Information Brief

Springfield-Sangamon County Regional Planning Commission

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Key Findings:

After reviewing some of the most often cited literature concerning the effect of wind farms on property values, the SSCRPC found:

-- No compelling research indicating that proximity to a wind farm results in a measurable decline in property values over time. Research was found indicating that people might *believe* it would lead to such a decline, which may result in a short-term decline prior to property owners gaining experience with a wind farm.

-- A trend in the quantitative research indicating that wind farms have no significant effect on surrounding property values, and may in some limited cases increase property values in an area. The belief that wind farms depress property values may have such an effect on the most proximate properties over the near term.

-- A great deal of econometric analysis indicating the overall economic benefits of wind farms to the areas in which they are located, which may affect surrounding property values and disguise any minimal losses for individual properties.

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Effect of Wind Farms on Property Values

A Brief Review of the Literature

The potential development of large-scale wind farms in Sangamon County has raised questions concerning their potential effect on local property values. This is not unimportant in that property often represents a family's largest investment.

Opponents of wind farms have pointed to such factors as changes in the income-earning potential of the property, aesthetic appearance of the turbines, and noise, as potentially reducing the value of surrounding properties. Proponents have argued that these factors are mitigated or eliminated by regulations that establish setback, aesthetic and noise requirements for wind farms, and that there is little empirical research that shows that wind farms negatively affect the value of surrounding property. They contend that under certain circumstances wind farms may even increase land value.

This report provides a brief review of some of the most often cited literature concerning the effect of wind farms on property values, as well as more recent studies. In conducting the research for this paper the SSCRPC focused on empirical research that had been subjected to scholarly review or provided enough information that scholarly review would be possible. We found that while there was a good deal of material prepared by both opponents and proponents of wind farms (and many of the studies noted below are cited by both to advance their arguments), there was not much independent analysis and a tendency toward qualitative (e.g., anecdotal, case-based) and opinion survey-based studies, rather than quantitative (e.g., land transaction-based) research, although this trend is changing.

The research would indicate that this is a difficult question to answer because property values are affected by many variables outside of the presence or absence of a wind farm. Additionally, wind farms are typically located in sparse rural communities with few property sales transactions for comparison; especially close to the wind farms. This leaves any study open to methodological challenge, even if that challenge is specious.

Recent research does suggest an anticipatory effect resulting in a short term decline in property values for residential properties in close proximity to the project. This loss appears to be corrected over time as residents gain more experience with the wind farm. However, the trend in the research leads us to conclude that there is no compelling finding to indicate that proximity to wind farms results in a decline in property values that is of significant magnitude or lasting.

The Studies Reviewed

As Hoen points out in his 2006 review of the literature surrounding the effect of wind farms on property values (Hoen, 2006, pp. iii-iv, and 6-18), the literature has typically been rather limited, often contradictory, and sometimes poorly constructed. Hinman (2010, pp. 15-19), for example, provides a list of 98 localized analyses of wind farms in relationship to property values, finding that 61 (62.3%) found no relationship between proximity to a wind farm and property values, 27 (27.6%) found a positive relationship, and 10 (10.2%) found a negative relationship. These 98 studies are of mixed empirical value, but include cases from one turbine to over 3,500, done from 1994 to 2009, and involving as little as one property to as many as 9,000.

In addition to these limitations, many of the studies do not differentiate between the pre-construction and post-construction periods of wind farm development, which reduces the predictive power of some the research. Hoen et al. (2011) report that:

> One of the overall conclusions that can be drawn from this literature is that wind facilities are often *predicted* to negatively impact residential property values in pre-construction surveys (Haughton, Giuffre, Barrett, and Tuerck, 2004; Khatri, 2004; Firestone, Kempton, and Krueger, 2007; Kielisch, 2009), but negative impacts have largely failed to materialize post-construction when actual transaction data become available for analysis (Jerabek, 2001; Sterzinger, Beck, and Kostiuk, 2003; Hoen, 2006; Poletti, 2007; Sims, Dent, and Oskrochi, 2008). (pp. 280-281. Italics in the original.)

For these reasons the SSCRPC found it important to consider the trend in the literature as well as the difference one finds between land values post wind farm announcement as well as post-construction. A number of the studies mentioned by Hoen above, as well as others, will be discussed further in this regard.

One of the oldest and most quoted studies of the effect of wind farms on land values was conducted by the Renewable Energy Policy Project (REPP) under federal agency sponsorship (Sterzinger et al., 2003). Noting that no systematic review of the impact on property values had been done at the time the study was undertaken, the authors looked at 10 existing wind farm projects under three different cases. The study found no support for the contention that wind farm development would harm property values:

> 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. (Sterzinger et al, p.2).

While objections to the REPP report have been raised on methodological grounds (see, for example, Energy Center of Wisconsin, 2004, Part 3, pp. 119-137; Hoen, 2006, pp. 16-18), other studies have come to the same conclusion regarding the effect of the view shed on property values.

Since the areas in which wind farms are typically located are rural ones, our attention was drawn to a study (Pedden, 2006) by the National Renewable Energy Laboratory (NREL). NREL is a laboratory of the US Department of Energy operated by Battelle's Midwest Research Institute. This study compiled completed studies on the economic impact of wind farms in rural communities and then compared them. While the majority of the studies considered dealt with the larger economic effects of wind farms, one study specifically addressed property values by considering whether or not views of wind turbines negatively affected property values. This study (ECONorthwest, 2002) focused on the Kittitas County, WA, wind farms and estimated the effects of the increase in jobs and local spending on property values, the local economy, and tax revenues. The study found that views of wind turbines would not negatively impact property values. This conclusion was repeated in a 2006 update of that study funded by the State of Washington's Office of Trade and Economic Development and the Energy Foundation. It noted:

> Based on a nation-wide survey conducted of tax assessors in other areas with wind power projects, we find no evidence supporting the claim that views of wind farms decrease property values. (ECONorthwest, 2006, p. 1).

Other studies of individual wind farm locations have shown similar results. A study of a site in Franklin County, New York, was conducted to determine if various factors associated with wind farms would affect local property values (Lloyd, 2007). The primary conditions specific to wind farms that might affect surrounding property values were seen as the view shed, noise and shadow flicker from the turbine blades. Three wind farms in New York State, each of which had been in operation for over five years, were considered in the analysis, and the effect of each was considered separately. The study found:

> …no influence on property values since the construction and operation of the wind farm. Average sales prices on a whole have increased indicating that the existence of the wind farm has not diminished real property values in this sub market. Additionally, the subject target area has appreciated at a similar rate as the remaining county … [and] [i]n conclusion it appears that the existence of the wind farm does not appear to have any impact on surrounding property values as a whole. (pp.19, 23, 30, 32)

An additional study of an existing site was conducted in Madison County, NY, in 2006 (Hoen, 2006). This study considered the adverse effects of wind farm visibility on surrounding property values. It analyzed 280 arms-length single-family residential sales that took place from 1996-2005 within five miles of a wind farm in Madison County. The analysis found no measurable effect of wind farm visibility on property transaction values, even for properties concentrated within one mile of the wind farm and those that sold immediately following the announcement and construction of the wind farm (Hoen, 2006, pp. 34-37).

This result is consistent with other studies. Sims and Dent (2007) studied 919 home transactions within five miles of two wind farms in the United Kingdom, finding that the limited evidence of a relationship between proximity to a wind farm and sales prices was due to other causes[1]. A subsequent study (Sims et al., 2008) of 199 residential transactions within a quarter mile of a wind facility in Cornwall, UK, found no relationship between the number of wind turbines and sales prices.

[1] See also Carter, 2011, pp. 6-7, for a discussion of this study as well as the Sims, et al., 2008 study.

Although conducted for a wind energy company, two studies by Poletti (2005; 2007) are instructive because they attempted to provide a comparison between target groups of homes and control groups using a *t*-Test. These studies compared the mean sales prices of 187 and 256 homes in Illinois and Wisconsin located near wind facilities with those further away, finding no statistical evidence that homes near wind farms sold for different prices than those further away.

The 2006 study by Hoen was ultimately expanded upon by Hoen and others under the auspices of the U.S. Department of Energy's Office or Energy Efficiency and Renewable Energy (Hoen et al., 2009). This study may be the most comprehensive and data-rich study of this subject to date[2], as it collected data on nearly 7,500 sales of single family homes situated within 10 miles of 24 existing wind farms in nine different states. It used eight different hedonic pricing models (used by economists and real estate professionals to assess the impacts of house and community characteristics on property values by investigating the sales prices of homes; see Hoen et al., pp. 4-6) as well as repeat and sales volume models in assessing possible wind farm impacts on property values.

Unlike previous studies, this study considered specific factors associated with wind farms that had been said to affect property values; what the researchers termed *Area Stigma* (the concern that the general area surrounding a wind energy facility would appear more developed, which might adversely affect home values in the local community regardless of whether any individual home has a view of the wind turbines), *Scenic Stigma* (the concern that a home may be devalued because of the view of a wind energy facility, and the potential impact of that view on an otherwise scenic vista), and *Nuisance Stigma* (the concern that factors that may occur in close proximity to wind turbines, such as sound and shadow flicker, will have a unique adverse influence on home values) (Hoen et al., p. 2).

The study concluded that:

> …none of the models uncovers conclusive evidence of the existence of any widespread property value impacts that might be present in communities surrounding wind energy facilities. Specifically, neither the view of the wind facilities nor the distance of the home to those facilities is found to have any consistent, measurable, and statistically significant effect on home sales prices. Although the analysis cannot dismiss the possibility that individual homes or small numbers of homes have been or could be negatively impacted, it finds that if these impacts do exist, they are either too small and/or too infrequent to result in any widespread, statistically observable impact. (Hoen et al., p. iii).

Additional analysis of this data (Hoen et al., 2011) concluded that the quality of the scenic vista did affect sales prices, but that:

> Despite this finding, the models are unable to identify any evidence of a scenic vista stigma associated with the wind facilities in the sample…Specifically, the 25 homes with extreme views in the sample, where the home site is "unmistakably dominated by the

[2] Following dissemination of the Jan. 2010 update to this paper, it was brought to our attention that the Hoen et al. study was negatively critiqued in an unpublished paper by Wilson (2010) available on Mr. Wilson's website. Many of the issues noted by Wilson appear identical to those posed earlier by the Industrial Wind Action Group (IWAG), of which the SSCRPC was already aware. These IWAG criticisms were addressed by Wiser et al. in a 2009 paper. We would refer the reader to these papers for a complete consideration of the methodological issues discussed, and provide this footnote for informational purposes.

> [visual] presence of the turbines," are not found to have statistically different selling prices than either those that sold in the same period but which did not have a view…or that sold prior to the wind facility's construction…The same finding holds for the 106 and 561 homes that were rated as having either moderate or minor views of the wind turbines, respectively. (p. 300)

Similar results were again also found for Area and Nuisance stigmas: to the extent that an impact was found, it was not statistically significant (pp. 300-303).

The results regarding Nuisance stigma are particularly informative in that this stigma is associated with potential effects on properties nearest to the wind turbines (e.g., noise, shadow flicker). One particular finding of note was that homes nearest the wind facilities tended to have more depressed values than those further away *prior* to the announcement of the wind farm, meaning that "relative prices did not fall after the announcement and eventual construction of the wind facility" for the sample of homes included in the study (pp. 303-304.) We believe that this is due to the fact that wind farms are most often located in remote rural areas, leading to lower residential home values, and speculate that wind farm operators seek the lowest property use costs while property owners (most often farmers and ranchers) prefer that their least productive property be used for this purpose.

In light of their results, the researchers concluded that if effects on property value do exist, they: (i) exist only at very close range to the turbines; (ii) are of small magnitude outside 800 feet; (iii) fade over time; and (iv) are either too small or too infrequent to result in any statistically observable impact (Hoen et al., 2011, p. 308). If further research confirms the finding, the conclusion that if such effects exist they are of small outside 800 feet is of particular note as this may help inform municipal setback requirements designed to address factors associated with Nuisance stigma.

More recently, Hinman (2010) and Carter (2011) conducted studies specific to Illinois.

Hinman examined whether or not proximity to Phases I and II of the 240-turbine Twin Groves wind farm in eastern McLean County, IL, had an impact on neighboring property values and whether property values changed over different stages of wind farm development (pre-announcement of the wind farm until after wind farm construction.) This analysis is considered particularly instructive due to: the similarities between McLean and Sangamon counties; its consideration of property values prior to project announcement through to operation; its addressing property transactions in much closer proximity to the wind farm than did the 2006 study by Hoen et al.; and its use of a pooled hedonic regression analysis that improved upon the method used by Hoen et al. in the 2009 study discussed above.

The Hinman study considered 3,851 residential property transactions in McLean and Ford counties that occurred from Jan. 1, 2001, through Dec. 1, 2009, comparing property transactions within one mile of the wind farm to those outside of this area. The results did indicate a "location effect", but a transient one. Hinman provides this summary of her results:

> The results demonstrate that before Twin Groves I and II were even approved by the McLean County Board, properties near the eventual wind farm site were valued less on average than properties located further away from the eventual wind farm site, and these results are statistically significant across all estimations. Thus, a *location effect* exists such that the wind farm happened to locate in an area that already exhibited depressed property values in comparison to other areas within parts of McLean and Ford Counties…

> Some of the estimation results support the existence of *wind farm anticipation stigma theory*, meaning that property values may have diminished due to the uncertainty surrounding a wind farm project regarding the aesthetic impacts on the landscape, the actual noise impacts from the wind turbines, and just how disruptive the wind farm will actually be.
>
> However, the results demonstrate that in comparison to properties in many of the surrounding areas in McLean and Ford Counties, properties in close proximity to Twin Groves I and II (*Near Wind Farm*) experienced higher appreciation rates, in addition to, higher property value levels (in percentage terms) after the wind farm achieved commercial operations (*Wind Farm Operation*), Thus, during the operational stage of the wind farm project, as surrounding property owners living close to the wind turbines acquired additional information on the aesthetic impacts on the landscape and actual noise impacts of the wind turbines to see if any of their concerns materialized, property values rebounded and soared higher in real terms than they were prior to wind farm approval. (Hinman, p. 83; italics in the original.)

In other words, to the extent that Hinman found a reduction in property values near the wind farm, this reduction appeared to be the result of property owners *anticipating* negative impacts, not the *result* of any negative impacts. Once the anticipated negative impacts were unrealized, values rebounded and increased in real terms. We interpret this as the nearby property owners perceiving an increased risk to their property, leading to early on – prior to wind farm completion – disposal of the property at less than its real longer-term value, depressing value on the near term. A theoretical framework for this interpretation is provided by Wolsink (2005), who also provides evidence based on an analysis of European survey data.

Hinman appears to agree with this interpretation, as she sees her results as providing evidence of a "transfer of welfare" between early sellers and buyers, similar to that found by Kiel and McClain in their study of incinerator siting. They write, "if a house was sold during a phase when fears of the facility depressed prices, the seller would suffer a capital loss. If those fears are later unrealized and prices rebound, that loss becomes the buyer's gain" (1995, p. 242). This appears to be the case found in the McLean County study, and will be mentioned again below.

Laposa and Mueller (2010) provide research that seems to also support the contention that the anticipation of negative effects may reduce property values in the near term. They looked at 2,910 single-family home transactions in northern Colorado pre- and post wind farm announcement to test for wind farm anticipation stigma. This was considered a good test of the impact of anticipation on property values as the wind farm had only been proposed, but not built due to problems with the developer, and considered impacts at two levels: census tract-wide within three tracts, and within adjacent home owner association areas. They found that the announcement of the wind farm reduced the selling price of the property by about 2%, but attributed this reduction in value more to the decline in the national housing market than to the wind farm announcement. They write:

> Our conclusion is that prices in Larimer County and the sample census tracts, as measured by the home price indices…, started to decline sometime around the start of 2007, and the cause of the decline may be linked to the announcement of the wind farm, but may also be linked to the general decline in housing prices nationally. The fact that the Maxwell Ranch announcement variable is insignificant indicates that the properties most likely to actually see or be affected by the wind farm, did not experience an impact from the announcement significantly different from other properties in the region that are

> least likely to experience any impact from the announcement. Thus, we can reasonably conclude that the announcement variable is acting as a proxy for the start of the downturn in overall market conditions rather than a negative impact caused by perceived externalities arising from the Maxwell Ranch wind farm project announcement. (p. 398)

Carter (2011) provides some further support in his study of Lee County, Illinois. Lee County is home to the first commercial wind farm constructed in Illinois. Operation of the Mendota Hills wind farm began in Nov. 2003, with two additional wind farms coming on-line in April 2007 (GSG 1) and Dec. 2009 (Lee-DeKalb Wind Center). This time period allowed Carter to use a hedonic price model to assess the impact arising from Area Stigma (as defined by Hoen et al., above) on 1,298 residential real estate transactions from 1998 to 2010. His analysis indicated that residential properties located near wind turbines in Lee County were not affected by their presence.

Carter made a number of adjustments in his analysis to address methodological issues that were not addressed in other research. First, he used transaction data from both near the wind farms as well as further away to allow the model to take into account similarities or differences on a region-wide basis. This is not an unimportant distinction, as it allowed the model to take into account property value declines or improvements that might be caused by more widespread factors than the presence or absence of a wind farm: such as the national downturn in property values noted by Laposa and Mueller above.

The SSCRPC gives particular credence to this methodological approach as it allows for a "control" to assess whether a reduction in property value is being caused by the wind farm instead of another more regional or intervening variable that is acting on the area. This addresses just the sort of "proxy" situation that Laposa and Mueller mentioned in their work.

He also used data from the period before any wind farms were proposed, instead of only using data from the post-construction period. This allowed for a consideration of the effects noted by Hinman, above. Finally, his use of data covering a 13-year time period allowed for a longer period than most studies consider, so that any slow developing effects could be examined. Data was assessed based upon three distances from each of the three wind farms in the area (homes within 0-1 mile, 1-2 miles, 2-3 miles, and greater than 3 miles) in order to measure the neighborhood effects within three miles of the wind farm area (see Carter, pp. 15, 18-20).

The results for GSG 1 and Mendota Hills were not statistically significant "in any specification, indicating that home values near those wind farms were not materially different from elsewhere in the County over the 1998 to 2010 period" (p. 20). The results for the Lee-DeKalb site were significant for two of three specifications:

> The positive coefficient reveals that residential properties near Lee-Dekalb Wind Center sell at a 17% to 24% premium (after adjustments) compared to similar properties elsewhere in the County. This does not indicate that the construction of the Lee-Dekalb Wind Center increased values of nearby residential properties, but rather the wind farm happened to locate itself in an area with higher residential property values relative to the rest of Lee County. (p. 20)

He attributes this difference to the relationship between farm land prices, which are dependent upon the land's productivity, and nearby residential property prices, which are driven by local residential demand. Thus developers are willing to pay more for the land due to other advantages.

All-in-all, Carter finds that the results of his analysis show that:

> …wind farms in Lee County have not had a statistically significant or reliably quantifiable impact on nearby residential property values. The results largely mirror those of other studies that use a hedonic price model to look at other locations with wind development. (p. 24)

While the studies cited above primarily deal with the effect on the value of properties in the vicinity of a wind farm, a study conducted by Northwest Economic Associates (2003) addressed land values for farmland involved in the project. This project was based upon the study of wind farms in three areas: Lincoln County, MN; Morrow and Umatilla counties, OR; and Culberson County, TX. Two findings from this study are pertinent. First, in looking at the overall impact of the projects to the areas, the study found that:

> While there were differences between the study areas in the mix of annual leases and permanent easements and the size and type of payment, ***the annual revenue received by households in the areas was a significant source of household income and had a significant total effect on the economies.*** In all cases, the cost of foregone opportunities from farming and livestock grazing was small compared to the revenues obtained. (Northwest Economic Associates, 2003, p. 43: emphasis in the original.)

Second, the study found that the form of the payment had an influence on land values:

> Payments from easements and leases on farmland for the wind power site are an important source of income. How this affects farmland values depends to a large extent on the terms of the contract entered into. If the contracted payment were a one-time lump sum payment, all of the benefit would accrue directly to the landowner at the time of the payment, and there would be no long term income stream associated with the contract. Under these conditions, it would not be expected that land values would be affected. If the contractual arrangement resulted in a potential future income stream, such as a lease payment based on a share of power revenues, and this income stream went to the owner at the time each payment was made, rather than the owner at the time the contract was made, then it would be expected that this future income stream would be capitalized into the value of the farmland. (Northwest Economic Associates, p. 46.)

This would indicate that the revenue generated by the wind farm would offset any value loss in the region should it occur. It might also provide an explanation as to why property values do not decline in areas around wind farms regardless of visual and other impacts.

To the extent that wind farms generate additional economic benefits in an area (see Pedden, 2006, for examples of studies that came to this conclusion), this new income would accrue to residents of the area in various ways, “rolling over” in the local economy and potentially leading to property improvements or new construction as incomes increased, ultimately increasing surrounding property values. Additionally this new revenue would accrue to the various taxing bodies, potentially reducing future tax demands and diversifying the tax base. This also could lead to increased property values. The end result may be to “disguise” any small or infrequent losses of the type the Hoen team considered possible.

The later analysis by Hoen et al. (2011) seems to suggest this as well. They write that because their study focused on the overall net effect of wind facilities on property values, “it did not seek to understand the possible separate negative and positive impacts that might exist; for example, wind facilities might be expected to increase property values if they lead to

improved job opportunities, and increased tax base, or improved community image" (p. 309), and suggest that future analysis to "unpack" these impacts should be considered. The SSCRPC believes that such research would be fruitful in identifying any positive or negative externalities that would affect property values around wind farms.

Hinman (2010, p. 84) comes to a supportive conclusion in her study of the McLean wind farm, pointing out that two of the reasons why she believed property values rose post wind farm development were: a decline in property tax rate because of the new revenue steam that the wind farm generated in local property taxes; and the increase in tax revenue to the school districts generated by the wind farm increasing the attractiveness of the areas for families. This second reason may however be unique to the area studied since she reports it was experiencing a decline in residents in the surrounding area prior to wind farm development.

We also wish to note that there have been studies conducted outside of the United States that would appear to reach the same conclusions as those above: little or no impact on property values. Since these are not based upon the US property market, Americans may have less familiarity with wind farms than some Europeans, and many are based on surveys rather than land transactions, they may not be as valid to the local situation as those mentioned above that studied wind farms in the United States, in general, and Illinois, in particular. Examples of these studies include:

- Research by the Danish Institute of Local Government Studies found that the economic expenses in connection with noise and visual effects from the turbines are minimal. It did find a small effect on house prices, but not at a level of statistical significance (Jordal-Jørgensen, 1996).

- A study of the Novar wind farm in Scotland in which a survey found 72% of property owners saying it did not decrease house prices and 26% saying they did not know. One percent noted an increase in property value (Robert Bell Associates, 1988).

- A study of the Nympsfield, Gloucestershire (UK), project that found house prices gained after plans for the turbine were announced and continued to increase after operations began. (British Wind Energy Association, 1998).

Some researchers have found that proximity to wind farms did affect property values, and as mentioned previously, Hinman identified 10 such studies in the 98 she reviewed. However only three of these 10 studies involved before and after wind farm land transaction analysis (see: Kielisch, 2009; Sterzinger et al., 2003), and two of those considered vacant residential land sales (see: Kielisch, 2009). Other studies identified and reviewed by the SSCRPC tend to be based upon small sample sizes, provide no statistical test, and most often do not report statistical significance.

For example, McCann (2008) found that two homes near a wind facility in Lee County, IL, had lengthy selling times that he contends adversely affected selling prices. Kielisch (2009) compared 12 transactions involving undeveloped land near two wind facilities in Wisconsin and found that they sold for lower prices per acre than undeveloped property further away, but unfortunately did not report statistical significance. Both of these studies were prepared for wind farm opponents.

While the studies provided above (and 61 of the 98 studies reviewed by Hinman) indicate little or no impact on surrounding land values, the study most often cited to provide a contradictory finding comes from an analysis of a wind farm proposed for Nantucket Sound (Haughton et al., 2004). This study provided a cost-benefit analysis of the proposed project and came to the conclusion that the wind farm would have a significant effect on property values in the area. However that conclusion was not based on actual property transactions but upon a survey of 501 home owners on Cape Cod and Martha's Vineyard, as well as a survey of 45 Cape Code realtors (Haughton et al., p. 8). Based upon the belief that the wind farm would worsen the view of Nantucket Sound:

> On average, homeowners believe that the wind farm would reduce property values by 4.0% (and among these, households with waterfront property believe that the loss would be 10.9%). When these numbers are grossed up to represent the six towns likely to be impacted by the wind farm, the total loss in property value would be over $1.3 billion. As a result, the six towns stand to lose $8.0 million in property tax revenue (Haughton et al, p. 8).

Hoen provides a critical analysis of this and similar survey studies (Hoen, 2006, pp. 6-11; see also Hoen et al., 2009, pp. 7-8), questioning their validity. Ultimately their usefulness in answering the question of wind farm effect on land values is dependent upon how accurate one thinks a group of homeowners and realtors might be in predicting future land values with and without the presence of wind farms. Overall it appears to us that studies based upon actual land transactions pre- and post-wind farm are more valid.

The most recent empirical study finding a negative impact was conducted by Heintzelman and Tuttle (2011). Using data on 11,369 property transactions over a nine year period in northern New York to assess the impact of new wind facilities on property values, they applied a repeat-sales framework hedonic analysis instead of the hedonic analysis methodology, mentioned previously, that was used by Hoen, Hinman, Carter, and others. The area considered was a three county one that included three wind farm projects, and distance was used as a proxy measure.

They found that nearby wind facilities did reduce property values "…decreasing the distance to the nearest turbine to 1 mile results in a decline in price of between 7.73% and 14.87% on average", and also found that a bias in some of the models used (census block-group fixed effects models) inflates "the negative impacts of turbines on property values by about 35%" (p. 9). As this is one of the few empirical studies that found a negative effect, it is worth detailed consideration.

One basis for comparison used was at the census block-group level. They found that at this level – which considered entire census blocks rather than individual parcels – the existence of turbines between up to one and three miles away negatively affected property values between 15.6% and 31%, while having at least one turbine on the parcel reduced prices by 65% (p. 21). Effects beyond these distances were negative but not statistically significant.

What is interesting in these results is their finding of "significant positive impact from having turbines within 0.1 miles when proximity measures are included individually, and weakly significant positive impacts for turbines between 0.5 and 1 mile away as well as negative impacts for turbines between 1 and 1.5 miles away in the concentric circle model" (pp. 22-23). They suggest that this result is plausible if homes close to existing turbines expect that future

wind development may result in their receiving easement payments, but this individual result is appears to be in conflict with their overall findings.

Using the repeat sales model, the results indicate that a home 0.5 miles away from a turbine would experience a decline in price of between 10.87% and 17.77%, depending upon initial distance from the nearest turbine and the particular specification, while homes at a distance of one mile would experience losses of between 7.73% and 14.87% (p. 26). While it is not clear from their paper, we assume that the difference between these results and census block results are due to the census block group bias noted above.

What is also not clear from their research is the extent to which the researchers were able to control for area effects on property values unrelated to the wind farms, such as those suggested by Carter (2011), mentioned above, and noted by Laposa and Mueller (2010). And we were also unable to determine how temporal effects (pre-announcement decline vs. post-construction decline) as mentioned by Hoen et al. (2011) and Hinman (2010) might play out. It is surprising that this was not described given that Heintzelman and Tuttle considered three different assumptions about the date of wind farm existence – date the environmental impact statement was submitted, date of final approval of the impact statement, and the date at which the turbines became operational – in their regression analysis. The reader should note, however, that the date of submission of the environmental impact statement would most likely be after announcement of the wind farm project, and there is evidence that this period can cause the anticipatory decline in property values mentioned previously, which may be real but not lasting. If this is true, it would make their findings more consistent with the trend in the literature, finding a short term decline for properties nearest the wind farm all other things being equal.

Again, other studies have found a negative impact. As mentioned at the beginning of this paper, of the 98 studies reviewed by Hinman (pp. 15-19), only 44 (44.9%) involved analyses of property values “before and after” wind farm construction. Of these 44 studies, 21 (47.7%) found no effect on property values, 3 (6.8%) found a negative effect, and 20 (45.5%) found a positive effect. These results should not be taken as indicative of a complete answer to the question of wind farm effect on property values for too many reasons to adequately list here. For example, Hinman notes (p. 19) that a “positive” or “negative” result does not necessarily imply that an increase or decrease in property values was due to the wind farm as property values could have changed for other reasons, and Heintzelman and Tuttle mention the problem of omitted variables in hedonic analysis (p. 15). It may also indicate that the period under study could affect the findings. For example, of the 10 studies showing a negative effect on property values, half did not compare post-wind farm land values to pre-wind farm values.

While a meta-analysis of these studies might help to resolve this question, and it appears to us that enough studies may have been conducted for such an analysis to be possible, at the present time we can only conclude that the results indicate a trend in the research findings: to the extent that property values are negatively affected by wind farms, the effect is small, appears to be transient, and could be masked by other factors. This leads us to give further consideration to proximity as a factor.

Proximity and Property Values

Critics of studies such as the Lawrence Berkley National Laboratory one (Hoen et al, 2009; 2011), contend that these studies under-estimate the true impact of wind farms on property

values either because they include properties too far from the turbines (which we will call *lack of sample proximity*) or are tainted by properties included in the project that may be reaping some financial benefit from it (*effect of project economic 'spillover'*)[3]. In the first case the contention is that if only the properties closest to the wind farm were considered, a larger, negative impact would be found. In the second case the contention is that if properties receiving benefits from a project were excluded from the results, a larger, negative impact would be found. Addressing these issues is not inappropriate and is important, but may also be methodologically problematic.

Related to the first issue (lack of proximity), as several studies point out, wind farms are often sited in rural or undeveloped areas where there are simply not enough arms length residential property transactions to generate a sample size large enough for sound statistical analysis. Should an analysis be done with a small sample, it is likely that no results would be statistically significant even if some effect would be found if the sample were larger. Only by enlarging the area or including multiple different areas could the number of transactions be enlarged to allow valid analysis.

Moreover, while there may be a sufficient number of transactions in a larger area to allow for some valid area-wide results, this would not mean that subsections of that area would have sufficient transactions to allow for proper statistical analysis. For example, simply because there are sufficient property transactions within a three-mile radius of a wind farm to provide an adequate number, does not mean that there would be a sufficient number within a quarter mile, between a quarter mile and a half mile, and so forth. Each "cell" or subset subject to the analysis would have to have a sufficient number.

In terms of economic spillover, we believe that this criticism asks the researcher to address the quandary of studying property transactions close enough to the wind farm to deal with proximity effect, but not too close, so as to avoid spillover. Extracting these properties from the analysis seems incongruent with the ultimate question the research is meant to address: what is the effect of wind farms on property values? It seems to us important to come to terms with this question both for properties that may be harmed (if any) as well as those that might benefit (if any). If the presence of a wind farm *does* result in some direct economic reward or spillover to surrounding properties because the property owners are receiving project benefits, these should be consider in assessing any property value effects.

A sole focus on properties immediate adjacent to the wind farm may lead to an additional methodological problem: a negative area spillover into the study area that is unrelated to the presence of the wind facility; such as that found and reported by Laposa and Mueller (2010). As noted previously, Carter (2011) addresses this by considering area influences, providing something of a control for his results, and this may be a factor in the results reported by Heintzelman and Tuttle.

In any event, recent work presented by Hoen (2010) using data from the 2009 Lawrence Berkley National Laboratory study is instructive as to the effect that distance to wind farms has on property values. Readers should be aware that the following information is drawn from the 2009 study as presented at the Feb. 27, 2010, Illinois Wind Working Group Conference, and

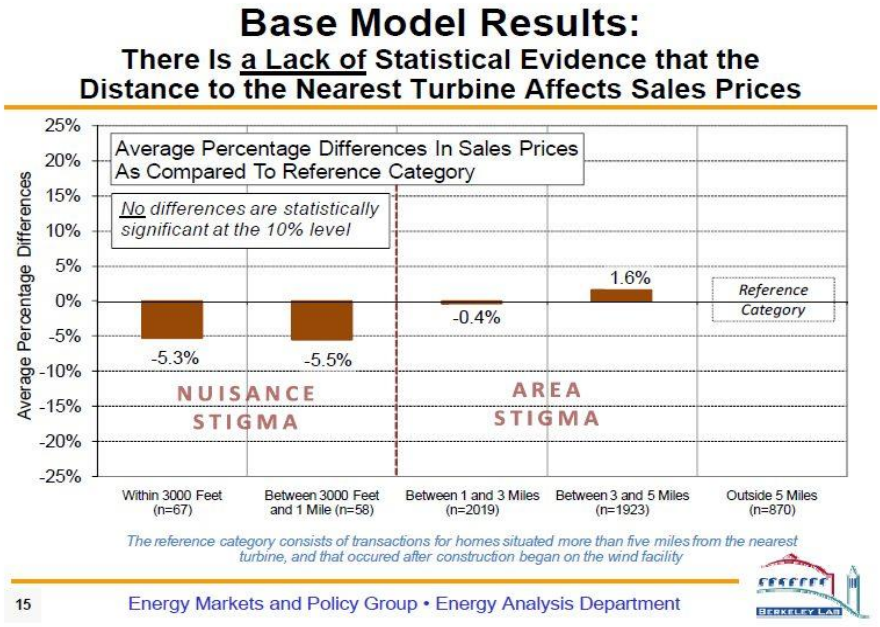
[3] This is reflected, for example, in the response to a study of property values conducted by the zoning administrator in Lincoln Township, WI, for the Lincoln Wind Turbine Moratorium Study Committee (Sagrillo, et al., 2000). For a complete review of this case see Energy Center of Wisconsin, 2004.

is also addressed in the 2011 paper prepared by Hoen et al. published in the *Journal of Real Estate Research.*

As previously mentioned, the Hoen et al. 2009 study considered three "stigmas" related to wind farms that could affect surrounding property values: *scenic vista*, *nuisance*, and *area* stigmas. Also as previously noted, nuisance stigma may be the most relevant to the consideration of proximity because nuisance stigma is intended to address the concern that factors that may occur in close proximity to wind turbines (such as sound and shadow flicker) will have a unique adverse influence on home values, and because a sufficient number of cases was presented for nuisance stigma to get some feel for the influence of closer proximity

Chart 1, below, shows the results, as presented by Hoen, related to both nuisance and area stigmas. Since nuisance stigma was considered as having a more proximate effect, analysis was done for properties within 3000 feet of the nearest turbine and between 3000 feet and one mile of the nearest turbine. Please note that the number of cases for both distances is roughly comparable. While 3000 feet is more than twice the requirement currently in the Sangamon County zoning ordinance for setback from properties not participating in the project, we believe that it is still informative.

Chart 1

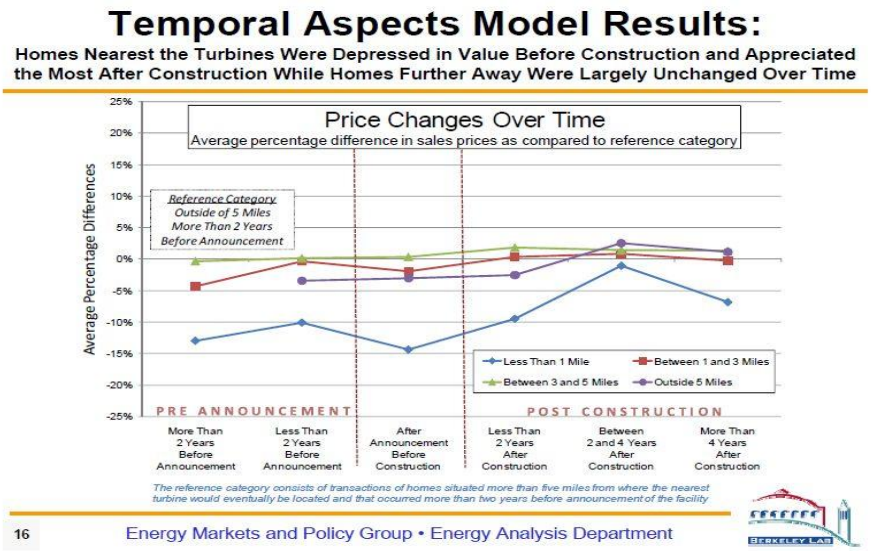


The data indicates that to the extent that nuisance stigma might exert an effect, the effect is similar (-5.3% and -5.5%) for both distances. This might lead one to conclude that there is a slight negative effect, but that it does not appear to vary much by distance (or at least for the distances assessed). However, these results were not even statistically significant at the 10% level, meaning that we cannot reach such a conclusion. Most often results are considered significant at 3% to 5% depending upon the research question. Because of this level of significance, we cannot say that proximity has an effect on property values as the results indicated may simply be due to chance.

Also informative is Chart 2, below. This chart displays the price change over time of homes based on distance. While the data does not present us with distances nearer than a mile, it indicates several things of note.

The first is that homes closest to a turbine (within less than a mile) tended to be of less value than properties further away at the outset, prior to wind farm project announcement (more than 2 years before). This finding by Hoen is consistent with the results found by Hinman in her study of the effect of wind farming on property values in McLean County, IL, discussed above. She found that prior to governmental actions to approve the wind farm, properties already exhibited depressed values when compared to other areas, a result further supported by evidence of a declining population and number of housing units, which the area had been experiencing for a number of years (p. 83).

Chart 2



We suspect that this is because wind farms are most often sited in the most rural and undeveloped areas where residential property values are less than in more urban, developed areas. This might be supported by Hoen's finding that more than 2 years prior to the announcement, properties between 1 and 3 miles were valued higher than those within less than 1 mile, and properties between 3 and 5 miles were valued higher than those between 1 and 3 miles. Only those outside of 5 miles had a slightly lower initial value prior to announcement, and these properties still were valued at higher levels than those less than 1 mile from the nearest turbine.[4]

The change in value over time of the homes nearest the turbines is noticeable. Pre-announcement the value of these homes appears to track with the other homes if the initial, lower value is taken into account and adjusted to be more comparable with homes further

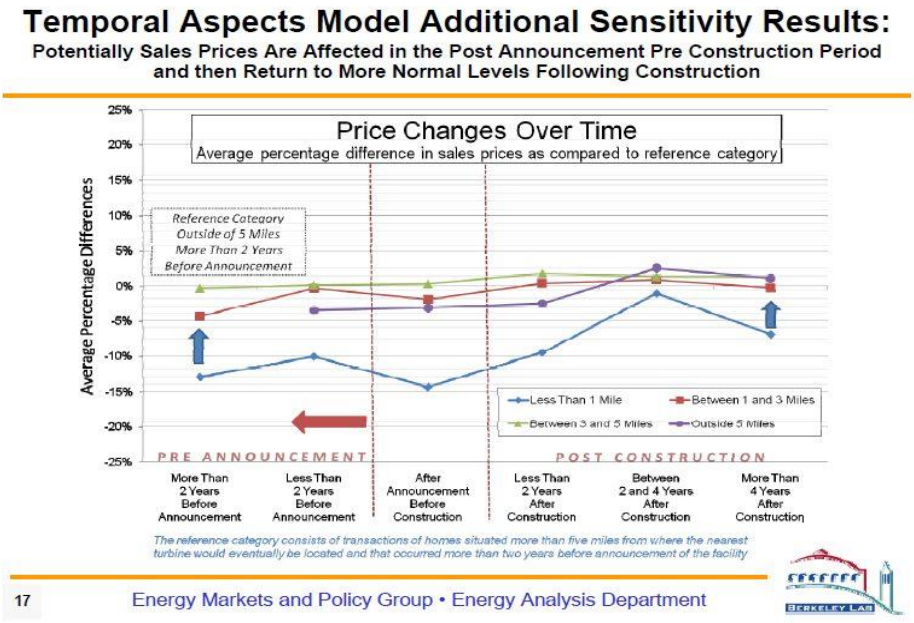
[4] We suspect that overlapping setback and other regulatory requirements may also lead to this finding as they may push the location of turbines toward more marginal properties that do not include residential structures. Further research would be needed to determine if this speculation is correct.

away. It falls after the project announcement and before construction, but begins to rebound following construction. Again, this is consistent with the results of the Hinman study noted previously.

It seems intuitive that if the construction of a wind farm has a significant effect on property values, one would expect a continuing decline of property value for the homes closest to the turbines, but this is not the case. Even the decline in value 4 years after construction appears to track with small declines in at least two of the other three categories, although the magnitude appears greater. What then might be happening?

We believe that this result is consistent with the findings from the opinion survey-based research that even if proximity to wind farms does not generate a statistically significant change in residential property values, people believe it will, leading to a self-fulfilling outcome. Public concerns about wind farm proximity may depress property values for properties closest to the turbines for a period of time, with these values rebounding following construction as referenced in Hoen's Chart 3, below. The extent to which they rebound is still open to conjecture, though the Hinman study provides more information in this regard than we had previously. [5]

Chart 3



This leads to the Berkeley Lab team's conclusion pertaining to nuisance stigma that "homes in the sample that are within a mile of the nearest wind facility, where various nuisance effects have been posited, were not found to have been significantly affected by the presence of those wind facilities" (Hoen, 2010), but:

[5] It may also be due to the fewer arms length residential transactions closer to a wind farm. If there are fewer transactions, a large decline in only a few properties could affect the average and overstate the trend.

> This is not to say that effects do not exist though; there is not reason to assume that they do not. But rather, if they do exist in our sample, they are either too small and/or too infrequent to result in any statistically observable effect. Further, where they do exist they are likely to do so immediately following the announcement and in close proximity. (Hoen, 2010).

Based upon the results found by both Hoen and Hinman, we believe that Hinman's conjecture of a "wind farm anticipation stigma" is correct.[6] Upon anticipation of a wind farm project, those concerned about the effect of the project on surrounding properties perceive a risk to their property and respond by disposing of them – when and if they can – resulting in a reduction in property value in what is already a rather limited market due to the mostly rural nature of the areas in which wind farms locate. Similarly, those considering the purchase of property in areas adjacent to the wind farm are hesitant to do so because of the concerns voiced, further depressing property values. However, following experience with the project once it becomes operational, fears are reduced as the realities associated with it are then better known and the perception of risk is reduced if not eliminated. This results in a rebounding of property values as the area is no longer stigmatized.

This conclusion is additionally supported by the work of Palmer (1997) who conducted a study of the public's pre- and post-construction attitudes about Vermont's Searsburg wind power project. We would note that since this study involved an early application of wind farming (11 550 kilowatt turbines) it may be limited in its current applicability, but the Searsburg facility was the largest wind power facility constructed in the United States at that time and Vermont is known for its "sensitivity to environmental issues and its landscape qualities" (Palmer, p. 7).

Palmer found palpable shifts in public acceptance pre- and post-construction. This included questions concerning: support for the project; visual quality of the project; and construction related effects. Palmer did find that initial support for the project had a bearing on final attitudes, concluding:

> Support for wind power in general was mixed at the time of the pre-construction survey. Approximately 30 percent of the respondents were big supporters of wind power, 36 percent were moderate supporters, and 35 percent were not supporters…
>
> Support for wind power grew in the year and a half between the two surveys. Over half of the respondents are big supporters after completion of the Searsburg project, 30 percent were moderate supporters and less than 20 percent are non-supporters. In general, people tended to retain their level of support or move up one level. Level of support fell for only a few respondents. (p. 7)

All-in-all, Palmer found that the level of support pre-construction appeared to determine the post-construction support for the project. Big and moderate pre-construction supporters of the project continued their support post-construction, however there was even a noticeable post-construction shift among those who did not favor the project at pre-construction. He writes:

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[6] We believe that the results described may also be similar to what has been termed a "nocebo" effect associated with wind turbine sound (SSCRPC, 2012, p. 8). The opposite of the "placebo" effect, a "nocebo" is associated with conditions under which a person believes that an inactive substance or an event will result in a negative outcome, so it is experienced as such, becoming a "self-fulfilling prophecy" .

> In 1996 the non-supporters of wind power were generally uncertain about their support of the Searsburg project, whether it was the only possible location or could be located elsewhere. After the project's construction, their overall ratings changed significantly to be somewhat supportive. Respondents who were moderate supporters of wind power were somewhat supportive of the Searsburg project in 1996, and became significantly more supportive by 1997. The big supporters of wind power were already very supportive of the Searsburg project, and there are no significant changes in their assessment. (p. 55)

A similar trend was reported when the "visual quality" of the project was considered (pp. 4, 60).

This pre-construction *anticipation* influence may also explain why studies of impact in Europe may result in different outcomes than in the US. Since Europeans have more experience with the proximate effects of wind farms than do Americans, they perceive less initial risk.

The wind farm anticipation stigma relates to the perception of risk, and Hinman quotes Slovic et al. (1987, p. 281) in this regard:

> Research further indicates that disagreements about risk should not be expected to evaporate in the presence of evidence. Strong initial views are resistant to change because they influence the way that subsequent information is interpreted. New evidence appears reliable and informative if it is consistent with one's initial beliefs; contrary evidence tends to be dismissed as unreliable, erroneous, or unrepresentative.

Summary

Based upon the research mentioned above, we continue to agree with the National Association of Realtors who report in their *Field Guide to Wind Farms and their Effect on Property Values*, "Although the research remains scant, wind farms appear to have a minimal or at most transitory impact on property values" (National Association of Realtors, 2009).

In our brief review we were unable to find compelling research, particularly research based upon actual arms-length, pre- and post-wind farm property transactions, that leads us to conclude that proximity to a wind farm results in a decline in property values that is significant or lasting over time. The trend in the research using pre- and post-transaction data appears to indicate minimal if any effect, and the recent work by Hinman and Carter is representative of this trend. Only the Heintzelman and Tuttle study found a different result, but this may be due to the influence of the anticipation effect or an area-wide influence not accounted for in the study due to lack of a control.

Clearly there is evidence that people believe that a wind farm will affect their property's value, as the Haughton study, referenced above, indicates, and this has come up during the siting of wind farms in other central Illinois jurisdictions (see, for example, Niziolkiewics, 2008). This belief may even lead to a self-fulfilling result, and Hinman's work appears to at least partially confirm this.

But the trend we found in the literature studied seems to indicate otherwise. While there does appear to be evidence from Hoen, Hoen et al., Hinman, and Carter indicating that a wind farm anticipation stigma may negatively affect property values during the early stages of a wind farm project, the evidence also indicates that this stigma is relatively short-lived, being

mitigated over time as property owners become more aware of the real effect of the project on the surrounding area.

There is also some indication that wind farm projects may slightly increase the value of properties, especially those that become part of the project, depending upon the extent of its larger economic impact and the form of the payment provided to property owners. Indeed these larger economic impacts may positively affect property values indirectly through their stimulative effect and the diversification of the local tax base, potentially disguising any localized value loss due to roll-over of financial gains in the local economy.

This report and update prepared by E. Norman Sims, SSCRPC, Executive Director

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The Springfield-Sangamon County Regional Planning Commission (SCRPC) serves as the joint planning body for Sangamon County and the City of Springfield, as well as the Metropolitan Planning Organization for transportation planning in the region.

The Commission has 17 members including representatives from the Sangamon County Board, Springfield City Council, special units of government, and six appointed citizens from the city and county. The Executive Director is appointed by the Executive Board of the Commission and confirmed by the Sangamon County Board.

The Commission works with other public and semi-public agencies throughout the area to promote orderly growth and redevelopment, and assists other Sangamon County communities with their planning needs. Through its professional staff, the SSCRPC provides overall planning services related to land use, housing, recreation, transportation, economics, environment, and special projects. It also houses the Sangamon County Department of Zoning which oversees the zoning code and liquor licensing for the County.

The Commission prepares area-wide planning documents and assists the County, cities, and villages, as well as special districts, with planning activities. The staff reviews all proposed subdivisions and makes recommendations on all Springfield and Sangamon County zoning and variance requests. The agency serves as the county's Plat Officer, Floodplain Administrator, Census coordinator, and local A-95 review clearinghouse to process and review all federally funded applications for the county. The agency also maintains existing base maps, census tract maps, township and zoning maps and the road name map for the county.

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