiring states to provide a certain percentage of their energy with green energy solutions by 2020. Utilities have to find some alternative energy to invest in. The second reason appears to be that utilities receive generous subsidies and tax incentives to build wind farms. The tax breaks include federal and state accelerated depreciation, production tax credits, and reduced (or forgiven) property and sales taxes.[200]

Wind farms are very attractive to utilities looking to bury taxable income. For example: A company proposing a new 300 megawatt wind farm costing $300,000,000 would be able to:

1. Shelter approximately $132 million from federal income tax liability in the tax year when the project went into service, an additional $67.2 million in the second year, $40.3 million in the third year, and the remaining $60.5 million in the next 3 years because of generous accelerated depreciation allowed for wind farms.[201]
2. Deduct an additional $14,191,200 per year for 10 years from its federal tax liability because of federal Production Tax Credits of $0.018 per kWh for all electricity produced.[202]
3. Escape significant corporate income tax liability because the federal accelerated depreciation reduces taxable income.[203]
4. Avoid most normal liabilities associated with other taxes including Business and Occupation taxes and property taxes.[204]

The above federal and state tax breaks add up to a total of $325,434,600 for the first 10 years. The tax breaks for wind farm owners shift tax burdens to remaining taxpayers, further degrading expected local economic benefits. The value of the tax breaks to the wind plant owner could easily exceed the owner's income from the sale of electricity, particularly in the early years of the project.[205]

Wind farms are heavily dependent upon large ratepayer and taxpayer subsidies and mandates to compete against conventional electrical power generation sources.[206] Electricity sales contribute approximately 30% of a renewable station's income, while the remaining 70% comes from indirect subsidy paid for by the consumer, whether they have elected for 'green' energy or not.[207]

Since opposition to wind farms can lead to costly delays, some New York energy companies were found to be unethically influencing municipal officers to allow the development of develop wind farms. As a result, New York's Attorney General drafted a Wind Code of Ethics to publicize every aspect of future wind farms and restrict such companies from influencing officials. Since there were no exiting ethical laws concerning the municipal officers, the Attorney General sought to rectify it with this work-around.[208] However, the Code is voluntary, and signers are required to help fund a government agency whose job it is to regulate the signers. The effectiveness of such a code is symbolic at best.

Economic Impact

How do wind farms impact local economies? Industry advocates say wind farms will add jobs and tax revenues to local communities, while their opponents say their adverse impacts on property values, tourism and the environment effectively neutralize any perceived economic benefits. Champaign County of Ohio estimated that a 100MW wind farm would yearly generate the tax dollar equivalent of 449 homes; and they estimated a 300MW farm would generate the tax dollar equivalent of 1,347 homes. They anticipate significant positive local property tax impacts are possible – assuming they can tax and collect at local levels.[209]

Unfortunately, wind farms contribute little to county property taxes. In some states, wind energy producing equipment is exempt from property taxes, and taxable items may be limited to the foundation and tower structure. Some developers also apply for additional local tax relief.[210]

Additional tax revenues are frequently mentioned as a positive reason to build wind farms.[211] General Electric, a major wind turbine manufacturer, claims that over the long term wind farms will add $250 million to the US Treasury.[212] However, they acknowledge they will only begin to "pump money into the US Treasury" once the Production Tax Credits expire. [213] PTCs are good for the first 10 years of a wind farm's production. They project 10 million metric tons per year of CO2 emissions avoided.[214] They project creating thousands of short-term construction jobs with a long-term employment of 1,600 over 20 years or more of operation.[215] In contrast, the Township of Bethany, New York, found in 2007 that, beyond the temporary construction phase, wind farm projects have little to no significant job impact.[216]

Despite potential benefits of wind farm projects, The Bacon Hill Institute – a public policy research group – studied a proposed wind farm in Nantucket Sound and found it failed the cost-benefit test recommended by the U.S. government for assessing large-scale projects. The wind farm developer stressed the value of wind power as a source of clean, renewable energy. But the study found that the overall economic costs of the project would exceed benefits by $211.8 million. Without $241 million from state and federal subsidies, the project would not be financially viable. And while the farm may generate some wind energy jobs, the impact on tourism would result in a net loss of 1,000 local jobs.[217]

Losing tourism is a major concern of any locale that depends on the allure of their land to attract visitors and support the economy. The success of rural enterprises is inextricably linked with the maintenance and conservation of a healthy, attractive and irreplaceable rural appeal.[218] Wind turbines are largely seen as a chief threat to such areas.

Rural tourism is big business in the UK (worth appx. $26.7 billion) and supports up to 800,000 jobs. In a 2006 study, the UK's Small Business Council examined the impact wind farms would have on small businesses – specifically those dependent on rural tourism. They found that 75% of visitors say the quality of the landscape and countryside is the most important factor in choosing a destination. Between 47% and 75% of visitors felt that wind turbines damage the landscape quality. Of the three areas they studied, they found that 11% of visitors would avoid the first area, resulting in a loss of $48.5 million and 800 jobs. Approximately 7% of visitors would not return to the second area, resulting in a loss of $117 million and 1,753 jobs. In the third area, just 5% would stay away, but its lost affluence would result in $668.5 million lost along with 15,000 jobs. In some areas, 49% of all sectors of rural businesses experienced a negative impact.[219]

In a separate tourist area of the UK, five wind farms are proposed totaling 71 turbines along 18 miles. In a pilot survey of 1,500 visitors, the Council found that approximately 95% of the visitors said wind turbines would spoil their enjoyment of the landscape. And this spoiling directly translates into less business from tourism and lost jobs.[220]

They studied another tourist area in the UK, and found that two-thirds of local businesses said turbines are visually intrusive. While 54% thought wind turbines would increase their 'green' credentials, 27% believed it would still have a negative impact on the tourism

industry by reducing visitor numbers. After the details of the tower heights were revealed the next year, the 27% grew to 39% who felt the 400-foot-high turbines would make visitors stop visiting completely.[221]

In North Devon, an area renowned for its beauty, a before-and-after survey was conducted to gauge visitors' feelings toward possible wind farms. Before details of their 300' height were revealed, 34% were generally favorable and 66% unfavorable towards turbines. After the size and location of the turbine proposals was revealed, the number of 'unfavorable' visitors rose to 84%. When asked if wind farms would affect their choice of holiday destination, less than 50% claimed that they would still choose North Devon. A further 39% said they would choose North Devon but subject to the size and location of the wind farms. Eleven percent would completely avoid North Devon.

Scotland is also proposing wind farms, but a visitor survey found that 15% of visitors would not return if wind turbines are built – resulting in a potential loss of $133.7 million and 3,750 jobs.[222]

In Vermont, the state government wants green energy at the potential cost of impacting its natural beauty.[223] But even in a prime location like on the top of a windy ridge, wind turbines sit idle 40% of the time.[224,225]

Wind farms negatively impact pastoral beauty, thus severely damaging rural Vermont's main industry: tourism.[226] Tourists don't want to pay to look at wind turbines, but wind supporters claim the turbines themselves will become an attraction and boost tourism.[227] The wind industry tried making them attractions in the UK, and both failed. In 1999, a visitors' center was built in Norfolk, UK – then home to one of the largest turbines in the world. It ran out of money and closed in 2002. Then in 2001, a $9.1 million visitor center was built with hopes of attracting 150,000 annual visitors to its wind farm. Despite opening to much publicity it attracted less than a tenth of projected visitors, and it went bankrupt. Its CEO said, "Sadly, just like many eco-attractions, they're not sustainable; there's just not enough interest."[228]

Conclusion

After reviewing articles and studies on wind energy, wind turbines appear to have a negative impact on the property values, health, and quality of life of residents in close proximity. Of the studies that found no impact on property value, nearly all were funded by wind farm developers or renewable energy advocacy groups. Of the studies and reports showing property loss, the average negative effect is -20.7%.

It is equally reasonable to conclude that some residents in close proximity to wind turbines experience genuine negative health effects from Low Frequency Noise, infrasound and blade flicker. Of the studies and reports cited, an average setback of little over a mile should significantly lessen detrimental health effects. In addition to noise and flicker issues, disrupted TV and cell phone receptions contribute to negatively impact the quality of life for residents living in close proximity to wind turbines.

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