

THE EFFECT OF WIND DEVELOPMENT ON LOCAL PROPERTY VALUES

R E P P
RENEWABLE ENERGY POLICY PROJECT

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CHAPTER I. PROJECT OVERVIEW

THE CLAIM AGAINST WIND DEVELOPMENT

Wind energy is the fastest growing domestic energy resource. Between 1998 and 2002 installed capacity grew from 1848 MW to 4685 MW, a compound growth rate of 26 percent. Since wind energy is now broadly competitive with many traditional generation resources, there is wide expectation that the growth rate of the past five years will continue. (Source for statistics: www.awea.org).

As the pace of wind project development has increased, opponents have raised claims in the media and at siting hearings that wind development will lower the value of property within view of the turbines. This is a serious charge that deserves to be seriously examined.

NO EXISTING EMPIRICAL SUPPORT

As a result of the expansion of capacity from 1998 to 2002, it is reasonable to expect any negative effect would be revealed in an analysis of how already existing projects have affected property values. A search for either European or United States studies on the effect of wind development on property values revealed that no systematic review has as yet been undertaken.

As noted above, the pace of development and siting hearings is likely to continue, which makes it important to do systematic research in order to establish whether there is any basis for the claims about harm to property values. (For recent press accounts of opposition claims see: *The Charleston Gazette*, WV, March 30, 2003; and *Copley News Service*. Ottawa, IL, April 11, 2003).

This REPP Analytical Report reviews data on property sales in the vicinity of wind projects and uses statistical analysis to determine whether and the extent to which the presence of a wind power project has had an influence on the prices at which properties have been sold. The hypothesis underlying this analysis is that if wind development can reasonably be claimed to hurt property values, then a careful review of the sales data should show a negative effect on property values within the viewshed of the projects.

A SERIOUS CHARGE SERIOUSLY EXAMINED

The first step in this analysis required assembling a database covering every wind development that came on-line after 1998 with 10 MW installed capacity or greater. (Note: For this Report we cut off projects that came on-line after 2001 because they would have insufficient data at this time to allow a reasonable analysis. These projects can be added in future Reports, however.) For the purposes of this analysis, the wind developments were considered to have a visual impact for the area within five miles of the turbines. The five mile threshold was selected because review of the literature and field experience suggests that although wind turbines may be visible beyond five miles, beyond this distance, they do not tend to be highly noticeable, and they have relatively little influence on the landscape's overall character and quality. For a time period covering roughly six years and straddling the on-line date of the projects, we gathered the records for all property sales for the view shed and for a community comparable to the view shed.

For all projects for which we could find sufficient data, we then conducted a statistical analysis to determine how property values changed over time in the view shed and in the comparable community. This database contained more than 25,000 records of property sales within the view shed and the selected comparable communities.

THREE CASE EXAMINATIONS

REPP looked at price changes for each of the ten projects in three ways: Case 1 looked at the changes in the view shed and comparable community for the entire period of the study; Case 2 looked at how property values changed in the view shed before and after the project came on-line; and Case 3 looked at how property values changed in the view shed and comparable community after the project came on-line.

Case 1 looked first at how prices changed over the entire period of study for the view shed and comparable region. Where possible, we tried to collect data for three years preceding and three years following the on-line date of the project. For the ten projects analyzed, property values increased faster in the view shed in eight of the ten projects. In the two projects where the view shed values increased slower than for the comparable community, special circumstances make the results questionable. Kern County, California is a site that has had wind development since 1981. Because of the existence of the old wind machines, the site does not provide a look at how the new wind turbines will affect property values. For Fayette County, Pennsylvania the statistical explanation was very poor. For the view shed the statistical analysis could explain only 2 percent of the total change in prices.

Case 2 compared how prices changed in the view shed before and after the projects came on-line. For the ten projects analyzed, in nine of the ten cases the property values increased faster after the project came on line than they did before. The only project to have slower property value growth after the on-line date was Kewaunee County, Wisconsin. Since Case 2 looks only at the view shed, it is possible that external factors drove up prices faster after the on-line date and that analysis is therefore picking up a factor other than the wind development.

Finally, **Case 3** looked at how prices changed for both the view shed and the comparable region, but only for the period after the projects came on-line. Once again, for nine of the ten projects analyzed, the property values increased faster in the view shed than they did for the comparable community. The only project to see faster property value increases in the comparable community was Kern County, California. The same caution applied to Case 1 is necessary in interpreting these results.

If property values had been harmed by being within the view-shed of major wind developments, then we expected that to be shown in a majority of the projects analyzed. Instead, to the contrary, we found that for the great majority of projects the property values actually rose more quickly in the view shed than they did in the comparable community. Moreover, values increased faster in the view shed after the projects came on-line than they did before. Finally, after projects came on-line, values increased faster in the view shed than they did in the comparable community. In all, we analyzed ten projects in three cases; we looked at thirty individual analyses and found that in twenty-six of those, property values in the affected view shed performed better than the alternative.

This study is an empirical review of the changes in property values over time and does not attempt to present a model to explain all the influences on property values. The analysis we conducted was done solely to determine whether the existing data could be interpreted as supporting the claim that wind development harms property values. It would be desirable in future studies to expand the variables incorporated into the analysis and to refine the view shed in order to look at the relationship between property values and the precise distance from development. However, the limitations imposed by gathering data for a consistent analysis of all major developments done post-1998 made those refinements impossible for this study. The statistical analysis of all property sales in the view shed and the comparable community done for this Report provides no evidence that wind development has harmed property values within the view shed. The results from one of the three Cases analyzed are summarized in Table 1 and Figure 1 below.

REGRESSION ANALYSIS

REPP used standard simple statistical regression analyses to determine how property values changed over time in the view shed and the comparable community. In very general terms, a regression analysis “fits” a linear relationship, a line, to the available database. The calculated line will have a slope, which in our analysis is the monthly change in average price for the area and time period studied. Once we gathered the data and conducted the regression analysis, we compared the slope of the line for the view shed with the slope of the line for the comparable community (or for the view shed before and after the wind project came on-line).

TABLE 1: SUMMARY OF STATISTICAL MODEL RESULTS FOR CASE 1

Project/On-Line Date	Monthly Average Price Change (\$/month)	
	View Shed	Comparable
Riverside County, CA	\$1,719.65	\$814.17
Madison County, NY (Madison)	\$576.22	\$245.51
Carson County, TX	\$620.47	\$296.54
Kewaunee County, WI	\$434.48	\$118.18
Searsburg, VT	\$536.41	\$330.81
Madison County, NY (Fenner)	\$368.47	\$245.51
Somerset County, PA	\$190.07	\$100.06
Buena Vista County, IA	\$401.86	\$341.87
Kern County, CA	\$492.38	\$684.16
Fayette County, PA	\$115.96	\$479.20

While regression analysis gives the best fit for the data available, it is also important to consider how “good” (in a statistical sense) the fit of the line to the data is. The regression will predict values that can be compared to the actual or observed values. One way to measure how well the regression line fits the data calculates what percentage of the actual variation is explained by the predicted values. A high percentage number, over 70%, is generally a good fit. A low number, below 20%, means that very little of the actual variation is explained by the analysis. Because this initial study had to rely on a database constructed after the fact, lack of data points and high variation in the data that was gathered meant that the statistical fit was poor for several of the projects analyzed. If the calculated linear relationship does not give a good fit, then the results have to be looked at cautiously.

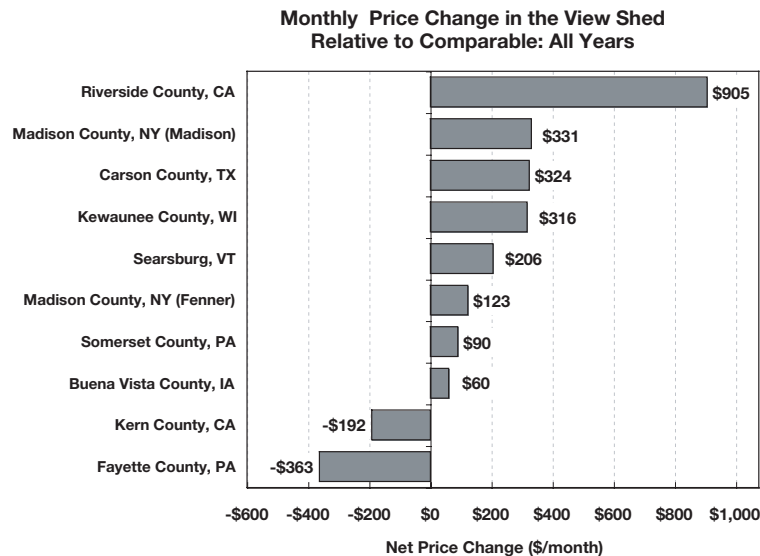


FIGURE I: MONTHLY PRICE CHANGE IN THE VIEW SHED
RELATIVE TO COMPARABLE: ALL YEARS

CASE RESULT DETAILS

Although there is some variation in the three Cases studied, the results point to the same conclusion: the statistical evidence does not support a contention that property values within the view shed of wind developments suffer or perform poorer than in a comparable region. For the great majority of projects in all three of the Cases studied, the property values in the view shed actually go up faster than values in the comparable region. Analytical results for all three cases are summarized in Table 2 below.

TABLE 2: DETAILED STATISTICAL MODEL RESULTS

Location: Buena Vista County, IA
Project: Storm Lake I & II

Model	Dataset	Dates	Rate of Change (\$/month)	Model Fit (R2)	Result
Case 1	View shed, all data	Jan 96 - Oct 02	\$401.86	0.67	The rate of change in average view shed sales price is 18% greater than the rate of change of the comparable over the study period.
	Comparable, all data	Jan 96 - Oct 02	\$341.87	0.72	
Case 2	View shed, before	Jan 96 - Apr 99	\$370.52	0.51	The rate of change in average view shed sales price is 70% greater after the on-line date than the rate of change before the on-line date.
	View shed, after	May 99 - Oct 02	\$631.12	0.53	
Case 3	View shed, after	May 99 - Oct 02	\$631.12	0.53	The rate of change in average view shed sales price after the on-line date is 2.7 times greater than the rate of change of the comparable after the on-line date.
	Comparable, after	May 99 - Oct 02	\$234.84	0.23	

Location: Carson County, TX
Project: Llano Estacado

Model	Dataset	Dates	Rate of Change (\$/ month)	Model Fit (R2)	Result
Case 1	View shed, all data	Jan 98 - Dec 02	\$620.47	0.49	The rate of change in average view shed sales price is 2.1 times greater than the rate of change of the comparable over the study period.
	Comparable, all data	Jan 98 - Dec 02	\$296.54	0.33	
Case 2	View shed, before	Jan 98 - Oct 01	\$553.92	0.24	The rate of change in average view shed sales price after the on-line date is 3.4 times greater than the rate of change before the on-line date.
	View shed, after	Nov 01 - Dec 02	\$1,879.76	0.83	
Case 3	View shed, after	Nov 01 - Dec 02	\$1,879.76	0.83	The rate of change in average view shed sales price after the on-line date increased at 13.4 times the rate of decrease in the comparable after the on-line date.
	Comparable, after	Nov 01 - Dec 02	-\$140.14	0.02	

Location: Fayette County, PA
Project: Mill Run

Model	Dataset	Dates	Rate of Change (\$/ month)	Model Fit (R2)	Result
Case 1	View shed, all data	Dec 97-Dec 02	\$115.96	0.02	The rate of change in average view shed sales price is 24% of the rate of change of the comparable over the study period.
	Comparable, all data	Dec 97-Dec 02	\$479.20	0.24	
Case 2	View shed, before	Dec 97 - Nov 01	-\$413.68	0.19	The rate of change in average view shed sales price after the on-line date increased at 3.8 times the rate of decrease before the on-line date.
	View shed, after	Oct 01-Dec 02	\$1,562.79	0.32	
Case 3	View shed, after	Oct 01-Dec 02	\$1,562.79	0.32	The rate of change in average view shed sales price after the on-line date is 13.5 times greater than the rate of change of the comparable after the on-line date.
	Comparable, after	Oct 01-Dec 02	\$115.86	0.00	

Location: Kern County, CA
Project: Pacific Crest, Cameron Ridge, Oak Creek Phase II

Model	Dataset	Dates	Rate of Change (\$/ month)	Model Fit (R2)	Result
Case 1	View shed, all data	Jan 96 - Dec 02	\$492.38	0.72	The rate of change in average view shed sales price is 28% less than the rate of change of the comparable over the study period.
	Comparable, all data	Jan 96 - Dec 02	\$684.16	0.74	
Case 2	View shed, before	Jan 96-Feb 99	\$568.15	0.44	The rate of change in average view shed sales price is 38% greater after the on-line date than the rate of change before the on-line date.
	View shed, after	Mar 99 - Dec 02	\$786.60	0.75	
Case 3	View shed, after	Mar 99 - Dec 02	\$786.60	0.75	The rate of change in average view shed sales price after the on-line date is 29% less than the rate of change of the comparable after the on-line date.
	Comparable, after	Mar 99 - Dec 02	\$1,115.10	0.95	

Location: Kewaunee County, WI
Project: Red River (Rosiere), Lincoln (Rosiere), Lincoln (Gregorville)

Model	Dataset	Dates	Rate of Change (\$/ month)	Model Fit (R2)	Result
Case 1	View shed, all data	Jan 96 - Sep 02	\$434.48	0.26	The rate of change in average view shed sales price is 3.7 times greater than the rate of change of the comparable over the study period.
	Comparable, all data	Jan 96 - Sep 02	\$118.18	0.05	
Case 2	View shed, before	Jan 96 - May 99	-\$238.67	0.02	The increase in average view shed sales price after the on-line date is 3.5 times the decrease in view shed sales price before the on-line date.
	View shed, after	Jun 99 - Sep 02	\$840.03	0.32	
Case 3	View shed, after	Jun 99 - Sep 02	\$840.03	0.32	The average view shed sales price after the on-line date increases 33% quicker than the comparable sales price decreases after the on-line date.
	Comparable, after	Jun 99 - Sep 02	-\$630.10	0.37	

Location: Madison County, NY
Project: Madison

Model	Dataset	Dates	Rate of Change (\$/ month)	Model Fit (R2)	Result
Case 1	View shed, all data	Jan 97 - Jan 03	\$576.22	0.29	The rate of change in average view shed sales price is 2.3 times greater than the rate of change of the comparable over the study period.
	Comparable, all data	Jan 97 - Jan 03	\$245.51	0.34	
Case 2	View shed, before	Jan 97 - Aug 00	\$129.32	0.01	The rate of change in average view shed sales price after the on-line date is 10.3 times greater than the rate of change before the on-line date.
	View shed, after	Sep 00 - Jan 03	\$1,332.24	0.28	
Case 3	View shed, after	Sep 00 - Jan 03	\$1,332.24	0.28	The rate of change in average view shed sales price after the on-line date increased at 3.2 times the rate of decrease in the comparable after the on-line date.
	Comparable, after	Sep 00 - Jan 03	-\$418.71	0.39	

Location: Madison County, NY
Project: Fenner

Model	Dataset	Dates	Rate of Change (\$/ month)	Model Fit (R2)	Result
Case 1	View shed, all data	Jan 97 - Jan 03	\$368.47	0.35	The rate of change in average view shed sales price is 50% greater than the rate of change of the comparable over the study period.
	Comparable, all data	Jan 97 - Jan 03	\$245.51	0.34	
Case 2	View shed, before	Jan 97 - Nov 01	\$587.95	0.50	The rate of decrease in average view shed sales price after the on-line date is 29% lower than the rate of sales price increase before the on-line date.
	View shed, after	Dec 01 - Jan 03	-\$418.98	0.04	
Case 3	View shed, after	Dec 01 - Jan 03	-\$418.98	0.04	The rate of decrease in average view shed sales price after the on-line date is 37% less than the rate of decrease of the comparable after the on-line date.
	Comparable, after	Dec 01 - Jan 03	-\$663.38	0.63	

Location: Riverside County, CA**Project: Cabazon, Enron, Energy Unlimited, Mountain View Power Partners I & II, Westwind**

Model	Dataset	Dates	Rate of Change (\$/ month)	Model Fit (R2)	Result
Case 1	View shed, all data	Jan 96 - Nov 02	\$1,719.65	0.92	The rate of change in average view shed sales price is 2.1 times greater than the rate of change of the comparable over the study period.
	Comparable, all data	Jan 96 - Nov 02	\$814.17	0.81	
Case 2	View shed, before	Jan 96 - Apr 99	\$1,062.83	0.68	The rate of change in average view shed sales price is 86% greater after the on-line date than the rate of change before the on-line date.
	View shed, after	May 99 - Nov 02	\$1,978.88	0.81	
Case 3	View shed, after	May 99 - Nov 02	\$1,978.88	0.81	The rate of change in average view shed sales price after the on-line date is 63% greater than the rate of change of the comparable after the on-line date.
	Comparable, after	May 99 - Nov 02	\$1,212.14	0.74	

Location: Bennington and Windham Counties, VT**Project: Searsburg**

Model	Dataset	Dates	Rate of Change (\$/ month)	Model Fit (R2)	Result
Case 1	View shed, all data	Jan 94 - Oct 02	\$536.41	0.70	The rate of change in average view shed sales price is 62% greater than the rate of change of the comparable over the study period.
	Comparable, all data	Jan 94 - Oct 02	\$330.81	0.45	
Case 2	View shed, before	Jan 94 - Jan 97	-\$301.52	0.88	The rate of change in average view shed sales price after the on-line date increased at 2.6 times the rate of decrease before the on-line date.
	View shed, after	Feb 97 - Oct 02	\$771.06	0.71	
Case 3	View shed, after	Feb 97 - Oct 02	\$771.06	0.71	The rate of change in average view shed sales price after the on-line date is 18% greater than the rate of change of the comparable after the on-line date.
	Comparable, after	Feb 97 - Oct 02	\$655.20	0.78	

Location: Somerset County, PA**Project: Excelon, Green Mountain**

Model	Dataset	Dates	Rate of Change (\$/ month)	Model Fit (R2)	Result
Case 1	View shed, all data	Jan 97 - Oct 02	\$190.07	0.30	The rate of change in average view shed sales price is 90% greater than the rate of change of the comparable over the study period.
	Comparable, all data	Jan 97 - Oct 02	\$100.06	0.07	
Case 2	View shed, before	Jan 97 - Apr 00	\$277.99	0.37	The rate of change in average view shed sales price after the on-line date is 3.5 times greater than the rate of change before the on-line date.
	View shed, after	May 00 - Oct 02	\$969.59	0.62	
Case 3	View shed, after	May 00 - Oct 02	\$969.59	0.62	The rate of change in average view shed sales price after the on-line date increased at 2.3 times the rate of decrease in the comparable after the on-line date.
	Comparable, after	May 00 - Oct 02	-\$418.73	0.23	

Each of the three Cases takes a different approach to evaluating the price changes in the view shed and comparable community. By finding consistent results in all three Cases, the different approaches help to address concerns that could be raised about individual approaches. The selection of the comparable community is based upon a combination of demographic statistics and the impressions of local assessors and is inherently subjective. It is possible that arguments about the legitimacy of the selection of the comparable could arise and be used to question the legitimacy of the basic conclusion. However, since Case 2 looks only at the view shed and since the results of the Case 2 analysis are completely consistent with the other Cases, the selection of the comparable community will not be crucial to the legitimacy of the overall conclusion. To take another example, Case 1 uses data from the entire time period, both before and after the on-line date. We anticipate possible criticisms of this Case as masking the “pure” effect of the development that would only occur after the project came on-line. However, Cases 2 and 3 look separately at the before and after time periods and produce results basically identical to the Case 1 results. Because all three Cases produce similar results, Cases 2 and 3 answer the concerns about Case 1.

THE DATABASE

The results of the analysis depend greatly upon the quality of the database that supports the analysis. The Report is based on a detailed empirical investigation into the effects of wind development on property values. The study first identified the 27 wind projects over 10 MW installed capacity that have come on-line since 1998. REPP chose the 1998 on-line date as a selection criterion for the database because it represented projects that used the new generation of wind machines that are both taller and quieter than earlier generations. (REPP did not consider projects that came on-line in 2002 or after since there would be too little data on property values after the on-line date to support an analysis. These projects can be added to the overall database and used for subsequent updates of this analysis, however.) REPP chose the 10 MW installed capacity as the other criterion because if the presence of wind turbines is having a negative affect it, should be more pronounced in projects with a large rather than small number of installations. In addition, we used the 10 MW cut-off to assure that the sample of projects did not include an over-weighting of projects using a small number of turbines.

Of the 27 projects that came on-line in 1998 or after and that were 10MW or larger installed capacity, for a variety of reasons, 17 had insufficient data to pursue any statistical analysis. For six of the 17 projects we acquired the data, but determined that there were too few sales to support a statistical analysis. For two of the remaining 11, state law prohibited release of property sales information. The remaining nine projects had a combination of factors such as low sales, no electronic data, and paper data available only in the office. (For a project-by-project explanation, see Chapter 2 of the Report.)

For each of the remaining ten projects, we assembled a database covering roughly a six-year period from 1996 to the present. For each of these projects we obtained individual records of all property sales in the “view shed” of the development for this six-year period. We also constructed a similar database for a “comparable community” that is a reasonably close community with similar demographic characteristics. For each of the projects, we selected the comparable community on the basis of the demographics of the community and after discussing the appropriateness of the community with local property assessors. As shown in Table 3 below, the database of view shed and comparable sales included more than 25,000 individual property sales. The initial included database of view shed and comparable sales included over 25,000 individual property sales. After review and culling, the final data set includes over 24,300 individual property sales, as shown in Table 3 below.

TABLE 3: NUMBER OF PROPERTY SALES ANALYZED, BY PROJECT

Project/On-Line Date	Viewshed Sales	Comparable Sales	Total Sales
Searsburg, VT / 1997	2,788	552	3,340
Kern County, CA / 1999	745	2,122	2,867
Riverside County, CA / 1999	5,513	3,592	9,105
Buena Vista County, IA / 1999	1,557	1,656	3,213
Howard County, TX / 1999*	2,192	n/a	2,192
Kewaunee County, WI / 1999	329	295	624
Madison Co./Madison, NY / 2000	219	591	810
Madison Co./Fenner, NY / 2000**	453	591	1,044
Somerset County, PA / 2000	962	422	1,384
Fayette County, PA / 2001	39	50	89
Carson County, TX / 2001	45	224	269
TOTAL	14,842	9,504	24,346

*Howard County, TX comparable data not received at time of publication.

**Both wind projects in Madison County, NY, use the same comparable. Column totals adjusted to eliminate double counting.

RECOMMENDATIONS

The results of this analysis of property sales in the vicinity of the post-1998 projects suggest that there is no support for the claim that wind development will harm property values. The data represents the experience up to a point in time. The database will change as new projects come on-line and as more data becomes available for the sites already analyzed. In order to make the results obtained from this initial analysis as useful as possible to siting authorities and others interested in and involved with wind development, it will be important to maintain and update this database and to add newer projects as they come on-line.

Gathering data on property sales after the fact is difficult at best. We recommend that the database and analysis be maintained, expanded and updated on a regular basis. This would entail regularly updating property sales for the projects already analyzed and adding new projects when they cross a predetermined threshold, for example financial closing. In this way the results and conclusions of this analysis can be regularly and quickly updated.