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1. INTRODUCTION

Harpers Somers O'Sullivan Pty Ltd acting on behalf of Wind Corporation Australia (WCA) has prepared a Preliminary Environmental Assessment for the Department of Planning to provide preliminary details of a wind farm proposal at Black Springs, in the Oberon Local Government Area.

As part of that assessment we have been asked to comment on the probable impact the proposal may have on property values of properties which may be impacted by the proposed Wind Farm.

2. THE PROPOSAL

The proposal is known as the Black Springs Wind Farm (BSWF) and includes nine wind turbine generators connected via underground cables to a substation and a facilities building. Access roads to the turbines will also be constructed to allow delivery of the turbines and ongoing maintenance.

The proposal is based on the SUZLON S88/2.1 MW turbine or equivalent turbine generators with a hub height of 80m. The rotor has 3 blades on the horizontal axis. The diameter of the blades is 88m and covers a swept area of 6082 m^2. The highest blade tip height would be 124m above ground level.

3. SITE LAYOUT AND DESCRIPTION

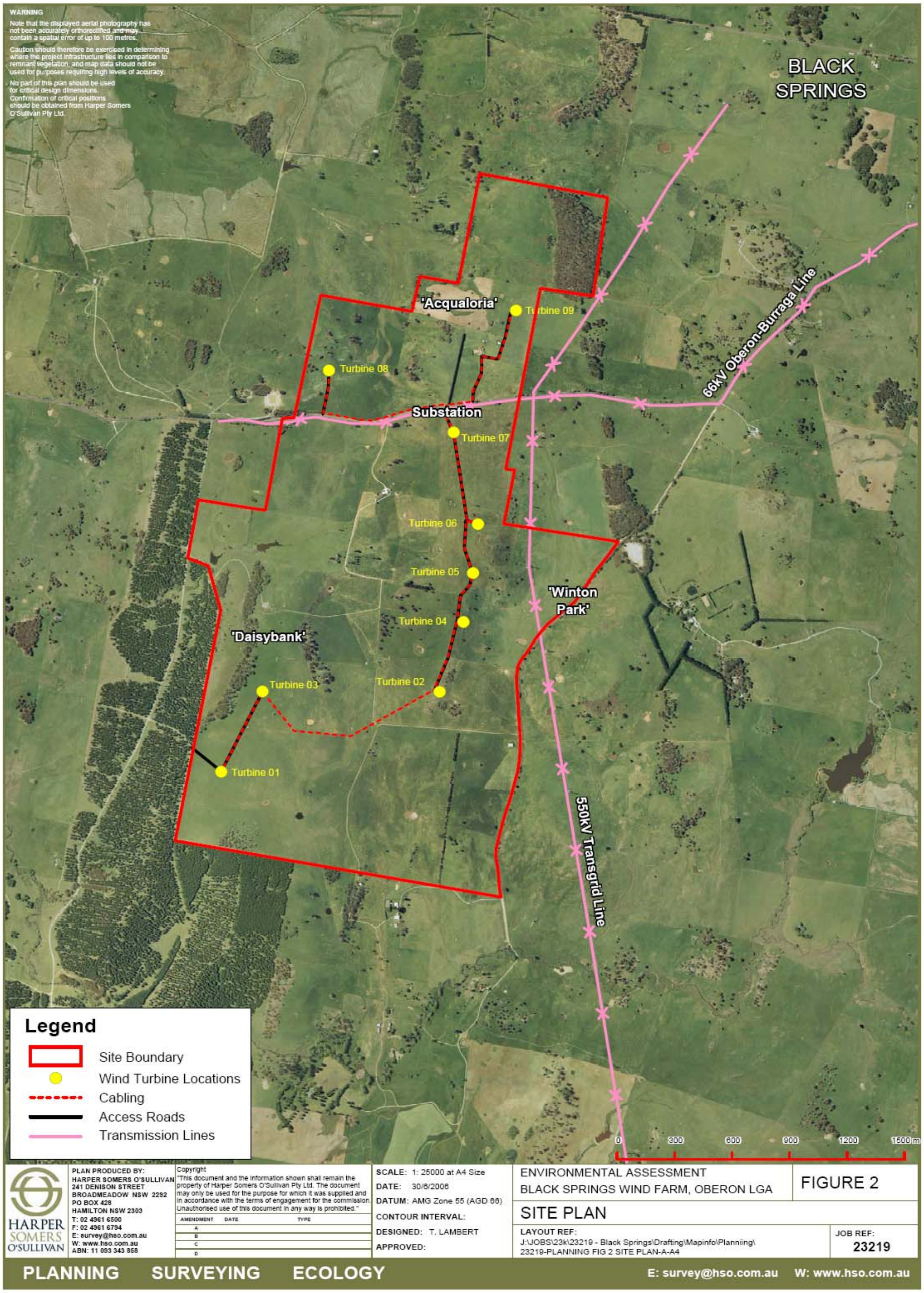
The site is located about 3 km from the village of Black Springs which is some 25 km south west from Oberon in the Blue Mountains on the Great Dividing Range.

The proposal covers a total area of 527 hectares comprising 13 parcels in two ownerships generally known as Daisy Bank and Acqualoria.

The topography of the project site can be described as a series of rolling hills typical of the locality. Elevation of the site ranges from 1100 metres to 1250 metres above mean sea level.
The surrounding areas are dominated by pine timber plantations and beef-sheep stock grazing

Figure 1 - Proposed Wind Farm

Extract from © Figure 2-1 – Plan Prepared by Harper Somers O'Sullivan – REPRODUCED WITH PERMISSION



4. ASSESSING THE IMPACT ON VALUE

The accepted valuation method for the assessment of the impact of any particular activity on value of adjacent properties is the so called "Before and After" method in which an assessment of value is made by normal valuation processes of the market value of a subject site i.e. the hypothetical price that a willing but not anxious purchaser and seller will agree upon when they are acting freely, carefully, and with complete knowledge of the situation – firstly before the event and secondly after the event.

Because of the unique nature of wind farm developments the before and after method of valuation becomes less relevant in that

- Wind farm developments are unique in nature and few are truly comparable in a valuation sense one with another and
- There tends to be no recent sales evidence to support one view or another because the often rural properties involved do not change hands with a frequency which would allow a reliable assessment to be made.

It therefore becomes an exercise in empirical and anecdotal evidence on what the impact on value to adjacent premises is likely to be of the development in a particular area.

5. RESEARCH

Given the difficulty of applying normally accepted methods of valuation to this issue it becomes necessary to look to anecdotal evidence from published material.

The Australian Wind Energy Association (AusWEA) provides a great deal of information on wind farming in Australia and publishes facts sheets on the subject, one of which is attached.
See **Attachment 1**

This document holds

> ***"From a property value perspective, the greatest actual impact will be if a revenue stream is derived from the development***.

> ***There is little evidence to suggest that because of landscape values, windfarms negatively impact upon the land values of neighbouring properties"***

And

> ***"In Australia, there is no evidence to suggest that the value of properties with views of distant wind turbines, are adversely impacted by the wind farms In Esperance [WA], an informal investigation was made into property prices at Salmon Beach, a premier residential area 200 metres away from Australia's first wind farm. Of 15 properties investigated, only one reduced in value after the wind farm had been constructed. This was due to the property being subdivided and sold as two separate lots. Since then, Esperance has seen another two wind farms and 15 more turbines installed without a single negative comment".***

This paper goes on to illustrate similar experience in USA, the United Kingdom, Scotland, Denmark and Wales.

In May 2003 the American Wind Energy Association published details of a study undertaken by the Renewable Energy Policy Project of the US Government which was presented to the annual Conference and Exhibition of the American Wind Energy Association in Austin, Texas which concluded that "Wind Farms do not Hurt Property Values".

This report represents the first in-depth study of the phenomenon and involved the examination of some 25,000 property transactions in the USA. Of particular significance is the statement from this report –
See Attachment 2

> ***"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."***

In a publication *"Impact of Wind Farms on the Value of Residential Property and Agricultural Land"* the Royal Institution of Chartered Surveyors studied the development of wind farms in the UK and found that *inter alia*

See Attachment 3

> ***"- 60% of the sample suggested that wind farms decrease the value of residential properties where the development is within view***
> ***- 67% of the sample indicated that the negative impact on property prices starts when a planning application to erect a wind farm is made***
>
> ***- The main factors cited for the negative impact on property values are:***
> - ***o visual impact of wind farm after completion***
> - ***o fear of blight***
> - ***o the proximity of a property to a wind farm***
>
> ***- Once a wind farm is completed, the negative impact on property values continues but becomes less severe after two years or so after completion***
>
> ***"……. surveyors with experience of residential sales affected by wind farm developments (40%) indicated that there is no negative price impact" -***

Further comment on the subject has been made by Sinclair Knight Merz in a report to Pacific Hydro entitled *"Socio Economic and Tourism Final Report"* which refers to experience gained in the Cape Nelson and Portland areas of Western Australia where wind farm developments were examined in relation to property value impacts and the following was concluded –

See Attachment 4

> ***"In conclusion we can estimate that there are two types of property price impacts. The properties that have the generators actually located on them <u>will</u> increase in value.***

Other properties <u>may</u> be adversely affected if they are within either sight or audible distance of the generators."

It should be noted that in the Sinclair Knight Merz paper the subject properties are urban in nature and although some of the same arguments may be applied to rural landholdings, one would expect the impacts if any to be lesser in extend.

There is some argument for the proposition that the development of a wind farm in a rural community might well have a beneficial impact generally on the land values of neighbouring properties by virtue of increased economic activity which might be expected to be generated through the existence of the wind farm.

Similarly there is much anecdotal comment on the negative impact of wind farm developments on neighbouring property values but none which could be relied upon as clear evidence for the case put.

The sale of Winton Park – Lots 2 in DP 1047456 and Lot 134 in DP 757072 and AC 6724-112 in July 2006 for a reported $5.875m belies any suggestion that the proposed Black Springs Wind Farm proposals will impact negatively on local property sales. The proposals for the Black Springs Wind Farm were known publicly at the time of the sale of Winton Park and the price achieved for the sale is representative of a robust market at full market value.

Attached are photographs of the subject site which show superimposed thereon images of the proposed turbines which serve to illustrate the visual impact of the proposed development on the area from which it can be seen that the impact is unlikely to be excessive in a rural setting.

See Attachment 5

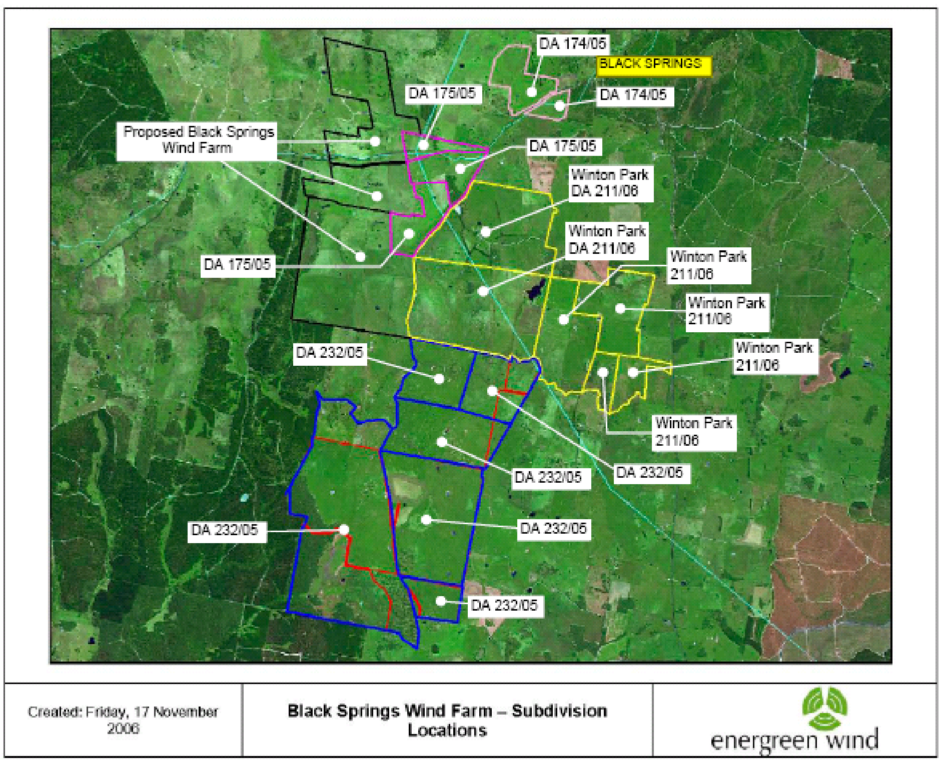
There has been some activity in rural subdivision in the Black Springs area over the period during which the proposed Wind Farm development proposal at Black Springs has been under consideration. See Table 1 below.

Figure 2 -Black Springs Subdivision Status

DA Number	Proposed Development	Property Address	Subdivision Approved Date	Use	Proximity
174/05	2 Lot Subdivision	Campbells River Road, Black Springs	11/04/2005	Proposed Dwelling	See Attached Plan*
175/05	3 Lot Subdivision	Campbells River Road & Swatchfield Road, Black Springs	1/05/2005	Proposed Dwelling	See Attached Plan*
217/05	4 Lot Subdivision	Gormans Lane, Black Springs	23/05/2005	Proposed Dwelling	See Attached Plan*
232/05	6 Lot Subdivision	334 Swatchfield Road, Black Springs	24/06/2005	Proposed Dwelling	See Attached Plan*
211/06	6 Lot Subdivision	69 Swatchfield Road, Black Springs	Not yet Approved	Proposed Dwelling	See Attached Plan*

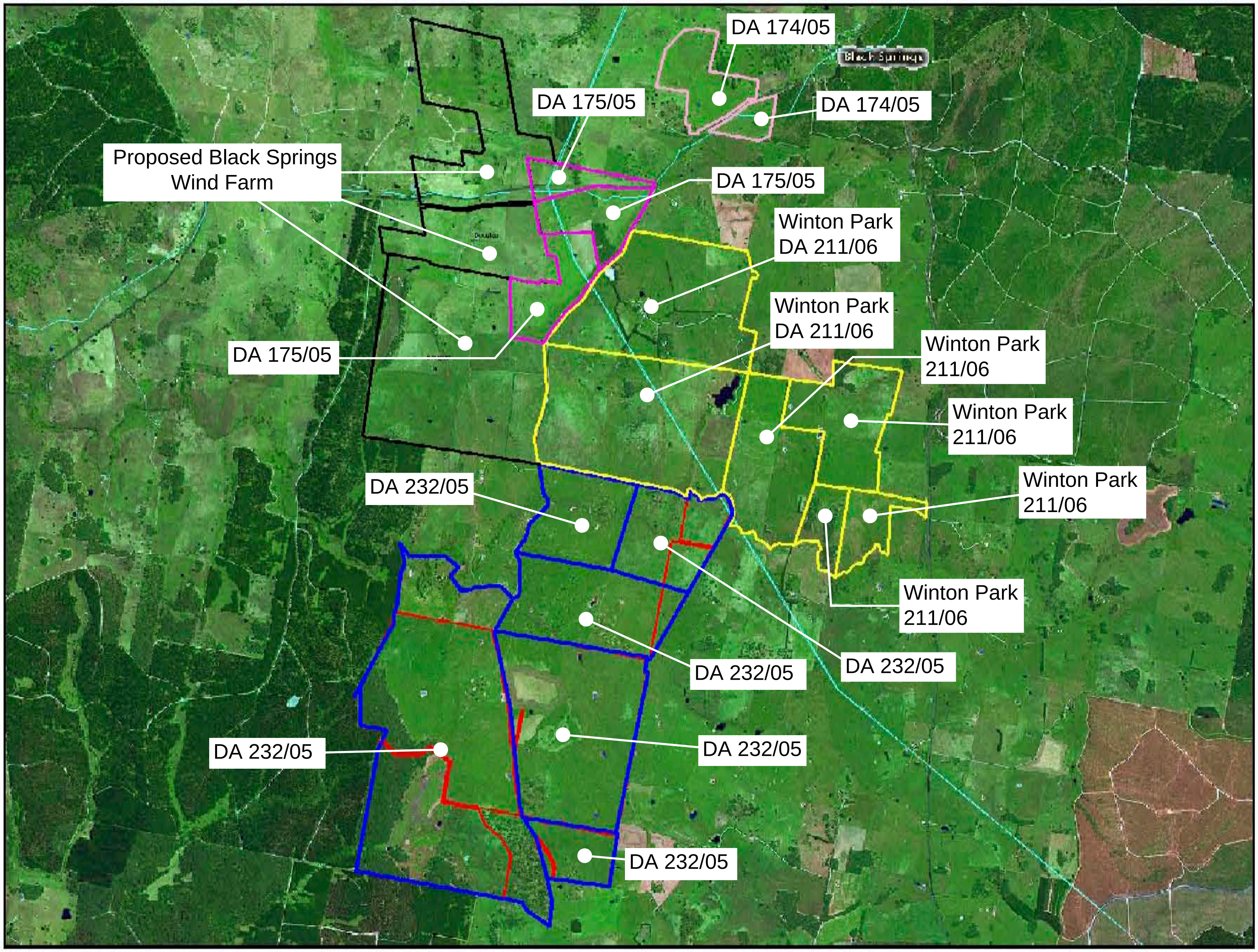
Provided by Oberon Shire Council - 23-10-06
*Black Springs Subdivision Applications.pdf

Figure 3 - Black Springs Subdivision Locations



Whether these were undertaken with or without the knowledge of the Black Springs Wind Farm development is unclear but some at least must have been proposed in the knowledge of the Wind Farm application and proposal.

These subdivisions are all rural residential in nature and comprise mostly large parcels.



Created: Friday, 17 November 2006	**Black Springs Wind Farm – Subdivision Locations**	energreen wind

We have been asked to comment on the subdivision potential of parcels surrounding the proposed Black Springs Wind Farm and in our view the subdivision potential, which is largely controlled by the planning process could be compromised by the existence of the Wind Farm proposals depending upon the weight the planning authority chooses to place upon the reaction to it.

The commercial viability of the subdivisional potential of the rural land in the vicinity of the Wind Farm development can be tested in relation to the current proposals by recognising that Winton Park, which had earlier been part of the Black Springs Wind Farm proposal, was sold at a record price post Wind Farm public consultation.
The purchaser then made application for subdivision of the land comprising Winton Park and in the circumstances we conclude that the purchaser must have been satisfied that the existence of the proposals for the Black Springs Wind Farm were unlikely to adversely impact on his opportunity to turn a profit from his venture or otherwise it seems unlikely that he would have completed the purchase of Winton Park.

6. CONCLUSION

From the foregoing evidence we are left with the view that it is unlikely that long-term there will be a negative impact on the market value of rural landholdings in the neighbourhood of the proposed Black Springs Wind Farm development by virtue solely of the Wind Farm.
The recent sale of Winton Park as mentioned above supports the view that the proposals for the Black Springs Wind Farm development have not produced a diminution in value of the Winton Park property which is adjacent to the Wind Farm proposal.
This view we accept is largely empirical (apart from the Winton Park sale) but derived from the most reliable data we have been able to source.

7. TABLE OF REFERENCES

8. TABLE OF FIGURES

FACT SHEET 1

Wind Farm Basics

What Is A Wind Farm?

"Wind Farm" is the name used for any group of adjacent wind turbine generators that are connected electrically. This includes vehicle access tracks, underground cabling for electrical interconnection and communications, and the switchyard at the point of connection to the grid. In Australia, wind farms have been built with between 1 and 60 wind turbines.

Each wind turbine acts independently, generating from the available wind resource. The electricity flows through common cabling out into the grid. The turbines are usually arranged to maximise use of the wind available and placed sufficiently far apart to avoid interference with one another.

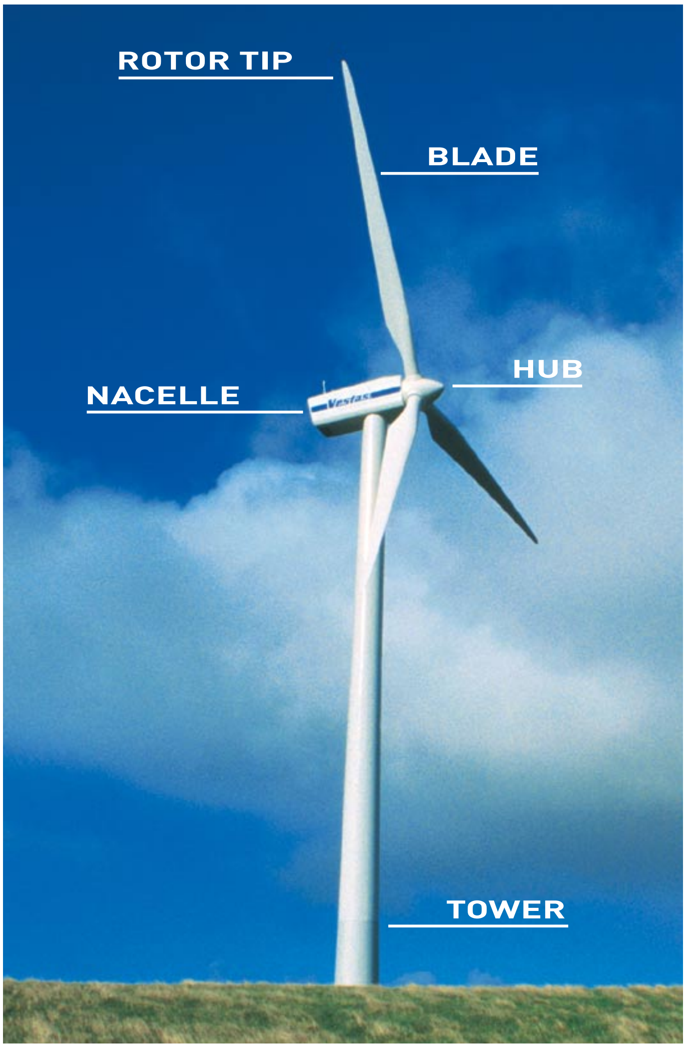
Wind farms produce electricity directly from a natural, clean and sustainable energy resource. This technology is now the world's fastest growing electrical generation source and Australia is beginning to see more wind farms proposed due to their environmental benefits.

Every development is different and site specific issues and local planning controls ultimately determine the design and layout of a wind farm. To provide a benchmark approach, AusWEA has published "Best Practice Guidelines for Grid Connected Wind Energy Projects in Australia" www.auswea.com.au.

What Is A Wind Turbine Generator?

A wind turbine generator consists of a foundation, tower, nacelle and a rotor (three blades mounted on a central hub). The foundation is typically a thick slab of reinforced concrete 12m wide and 3m deep. This is buried in the ground, allowing stock to graze right up to the tower. The nacelle rests on a large bearing which allows the whole machine to be driven by motors into the prevailing wind direction.

Whereas early wind generators overseas were built on lattice towers, in Australia only enclosed tubular steel towers are used. Towers are typically coloured white or light grey as these colours have been found to create the least visual impact. Internal ladders provide access to the nacelle which contains the drive-train, gearbox, generator and controlling equipment. Wind turbines for today's wind farms cost up to $3M each.



How Do Wind Generators Work?

The rotor turns a generator inside the nacelle, converting some of the wind's energy to electricity. As wind speed increases, more energy is delivered to the wind turbine's rotor. This energy is extremely sensitive to wind speed - doubling the wind speed gives eight times the energy.

Wind turbine generators deal with these huge variations in power using several aerodynamic strategies that regulate the power captured by the rotor.

Wind Speed (m/s)	Wind Speed (km/h)	Operating Strategy
<4	<14	machine shut down – not worth wear and tear
4– 12	14 - 45	output increases steadily with increasing wind speed
12 – 25	45 – 90	output remains steady and excess energy "spilled" from rotor
> 25	>90	machine shutdown for self protection

Blade Speed and Materials

The blades of grid connected wind generators range between 25 and 50 meters long and typically sweep to about half way down the tower. Depending on the size and design of the machine, the rotor will turn at between 10 and 25 revolutions per minute. From a distance this rotation seems quite slow and stately. Up close the strength, flexibility and speed of the rotor blades is revealed.

The blades are made from advanced composite materials that have high strength and are light weight and flexible. The maximum blade tip speed is about 215 km/h and it is quite normal to see the blades flex backward several metres under the enormous pressure of the wind.

Integrated lightning protection systems ensure the blades can withstand a direct strike without serious damage. In Australia towers are nearly always steel, whereas in Europe concrete towers are also used.

Where Are Wind Farms Sited?

Wind farms are usually sited where there is a good wind resource, access to transmission lines, local community support and plenty of open land available. Typically, the best wind resources in Australia are in coastal regions or inland at higher altitudes. Wind farms are unlikely to be built offshore in Australia in the near future because of the extraordinarily high cost of offshore construction. Nonetheless, in Europe offshore wind farms have become economically viable because of higher energy prices.

How Much Energy Does A Wind Turbine Produce?

This depends on the size of the machine and the wind resource. Typically each wind turbine can can produce enough energy to meet the needs of up to 1,000 homes, saving several thousand tonnes of CO2 emissions per year.

How Do The Costs Add Up?

Wind power and other renewables are economically viable in Australia because the Federal Government, like many governments in the world, is encouraging the uptake of renewable energy through legislated measures. The Mandatory Renewable Energy Target (MRET) requires that a certain amount of the energy sold by Australian retailers be from renewables such as wind and solar.

Currently wind energy costs around twice as much as energy from coal generation, but the cost of wind power and other renewables is falling. Importantly, the cost of fossil fuel based energy does not factor in environmental costs and should these be imposed in the future (as seems likely), the gap between wind and fossil fuel based energy will close rapidly. In more remote parts of Australia where fuel costs are higher (eg because of transport of diesel), wind energy can be cheaper than fossil fuel based generation.

Where Can I See A Wind Farm?

Wind farm locations can be found by visiting the Australian Wind Energy Association's web site www.auswea.com.au. Most wind farms have viewing areas with informative displays, some with self guided or commercial tours. Some of the larger wind farms have "virtual tours" on their web sites.

Please remember that most wind farms in Australia are located on private property. You should keep to the path and designated visitors' area and not enter private property unless invited.

Wind Farming & the Australian Electricity System

How Do I Know Wind Farms Are Reducing Greenhouse Emissions?

Whenever a wind farm is operational, its output is being fed into an electricity grid and the energy is being used somewhere in the system downstream. Although the contribution of wind energy is currently quite small relative to the total generation on Australian electricity networks, every unit generated from wind is a unit that does not need to be produced by other generation, 90% of which comes from fossil fuels. The type of generation actually displaced (and hence the emissions saved) by wind energy, will vary depending on the geographic location of the wind farm and the time of generation.

How Much Fossil Fuel Does Wind Power Offset?

Depending on where it is located in Australia, a typical new 50 megawatt (MW) wind farm displaces between 65,000 and 115,000 tonnes of carbon dioxide - equivalent to leaving tens of thousands of tonnes of coal in the ground each year. The amount varies depending on what type of fossil fuel the wind energy is displacing.

What Happens When The Wind Stops Blowing?

The output of fossil fuel fired generators can be controlled, wind power cannot. Presently, wind power variability has no impact on the operation of most large Australian electrical networks because it still makes a relatively small contribution to the total generation. Today when wind farm outputs increase, the fossil fuel generators simply back off, and vice-versa when output decreases. Networks have to be able to accommodate changes like this all the time because of fluctuations in load.

In the future, more wind farms will be built and the percentage of the electricity from wind will increase. How well the networks cope with this depends largely on the type and size of fossil fuel generation being used, network operational policy, and whether the lessons learnt from other places in the world can be applied.

In some parts of Germany, wind energy can contribute up to 70% of a region's electricity needs. This has required the use of long term wind energy forecasting and changes to the way that these networks are controlled. These changes have been driven by a desire from community and Government, to see the environmental benefits of wind energy increased.

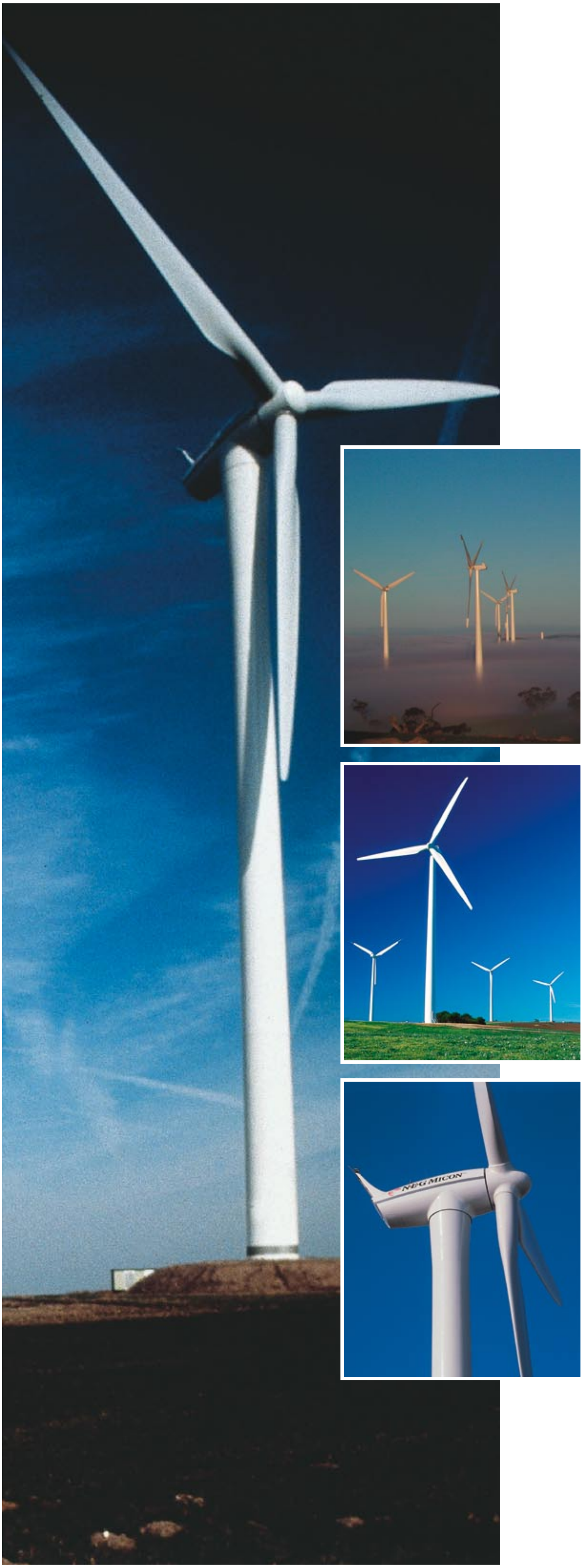
It has also been found that as more wind farms are built, their combined fluctuations and hence overall impact on electrical networks are reduced. This is because wind speed depends largely on local weather patterns and these become more diverse the further they are apart.

How Predictable Is Wind Power?

Wind power output is intermittent, but the output from wind farms can be usefully predicted as much as 24-48 hours in advance. With increasingly effective data collection across Australian wind sites, forecasts are likely to improve with significant benefit to network managers.

How Does Wind Energy Compare To Other Types Of Generation?

In terms of mechanical operation and maintenance, wind turbines are more than 99% reliable, compared to around 97% for the steam turbines used by coal plants.



Because turbines in Australia are generally located to take advantage of strong and consistent winds, their utilisation rates (the amount of time they are in use) are generally in excess of 95%, which compares favourably with conventional power plants. Wind turbines are very efficient in converting the primary fuel (wind) to energy. Today's large scale machines typically operate at efficiencies of approximately 47%. This compares with coal to energy conversion efficiencies of 30 – 40 % for coal burning plants, where the majority of energy is lost as heat in the exhaust.

How Much Wind Power Can We Have In Our Energy Mix?

Large scale wind generation needs to work hand in hand with conventional sources. AusWEA has a target of 5,000 MW of wind to be installed in Australia by 2010 - about 6% of Australia's electricity needs. Recent modelling by technical experts has revealed that at least this amount of wind power can be integrated into the national grid subject to wide distribution, strong interconnection and state of the art forecasting. However, there are plans in some overseas countries for wind power to contribute as much as 10% of energy needs by 2010.

How Can I Help Promote Wind Power?

In almost every State, householders and businesses can elect to pay a little extra on their power bills for "Green Power". Through a process audited by a third party, "Green Power" customers are assured that renewable electricity, equivalent to the normal consumption, is fed into the grid reducing the amount of fossil fuel based generation needed. The collective purchasing power of "Green Power" customers represents a significant benefit to the environment and is a way of promoting renewable energy sources such as wind power.

AusWEA
Australian Wind Energy Association
www.auswea.com.au

Wind Farming & The Environment

Why Are Renewable Energy Sources Like Wind Power Important?

Most (90%) of the electrical energy used in Australia comes from the burning of fossil fuels such as coal and natural gas. In April 2001, the Renewable Energy [Electricy] Act was passed as one of the measures proposed by the government aimed at reducing human induced changes to our climate. This Act set targets for the increased use of renewable energy through the Mandatory Renewable Energy Target (MRET). Wind energy is clean, free and renewable. The technology is proven, fast to build and cheap in comparison to other renewable energy technologies. Wind energy is well placed to grow and deliver greenhouse pollution cuts on an increasingly cost competitive basis.

Is Climate Change Real?

The Greenhouse Effect is a natural phenomenon whereby greenhouse gases trap heat in the atmosphere, keeping earth warm enough for us to habitate. Human activity is however, releasing unprecedented quantities of these gases into the atmosphere principally through the use of fossil fuels. This is believed to be causing too much warming and may lead to accelerated climate change. While the extent and severity of the effects on the environment are uncertain, it is a serious environmental problem for humanity. To avoid dangerous climate change, well beyond what we have seen already, greenhouse emissions will need to be reduced by at least 60% below 1990 levels by 2050. While the "Kyoto Protocol" will reduce emissions by an average of 5% by 2012, it will only be the first of many initiatives required to achieve the massive reductions needed.

Where Does Australia Rate In Greenhouse Gas Production?

Australia has the highest per capita greenhouse gas emissions in the developed world. Although Australia's emissions contribute only 3.6% to the global total, they are roughly the same as the combined emissions from Austria, Denmark, Finland, Ireland, New Zealand, Norway, Portugal, Sweden and Switzerland.

Why Are Australia's Greenhouse Emissions So High?

Electricity consumption due to the burning of coal and other fossil fuels, is the most significant source of greenhouse emissions in Australia (45%). This continues to increase rapidly with economic growth. In Australia, around 10% of our electricity is renewable, most of which comes from large scale hydroelectric power stations that were built several decades ago such as the Snowy Mountains Scheme .

How Much Energy Goes Into Building Wind Turbines?

It takes only a few months for a wind turbine to pay back the energy used in its manufacture and over its 20 year lifetime, a wind turbine will produce more than 50 times the energy used in its manufacture, transportation and erection. Once dismantled at the end of its life, it will leave very little legacy of pollution for future generations.

Are There Other Benefits To Wind Generation?

Rather than generating a large amount of power in one centralised location, wind farms are often located close to where the electricity is actually used. This means that the losses usually associated with the transmission of electricity over long distances (up to 10%) can be significantly reduced. This further increases the emission reduction benefits.

How Much Energy Can A Wind Farm Produce?

Depending on siting, a typical wind turbine can produce the equivalent energy needs of up to 1,000 homes. A typical 50 megawatt (MW) wind farm in Australia displaces between 65,000 and 115,000 tonnes of carbon dioxide per annum – enabling tens of thousands of tonnes coal to be left in the ground each year.

What Is The Impact On The Local Environment?

Wind power offers an environmentally benign means of generating electricity and since the area occupied by the wind turbines themselves is so small, the impact on the natural environment is usually quite minimal. Having said this, wind turbines do need to be located in elevated and exposed places and are often visually prominent in the landscape. There is little doubt that in terms of local environmental impact, it is the visual aspects which will tend to dominate debate. This is addressed in more detail in Fact Sheet # 7. In terms of other local environmental impacts, wind developers are often able to integrate beneficial local environmental measures into their construction and operational activities. This can include the collection of indigenous plant seeds, planting of shelter belts or habitat areas, land class fencing, erosion control measures or easing fire hazard management through improved site access. Income to landowners hosting wind generators can ease pressure on agricultural land by reducing the stocking or cropping of marginal land.
In addition, these landowners are often able to adopt superior pest, weed and erosion management practices as well as affording environmental plantings and other land care initiatives.

What Is The Impact On Wildlife?

Wind farms undergo stringent environmental approval processes including detailed studies of the impact on wildlife. Generally, the adverse impacts if any, will be negligible and positive outcomes can often be achieved through the integration of environmental works by the developer and host landholders.

How do Wind Turbines Impact Birds?

Monitoring at the Codrington, Woolnorth and King Island wind farms has found bird deaths to be below levels predicted and accepted during the wind farm approvals process. The rate of bird mortality on those sites ranged from between 0.23 to 2.7 birds per turbine per year, none of which was a rare, threatened or endangered species. Putting this into perspective, millions of birds are killed by cars and other man made structures every year. Impacts on Birds are discussed in more detail in Fact Sheet #8.

What Are The Long Term Impacts Of Wind Farming?

The long term impacts of wind farming are negligible. During operation there is no depletion of the fuel source (wind). When a wind farm is removed, there is no lasting residual impact on the landscape and it can be returned to essentially the same state as it was before the wind farm was built. Most wind farm development approvals have clauses requiring developers to decommission wind turbines at the end of their design life or if they cease operation for an extended period of time.

How Much Land Do Wind Farms Take Up?

In Australia, the land occupied by wind farms may not be as much of an issue as in countries where vacant land is at a premium (eg. Europe or Japan). Yet in comparison with other energy generation technologies, wind farms still show a greater energy yield per square meter with the impact intensity of wind generation facilities being significantly lower than an equivalent sized fossil fuel based plant :

Technology	m2 land used per GWh
Coal	3,642
Solar Thermal	3,561
Photo Voltaic	3,237
Wind	1,335

AusWEA
Australian Wind Energy Association
www.auswea.com.au

Wind Farming & Tourism

Wind farms are usually located in exposed and windy landscapes and the values placed upon these landscapes and the perceived impacts of development upon them vary considerably. Generally, responses depend on both the individual observer and the site being considered.

Wind farms tend to get more support than many other visually prominent forms of development because they produce clean energy, reduce greenhouse gas emissions and ultimately help mitigate climate change. While climate change is very important, some landscapes should be cherished and protected from all development.

Like other human-made structures such as bridges and lighthouses, well designed wind farms can give interesting perspectives and furnish the landscape with new architectural and heritage values.

In 2001, a poll[1] in Victoria showed that 94% of respondents described wind generators as "interesting" and 74% as "graceful". A subsequent survey[2] showed that 36% of respondents were more likely to visit a coastal area if it had a wind farm, while 55% said it would make no difference. Only 8% said it would deter them from visiting.

The February 2002 survey also showed that 95% of respondents supported the construction of more wind farms. This result was again backed up in a national poll[3] by AusWEA in 2003 which found that 95% support (27%) or strongly support (68%) building wind farms to meet Australia's rapidly increasing demand for electricity.

Are Wind Farms Tourist Attractions?

Yes. Hundreds of thousands of people visit Australian wind farms each year. Some of these are casual observers who stop at roadside interpretative centres or displays. Others pay to participate in organised tours. In a number of cases, tourists are able to walk right up to the base of the tower, gaining a full appreciation of their size and the power generated by these machines.

In Esperance (WA), more than 80 cars per day travel down the wind farm access roads with the majority visiting the wind farms. Although wind farms have been in operation in the region for over 20 years, visitor numbers have not declined over time.

What Is The Experien ce Overseas?

Utility scale wind energy is relatively new for most Australians but we can look to the long-term experience overseas. However we need to remain aware of differences – Australian landscapes are generally more impressive and our perceptions of environmental values may be different.

Tourism Overseas

In Denmark, there are 6,000 wind turbines in an area approximately the size of Tasmania and wind farms there are used for marketing tourism. Hotels, guest houses and camp sites may use wind turbines for "green tourism" promotion. This is particularly targeted towards the German market, where the public is known to have a high level of interest in both environmental issues and new technology.

In a Scottish study[4], 43% of responding visitors said a wind farm would have a positive effect on their inclination to visit the Argyll area, an area of high landscape value. About the same proportion said it would make no difference, whilst less than 8% felt it would have a negative effect.

Surveys in the UK show that for 94% of visitors to North Cornwall, the presence of wind farms has had no adverse impact on the likelihood of them visiting North Cornwall again. The majority of the remaining 6% say that the presence of wind farms would actually encourage them to revisit. Such public interest has led to a steady increase in the use of serviced accommodation in the area of the Delabole Wind Farm.

Public Perception Overseas

Research from a wide variety of sources consistently shows that general public support for wind power is between 70% and 80%.

In Denmark since 1991, the share of electricity consumption from wind power has grown six-fold to current levels of around 30%. However, a 2001 poll[5] indicated that 65% of Danes still believed it was a good idea to increase the share of wind energy in the Danish electricity supply. This is exactly the same share of the population as in two previous opinion polls taken five and ten years earlier. Further information on public attitudes to wind energy can be found at; http://www.bwea.org/ref/surveys.html

Visit a Working Wind Farm?

Viewing Areas

Most wind farms are located on private land so it is not always possible to walk up to the wind turbines. However in Australia every utility scale wind farm has a viewing area at which members of the public are able to safely pull

off the road and learn more about the project. Some wind farms have visitor information centres such as the Visitor Information Centre for the Toora wind farm in Victoria - www.toorawind.com.au/windfarm.

In Western Australia, a major Wind Discovery Centre for the Albany wind farm is being planned by the Albany Council to attract additional tourists to the region - www.albany.wa.gov.au/albany/windfarm/windfarm.

Self Guided Tours

Some wind farms are located on public land and allow members of the public to walk amongst the turbines at their leisure (e.g. the 9 and 10 Mile Lagoon Wind Farms - Esperance, WA and the Albany wind farm - Albany, WA).

Commercial Tours

Several wind farms in Australia attract so many visitors that commercial tour operators have been established and provide an opportunity for the public to get a close up view of the wind farm.

- Woolnorth, Tasmania: www.woolnorthtours.com.au/windfarm.html
- Challicum Hills, Victoria: www.windfarmtours.com.au
- Codrington, Victoria: www.myportfairy.com/windfarmtours

Virtual Tours on the Web

Many wind farms around the world have virtual tours on the web, in particular some of the large offshore wind farms.

1 AusPoll study - June 2001
2 AusPoll study - February 2002
3 Australian Research Group Study - September 2003
4 Tourist Attitudes Toward Wind Farms, MORI Summary Report, September 2002: http://www.bwea.com/pdf/MORI.pdf
5 http://www.windpower.org/en/faqs.htm#anchor29566

Wind Farm Siting Issues

What Do Wind Farm Developers Look For?

Wind developers favour sites with the following attributes:

- Strong and consistent winds
- Winds that blow at times of the day when the electricity is most needed
- Proximity to a suitable electrical grid
- Land where wind farm development is appropriate, away from areas of high conservation value or areas with endangered flora or fauna species [eg. National Parks and wetlands are not considered]
- Identifiable and manageable cultural heritage issues
- Open land without obstacles to the wind flow, and where such obstacles are unlikely
- Broad community support and acceptance
- Low population density
- Good access for wind farm construction and maintenance
- Suitable geology for access track base and foundations

Often a compromise needs to be found amongst these factors.

Land Use

Wind farming is compatible with many land uses ranging from cropping and grazing properties, to industrial estates, port break-waters and sometimes even forestry. In Australia, wind farms have been built on, or construction is currently proposed for most of these types of land.

Impact on local amenities such as airports, must also be considered when siting a wind farm. The long life span (20-25 years) of a wind farm means that it is also important to consider the future uses of adjacent land.

How Far Away From Houses Are They Built?

Although wind farms are not noisy in operation they still need to comply with very strict noise standards. It is therefore normally noise criteria that determines their set backs from residences. Setback distances range from about 400m to 1km or more, according to a variety of factors. These include the noise standard prescribed, local topography, prevailing wind conditions and the wind farm layout.

Why So Much Emphasis On Wind Speed?

The commercial success of a wind farm depends upon its electricity output and the selling price. Wind power in Australia has to compete with some of the cheapest electricity prices in the world, largely due to our extensive reserves of fossil fuel.

The output of a wind farm is extremely sensitive to wind speed. A 15% percent increase in wind speed adds 50% to the energy available. Only a 20% reduction in wind speed halves the wind energy produced. Wind farm developers must therefore, seek out the very best wind resources in order to develop commercial projects.

In Europe where electricity prices are much higher, wind farms can and are built in areas with considerably lower wind resources.

Where Are The Windy Sites?

Generally it gets windier away from the equator. The southern latitudes of Western Australia, South Australia, Victoria and Tasmania have excellent wind resources. However regional effects such as land/sea interactions, hills, ridges and mountains can enhance wind speeds making an otherwise uneconomic area suitable for wind farm development.

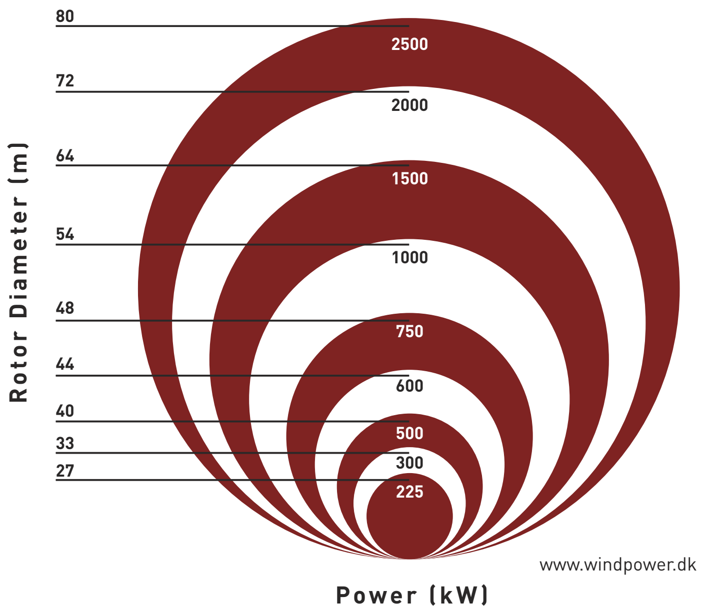
What Do Developers Avoid?

Wind developers will avoid any site with features that might slow down the wind. The impact of an obstacle will be determined by its height, its width and its porosity to the wind. Obstacles can be natural; ranging from dense forests to scattered trees, or human-made; such as wind rows or buildings. They can not only slow wind down, but induce turbulence which has a negative impact on energy yield and blade wear.

"Surface roughness" is another factor to be considered. Rougher surfaces slow the wind and introduce turbulence into the flow of air. Even a mature wheat crop will slow the wind down more than a closely grazed pasture. Scattered trees will have an even greater effect and big cities have the worst impact. The further the wind travels over rough surfaces, the more the wind slows down. This is one reason why inland sites have lower wind speeds.

Why Are Wind Turbines So Tall?

Wind speed increases with distance above ground level. In addition, towers must be tall enough to accommodate the rotor which normally sweeps past the tower at about half its height. Power output dramatically increases with rotor diameter as shown below.



Why Are Wind Farms Put On Top Of Hills?

Due to speed up effects, wind speed is significantly higher at the top of a hill or ridgeline.

Why Aren't More Wind Farms Built Inland?

Wind farms can be built inland where wind speeds are sufficient and the electricity grid is nearby. Inland sites do however, generally need to be in elevated terrain to be acceptable. Many coastal areas have stronger winds because of their exposure and proximity to the ocean where sea breeze effects are the greatest.

Why Aren't More Wind Farms Built Offshore?

In Europe there are several offshore developments underway, however they are very expensive to build and cannot be supported by Australia's low electricity prices. In Australia, there is still plenty of room for development onshore.

How Far Apart Are The Turbines

In general, wind generators will be separated by 3 to 5 rotor diameters across the prevailing wind energy direction and 5 to 7 rotor diameters with the prevailing wind energy direction.

What Other Issues Impact Wind Farm Layout?

Layout issues are very complex with several factors coming into play in varying degrees according to site conditions. Major factors include local terrain, noise constraints, aesthetic appearance, and avoidance of areas of important native vegetation and sites of cultural or archaeological significance.

Sophisticated three dimensional computer models help developers plot the many complex and often competing issues involved in designing a wind farm. The layout of most wind farms will normally need to go through many iterations before the final design is reached.

What Influences The Wind Farm Size?

Australian wind farms tend to be larger than European facilities as greater economy of scale is required to make them economically viable. In Australia, wind farms of between 10 and 50 wind turbines are usually pursued.

How Much Land Is Needed?

Although spread out, less than 1% of the land is used by the wind farm. Theoretically a 50 turbine wind farm could be squeezed into just 100 hectares, but local terrain and other factors usually means a much larger area is required and more than one landholder may be involved. For example, an attractive ridge may take in several land holdings, particularly where the ridgeline constitutes a property boundary.

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Wind Farms & Noise

How Noisy Are Wind Turbines?

Although wind turbines do make noise, today's modern generators are generally much quieter than most people expect. It is quite possible to carry out a normal conversation at the base of a turbine running at maximum power, without raising one's voice.

The noise at locations within or around a wind farm can vary considerably depending on a number of factors including the layout of the wind farm, the topography or shape of the land and the speed and direction of the wind. It can be accurately measured using acoustic equipment.

What Do Wind Turbines Sound Like?

The main sound is the swooshing of the blades as they rotate. Sometimes when standing close to the tower, the whirr of the gearbox and generator may also be audible.

An unusual feature of wind turbine noise is that unlike most sources of industrial noise, it increases with wind speed. Around wind farms, many sources of background noise such as vegetation, are also affected by wind speed. At any given location, a wind farm's level of audibility will depend upon the relative levels of noise produced by the wind farm and the surrounding background noise.

When there is little or no wind, a wind turbine does not operate and therefore produces no noise. As the wind speed increases, the turbine commences operation and will start to produce noise which will increase as the wind speed rises. Wind related background noise at locations around the wind farm will also increase. Typically, this background noise rises more quickly and tends to mask the noise from the wind turbines.

The "noisiness" of a wind farm is therefore dependent on not only the level of noise that the wind turbines produce, but also the levels of background noise where the listener is situated. This will vary in different operational conditions.

The sound of a wind farm 100 m away would be inaudible in many urban areas of Australia as it would be drowned out by wind related and other background noises.

A listener's perception of noisiness is influenced not only by how much louder the noise is than that of the existing environment, but also by additional factors which include the acoustic characteristics of the noise itself [ie. whether it has audible tones or characteristics that may annoy the hearer]. All of these factors are considered when setting noise limits for wind farms.

Low Frequency Noise & Infrasound?

Concern is sometimes expressed about the possible effects of low frequency noise from wind turbines on nearby residents. Low frequency noise was a feature of some early wind turbine designs with the blades down-wind of the tower. This caused a low frequency 'thump' each time a blade passed the tower. Modern wind turbines have their blades upwind of the tower, thus reducing the level of this type of noise to below the threshold of human perception, eliminating any possible effect on health or wellbeing.

How Does Noise Affect Wind Farm Layout?

Noise limits are carefully determined and result in turbines being located far enough away from occupied houses to protect the amenity of the people living in them. This can have a significant impact on the number and type of turbines included in the design of a wind farm and where they are located.

In Europe, it is common to have wind turbines within 100m of houses. In Australia however, a more conservative approach has been taken and wind turbines are usually placed at least 400m from noise sensitive locations.

How Does Wind Turbine Noise Compare With Other Sounds?

Levels of sound perceived by the human ear are usually expressed in decibels, denoted dB(A). The "A" represents a weighting of the measured sound to mimic that discernable by the human ear, which does not perceive sound at low and high frequencies to be as loud as mid range frequencies.

- A change of 1dB(A) is the smallest difference one can hear within an acoustically controlled environment
- A change of 3dB(A) is a just noticeable change in level difference in an external environment
- A change of 5dB(A) is a clearly noticeable difference in level
- A change of 10dB(A) is heard as a doubling in loudness of the noise

The following table shows that at 350m, a wind farm has a noise level of between 35 and 45dB(A). In a very quiet rural setting you might therefore be able to hear a wind farm at this distance, depending on the level of wind related background noise.

Source/Activity	Indicative noise level dB (A)
Threshold of hearing	0
Rural night-time background	20-50
Quiet bedroom	35
Wind farm at 350m	35-45
Busy road at 5km	35-45
Car at 65 km/h at 100m	55
Busy general office	60
Conversation	60
Truck at 50km/h at 100m	65
City traffic	90
Pneumatic drill at 7m	95
Jet aircraft at 250m	105
Threshold of pain	140

Who Determines Wind Farm Noise Limits?

As wind farms have become more plentiful, they have attracted greater regulatory scrutiny. This particularly relates to noise, which is an important design criterion. A regulatory authority, often the state's Environment Protection Authority (EPA), will issue guidelines for noise limits and recommend standard methods to use in predicting and measuring noise. Standards Australia is currently developing a standard methodology for predicting and measuring noise emissions from wind farms, but the setting of noise level criteria will remain the responsibility of the relevant Regulatory Authority.

Wind Farms & Visual Amenity

Background

At a local level, the response of the public to a wind farm proposal can vary considerably. To some, the prospect of direct views to a wind farm can be a pleasing addition to the landscape. To others, a wind farm may be seen as an unsightly blight. The response does not only depend upon the particular landscape; it is also affected by the observer and the values they ascribe it.

Wind turbines need to be placed in locations exposed to consistently strong winds. They are large machines and a wind farm will feature prominently in the landscape. In contrast, the impacts of the greenhouse gas emissions that wind power helps to reduce, are predominantly out of the public eye. Large scale coal-fired power stations – the source of 84% of Australia's electricity – are by and large "out-of-sight and out-of-mind".

Wind energy is one of the cheapest forms of renewable energy and its environmental benefits are clear. Polls show a remarkably high level of support in Australia, with one survey[1] indicating 95% support for the building of wind farms to meet our rapidly increasing demand for electricity. Opinion surveys[2] suggest most Australians use words like "interesting", "graceful" and "attractive", rather than "industrial" to describe wind turbines . Nevertheless, a wind farm's impact on visual amenity is generally the dominant issue in the reviews of wind farm proposals and it can be the cause of bitter and acrimonious debate.

The range of views, and importance of considering the context, is demonstrated by the wind farm at Esperance, a coastal town in Western Australia. Here the community actually objected to a wind farm being decommissioned, because residents had become fond of it and identified it as part of the region's cultural heritage. In other cases, wind farm approvals have been withheld because of perceived impacts on heritage landscapes.

What Is The Industry Doing?

AusWEA recognises that the long term sustainability of the wind industry depends on appropriately sited and sensitively developed projects. AusWEA strongly supports the development of guidelines to inform the assessment of all potential impacts of wind developments, including visual amenity.

Unfortunately, there is currently no universally agreed methodology for assessing landscape values across Australian states. For this reason AusWEA, in cooperation with the Australian Council of National Trusts, is undertaking a "Landscape Values Project" to jointly develop agreed landscape assessment methodologies that can be used by regulators as part of the overall project evaluation process.

The project is divided into three stages -

(i) Stage 1 will scope issues surrounding wind farms and landscape assessment, and solicit possible solutions relevant to the siting of wind farms on the landscape.

(ii) Stage 2 will establish agreed landscape assessment methodologies.

(iii) Stage 3 will trial and test the methodologies.

Stage 2 and 3 are contingent upon the successful completion of Stage1 which has been funded by the Australian Greenhouse Office and is scheduled for completion mid 2004.

Some Of The Visual Amenity Issues

Visual amenity issues can be broadly categorised into two groups; those relating to the wind turbines themselves and those that relate to their interaction with the landscape. The first category is relatively easy to deal with whilst the latter is much more complicated.

Issues relating to the general appearance of wind turbines, their colour and the impacts of shadows cast, can be reasonably easily managed in the design process. Machines in a given wind farm should be of a consistent size and visual appearance and it has been found that the best colour for wind turbines is off-white or light grey.

For visual amenity issues relating to the surrounding environment, the landscape character needs to be considered along with assessment of the primary views of that particular landscape and the values the community ascribes it. This is important because the way in which we view a landscape, the value we place on it and our perception of the impact of a wind farm on that view, are highly variable and quite subjective.

All of this is complicated by the fact that wind farm layouts are the product of a complex iterative process. The layout that provides the "best" visual outcome may have unacceptable ecological or financial outcomes and vice versa.

How Should Developers Do?

The first step is to identify the neighbours to a proposed wind farm site and the important public view points, which may vary from a scenic vantage point to simply the main roadway. Through consultation, the developer should familiarise themselves with the visual settings that members of the community and special interest groups value. This allows for a broad assessment of the visibility of the proposal.

During and sometimes prior to the planning application stages, developers are required to prepare photomontages (computer simulations) of how the wind farm will appear from these important view points. These photomontages can also play an important role in the community consultation process, allowing the developer to test different layouts as they develop the proposal in the lead up to a request for formal approval.

How Can The Visual Impact Of Wind Farms Be Minimised?

AusWEA recommends :

- Extensive community consultation on turbine placement
- If possible, important view points should be agreed with the community early in the process
- The cumulative effect of neighbouring wind farms should be considered
- Wind generators must be uniform in size and design (including direction of rotation)
- Support tower, blades and nacelles should be painted the same colour – preferably off-white or light grey – and have a matt finish. They should not be used as billboards
- All wind generators within a wind farm should be kept operating at once
- The potential for shadow and flicker at residences should be assessed and minimised

1 Australian Research Group study - September 2003
2 AusPoll study - June 2001

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FACT SHEET 8

Wind Farms & Bird & Bat Impacts

Do Wind Farms Present A Collision Risk To Birds?

Wind turbines, like virtually all tall man-made structures, present a collision risk to birds and bats. The risks however are far lower than many imagine – especially when compared to risks of collision with other structures such as communication towers, tall buildings and transmission towers. The impact of wind turbines on birds and bats is insignificant compared to the impact of domestic cats and the loss of habitat through development or even more dramatically, the chronic impact of ecological change due to climate change and rises in sea level induced by increased greenhouse gas emission. In Australia, collision rates are generally around one to two birds per turbine per year.

What Are The Other Risks?

Wind farm construction and/or operation may impact the way some birds move about in a particular area. This might include direct impacts on flight, breeding and feeding behaviour as well as indirect impacts due to disturbance associated with construction activity and noise.

What Do We Know About The Impact Of Wind Farms On Birds & Bats?

Today, bird mortality from wind turbines is probably one of the best researched areas of risk to avian species. Despite some bad experiences early in the US, where wind farms were constructed with little or no understanding about the potential bird impacts, environmental scientists agree that properly sited, today's wind farms present minimal danger to bird and bat populations.

What Is The Experience In Australia?

Wind farming is relatively new to Australia, but evidence from surveys measuring the impacts of Australia's first wind farms on birds and bats, is starting to emerge. Although several years of post construction monitoring are required to fully understand the impacts, the initial results are encouraging.

- At Pacific Hydro's Codrington Wind Farm in Victoria (comprising 14 wind generators and opened in July 2001) a total of four bird deaths and one bat death were reported as a consequence of colliding with wind generators between 2001 and 2003. None of these were rare, threatened or endangered species. The measured mortality rates were used to predict a likely level of mortality from the wind farm as a whole of between 18 and 38 birds per year. Although there were some early concerns about the potential impact the wind farm might have on water birds, behavioural studies showed that this group was adept at avoiding turbines
- Stanwell's Toora wind farm in South Gippsland comprises 12 wind turbines. Between 2002 and 2003 six bat corpses were found. Common starlings, Australian magpies and ravens declined in numbers after operations started (although no fatalities were recorded), while the numbers of skylarks and gold finches increased. Wedge-tailed eagles were regularly observed before and after operations began, but these avoided the turbines by flying around or between them, not into them. The survey found no evidence that the wind farm has caused significant levels of bird mortality and stated that the impact seems to be confined to localised, indirect effects on common, farmland birds. No threatened bird species were observed on the site during a total of two years of surveys and whilst bats have been impacted, the effect is not of conservation significance.
- For Stage 1 of its Woolnorth Wind Farm, Hydro Tasmania has released results of bird studies conducted from October 2002 to October 2003,

during which wind turbines were monitored for evidence of any collisions. The wind turbines were monitored daily during peak activity periods and twice weekly throughout the remainder of the year. These studies show that mortality rates for all species are at the lower end of the levels predicted at the development assessment stage. After October 2003, Hydro Tasmania did report an additional nine birds having collided with wind turbines, one of which was a wedge-tailed eagle, which is a threatened species in Tasmania (but not on the mainland). Under the conditions of its planning permit from the Tasmanian Environmental Management and Pollution Control Board, Hydro Tasmania is required to make a contribution to the species' recovery.

What are the Regulatory Controls & Measurement Methodologies?

All Australian wind farm developers must currently comply with planning guidelines set out by Statutory Authorities. At a Federal level, all wind farm developments are accountable under the Commonwealth Environmental Protection and Biodiversity Conservation Act 1999 (EPBC). This powerful piece of legislation prescribes Commonwealth involvement in environmental matters where an action has or will have a significant impact on "matters of national environmental significance". There is specific reference in the Act to consideration of threatened species and listed migratory species.

In June 2003, the Australian Wind Energy Association was awarded a grant to develop bird impact assessment protocols and dataset standards to assist in data recording and analysis for evaluating the level of bird impact and mortality at Australian wind farms. The work supplements recommendations for bird assessment in AusWEA's Best Practice Guidelines and has been put together with the assistance of a broad range of stakeholders including Commonwealth and State Government agencies, bird experts and non-governmental organisations. This work will help :

- Industry in implementing effective monitoring and in addressing the bird impact issue
- Regulators in setting impact assessment and monitoring requirements as part of the development approval process
- Consultants in designing, costing and reporting impact assessment and mortality monitoring work
- Community and environment groups in understanding the significance of the bird and bat impacts of wind farms.

Importantly, the outcomes will provide a transparent and defensible basis for discussions about bird and bat mortality at wind farms in Australia.

How Does Mortality Due To Wind Farms Rate Against Other Causes & Compare With Overseas?

A US study[1] published in 2001 carried out by Western Ecosystems Technology puts wind turbine collisions into perspective with bird collisions with other structures :

- Vehicles: 60 million - 80 million
- Buildings and Windows: 98 million - 980 million
- Powerlines: tens of thousands - 174 million
- Communication Towers: 4 million - 50 million
- Wind Generation Facilities: 10,000 - 40,000

The study estimates that wind farms kill an average of 2.9 birds per turbine, per year in the US – equivalent to less than 0.02 percent of the staggering 200-500 million collision related deaths in that country. This estimate includes the fatalities at wind facilities such as those in Altamont, California which were sited in an area of high avian usage and have caused disproportionately high levels of bird mortality.

As the Australian industry enters its next stage of development, more and more information is coming to light that the mortality rates at Australian windfarms are lower than in the northern hemisphere. This appears to be due to the lack of large numbers of night-migrating songbirds in Australia. These occur in the northern hemisphere by the hundreds of millions and they make up about half of the birds that collide with wind turbines.

Further information can be found in AusWEA's Best Practice Guidelines for Implementation of Wind Energy Projects in Australia, May 2002. www.auswea.com.au.

1 National Wind Coordinating Committee (NWCC) Resource Document: Avian collisions with wind turbines: A summary of existing studies and comparisons to other sources of avian collision mortality in the United States.

Wind Farming On A Traditional Farm

Many wind farms in Australia are on freehold grazing property where the landowner enters into an agreement to host the machines in return for rental payments over the 20-25 year life of the development.

Can Wind Farming & Traditional Farming Coexist?

Yes. Most wind farm developers lease only a part of the property for the wind farm - that affected by the turbine footprint and access tracks - leaving the owner to continue their normal farming on more than 99% of the land. Broad acre agro-forestry however is sometimes prohibited because it reduces the commercial returns of the wind farm by slowing the wind. This may not be an issue if the wind resource is good enough.

In some ways, wind farms can be thought of as a vertical crop. Once construction is complete, traditional agriculture can continue underneath and around the wind farm. In most cases the land occupied by the wind farm becomes the most productive part of a holding.

How Much Land Is Required?

Theoretically, 20 machines with a rotor diameter of 40 meters can be accommodated on as little as 40 Ha. In practice however much more land is usually required after topography and other layout constraints have been taken into account.

Access tracks to each turbine need to be about 5m wide and are made from material like limestone or gravel. Interconnecting cabling between turbines is normally installed underground, alongside the access tracks. By being buried between wind turbines, ongoing cropping is not compromised.

For some developments, a single substation - about 40m by 30m - may be required to house the electrical plant, associated switchgear and metering equipment. Security fencing around the substation is also usually installed. The electrical interconnection to the existing grid is normally a common pole mounted three phase power line.

Developers are required to comply with noise regulations which impact the positioning of wind generators relative to residences. Setbacks from existing residences are usually a few hundred metres and sometimes buffer zones within which no houses can be built, need to be defined. Agriculture however, will normally be able to continue unaffected.

How Much Rent Is Paid?

Income payable to the farmer is normally agreed on a per turbine basis. Payments vary according to turbine size and wind regime, but are typically in the order of $5,000 per machine per annum.

What Agreements Are Needed?

Formal agreements range from initial option agreements, which may give the developer the right to collect wind data and other feasibility studies over a few years, to full lease agreements. These set out the responsibilities and obligations of both parties over the life of the wind farm project. Owing to the long life of a wind farm, the developer's rights will need to be transferable to any future purchaser of the host property.

What Are The Impacts During Construction?

Construction typically takes around 12 months. During this time there can be relatively high impacts compared to those experienced during ongoing operation, including frequent traffic movements that could cause disturbance.

All weather access tracks are built to link the wind turbines and can dramatically improve access across the property. Where possible, the existing farm track network is used. New fencing and gates may be required where access tracks cross pre existing fences. As part of these works, there is sometimes an opportunity to create laneway systems for stock.

Trenches and excavations are generally left open for only a few days. Appropriate fencing is used during this period. Each foundation takes approximately one week to prepare and a day to pour. The formwork is removed from the foundation a day or two later and backfilled within a week. Following approximately 4 weeks of curing, the wind generators can be erected.

Several foundations may be constructed in parallel and typically, the excavated material is stockpiled for back filling and road making. The large volumes of concrete required are mixed on site using a mobile batching plant.

Impact on livestock is minimal provided there is good communication between farm management and the construction team. Electric grids can be used to control stock as gates will generally need to be left open during construction hours to minimise delays to traffic. Stock must be kept away from excavations, usually using mobile electric fences. Alternatively, stock may need to be moved from a particular paddock for a short period of time.

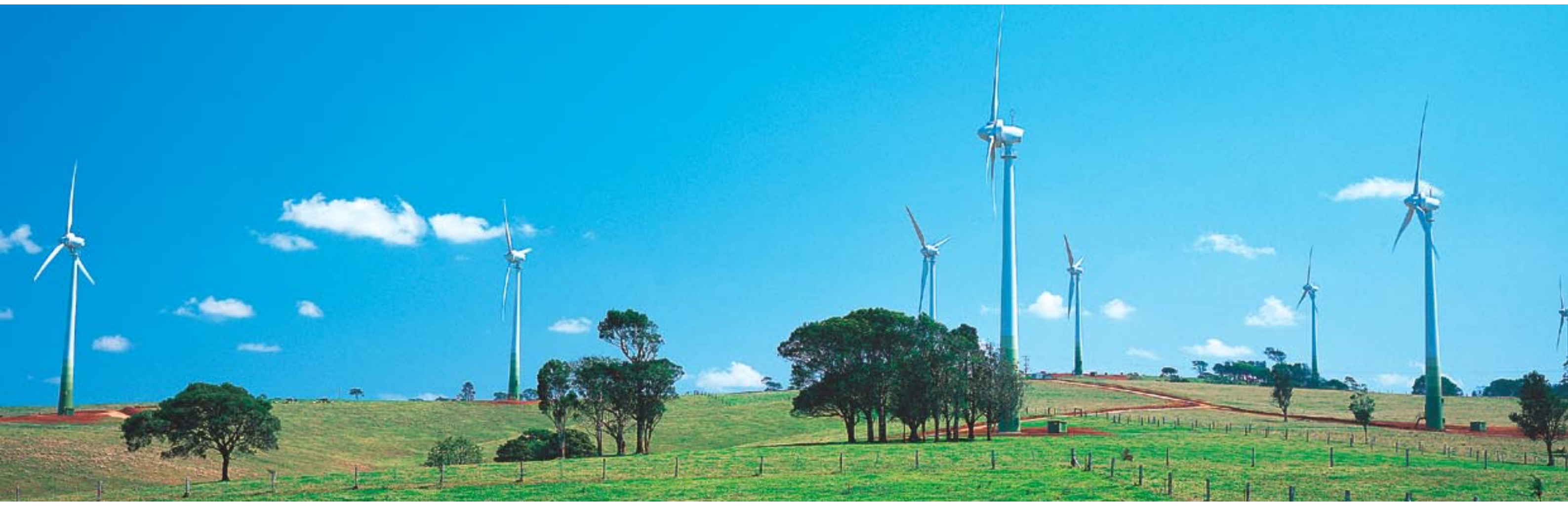
Impact on cropping is mainly due to the access tracks. Normal sowing patterns may be disrupted as it is unlikely that turbines will all end up on unproductive land or in the corners of paddocks. This said, careful planning and consultation will usually enable the landowner and developer to come to a mutually acceptable outcome.

Generally, pivot irrigators cannot be used in the vicinity of wind turbines because of the large area they occupy.

Depending on the site, agricultural aviation such as crop dusting or super phosphate spreading may be impacted. Agricultural pilots are highly trained and operate very manoeuvrable aircraft at very low altitudes (as low as 2m). They are very experienced in hazard management and the local operator is best placed to assess the potential impact.

Extensive tree plantings can slow the wind and cause turbulence and both of these factors reduce the commercial returns of the wind farm. Stock shelters and environmental plantings can however normally be accommodated.

Local microclimate effects are negligible. In the field measurements show little or no change in air temperature or carbon dioxide concentrations as a result of wind turbine movement and evapo-transpiration from the soil is not changed. Thus moisture content of the soil is unaffected.



Local and passing tourist interest will be stimulated by the wind farm construction. Landowners may receive phone calls from a variety of people including neighbours, the media, government departments, tourism operators, and other farmers considering wind farming, etc. Some wind developers help landowners manage enquiries of this nature.

Construction of new residences or other buildings may be restricted. This may be due to either the impacts on the wind resource, or in the case of occupied buildings, noise criteria. Detailed noise modelling during planning can provide a very good idea of "no go" zones for future residences.

How Are Farming Operations Impacted After Construction?

Impact on livestock is minimal. Sheep, cows and horses are not disturbed by wind turbines and typically graze right up to the base of the towers which they often use as rubbing posts or for shade.

Wind Farming, Electromagnetic Radiation & Interference

What Is Electromagnetic Radiation?

Electromagnetic radiation (EMR) is a wavelike pattern of electric and magnetic energy moving together. Types of EMR include X-rays, ultraviolet, visible light, infrared and radio waves. As a natural phenomenon, EMR is emitted by natural sources like the Sun, the Earth and the ionosphere.

Radio frequency (RF) EMR is commonly used for a wide variety of communications applications from the broadcast of television and radio, through to radars and mobile phones. It is important that wind farms do not impact the quality of this communication.

Is EMR Safe?

Whilst higher frequency EMR [eg X-rays] can be damaging to human health, only long-term exposure to very high levels of radio frequency (RF) EMR will heat or burn biological tissue. The levels of EMR that members of the general public are normally exposed to are far below these dangerous levels.

What About Electromagnetic Fields?

Electromagnetic Fields (EMF) emanate from any wire carrying electricity and Australians are routinely exposed to these fields in their everyday lives. The electromagnetic fields produced by the generation and export of electricity from a wind farm, do not pose a threat to public health. Typically, electrical cabling between wind turbines is buried in the ground, effectively eliminating any EMF. Grid connection is usually made at no more than 132kV, similar to the voltages used by utilities in existing distribution networks.

What Do Wind Farms Have To Do With EMR?

From a wind resource perspective, high and exposed sites are attractive. So it is not unusual for any of a range of telecommunications installations; radio and television masts, mobile phone base stations or emergency service radio masts, to be located nearby.

Care must be taken to ensure that wind turbines do not passively interfere with these facilities by directly obstructing, reflecting or refracting the RF EMR signals from these facilities. There is also potential for a wind turbine to actively interfere by producing its own low energy RF signal.

What Is EMR Interference?

Unwanted radio and background noise can impair effective telecommunications which rely on a strong signal to noise ratio. An appropriate transmitting antenna can dramatically improve this signal to noise ratio. A transmitting antenna can also increase the signal strength in a particular direction (ie toward a receiver). The directionality of a receiving antenna can also be enhanced, thus reducing the amount of unwanted noise.

How Are Wind Farm EMR Issues Managed?

The impact of wind turbine generators on electromagnetic waves is relatively minor and a means of mitigation, avoidance or remedy can be found for all potential impacts. Any interference can be minimised or eliminated through a combination of appropriate turbine siting and special technical solutions.

Point to Point Communications: Careful siting and directional antennae can eliminate any impact on point to point links.

Mobile Radio Services: Interference can be overcome by moving the mobile unit a short distance away as per normal practice for avoiding any other structure. Any interference to mobile radio services is usually negligible and limited to mobile communications within the wind farm site itself.

Television: Interference to television signals in the wind farm area can be caused by either the reflection or obstruction of the signal by the turbine blades. With glass reinforced plastic blades, modern wind turbine generators will cause minimal television interference. It cannot however, be completely discounted for houses within a few kilometres of turbines. If interference does become apparent after construction, the possible mitigation techniques include :

- the installation of a better quality antenna or more directional antenna,
- directing the antenna toward an alternative broadcast transmitter,
- installation of an amplifier,
- relocation of the antennae to achieve better signal to noise ratio,
- installation of a terrestrial, digital set top box for digital TV,
- installation of satellite or cable TV, or
- if a wide area is affected then the construction of a new repeater station may be considered.

Active interference is minimised or completely avoided by ensuring that all equipment complies with relevant electromagnetic compatibility standards, as all wind farm equipment does.

In the unlikely event that a problem arises over time at a particular site, the wind farm operator will usually be able to rectify it using one of the aforementioned solutions.

The Australian Communications Authority web site provides details of a variety of television signal interference patterns and ways to overcome these problems - www.aca.gov.au/radcomm/publications/better_tv_radio/index.

Wind Farm Safety Issues

How Safe Are Wind Farms?

The wind energy industry enjoys an outstanding health and safety record. In over 20 years of electricity generation with more than 100,000 machines installed worldwide, no member of the public has ever been injured during the operation of a wind farm. The reality is that wind power, like most renewable energy technologies, poses a very low risk to human beings.

Are Wind Turbines Designed To Be Safe?

Modern wind turbines are sophisticated machines built to last for at least 20 years in all the extremes expected in their operational environment. International safety standards are used in machine design by all major wind turbine manufacturers. Compliance to these standards is audited by third party organisations.

Wind turbines have special inbuilt safety equipment to deal with emergencies. For example, they are equipped with vibration sensors to detect rotor problems and all modern turbines allow complete shut down during excessive wind speeds, virtually eliminating the risk of the turbine rotor or tower failing. In fact wind turbines are considered so safe that at wind farms on public land in Australia, the general public is allowed to walk to the base of turbines at any time.

How Is The General Public Protected?

Many of the potential risks to the public are reduced by the use of enclosed tubular steel towers (rather than open lattice towers), locking systems on doors, intruder alarms, and protective safety fencing around open switchyards.

Wind turbines do not burn anything to generate electricity and therefore, produce no harmful emissions. The only potentially toxic or hazardous materials involved in the operation of wind farms are relatively small amounts of lubricating oils, hydraulic and insulating fluids. The potential for exposure of the general public to any of these is very small.

What Are The Air Safety Implications?

Unless they are constructed on or located near airports, wind farms are unlikely to impact on the safety of commercial and domestic air transport . In relation to the impact of wind farms on aviation operations, wind developers are required to liaise with the Civil Aviation Safety Authority (CASA) and the RAAF Aeronautical Information Service, which maintains a database of structures on behalf of CASA. Each wind farm is assessed by a CASA Flying Operations Inspector for its potential aviation risk and any obstruction lighting requirements.

Do Wind Farms Impact Agricultural Aviation?

The pilots of crop dusting or super phosphate fertiliser spreading aircraft are highly skilled and are easily able to negotiate between the wind turbines which are normally positioned hundreds of meters apart. These pilots regularly navigate other less obvious hazards such as power and phone lines. During the wind farm design phase, landowners (and in some cases pilots) are consulted on the position of wind turbines, particularly any machines near the approach and takeoff paths of unregulated rural airstrips.

How Do Wind Farms Impact Recreational Aviation?

The operation of recreational aircraft is less predictable than that of commercial aircraft. The array of flight instruments is typically less extensive and sophisticated and often the pilot is less experienced than commercial pilots.

Under Visual Flight Rules, pilots must have good visibility, fly at sub-sonic speeds and must not fly lower than 500 feet above the highest point of the terrain or any object on it. This is well above the height of any part of a wind farm.

What About Impacts on Hang Gliders?

The nature of operation of hang gliders, micro-light aircraft and model aeroplanes varies considerably. Takeoff points for these activities are sometimes favoured as attractive wind generation sites and local groups need to be consulted during the planning process to assess the impacts. Whilst the modification of activities may be required, they may not need to be precluded altogether.

Are There Fire Risks?

The risk of fire at wind farms is very low; both fire damage to wind turbine generators and fire caused by the generators themselves. This is because of the following factors :

- The flammable components are located high above the ground
- There is normally no vegetation around the base of the turbine towers
- High-voltage connections are underground
- Access tracks act as firebreaks and provide fire fighting access
- Lightning protection devices are installed on every wind turbine
- Dedicated monitoring and control systems shut down the wind turbines when the threshold temperatures of critical components are reached

Does Lightning Pose A Threat?

Wind turbines are often struck by lightning, but are equipped with comprehensive lightning protection systems. These systems transfer the high voltages and currents to the ground, without affecting turbine operations. In particular, turbine blades usually have internal lightning conductor rods running all the way to the blade tips.

Blade Icing

Experience has shown that icing in severely cold weather only occurs when the rotor is stationary. Once operation recommences, blade flexing causes the ice to break off and fall vertically to the ground. Actual "sling shooting" of ice has never been reported.

What About Safety During Manufacture & Construction?

As with other similar heavy engineering there are occupational safety risks for employees during manufacturing and construction. These include :

- Working at heights (particularly in windy conditions)
- Working with cranes
- Heavy machinery
- Rotating machinery
- High voltage electricity
- Working in hazardous weather conditions
- Driving vehicles

How Many Deaths Has The Industry Seen?

Since the early 1970's the wind energy industry has experienced 14 worker fatalities worldwide, directly or indirectly during wind farm construction or related accidents. All of these deaths could have been prevented if today's safe work practices had been adopted.

AusWEA
Australian Wind Energy Association
www.auswea.com.au

Wind Farms & Land Values

In Australia, a number of wind farms have been built on or close to private land. There is often debate as to whether the value of those properties has been affected.

Factors impacting land values include :

- Changes in income earning potential of property
- Aesthetic appearance - impact on scenic views
- Changes in fencing and on site access roads
- Changes in natural vegetation and ecology
- Noise
- General trends in property prices in the area independent of wind farming.

Although no formal studies have yet been carried out in Australia, we can learn from information and studies from overseas.

What Are The Potential Effects On Land?

The most contentious and subjective issue relating to wind farms tends to be the impact on the landscape and whether the wind farm constitutes an enhancement or a negative impact on visual amenity. From a property value perspective, the greatest actual impact will be if a revenue stream is derived from the development. There is little evidence to suggest that because of landscape values, wind farms negatively impact upon the land values of neighbouring properties.

The effects are not limited to visual amenity considerations. When considering changes in land values, the impacts of ancilliary services such as grid interconnection and roadworks also need to be taken into account . Main road access is sometimes enhanced and in cases where grid upgrades are required to enable the connection of a wind farm, there can be an improvement in the quality of local supply.

Wind farms do produce some noise during operation, but provided the wind farm has been sensitively designed this should not be an issue (see Fact Sheet #6). Similarly, appropriate design is usually able to mitigate the negative impacts arising from shadow and flicker at residences near the wind farm and can ensure that such factors will not impact property values.

Wind farms also bring tourists. Although this can affect landowners by increasing traffic flows, traffic noise & human pressure on an area that may previously have experienced little such pressure, it is unlikely to impact land values.

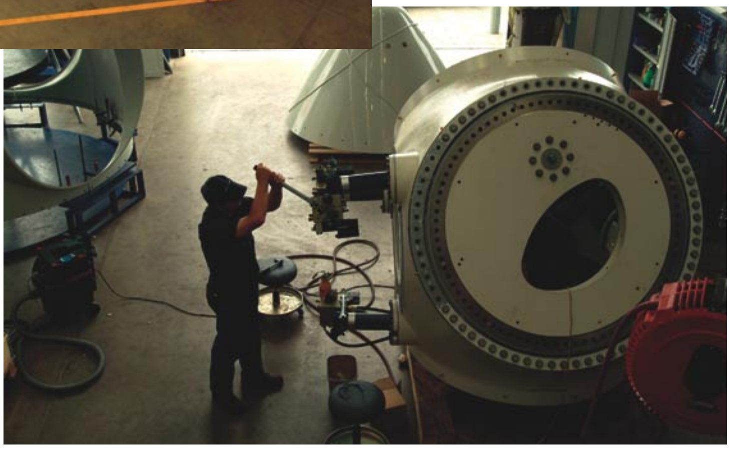
Wind farms do not have any noticeable effect on stock or cropping.

During construction there will be increased traffic movements and generally more activity than normal. This can mean some disruption to land owners caused by the increased noise during this period, but again is unlikely to impact land values.

What Is The Experience In Australia?

Owners of land where a wind farm is built receive income through land leasing and royalty agreements without impacting farming practices. This can be a very positive result for a rural property and the local rural community. However, landowners should be aware that wind farm agreements typically run for 20 years or more and therefore the impacts of this time frame need to be taken into account when considering any long term aspirations for the property. For example, a wind farm will generally limit rural subdivision potential and there may be a noise buffer of several hundred metres required around the turbines.

In Australia, there is no evidence to suggest that the value of properties with views of distant wind turbines, are adversely impacted by the wind farms In Esperance [WA], an informal investigation was made into property prices at Salmon Beach, a premier residential area 200 metres away from Australia's first wind farm. Of 15 properties investigated, only one reduced in value after the windfarm had been constructed. This was due to the property being subdivided and sold as two separate lots. Since then, Esperance has seen another two wind farms and 15 more turbines installed without a single negative comment.



Some people simply do not like the look of wind farms and this may influence their property buying decisions. In contrast, a 2001 Auspoll [VIC} survey found that the words most commonly used to describe wind farms were "interesting" (94%) and "graceful" (74%). In some situations, wind projects can provide a 20 year buffer and a net benefit to the landscape and environment by occupying an area that would otherwise have been subject to other development initatives.

What Is The Experience Overseas?

USA: Research in 2002 by ECONorthWest[1] concluded there was "no evidence supporting the claim that views of wind farms decrease property values". This was backed up by a May 2003 Analytic Report for the Renewable Energy Policy Project[2] involving the review of over 25,000 records of property sales within a distance of five miles of wind farms and interviews with property tax assessors. The report found that property values increased faster within the view shed of the wind farm than in comparable locations away from wind farms. The rate of change in average sales price within the view shed was 18% greater over the study period. Once again the report's summary concluded: "we found no evidence supporting the claim that views of wind farms decrease property values".

Denmark: A report by the Institute of Local Government Studies (AKF) found that "the economic expenses in connection with noise and visual effects from wind mills are minimal".[3]

United Kingdom: A British Wind Energy Association investigation based on a number of different studies, found no evidence that wind farms caused house prices to decrease. This is backed up by the experience of more than 70 operating wind farms in England, Wales and Scotland. In fact, when an opposition group advertised that a wind farm in Glens of Foudland, Scotland would have a detrimental effect on house prices, they were censured by the Advertising Standards Authority (ASA) when the group could not provide evidence to support its claims.[4]

An independent market research study in the UK carried out two public opinion surveys involving hundreds of face to face interviews with residents living near wind farms :

At Novar Wind Farm, Scotland: "In regards to house prices, 72 per cent say the wind farm has had no effect, with a further 26 percent saying "don't know". None of the respondents say house prices have decreased as a result of the wind farm." [5]

At Taff Ely Wind Farm, South Wales: A new housing development has been built just a few hundred metres away from Taff Ely, with views across open fields towards the wind farm. According to a study[6] 70% say they are able to see the wind farm from their home. "In regards to house prices, 78% say the wind farm has had no effect, with a further 15% saying "don't know". As many residents say house prices have increased a little because of the wind farm (3%) as say they have decreased a little. Similarly, as many say they have increased a lot (1%) as say decreased a lot."

In Nympsfield in Gloucestershire, house prices continued to gain after plans for a wind turbine were announced in 1992. They have continued to increase since the turbine began operating in 1997.[7]

1. Pheonix Economic Development Group
http://www.kvalley.com/phoenix/Kittitas%20Wind,%20final.pdf

2. Sterzinger, Beck, Kostiuk: May 2003 Analytic Report

3. Institute of Local Government Studies Denmark: Social assessment of wind power, Jorgen Jordel-Jorgensen, April 1996.

4. Renew online: Wind Works for Farmers, estracts from the Jan-Feb 2002 edition of Renew. http://technology.open.ac.uk/eeru/natta/renewonline/rol35/5

5. Novar residents survey: Robertson Bell Associates, July 1998

6. Taff Ely, Residents survey: Robertson Bell Associates, December 1997.

7. BWEA: http://www.bwea.com/ref/stroud.html

ATTACHMENT 2

The Effect of Wind Development on Local Property Values

REPP

Renewable Energy Policy Project

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Analytical Report | May 2003

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Notice

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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.

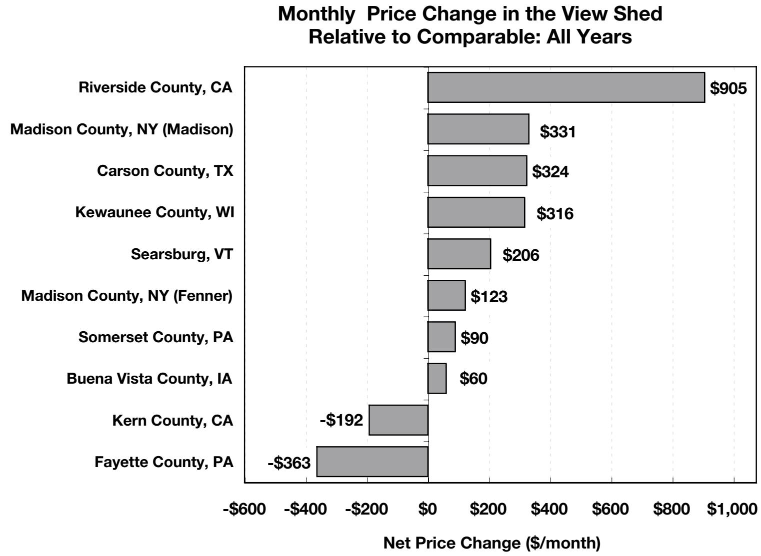

Figure 1: Monthly Price Change in the View Shed
Relative to Comparable: All Years

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 Comparable, all data	Jan 96 - Oct 02 Jan 96 - Oct 02	$401.86 $341.87	0.67 0.72	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.
Case 2	View shed, before View shed, after	Jan 96 - Apr 99 May 99 - Oct 02	$370.52 $631.12	0.51 0.53	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.
Case 3	View shed, after Comparable, after	May 99 - Oct 02 May 99 - Oct 02	$631.12 $234.84	0.53 0.23	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.

Location: Carson County, TX
Project: Llano Estacado

Model	Dataset	Dates	Rate of Change ($/ month)	Model Fit (R2)	Result
Case 1	View shed, all data Comparable, all data	Jan 98 - Dec 02 Jan 98 - Dec 02	$620.47 $296.54	0.49 0.33	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.
Case 2	View shed, before View shed, after	Jan 98 - Oct 01 Nov 01 - Dec 02	$553.92 $1,879.76	0.24 0.83	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.
Case 3	View shed, after Comparable, after	Nov 01 - Dec 02 Nov 01 - Dec 02	$1,879.76 -$140.14	0.83 0.02	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.

Location: Fayette County, PA
Project: Mill Run

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

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 Comparable, all data	Jan 96 - Dec 02 Jan 96 - Dec 02	$492.38 $684.16	0.72 0.74	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.
Case 2	View shed, before View shed, after	Jan 96-Feb 99 Mar 99 - Dec 02	$568.15 $786.60	0.44 0.75	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.
Case 3	View shed, after Comparable, after	Mar 99 - Dec 02 Mar 99 - Dec 02	$786.60 $1,115.10	0.75 0.95	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.

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 Comparable, all data	Jan 96 - Sep 02 Jan 96 - Sep 02	$434.48 $118.18	0.26 0.05	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.
Case 2	View shed, before View shed, after	Jan 96 - May 99 Jun 99 - Sep 02	-$238.67 $840.03	0.02 0.32	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.
Case 3	View shed, after Comparable, after	Jun 99 - Sep 02 Jun 99 - Sep 02	$840.03 -$630.10	0.32 0.37	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.

Location: Madison County, NY
Project: Madison

Model	Dataset	Dates	Rate of Change ($/month)	Model Fit (R2)	Result
Case 1	View shed, all data Comparable, all data	Jan 97 - Jan 03 Jan 97 - Jan 03	$576.22 $245.51	0.29 0.34	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.
Case 2	View shed, before View shed, after	Jan 97 - Aug 00 Sep 00 - Jan 03	$129.32 $1,332.24	0.01 0.28	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.
Case 3	View shed, after Comparable, after	Sep 00 - Jan 03 Sep 00 - Jan 03	$1,332.24 -$418.71	0.28 0.39	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.

Location: Madison County, NY
Project: Fenner

Model	Dataset	Dates	Rate of Change ($/month)	Model Fit (R2)	Result
Case 1	View shed, all data Comparable, all data	Jan 97 - Jan 03 Jan 97 - Jan 03	$368.47 $245.51	0.35 0.34	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.
Case 2	View shed, before View shed, after	Jan 97 - Nov 01 Dec 01 - Jan 03	$587.95 -$418.98	0.50 0.04	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.
Case 3	View shed, after Comparable, after	Dec 01 - Jan 03 Dec 01 - Jan 03	-$418.98 -$663.38	0.04 0.63	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.

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 Comparable, all data	Jan 96 - Nov 02 Jan 96 - Nov 02	$1,719.65 $814.17	0.92 0.81	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.
Case 2	View shed, before View shed, after	Jan 96 - Apr 99 May 99 - Nov 02	$1,062.83 $1,978.88	0.68 0.81	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.
Case 3	View shed, after Comparable, after	May 99 - Nov 02 May 99 - Nov 02	$1,978.88 $1,212.14	0.81 0.74	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.

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 Comparable, all data	Jan 94 - Oct 02 Jan 94 - Oct 02	$536.41 $330.81	0.70 0.45	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.
Case 2	View shed, before View shed, after	Jan 94 - Jan 97 Feb 97 - Oct 02	-$301.52 $771.06	0.88 0.71	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.
Case 3	View shed, after Comparable, after	Feb 97 - Oct 02 Feb 97 - Oct 02	$771.06 $655.20	0.71 0.78	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.

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 Comparable, all data	Jan 97 - Oct 02 Jan 97 - Oct 02	$190.07 $100.06	0.30 0.07	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.
Case 2	View shed, before View shed, after	Jan 97 - Apr 00 May 00 - Oct 02	$277.99 $969.59	0.37 0.62	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.
Case 3	View shed, after Comparable, after	May 00 - Oct 02 May 00 - Oct 02	$969.59 -$418.73	0.62 0.23	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.

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.

Chapter II. Methodology

The work required to produce this report falls into two broad categories – data collection and statistical analysis. Each of these areas in turn required attention to several issues that determine the quality of the result.

According to the American Wind Energy Association (AWEA), approximately 225 wind projects were completed or under development in the United States as of 2002. The first wave of major wind project development in the United States took place between approximately 1981 and 1995. Wind farm development slowed considerably in 1996, with only three wind projects installed, the largest of which was 600 kW. The first major post-1996 project was the 6 MW Searsburg site in Bennington County, Vermont, which came on-line in 1997.

A. Project Selection Criteria

This report focuses on major wind farm projects that constitute the second wave of wind farm development. This second wave of projects employs modern wind turbine technology likely to be installed over the next several years as part of continuing U.S. wind farm development. Compared to the previous generation of wind turbines, modern wind turbines generally have greater installed capacities, taller towers, larger turbine blades, lower rotational speeds and reduced gearbox noise.

In addition to the 6 MW Searsburg wind farm, this report analyses potential property value effects for wind farms of 10 MW capacity or greater installed from 1998 through 2001. Projects completed in 2002 and later are excluded from this analysis because not enough time has elapsed to collect sufficient data to statistically determine post-installation property value effects. To determine property value trends prior to wind farm installation, we collected property sales data from three years prior to the on-line year to the present for each of the wind farms analyzed.

Twenty-seven wind farm projects met the project selection criteria.

B. Data Compilation

Once the projects were selected for analysis, the process of acquiring data was initiated through phone calls to county assessment offices. For each project, varying sources of data and information were available, ranging from websites with on-line data, purchased data on CD-ROM or via e-mail from government offices, purchased data from private vendors or postal carried paper records. In many cases data was only available in paper, but not by mail – a person would physically have to appear before the assessment office clerk and search storage boxes, which in some cases had been archived to remote locations for long-term storage. Many states do not require local offices to retain records past certain age limits, often between one to five years. After that, files may be destroyed, and in some cases had been.

Where paper records were obtained, data was transferred into electronic form through scanning or manual data entry. In many cases, both with paper and/or electronic data, the fields we received did not provide good geographic specificity. For example, in some cases, townships and/or cities, but not street addresses were identified. Where street addresses were included, in some cases not all properties had street addresses given, or street addresses were truncated or otherwise incomplete.

Out of the 27 counties with wind farms meeting the project selection criteria, ten sites were selected for statistical analysis based on availability of property sales data. The other 17 eligible sites were excluded from statistical analysis for a number of reasons, including insufficient sales to perform statistical analysis (for example, one site had only five sales in five years), lack of readily available data (data requiring in-person visits to the Assessors Office to manually go through paper files), and two cases where state law prohibited the Assessors Office from releasing property sales data to the public.

This report contains one section for each of the ten sites analyzed, with project site and community descriptions, view shed and comparable selection details, and analytical results and discussion. In addition, the report contains one section providing detailed explanations of why each of the 17 other sites are excluded from analysis. The dataset used in this report, exclusive of proprietary data, is available on the REPP web site at www.repp.org, or by request from REPP.

C. View Shed Definition

In order to determine whether the presence of a wind farm has an adverse effect on property values in the wind farm's vicinity, the area potentially affected by the wind farm must be defined. In this report, the area in which potential property value effects are being tested for is termed the "view shed."

How the view shed is defined will affect the type of data required to test for property value effects, as well as the analytical model employed. Choosing the value of the appropriate radius for such a view shed is subjective. To help determine the radius, numerous studies regarding line-of-sight impacts were reviewed, and interviews with a power industry expert on visual impacts of transmission lines were conducted. In the end, three separate resources for estimates of visual impact were used to support defining the view shed as the area within a five-mile radius of the wind farms. These resources are:

- The U.S. Department of Agriculture (USDA). In a handbook titled "National Forest Landscape Management" (1973) developed for the Forest Service by the USDA, three primary zones of visual impact are defined: foreground, middleground and background. These zones relate to the distance from an object in question, be it a fire lookout tower, tall tree, or mountain in the distance. In this definition, foreground is 0 to 1/2 mile, middleground is 1/4 to 5 miles and background is 3 to 5 miles. The USDA handbook states that for foreground objects people can discern specific sensory experiences such as sound, smell and touch, but for background objects little texture or detail are apparent, and objects are viewed mostly as patterns of light and dark.

- The Sinclair-Thomas Matrix. This is a subjective study of the visual impact of wind farms published in the report Wind Power in Wales, UK (1999). Visual impact is defined in a matrix of distance from a wind turbine versus tower hub height. At the highest hub height considered in the matrix, 95 meters [312 feet], the visual impact of wind towers is estimated to be moderate at a distance of 12 km [7.5 miles]. The matrix estimates that not until a distance of 40 km [25 miles] is there "negligible or no" visual impact from wind turbines under any atmospheric condition. Of the ten sites considered in this REPP report, the majority of towers have hub heights of 60 to 70 meters, which, according to the Sinclair-Thomas matrix, corresponds to moderate visual impact at a distance of 9 to 10 km [5.6– 6.2 miles].

- Interviews with Industry Experts. A power industry analyst with extensive experience in quantitative analysis of visual impacts of transmission lines stated in an interview that a rule of thumb used for the zone of visual influence of installations such as transmission lines and large wind turbines is a distance of approximately five miles.

There are other possible definitions of the view shed. At present, new proposals are sometimes required to conduct a Zone of Visual Influence (ZVI) analysis to determine the extent of visibility of a development. The zone comprises a visual envelope within which it is possible to view the development, notwithstanding the presence of any intervening obstacles such as forests, buildings, and other objects. Digital terrain computer programs are used to calculate and plot the areas from which the wind farm can be seen on a reference grid that indicates how many turbines can be seen from a given point. One weakness of the standard ZVI analysis is that all turbines are given equal weight of visual impact. That is, a turbine 20 miles from the viewer is assigned the same visual impact as a turbine one mile away.

Possible definitions for view sheds include the set of real properties that have a view of one or more wind turbines from inside the residence, that have a view of one or more turbines from any point on the property, or that are simply within some defined distance from the wind turbines, whether there is a view from each property in that area or not. In the last case, it is assumed that property owners in the area will still be potentially affected by views of the wind farms, as they will see them while traveling and conducting business in their vicinity.

Because this project lacked the resources to determine (through site visits, interviews, or other means) whether or not individual properties in the vicinity of the ten selected wind farms have a direct view of the wind turbines, the view shed is defined as all properties within a given radius of the outermost wind turbines in a wind farm. The value of this radius will clearly affect the results of the analysis. If the radius is too large, including many properties not potentially affected will overshadow the potential effect of the presence of wind turbines on property values. If the radius is too small, not all potentially effected properties will be accounted for in the analysis, and the number of data points gathered may be too small to yield valid statistical results.

D. Comparable Criteria

With the view shed of the wind farm defined, a set of neighboring communities outside of the view shed is selected to evaluate trends in residential house sales prices without the potential effects of wind farms on property values. These townships and incorporated cities are required to be clearly outside of the view shed area and not containing any large wind turbines. This selection is the “comparable” region. To define the comparable REPP consulted with local County Assessors and analyzed 1990 and 2000 U.S. Census data for the townships and incorporated cities under consideration.

Criteria used in selection of comparable communities include economic, demographic, and geographic attributes and trends. The goal in selecting comparable communities is to have communities that are as similar as possible with respect to variables that might affect residential house values, with the exception of the presence or absence of wind farms. When possible, comparable communities are selected in the same county as the wind farm location. If this is not possible due to placement of wind farm or availability of suitable data, comparable communities are selected from counties immediately adjacent to the county containing the wind farm.

After considering a number of criteria, including population, income level, poverty level, educational attainment, number of homes, owner occupancy rate, occupants per household, and housing value, five criteria from 1990 and 2000 U.S. Census were selected for evaluation:

- Population
- Median Household Income
- Ratio of Income to Poverty Level
- Number of Housing Units
- Median Value of Owner-occupied Housing Units

Data for these criteria is obtained for both the wind farm and comparable communities. Percent change from 1990 to 2000 for each criterion is calculated for each township or city considered as potentially comparable areas. The criteria are used in the following manner:

a) Change in population is calculated to identify any communities that had excessively large changes in population relative to the change in population from 1990 to 2000 in the wind farm area. Such large changes could indicate either a major construction boom, or major exodus of habitants from an area, which could skew comparisons in residential home values over the period in question. These communities are eliminated as possible comparables.

b) The average median household income in the wind farm communities in 1990 and 2000 is calculated. The first criterion is that comparable communities should have similar median household incomes in 2000. The second criterion is that median incomes should not have changed at significantly different rates from 1990 to 2000 between wind farm and comparable communities. Communities that meet both criteria are considered as potential comparables.

c) The percent of the population whose income is below poverty level is calculated from the ratio of income to poverty level. Absolute poverty levels and percent changes in poverty levels from 1990 to 2000 are compared. Communities that have significantly different poverty levels or rates of change of these levels as compared to the wind farm areas are eliminated as possible comparables.

d) Change in the number of housing units is used to identify any communities that had excessively large changes in housing relative to the change in housing from 1990 to 2000 in the wind farm area. Such large changes could indicate a major construction boom, or reduction in housing stock, which could skew comparisons in residential home values over the period in question. These communities are eliminated as possible comparables.

e) The average median house value in the wind farm communities in 1990 and 2000 is obtained from Census data. These values are owner-reported, and therefore may not accurately reflect actual market value of the properties. The criterion is that comparable communities should have similar median house values. Communities meeting these criteria are considered as potential comparables.

Communities that meet all five of the above criteria are selected for consideration as comparable communities. In addition to analysis of Census data, interviews with County Assessors, other local and state officials, and in some cases with knowledgeable real estate agents are taken into account in the selection of comparables.

E. Analysis

i. Literature Review

In selecting the type of analysis to use in determining whether there is any statistical evidence that wind farms negatively affect property values, we first conducted literature research to identify any studies previously conducted for this purpose. We found only four studies relating wind and property value effects, three of which are only qualitative.

A 1996 quantitative study, Social Assessment of Wind Power (Institute of Local Government Studies, Denmark), applied regression analysis to determine the effect of individual wind turbines, small wind turbine clusters, and larger wind parks on residential property values. The regression used the hedonic method, discussed in more detail below, in which site-specific data on a number of quantitative and qualitative variables is used to predict housing values. The study concluded that homes close to a wind turbine or turbines ranged in value from DKK 16,200 to 94,000 [approximately $2,900 to $16,800] less than homes further away. The study had a number of weaknesses, including a lack of definition of the distance from turbines, lack of specification of the size and number of turbines, and regression on a very small data sample. In contrast, a 2002 qualitative study, Public Attitudes Towards Wind Power (Danish Wind Industry Association), quoted the 1997 Sydthy Study as concluding that residents closer than 500 meters to the nearest wind turbine tend to be more positive about wind turbines than residents further away.

A 2001 qualitative study, Social Economics and Tourism (Sinclair Knight Mertz), said that for highly sought after properties along Salmon Beach, Australia closer than 200 meters from wind turbines, the general consensus among local real estate agents is that "property prices next to generators have stayed the same or increased after installation." However, the study concluded that while properties with wind turbines on them may increase in value, other properties may be adversely affected if within sight or audible distance of the wind turbines. Finally, the 2002 qualitative study, Economic Impacts of Wind Power in Kittitas County (ECO Northwest), concluded from interviews with assessors around the United States that there is no evidence of a negative impact on property values from wind farms. The weakness of the study is that it relies on subjective comment to arrive at its conclusion.

We also reviewed several studies that attempt to quantify the visual and property value impacts of electric transmission towers and lines. There is a large body of information on this subject, as transmission lines have been the subject of scrutiny and regulation for many years.

A 1992 study, The Effects of Overhead Transmission Lines on Property Values (C.A. Kroll and T. Priestley), reviews the methodology and conclusions of a number of studies on overhead transmission lines and property values over the 15 year period of 1977 through 1992. This study was very helpful in identifying the types of analysis, and their strengths and weaknesses, which could be adopted for use in this REPP report. The study concluded that appraisal offices have the longest history of studying and evaluating line impacts, but lack in-depth statistical analysis to verify obtained results. Data collected from face-to-face conversation and through surveys attempts to ascertain the attitudes and reactions of property owners to transmission equipment, but personal opinions were found to produce widely varying results. Statistical analysis of appraiser findings provided a better interpretation of appraiser information, but produced varying results due to different methodologies.

ii. Choice of Analytic Method

A number of analytic methods may be used to assess property value impacts from wind farms, ranging from interviews with assessors and surveys of residents to simple regression models and hedonic regression analysis. In order to produce results that could determine whether or not there was statistical evidence that wind farms have a negative impact on property values, simple linear regression analysis on property sales price as a function of time was selected.

A more complex method, hedonic regression analysis, can also be used to gauge property value impacts. Hedonic analysis, used in a number of studies on visual impacts of transmission lines, employs both quantitative and qualitative values to describe the property and local, regional, and even national parameters that may influence housing values. Property data such as number of bedrooms and bathrooms, linoleum or tile floors, modern appliances, kitchen cabinets or not are collected for each property in the study area, as well community information such as school district quality, subjective criteria derived from interviews with every resident in a study area, and other parameters. However, because this report is based on historic data, much of the detail needed for a hedonic analysis may not be available. An important consideration for this analysis, given the limits of the data, was to apply a consistent methodology to the site analyses. The only data consistent across all sites is sales date and sales price.

iii. Data Analysis

The key variables used in this analysis are sale price, sale date, and one locational attribute allowing data to be separated into view shed and comparable data sets. The first step of analysis was to remove any erroneous data from the dataset. Sales with incomplete information, duplicate sales, and zero price were removed. Parcel sales under $1,000 were also removed, as they often represent transfer within a family or business, rather than a bona fide sale. Finally, any sales with values much higher than any other sales were researched to determine whether or not that sale was bona fide. Interviews with assessors with knowledge of the properties in question were used to determine whether these high value sales were erroneous. Where they were, they were removed.

The second step in data analysis was to reduce cyclic effects of the real estate market on sales prices, as well as to reduce the high variability and heterogeneity of the data when viewed on a day sale basis. First, for each month, we calculated the monthly average sales price for each month to eliminate the variability of day-to-day sales. In some cases data supplied was already in monthly averaged form. Second, a six-month trailing average of the average monthly sales price is used to smooth out seasonal fluctuations in the real estate market. The averaging technique used the current month sales plus the previous six months of sales to compute trailing averages.

Third, a unit of analysis is defined. Because this project generally lacks resources to identify properties by street address, the smallest units of geographical analysis used are townships and incorporated cities within each county. Townships that are partly but not fully within the view shed radius are excluded from the view shed. In some cases zip code 4-digit ZIP+4 regions are used to identify location, and in some cases where the data offered no other alternative, individual street locations were manually identified in order to define the location of properties within the view shed and comparable.

Fourth, as stated above, linear regression is selected as the method to test for potential property value impacts. A least-squares linear regression of the six-month trailing average price is constructed for the view shed and comparable areas to determine the magnitude and rate of change in property sales price for each of the areas. The regression yields an equation for the line that best fits the data. The slope of this line gives the month-by-month expected change in the price of homes in the view shed and comparable areas. The regression also yields a value for "R2."

The R2 value measures the goodness of fit of the linear relationship to the data, and equals the percentage of the variance (change over time) in the data that is described by the regression model. The value of R2 ranges from zero to one. If R2 is small, say less than 0.2 to 0.3, the model explains only 20 to 30 percent of the variance in the data and the slope calculated is a poor indicator of the change in sales price over time. If R2 is large, say 0.7 or greater, then the model explains 70 percent or more of the variance in the data, and the slope of the regression line is a good indicator for quantifying the change in sales price over time. Regression models with low R2 values must be interpreted with caution. Often, knowledge and examination of factors not included in the regression model can help one understand why the regression provides a poor fit.

iv. Case I, II, and III Definitions

This report tests for effects of wind farms on property sales prices using three different models, or cases. All employ linear regression on six-month trailing averaged monthly residential sales data as outlined above.

> **Case 1** compares changes in the view shed and comparable community sales prices for the entire period of the study. If wind farms have a negative effect, we would expect to see prices increase slower (or decrease faster) in the view shed than in the comparable. Case 1 takes into account the wind farm on-line date only in that the data set begins three years before the on-line date. An appropriate comparable is important in this case in order that meaningful comparison of sale price changes over time can be made.
>
> **Case 2** compares property sales prices in the view shed before and after the wind farm in question came on-line. If wind farms have a negative effect, we would expect to see prices increase slower (or decrease faster) in view shed after the wind farm went on-line than before. Case 2 is susceptible to effects of macroeconomic trends and other pressures on housing prices not taken into account in the model. Because Case 2 looks only at the view shed, it is possible that external factors change prices faster before or after the on-line date, and the analysis may therefore pick up factors other than the wind development.
>
> **Case 3** compares property sales prices in the view shed and comparable community, but only for the period after the projects came on-line. If wind farms have a negative effect, we would expect to see prices increase slower (or decrease faster) in view shed than comparable after the on-line date. Again, an appropriate comparable is important in this case in order that meaningful comparison of sale price changes over time can be made.

Chapter III. Site Reports

Site Report 1: Riverside County, California

A. Project Description

The topography ranges from desert flats to arid mountains with views of snow capped peaks in winter – all of which encompass areas both in and out of the view shed.

The area has extreme elevation changes from the Palm Springs flats at an elevation of 450 feet, to the San Gorgonio Pass at an elevation of 2,500 feet. The Pass cuts through the two peaks of Mt. San Gorgonio to the north and Mt. San Jacinto to the southeast, and is five miles from the western edge of Palm Springs (15 to downtown), and about 80 miles east of Los Angeles.

Figure 1.1 View of wind farms at San Gorgonio Pass, Riverside County, CA

Photo by David F. Gallagher, 2001 - www.lightningfield.com

The projects are located in the San Gorgonio Pass immediately west of the Palm Springs area in Riverside County, California. Developers installed 3,067 turbines from 1981 to 2001, with the tallest turbine at 63 meters (207 feet). Repowering projects built 130 modern turbines. They begin northwest of Palm Spring heading up Interstate 10 from Indian Avenue; then they extend more than 10 miles along the flats up into the San Gorgonio Mountains, along the Pass, and stop shortly before reaching Cabazon.

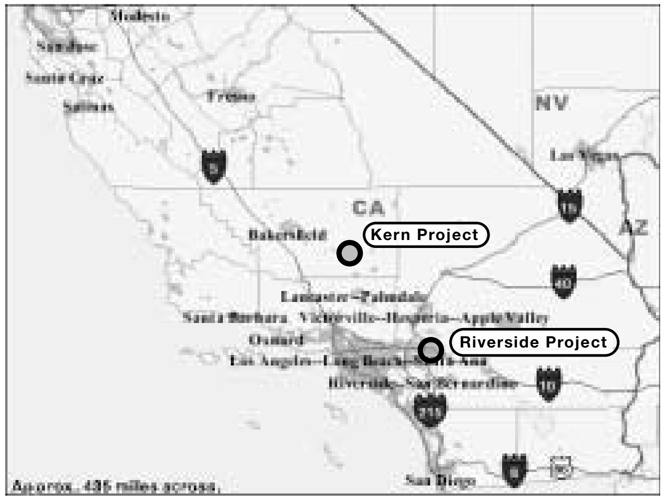

Figure 1.2 Regional Wind Project Location
(Dots approximate wind farm locations)

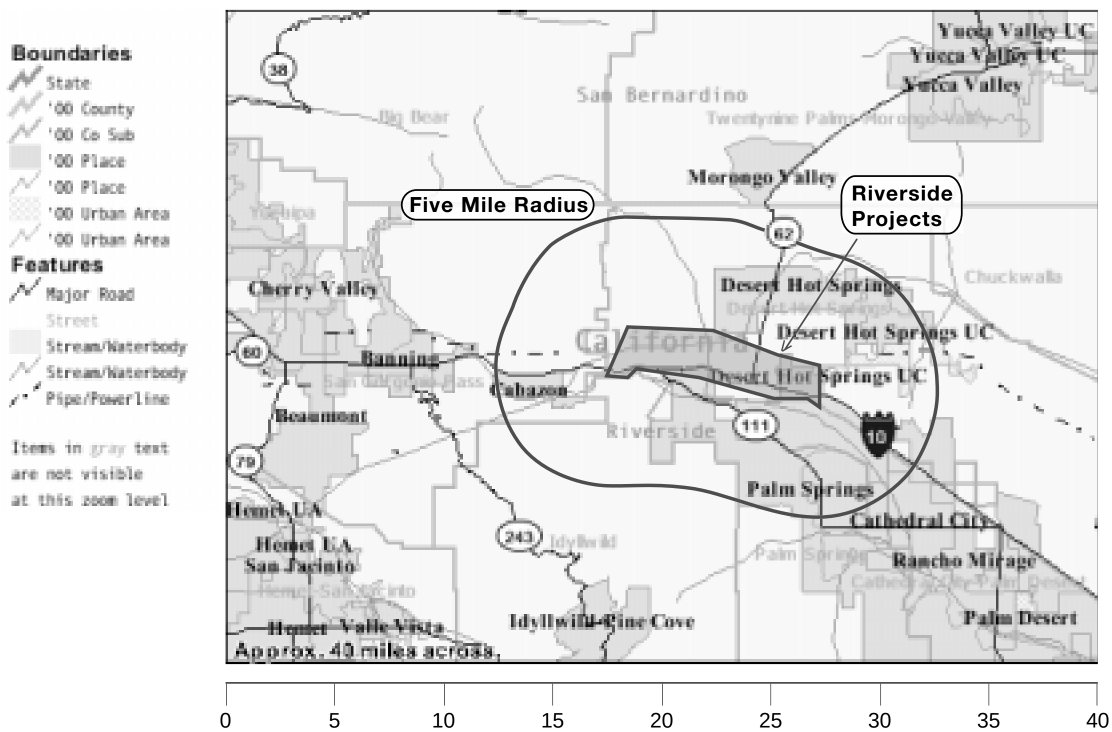

Figure 1.3 San Gorgonio, Riverside County, California View shed
(5 Mile Radius from project edge)
Map Source: U.S. Census Bureau Website
Project Location Details: Interviews and Aerial Photographs

The county is considered a metro area with 1 million population or more, but that is due to the population of the Los Angeles area. See Appendix 1 for a definition of rural urban continuum codes. The view shed represents fewer than 30,000 people.

B. Project Timeline

Table 1.1 Wind Project History, San Gorgonio, CA

Project Name	Completion Date	Capacity (MW)	Project Name	Completion Date	Capacity (MW)
Mountain View Power Partners I	2001	44.4	Altech 3	1981-1995	21.7
Mountain View Power Partners II	2001	22.2	Westwind Trust	1981-1995	15.7
Enron Earth Smart/Green Power	1999	16.5	Painted Hills B & C	1981-1995	15.3
Energy Unlimited	1999	10.0	Difwind, Ltd.	1981-1995	15.0
Pacific West I	1999	2.1	Energy Unlimited	1981-1995	14.5
Westwind-Repower	1999	47.3	Edom Hill	1981-1995	11.0
Cabazon-Repower	1999	39.8	So. Cal. Sunbelt	1981-1995	10.5
Westwind - PacifiCorp-Repower	1999	1.5	Difwind V	1981-1995	7.9
East Winds-Repower	1997	4.2	Meridian Trust	1981-1995	7.5
Karen Avenue-Repower	1995	3.0	Kenetech/Wintec	1981-1995	7.3
Dutch Pacific	1994	10.0	San Jacinto	1981-1995	5.0
Kenetech (various)	1981-1995	30.3	Painted Hills B & C	1981-1995	4.0
Zond-PanAero Windsystems	1981-1995	29.9	Altech 3	1981-1995	3.3
Alta Mesa	1981-1995	28.2	San Gorgonio Farms	1981-1995	3.2
Section 28 Trust	1981-1995	26.2	San Gorgonio Farms	1981-1995	2.0
San Gorgonio Farms	1981-1995	26.1			

C. Analysis

i. Data

Real property sales data for 1996 to 2002 was obtained from First American Real Estate Solutions in Anaheim, CA. The dataset is quite detailed and contains many property and locational attributes, among them nine-digit zip code (ZIP+4) locations. Sales data was purchased for four zip codes encompassing the wind farm area and surrounding communities. These zip codes are Palm Springs (92262), White Water (92282), Cabazon (92230), and Banning (92220).

Sales for the following residential property types were included in the analysis: Condominiums, Duplexes, Mobile Homes, and Single-Family Residences. Upon initial analysis, of the 9105 data points analyzed, approximately 10 sales in the view shed had unusually high prices. Conversations with the Assessors Office confirmed these were incorrect values for the data points. Correct values were obtained and the data corrected.

Projects that went on-line during the study period are the Cabazon, Enron, Energy Unlimited, Mountain View Power Partners I & II, and Westwind sites. Of these, two sites added 87 MW of repowered capacity in May 1999, two sites added 27 MW of new capacity in June 1999, and two sites added 66 MW of new capacity in October 2001.

ii. View shed Definition

All ZIP+4 regions within five miles of the wind turbines define the view shed. The location of the ZIP+4 regions were derived from the latitude and longitude of the ZIP+4 areas obtained from the U.S. Census TIGER database. The view shed includes the northwest portion of Palm Springs, Desert Hot Springs, and Cabazon, and 5,513 sales from 1996 to 2002. The view shed portion of northwest Palm Springs corresponds very closely to the boundaries of Palm Springs zip code 92262.

Interviews with State of California Palm Springs Regional Assessors Office were conducted by phone to determine what percentage of residential properties in the view shed can see all or a portion of the wind turbines. In Assessment District Supervisor Gary Stevenson's opinion, over 80 percent of Cabazon properties can see some wind turbines; over 80 percent of Desert Hot Springs properties can see some wind turbines; almost all of the properties on the outer edge of northwest Palm Springs can see some wind turbines, but due to foliage (mainly palm trees) and tall buildings, only five percent or less of the properties in the interior of Pam Springs can see any wind turbines.

iii. Comparable Selection

The comparable community was selected through interviews with State of California San Gorgonio Regional Assessors Office personnel, as well as analysis of demographic data from the 1990 and 2000 U.S. Census for communities near but outside of the view shed. Selection of the comparable in this case was difficult, as the eastern side of the view shed is close to downtown Palm Springs, which is growing fairly quickly, while the western portion of the view shed, including Cabazon, is not growing quickly and has more stable housing sales prices. Tables 1.2 and 1.3 summarize the Census data reviewed. Because Census data by zip code is not available for 1990, we were unable to determine 1990 demographic statistics for the Palm Springs view shed, as it is not separable from the Palm Springs non-view shed area.

Based on his extensive experience in the area, Assessment District Supervisor Gary Stevenson suggested Banning and Beaumont in Riverside County, to the west of the wind farms, and Morongo Valley in San Bernardino County, to the north of the wind farms as appropriate comparables to the view shed area. Banning and Beaumont are visually separated from the wind farm area by a ridge, and Morongo Valley is separated by approximately seven miles distance.

In order to determine the most appropriate comparable community we looked at the demographics of 10 surrounding areas. The 92264 zip code area of Palm Springs to the south of northwest Palm Springs was initially considered as a comparable, but Supervisor Stevenson said that this area was closer to the metropolitan center and had significantly different demographics than the view shed area. Towns adjacent to Banning and Beaumont, including Hemet, San Jacinto, and Cherry Valley, were considered but rejected for use after discussion with Supervisor Stevenson. Upon examination of Census data, sales data availability, and review of Assessor comments, Banning was selected as the comparable, with a total of 3,592 sales from 1996 to 2002.

Table 1.2 Riverside County, California: 1990 Census Data

Year	View shed	Location	Population	Median Household Income	% Population below poverty level	Number housing units	Median value-owner-occupied housing unit
1990	Y	Cabazon CDP	1,588	$13,830	19%	754	$64,000
1990	Y	Palm Springs City*	n/a	n/a	n/a	n/a	n/a
1990	Y	White Water**	n/a	n/a	n/a	n/a	n/a
1990	VIEW SHED DEMOGRAPHICS		n/a	n/a	n/a	n/a	n/a
1990	COMP	Banning City	20,570	$22,514	17%	8,278	$89,300
1990	COMPARABLE DEMOGRAPHICS		20,570	$22,514	17%	8,278	$89,300
1990	N	Beaumont City	9,685	$22,331	23%	3,718	$89,700
1990	N	Cathedral City	30,085	$30,908	13%	15,229	$114,200
1990	N	Cherry Valley CDP	5,945	$29,073	9%	2,530	$127,500
1990	N	Hemet City	36,094	$20,382	14%	19,692	$90,700
1990	N	Idyllwild-Pine Cove CDP	2,937	$31,507	4%	3,635	$147,200
1990	N	Morongo Valley CDP***	1,554	$38,125	23%	827	$74,100
1990	N	Rancho Mirage City	9,778	$45,064	7%	9,360	$252,400
1990	N	San Jacinto City	16,210	$20,810	16%	6,845	$90,200
1990	N	Valle Vista CDP	8,751	$22,138	8%	4,444	$125,500

*Census data by zip code not available for 1990. Unable to determine demographics of view shed as the Palm Springs view shed area is not separable from the Palm Springs non-view shed area.
**White Water not listed in 1990 U.S. Census.
***San Bernardino County.

Table 1.3 Riverside County, California: 2000 Census Data

Year	View shed	Location	Population	Median household income	% Population below poverty level	Number housing units	Median value-owner-occupied housing unit
2000	Y	Cabazon-- Zip Code 92230	2,442	$22,524	32%	884	$48,200
2000	Y	Palm Springs- Zip Code 92262	24,774	$32,844	18%	15,723	$133,100
2000	Y	White Water-- Zip Code 92282	903	$35,982	23%	380	$82,400
2000	VIEW SHED DEMOGRAPHICS		28,119	$30,450	24%	16,987	$87,900
2000	COMP	Banning City—Zip Code 92220	23,443	$32,076	20%	9,739	$97,300
2000	COMPARABLE DEMOGRAPHICS		23,443	$32,076	20%	9,739	$97,300
2000	N	Beaumont City	11,315	$29,721	20%	4,258	$93,400
2000	N	Cathedral City	42,919	$38,887	14%	17,813	$113,600
2000	N	Cherry Valley CDP	5,857	$39,199	6%	2,633	$121,700
2000	N	Hemet City	58,770	$26,839	16%	29,464	$69,900
2000	N	Idyllwild-Pine Cove CDP	3,563	$35,625	13%	4,019	$164,700
2000	N	Morongo Valley CDP*	2,035	$36,357	19%	972	$73,300
2000	N	Rancho Mirage City	12,973	$59,826	6%	11,643	$251,700
2000	N	San Jacinto City	23,923	$30,627	20%	9,435	$78,500
2000	N	Valle Vista CDP	10,612	$32,455	12%	4,941	$76,500

*San Bernardino County.

iv. Analytical Results and Discussion

In all three of the regression models, monthly average sales prices grew faster in the view shed than in the comparable area, indicating that there is no significant evidence that the presence of the wind farms had a negative effect on residential property values. For Cases II and III, the on-line date is defined as the month the first wind project came on-line during the study period, May 1999.

In Case I, the monthly sales price change in the view shed is twice the monthly sales price change of the comparable over the study period. The Case I model provides a good fit to the data, with over 80 percent of the variance in the data explained by the linear regression. In Case II, the monthly sales price change in the view shed is 86 percent greater after the on-line date than before the on-line date. The Case II model provides a good fit to the data, with over two-thirds of the variance in the data explained by the linear regression. In Case III, the monthly sales price change in the view shed after the on-line date is 63 percent greater than the monthly sales price change of the comparable after the on-line date. The data for the full study period is graphed in Figure 1.4, and regression results for all cases are summarized in Table 1.4 below.

Table 1.4 Riverside County, California: Regression Results

Projects: 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 Comparable, all data	Jan 96 - Nov 02 Jan 96 - Nov 02	$1,719.65 $814.17	0.92 0.81	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.
Case 2	View shed, before View shed, after	Jan 96 - Apr 99 May 99 - Nov 02	$1,062.83 $1,978.88	0.68 0.81	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.
Case 3	View shed, after Comparable, after	May 99 - Nov 02 May 99 - Nov 02	$1,978.88 $1,212.14	0.81 0.74	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.

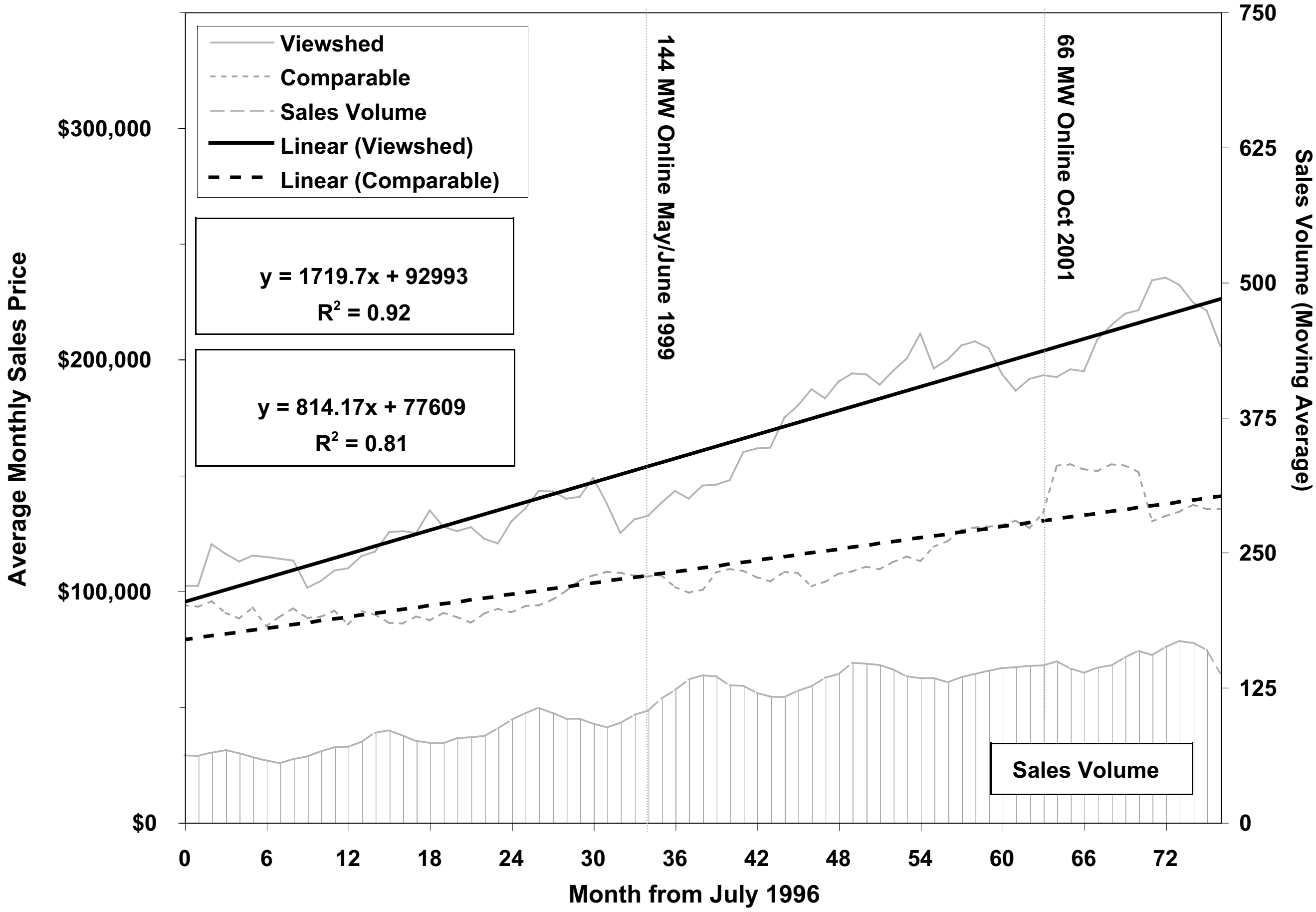

Figure 1.4 Average Residential Housing Sales Price

Riverside County, California 1996-2002

D. Additional Interviewee Comments

Jack Norie of Desert Hot Springs, who provides tours of the wind projects, said that since 1998 there has been a discernable sense that more turbines were in the area. Norie felt that the 41 new turbines built high up along the nearest peaks facing Palm Springs near the intersection of Highway 111 and Interstate 10 on the north side, contributed to this impression. (These are possibly the Mountain View Power Partners II project with 37 turbines). Mr. Norie's descriptions of project locations and aerial photographs available from Microsoft's Terraserver and Mapquest, allowed us to determine project locations.

Site Reports 2.1 and 2.2: Madison County, New York

A. Project Description

Madison County has two wind farms meeting the criteria for analysis, Madison and Fenner. Because they are separated by distance, and have different on-line dates, each wind farm is analyzed separately. However, since they are in the same county and share the same comparable region, both analyses are presented in this section.

The Fenner turbines are seated in a primarily agricultural region southeast of Syracuse and southwest of Utica, with 20 turbines at 100 meters (328 feet). The Madison project is about 15 miles southeast of Fenner, and 2.5 miles east of Madison town with seven turbines standing 67 meters (220 feet).

Madison County is classified as a "county in a metro area with 250,000 to 1 million population." See Appendix 1 for a definition of rural urban continuum codes. The view shed areas have a population less than 8,000.

Figure 2.1 View of Fenner wind farm.

Photo Courtesy: New York State Energy Research and Development Authority (NYSERDA)

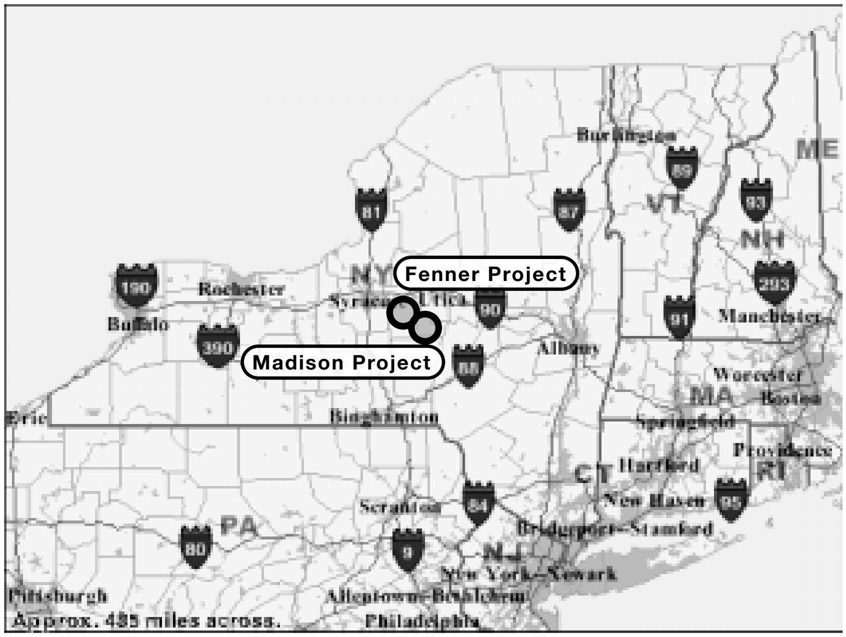

Figure 2.2. Regional Wind Project Location

(Dots approximate wind farm locations)

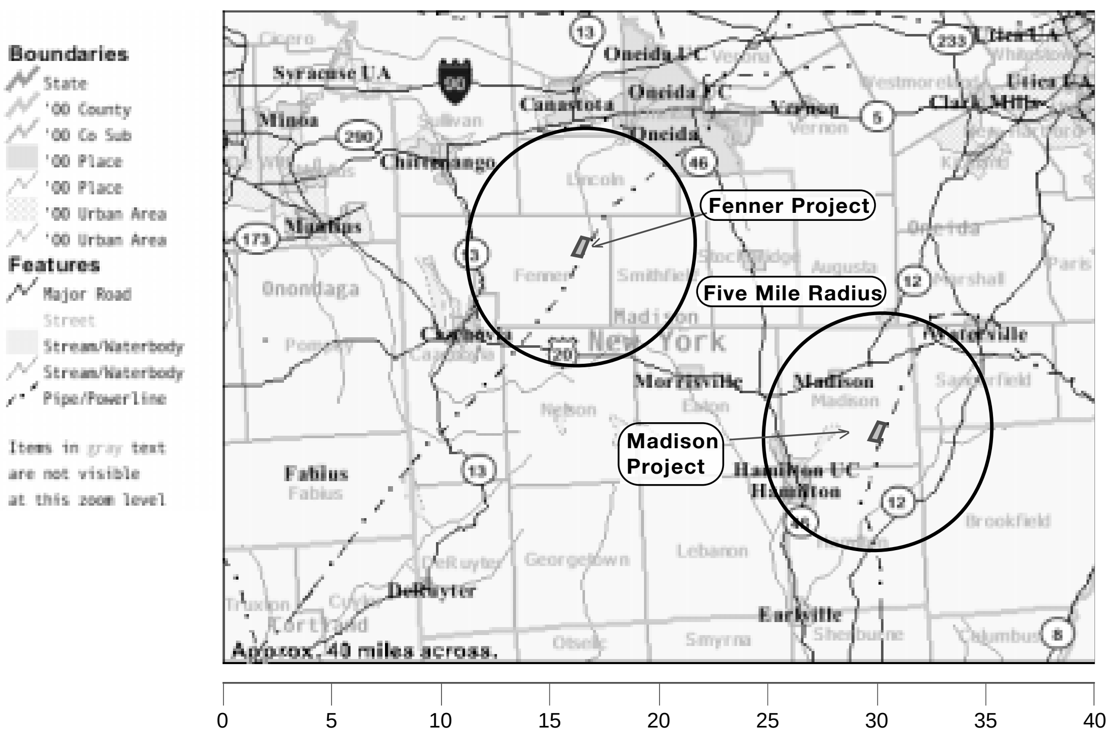

Figure 2.3. Location of Wind Projects in Madison County

Site Locations Source: Madison Assessors Office

Base Map Source: U.S. Census Bureau

B. Project Timeline

Table 2.1 Wind Project History, Madison County, NY

Project Name	Completion Date	Capacity (MW)
Fenner Wind Power Project	2001	30.0
Madison Windpower	2000	11.6

C. Analysis

i. Data

Real property sales data for 1997 to 2002 was purchased on CD-ROM from Madison County Real Property Tax Services in Wampsville, NY. The sales data was purchased for the townships and cities encompassing the wind farm areas and surrounding communities. The unit of analysis for this dataset is defined by either township or incorporated city boundaries. Though street addresses are included in the dataset, this analysis lacked the resources to identify the location of properties by street address.

In addition to basic sales data, the dataset included property attributes such as building style, housing quality grade, and neighborhood ratings. The CD-ROMs contained four files that required merging on a common field to create the composite database of all sales. A significant number of redundant, incomplete, and blank entries were deleted prior to analysis. Sales for the following residential property types were included in the analysis: one-, two-, and three-family homes, rural residences on 10+ acres, and mobile homes.

Upon initial analysis, of the 1,263 data points analyzed, approximately six sales in the Madison view shed had unusually high prices. Conversations with the Assessors Office confirmed four of these were valid sales, but that two were not. The invalid sales were eliminated from the analysis.

Projects that went on-line during the study period are the Madison wind farm, which went on-line September 2000 with a capacity of 11.6 MW, and the Fenner wind farm, which went on-line December 2001 with a capacity of 30 MW. The wind farms are approximately 15 miles apart.

ii. View Shed Definition

Two separate view sheds are defined for Madison County, one for each wind farm. A five-mile radius around the Madison wind farm encompasses the town of Madison and over 95 percent of Madison Township. The view shed also encompasses portions of three townships in Oneida County. However, due to lack of resources to identify the location of individual properties within townships, the Oneida townships were excluded from the analysis. The Madison view shed is defined as Madison town and all of Madison Township. The Fenner view shed is defined as all of Fenner, Lincoln, and Smithfield Townships, which are fully within a five-mile radius around the Fenner wind farm, with the exception of a small corner of Smithfield Township. The Madison and Fenner view sheds accounts for 219 and 453 sales over the study period, respectively.

Interviews with the State of New York Madison County Assessors Office were conducted by phone to determine what percentage of residential properties in the view shed can see all or a portion of the wind turbines. In Fenner Assessment District Supervisor Russell Cary's opinion, over 80 to 85 percent of Fenner properties can see some wind turbines, over 85 percent of Lincoln properties can see some wind turbines, over 75 percent of Madison properties can see some wind turbines, and approximately 60 percent of Smithfield properties can see some wind turbines. Cary said that in his opinion, only a few properties in Fenner Township, near Route 13, could not see some wind turbines.

iii. Comparable Selection

The comparable community was selected through interviews with State of New York Madison County Assessors Office personnel, as well as analysis of demographic data from the 1990 and 2000 U.S. Census for communities near but outside of the view shed. Tables 2.2 and 2.3 summarize the Census data reviewed. In order to determine the most appropriate comparable community, we looked at the demographics of 13 surrounding areas. Based on his experience in the area, Assessment District Supervisor Russell Cary suggested Lebanon, Deruyter and Stockbridge Townships along with villages of Deruyter, Munnsville and Hamilton, all in Madison County, as appropriate comparables for both view sheds. However, Cary added that Hamilton has higher property values than Madison because it is home to Colgate University. Upon examination of Census data, sales data availability, and review of Assessor comments, Lebanon, Deruyter, Hamilton, Stockbridge Townships, and the Villages of Deruyter and Munnsville were selected as the comparable for both view sheds, with a total of 591 sales from 1997 to 2002.

Table 2.2 Madison County, New York: 1990 Census Data

Year	View shed	Location	Population	Median household income	% Population below poverty level	Number housing units	Median value-owner-occupied housing unit
1990	Y	Fenner town	1,694	$31,875	13%	609	$73,700
1990	Y	Lincoln town	1,669	$32,073	8%	587	$63,900
1990	Y	Smithfield town	1,053	$23,355	13%	380	$52,200
FENNER DEMOGRAPHICS			4,416	$29,101	11%	1,576	$63,267
1990	Y	Madison town	2,774	$29,779	10%	1,239	$65,200
1990	Y	Madison village	316	$26,250	12%	135	$50,000
MADISON DEMOGRAPHICS			3,090	$28,015	11%	1,374	$57,600
1990	COMP	DeRuyter town	1,458	$26,187	11%	811	$51,800
1990	COMP	DeRuyter village	568	$24,125	10%	218	$52,200
1990	COMP	Hamilton town	6,221	$28,594	17%	1,820	$69,800
1990	COMP	Lebanon town	1,265	$26,359	12%	581	$49,600
1990	COMP	Munnsville village	438	$23,194	15%	174	$54,700
1990	COMP	Stockbridge town	1,968	$24,489	11%	723	$53,600
COMPARABLE DEMOGRAPHICS			11,918	$25,491	13%	4,327	$55,283
1990	N	Cazenovia town	6,514	$39,943	4%	2,372	$122,300
1990	N	Cazenovia village	3,007	$31,622	5%	995	$101,100
1990	N	Chittenango village	4,734	$34,459	7%	1,715	$72,400
1990	N	Earlville village	883	$28,839	5%	362	$44,300
1990	N	Georgetown town	932	$25,000	10%	287	$42,700
1990	N	Hamilton village	3,790	$31,960	16%	869	$88,000
1990	N	Morrisville village	2,732	$26,875	30%	443	$55,500

Table 2.3 Madison County, New York: 2000 Census Data

Year	View shed	Location	Population	Median household income	% Population below poverty level	Number housing units	Median value-owner-occupied housing unit
2000	Y	Fenner town	1,680	$43,846	7%	651	$84,400
2000	Y	Lincoln town	1,818	$46,023	5%	700	$85,000
2000	Y	Smithfield town	1,205	$35,109	16%	446	$61,900
FENNER DEMOGRAPHICS			4,703	$41,659	9%	1,797	$77,100
2000	Y	Madison town	2,801	$35,889	13%	1,325	$77,100
2000	Y	Madison village	315	$27,250	13%	151	$68,400
MADISON DEMOGRAPHICS			3,116	$31,570	13%	1,476	$72,750
2000	COMP	DeRuyter town	1,532	$34,911	12%	867	$68,200
2000	COMP	DeRuyter village	531	$31,420	12%	231	$70,300
2000	COMP	Hamilton town	5,733	$38,917	14%	1,725	$79,300
2000	COMP	Lebanon town	1,329	$34,643	14%	631	$62,900
2000	COMP	Munnsville village	437	$35,000	15%	176	$66,400
2000	COMP	Stockbridge town	2,080	$37,700	13%	802	$67,900
COMPARABLE DEMOGRAPHICS			11,642	$35,432	13%	4,432	$69,167
2000	N	Cazenovia town	6,481	$57,232	4%	2,567	$142,900
2000	N	Cazenovia village	2,614	$43,611	7%	1,031	$115,200
2000	N	Chittenango village	4,855	$43,750	6%	1,968	$75,700
2000	N	Earlville village	791	$32,500	12%	329	$51,400
2000	N	Georgetown town	946	$37,963	11%	315	$54,600
2000	N	Hamilton village	3,509	$36,583	19%	785	$104,600
2000	N	Morrisville village	2,148	$34,375	20%	398	$73,900

iv. Analytical Results and Discussion

In five of the six regression models, monthly average sales prices grew faster or declined slower in the view shed than in the comparable area. However, in the case of the underperformance of the view shed, the explanatory power of the model is very poor. Thus, there is no significant evidence in these cases that the presence of the wind farms had a negative effect on residential property values.

Madison View shed

In Case I, the monthly sales price change in the view shed is 2.3 times the monthly sales price change of the comparable over the study period. However, the Case I model provides a poor fit to the data, with approximately 30 percent of the variance in the data explained by the linear regression. In Case II, the monthly sales price change in the view shed is 10.3 times greater after the on-line date than before the on-line date. However, the Case II model provides a poor fit to the data, with less than 30 percent of the variance in the data after the on-line date, and only 1 percent of the variance before the on-line date explained by the linear regression. In Case III, average monthly sales prices increase in the view shed after the on-line date, but decrease in the comparable region. The 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. The Case III model describes less than 30 percent of the variance in the view shed, but almost 40 percent of the variance in the comparable. The poor fit of the models, at least for the view shed, is partly due to a handful of property sales that were significantly higher than the typical view shed property sale. The data for the full study period is graphed in Figure 2.4, and regression results for all cases are summarized in Table 2.4 below.

Table 2.4 Madison County, New York: Regression Results
Project: Madison

Model	Dataset	Dates	Rate of Change ($/month)	Model Fit (R2)	Result
Case 1	View shed, all data Comparable, all data	Jan 97 - Jan 03 Jan 97 - Jan 03	$576.22 $245.51	0.29 0.34	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.
Case 2	View shed, before View shed, after	Jan 97 - Aug 00 Sep 00 - Jan 03	$129.32 $1,332.24	0.01 0.28	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.
Case 3	View shed, after Comparable, after	Sep 00 - Jan 03 Sep 00 - Jan 03	$1,332.24 -$418.71	0.28 0.39	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.

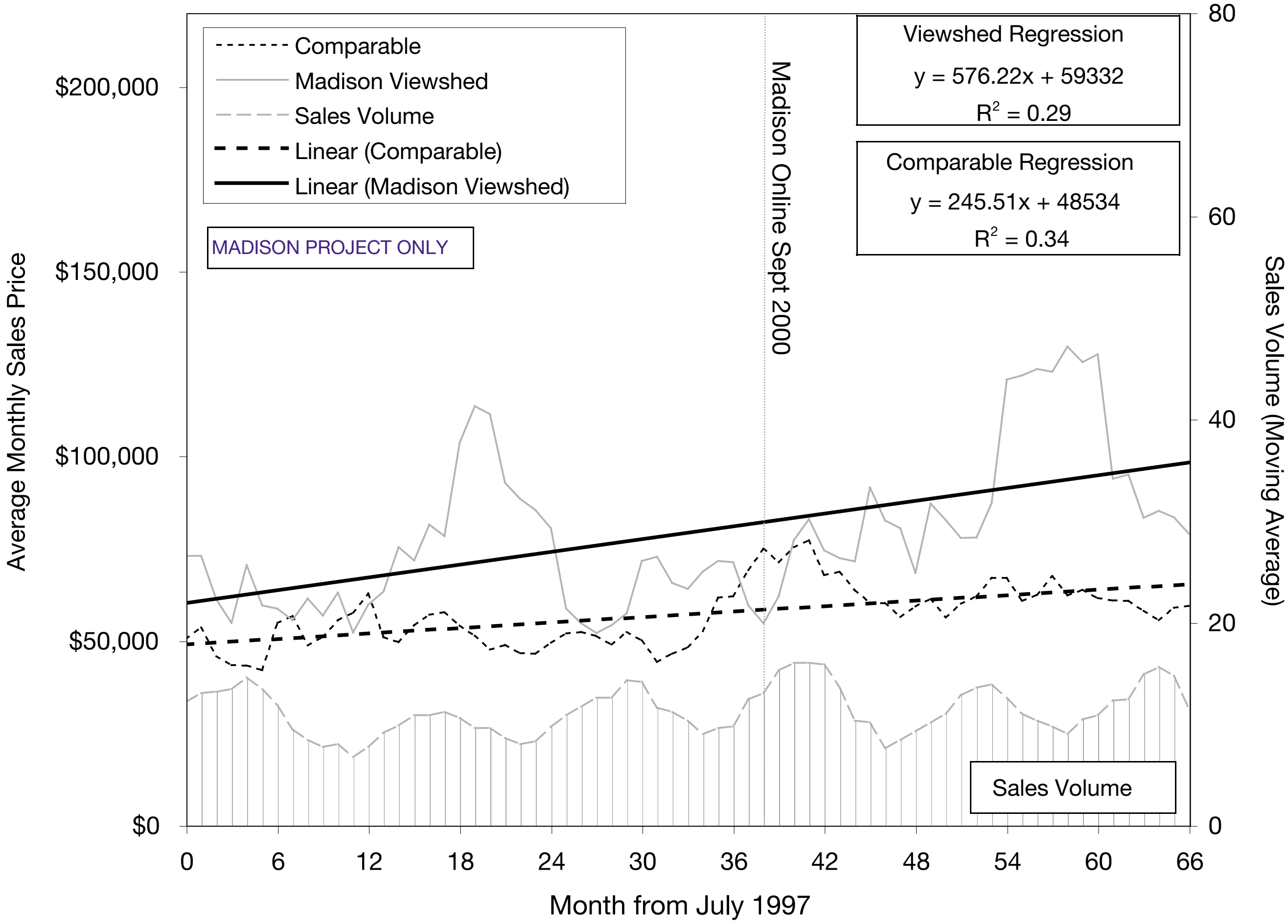

Figure 2.4 Average Residential Housing Sales Price For Madison Project

Madison County, New York 1997-2002

Fenner View shed

In Case I, the monthly sales price change in the view shed is 50 percent greater than the monthly sales price change of the comparable over the study period. The Case I model explains approximately one-third of the variance in the data. In Case II, average monthly sales prices increase in the view shed prior to the on-line date, but decrease after the on-line date. The average view shed sales price after the on-line date decreased at 29 percent of the rate of increase before the on-line date. The Case II model provides a fair fit to the data before the on-line date, with half of the variance in the data explained by the linear regression, but a poor fit after the on-line date, explaining only 4 percent of the variance in the data. The poor fit is partly due to having only 14 months of data after the on-line date, which may not be enough data establish clear price trends in a housing market that exhibits significant price fluctuations over time. In Case III, average monthly sales prices decrease in both the view shed and comparable after the on-line date, with the view shed decreasing less quickly. The decrease in average view shed sales price after the on-line date is 37 percent less than the decrease of the comparable after the on-line date. The Case III model again describes only 4 percent of the variance in the view shed, but over 60 percent of the variance in the comparable. The data for the full study period is graphed in Figure 2.5, and the regression results are summarized in Table 2.5.

Table 2.5 Madison County, New York: Regression Results
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	

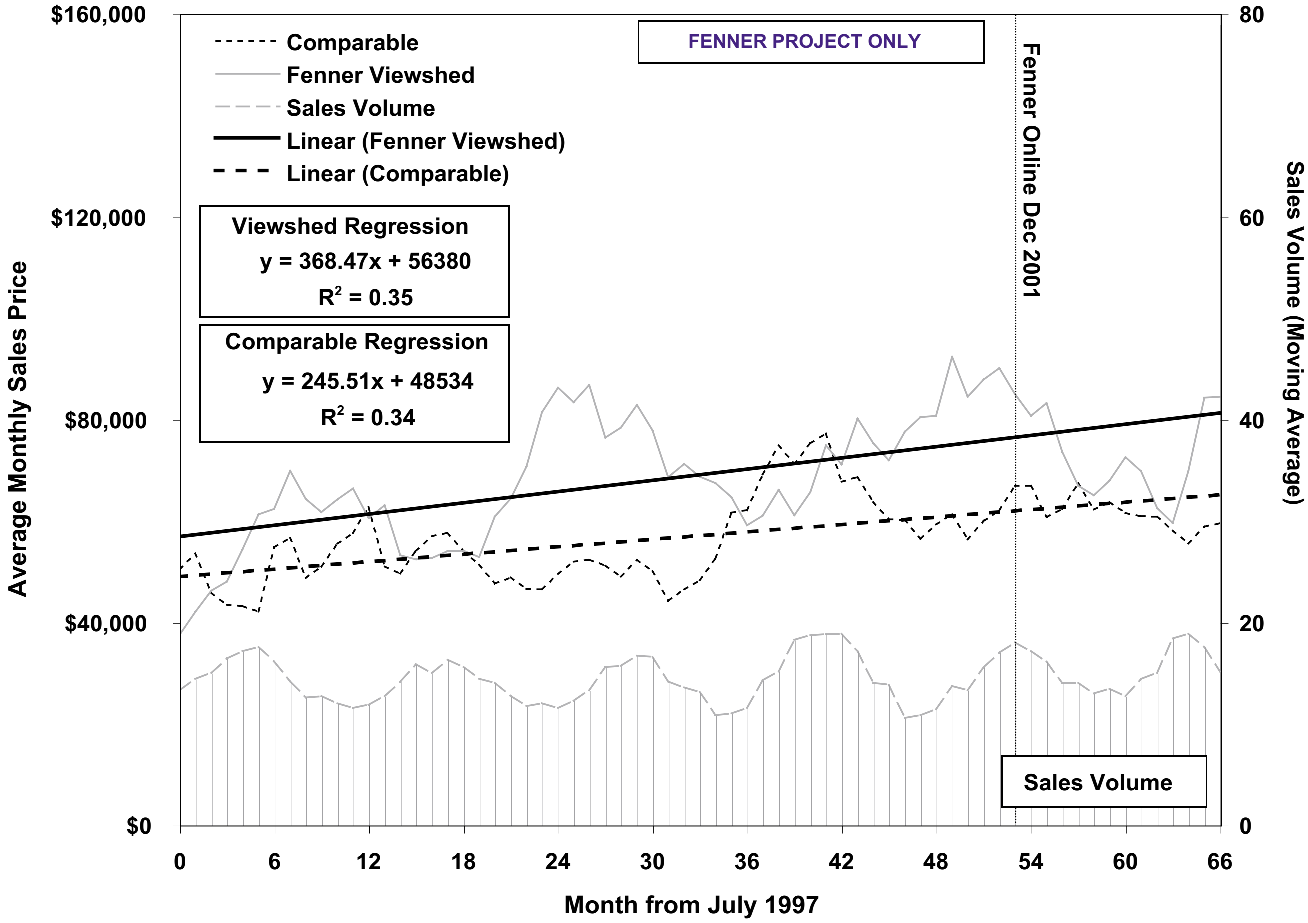

Figure 2.5 Average Residential Housing Sales Price For Fenner Project

Madison County, New York 1997-2002

D. Additional Interviewee Comments

Madison County assessors Carol Brophy and Priscilla Suits said they have not seen any impact of the turbines on property values, and Suits added, “There’s been no talk of any impact on values.” Assessor Russell Cary noted that there were worries about views of the turbines, and that the project siting was designed such that the town of Cazenovia could not see the project – it rests just outside the five-mile perimeter view shed this study designated.

Site Report 3: Carson County, Texas

A. Project Description

Situated in the middle of the Texas panhandle among large agricultural farms and small herds of cattle on fallow, 80 turbines stand at 70 meters (230 feet) high. Southwest of the project by 2.5 miles is White Deer town, which is 41 miles northeast of Amarillo.

The area is just about dead flat since Carson is right on the edge of the Texas High Plains. The general classification of the county is "completely rural or less than 2,500 urban population, but adjacent to a metro area." See Appendix 1 for a definition of rural urban continuum codes. The view shed represents fewer than 1,200 people.

Figure 3.1 : White Deer Wind Farm
Photo Courtesy: Ted Carr © 2003

B. Project Timeline

Table 3.1 Wind Project History, Carson County, TX

Project Name	Completion Date	Capacity (MW)
Llano Estacado Wind Ranch	2001	80

Figure 3.2. Regional Wind Project Location
(Dots approximate wind farm locations)

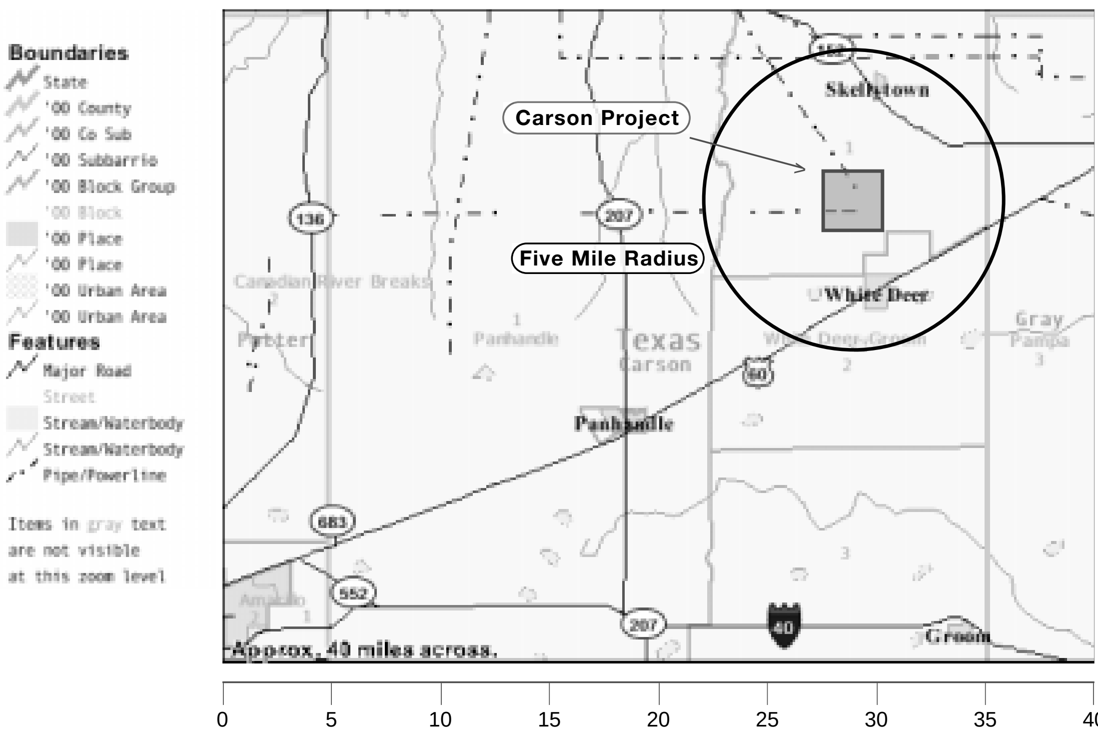

Figure 3.3. Carson County, Texas View shed
Site Location Source: Carson Appraisal District
Base Map Source: U.S. Census Bureau

C. Analysis

i. Data

Real property sales data for 1998 to 2002 was purchased in paper format from Carson County Appraisal District in Panhandle, TX. The sales data was purchased for the entire county, including the wind farm area and surrounding communities. The unit of analysis for this dataset is defined by census block and section and incorporated city boundaries. A detailed landowners map from for the County that identified every parcel, section, and block in the county was purchased. The Appraiser marked the exact parcel locations of the wind farms on the map, eliminating any estimation of the actual wind farm location.

The dataset included only a few property attributes, such as residence square footage and age of home. While the dataset included all sales of land, commercial property, and residential property, the analysis included only improved lots with residential housing, with a total of 269 sales over the study period. While there were no questions about unusual data points, the view shed had only 45 sales over the five years of data analyzed. This meant that many months had no sales in the view shed. While the six-month trailing average smoothed out most of the gaps, there was a seven-month gap in view shed data from August 2001 through February 2002. As a proxy for the missing data, the average of the two previous months with sales was used to fill in the gap. In addition, a few low value sales and a number of months with no sales contributed to a very low average sale price in the view shed between July 2000 and May 2001.

ii. View Shed Definition

View shed definition using the five-mile radius was straightforward given the land owner map, exact wind farm location, and one-mile reference scale on the map. The town of White Deer lies entirely within the view shed. The region of Skellytown lies just outside the edge of the five-mile radius, too far to be defined as view shed, but too close given the flat land and easily seen wind turbines to be considered as part of the comparable. Thus Skellytown, with a total of 16 sales, was excluded from the analysis. The view shed accounts for 45 sales over the study period.

Interviews with the State of Texas Carson County Appraisal District officers were conducted by phone to determine what percentage of residential properties in the view shed can see all or a portion of the wind turbines. In Appraiser Mike Darnell's opinion, 90 to 100 percent of White Deer residents can see the project.

iii. Comparable Selection

The comparable community was selected through interviews with State of Texas Carson County Appraisal District personnel, as well as analysis of demographic data from the 1990 and 2000 U.S. Census for communities near but outside of the view shed. Tables 3.2 and 3.3 summarize the Census data reviewed. In order to determine the most appropriate comparable community we looked at the demographics of three remaining residential areas in the county that were not part of the view shed and not excluded by being too close to the view shed.

Based on his experience in the area, Appraiser Mike Darnell suggested that Groom would be an appropriate comparable to the view shed area. However, Darnell said that homes in Fritch and Panhandle are more expensive, and have been increasing in value faster over time. Upon examination of Census data, sales data availability, and review of Assessor comments, all three residential areas, Fritch, Groom, and Panhandle were selected as the comparable, with a total of 224 sales from 1998 to 2002.

Table 3.2 Carson County, Texas: 1990 Census Data

Year	View shed	Location	Population	Median household income	% Population below poverty level	Number housing units	Median value-owner-occupied housing unit
1990	Y	White Deer-Groom division	2,863	$23,883	8%	1,319	$34,700
1990	N	Panhandle division	3,713	$28,569	10%	1,537	$44,100
1990 COUNTY DEMOGRAPHICS			6,576	$26,226	9%	2,856	$39,400

Table 3.3 Carson County, Texas: 2000 Census Data

Year	View shed	Location	Population	Median household income	% Population below poverty level	Number housing units	Median value-owner-occupied housing unit
2000	Y	White Deer-Groom CCD	2,702	$36,117	9%	1,261	$46,900
2000	N	Panhandle CCD	3,814	$43,349	6%	1,554	$59,400
2000 COUNTY DEMOGRAPHICS			6,516	$39,733	7%	2,815	$53,150

iv. Analytical Results and Discussion

In all three of the regression models, monthly average sales prices grew faster in the view shed than in the comparable area, indicating that there is no significant evidence that the presence of the wind farms had a negative effect on residential property values.

In Case I, the monthly sales price change in the view shed is 2.1 times the monthly sales price change of the comparable over the study period. The Case I model provides a fair fit to the view shed data, with almost half of the variance in the data explained by the linear regression. However, the model only explains one-third of the variance in the comparable data. In Case II, the monthly sales price change in the view shed is 3.4 times greater after the on-line date than before the on-line date. The Case II model provides a poor fit to the data prior to the on-line date, with a quarter of the variance in the data explained by the linear regression. However, the fit after the on-line date is good, with over 80 percent of the variance explained. In Case III, average monthly sales prices increase in the view shed after the on-line date, but decrease in the comparable region. The 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. The Case III model describes over 80 percent of the variance in the view shed, but provides a very poor fit with only 2 percent of the variance explained in the comparable. The data for the full study period is graphed in Figure 3.4, and regression results for all cases are summarized in Table 3.4 below.

Table 3.4 Carson County, Texas: Regression Results
Project: Llano Estacado Wind Ranch

Model	Dataset	Dates	Rate of Change ($/month)	Model Fit (R2)	Result
Case 1	View shed, all data Comparable, all data	Jan 98 - Nov 02 Jan 98 - Nov 02	$620.47 $296.54	0.49 0.33	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.
Case 2	View shed, before View shed, after	Jan 98 - Oct 01 Nov 01 - Nov 02	$553.92 $1,879.76	0.24 0.83	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.
Case 3	View shed, after Comparable, after	Nov 01 - Nov 02 Nov 01 - Nov 02	$1,879.76 -$140.14	0.83 0.02	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.

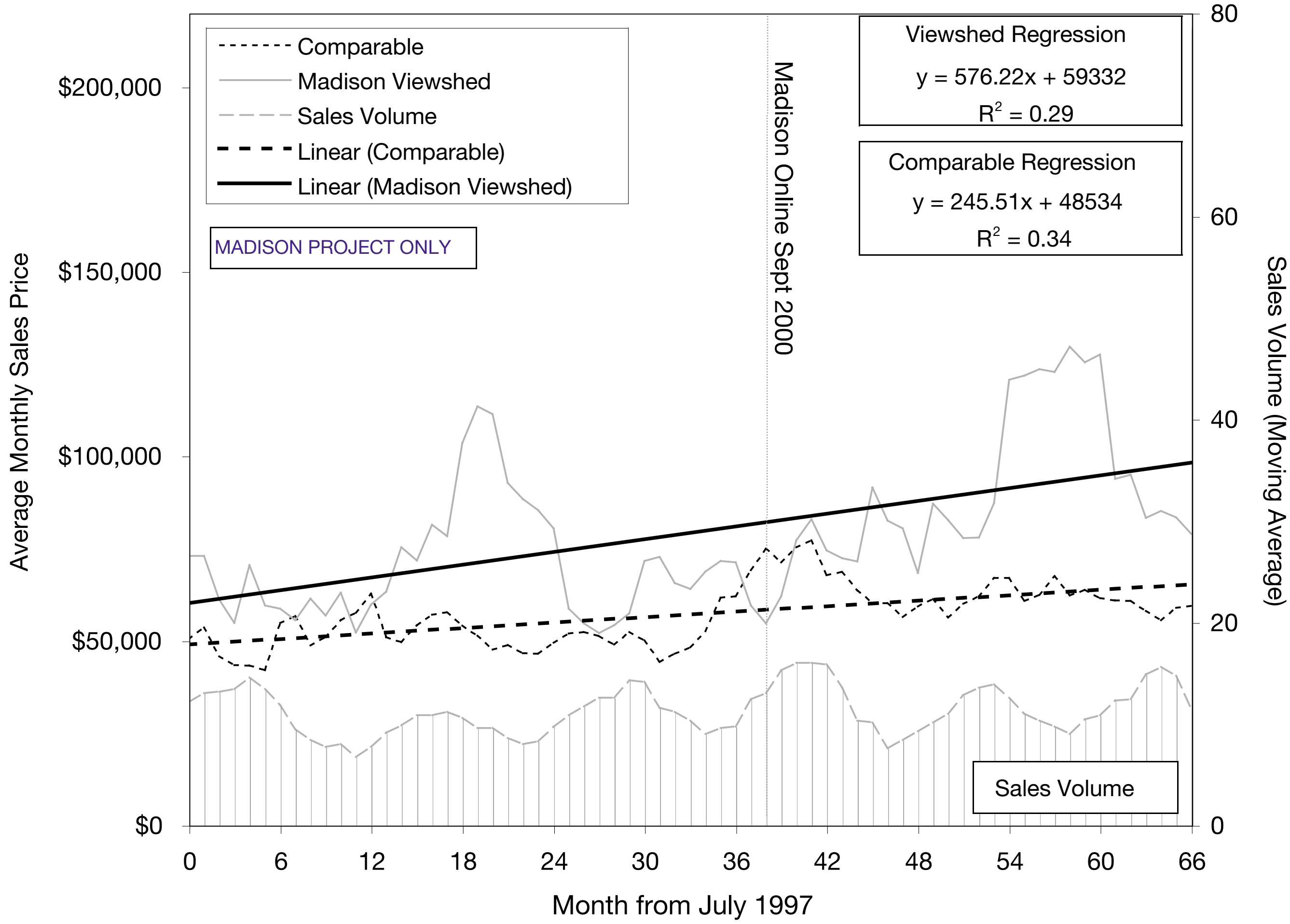

Figure 3.4 Average Residential Housing Sales Price

Carson County, Texas 1998-2002

D. Additional Interviewee Comments

Carson County officers Mike Darnell, appraisal district office, and Barbara Cosper, tax office, said most of the land in the view shed were farms, and that most residents in White Deer worked on the farms. Therefore, White Deer residents' interest in housing values was wholly dependent on their proximity to farms with no concern for the wind towers, she said. Darnell added that most residents in White Deer liked the turbines because they brought new jobs to the area, and there has been no talk of discontent with the turbines.

The county's main claim to fame is it's the home of Pantex; the only nuclear armament production and disassembly facility in the U.S., according to Department of Energy's www.pantex.com website.

Site Report 4: Bennington County, Vermont

A. Project Description

One mile due south of Searsburg, atop a ridge, stand 11 turbines with 40-meter (131 foot) hub heights in a line running north-south. The solid, white, conical towers rise well above dense woods, but the black painted blades are virtually invisible – especially when in motion. The site is in Bennington County less than a mile west of Windham County, and is midway between the two medium-size towns of Bennington and Brattleboro.

The area is defined as a non-metro area adjacent to a metro area, though not completely rural and with a population between 2,500 and 19,999. See Appendix 1 for a definition of rural urban continuum codes. The view shed has a population of fewer than 4,000.

Figure 4.1 Searsburg wind project turbines
Photo courtesy Vermont Environmental Research Associates, 2002. www.northeastwind.com

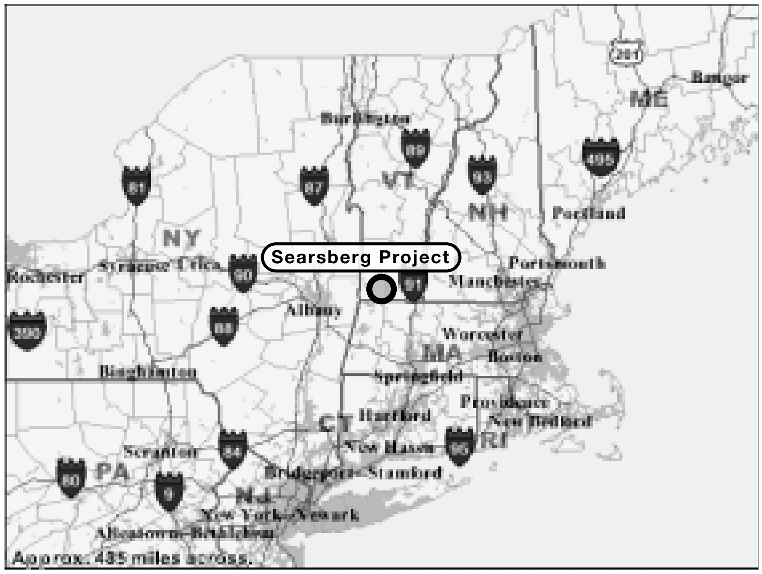

Figure 4.2 The Searsburg wind project is located in Southern Vermont

Base map image source: U.S. Census Bureau

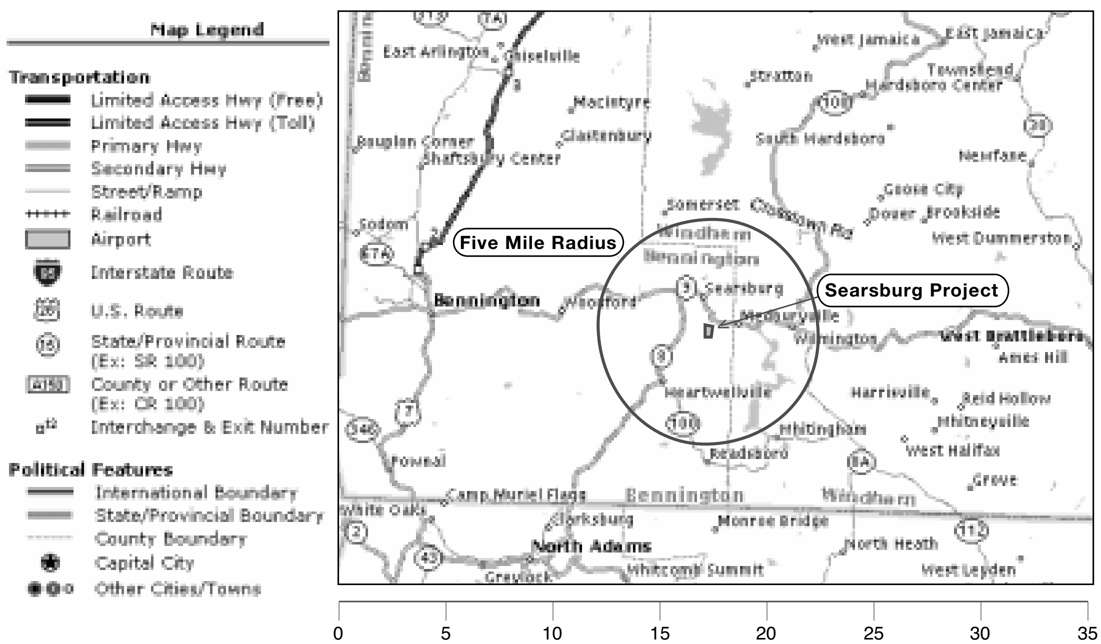

Figure 4.3. Searsburg, Vermont area View shed

Location Source: Vermont Environmental Associates

Base Map Source: MapQuest.com

B. Project Timeline

Table 4.1 Wind Project History, Bennington County, VT

Project Name	Completion Date	Capacity (MW)
Searsburg	1997	6

C. Analysis

i. Data

Real property sales data for 1994 to 2002 was purchased in electronic form from Phil Dodd of VermontProperty.com in Montpelier, VT. Sales data was purchased for the townships and cities encompassing the wind farm area and surrounding communities, and was provided in two separate datasets. The first dataset, covering years 1994 through 1998, contained only annual average property sale prices and sales volumes, by town. No other locational data or property attributes were included. Property types from this dataset used in the analysis are primary residences and vacation homes, accounting for 1,584 sales.

The second dataset, contained information on individual property sales from May 1998 through October 2002, and accounted for 2,333 sales. The unit of analysis for the second dataset is towns. Some street addresses were included in the property descriptions, but many of these were only partial addresses. Property types from this dataset used in the analysis are primary homes, primary condominiums, vacation condominiums, and camp or vacation homes. The Searsburg wind farm went on-line in February 1997, with a capacity of 6 MW, during the time when only annually averaged sales data was available.

ii. View Shed Definition

The view shed is defined by a five-mile radius around the wind farm, and encompasses four incorporated towns: Searsburg in Bennington county, and Dover, Somerset, and Wilmington in Windham County. Interviews with the State of Vermont Windham County Listers Office were conducted by phone to determine what percentage of residential properties in the view shed can see all or a portion of the wind turbines. According to Newfane town Lister Doris Knechtel, approximately 10 percent of the Searsburg homes can see the wind farm. Listers were unable to estimate what percentage of properties could see the wind farms in the other view shed towns. The final view shed dataset contained 1,055 sales from 1994 to 1998 and 1,733 sales for 1999 to 2002, for a total of 2,788 sales.

iii. Comparable Selection

The comparable community was selected through interviews with Phil Dodd of VermontProperty.com, interviews with State of Vermont Listers, as well as analysis of demographic data from the 1990 and 2000 U.S. Census for communities near but outside of the view shed. Tables 4.2 and 4.3 summarize the census data reviewed. In order to determine the most appropriate comparable community, we looked at the demographics of seven surrounding areas. Upon examination of Census data, sales data availability, and review of interview comments, Newfane and Whitingham in Windham County were selected as the comparable. The final comparable dataset contained 288 sales from 1994 to 1998 and 264 sales for 1999 to 2002, for a total of 552 sales from 1994 to 2002.

iv. Analytical Results and Discussion

In all three of the regression models, monthly average sales prices grew faster in the view shed than in the comparable area, indicating that there is no significant evidence that the presence of the wind farms had a negative effect on residential property values.

Table 4.2 Bennington and Windham Counties, Vermont: 1990 Census Data

Year	View shed	Location	Population	Median household income	% Population below poverty level	Number housing units	Median value-owner-occupied housing unit
1990	Y	Searsburg village, Bennington Cty.	85	$26,875	9%	92	$61,500
1990	Y	Dover village, Windham Cty.	994	$30,966	7%	2450	$103,000
1990	Y	Wilmington village, Windham Cty.	1,968	$27,335	6%	2,176	$110,600
1990	VIEW SHED DEMOGRAPHICS		3,047	$28,392	7%	4,718	$91,700
1990	COMP	Newfane town, Windham Cty.	1,555	$31,935	7%	974	$103,000
1990	COMP	Whitingham village, Windham Cty.	1,177	$28,580	8%	737	$88,500
1990	COMPARABLE DEMOGRAPHICS		2,732	$30,258	8%	1,711	$95,750
1990	N	Halifax village, Windham Cty.	588	$23,750	15%	473	$81,600
1990	N	Readsboro village, Bennington Cty.	762	$25,913	12%	478	$65,400
1990	N	Stratton village, Windham Cty.	121	$31,369	2%	864	$162,500
1990	N	Woodford village, Bennington Cty.	331	$24,118	18%	267	$75,000
1990	N	Marlboro village, Windham Cty.	924	$29,926	10%	474	$103,300

Table 4.3 Bennington and Windham Counties, Vermont: 2000 Census Data

Year	View shed	Location	Population	Median household income	% Population below poverty level	Number housing units	Median value-owner-occupied housing unit
2000	Y	Searsburg village, Bennington Cty.	114	$17,500	18%	65	$86,700
2000	Y	Dover village, Windham Cty.	1410	$43,824	10%	2749	$143,300
2000	Y	Wilmington village, Windham Cty.	2,225	$37,396	9%	2,232	$120,100
2000	VIEW SHED DEMOGRAPHICS		3,749	$32,907	12%	5,046	$116,700
2000	COMP	Newfane town, Windham Cty.	1,680	$45,735	5%	977	$123,600
2000	COMP	Whitingham village, Windham Cty.	1,298	$37,434	8%	802	$111,200
2000	COMPARABLE DEMOGRAPHICS		2,978	$41,585	6%	1,779	$117,400
2000	N	Halifax village, Windham Cty.	782	$36,458	16%	493	$98,800
2000	N	Readsboro village, Bennington Cty.	803	$35,000	7%	464	$78,600
2000	N	Stratton village, Windham Cty.	136	$39,688	5%	1,091	$125,000
2000	N	Woodford village, Bennington Cty.	397	$33,929	17%	355	$91,300
2000	N	Marlboro village, Windham Cty.	963	$41,429	4%	495	$150,000

In Case I, the monthly sales price change in the view shed is 62 percent greater than the monthly sales price change of the comparable over the study period. The Case I model provides a reasonable fit to the view shed data, with 70 percent of the variance in the data for the view shed and 45 percent of the variance in the data for the comparable explained by the linear regression. In Case II, sales prices decreased in the view shed prior to the on-line date, and increased after the on-line date. The average view shed sales price after the on-line date increased at 2.6 times the rate of decrease in the view shed before the on-line date. The Case II model provides a good fit to the data, with 71 percent of the variance in the data for the view shed after the on-line date and 88 percent of the variance in the data before the on-line date explained by the linear regression. In Case III, average view shed sales prices after the on-line date are 18 percent greater than in the comparable. The Case III model describes over 70 percent of the variance in the data. The data for the full study period is graphed in Figure 4.4, and regression results for all cases are summarized in Table 4.4 below.

D. Additional Interviewee Comments

Newfane town Lister[1] Doris Knechtel said the area has a wide cross section of home values, styles, and uses (permanent residential and vacation homes). The other primary community in the view shed was Wilmington, which Knechtel said was a resort destination with more turnover than Searsburg.

Table 4.4 Regression Results, Bennington and Windham Counties, VT
Project: Searsburg

Model	Dataset	Dates	Rate of Change ($/month)	Model Fit (R2)	Result
Case 1	View shed, all data Comparable, all data	Jan 94 - Oct 02 Jan 94 - Oct 02	$536.41 $330.81	0.70 0.45	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.
Case 2	View shed, before View shed, after	Jan 94 - Jan 97 Feb 97 - Oct 02	-$301.52 $771.06	0.88 0.71	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.
Case 3	View shed, after Comparable, after	Feb 97 - Oct 02 Feb 97 - Oct 02	$771.06 $655.20	0.71 0.78	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.

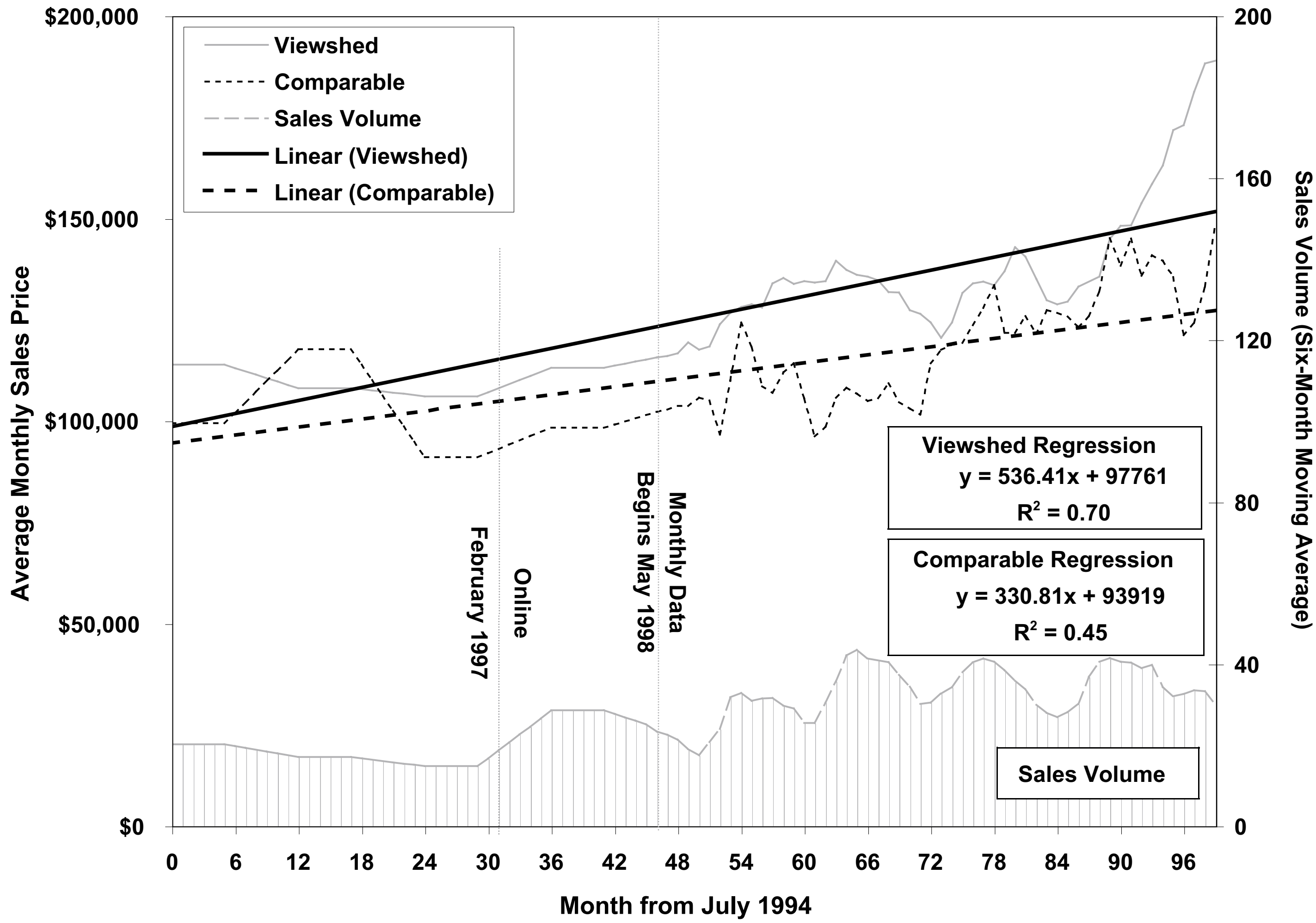

Figure 4.4 Average Residential Housing Sales Price
Bennington and Windham Counties, Vermont 1994-2002

1 Vermont property assessors are organized differently from any other state researched for this analysis. Assessors are called “listers” and operate per town – not on a township or county level. With small tax regions to support officials, local town offices are infrequently available, and in many cases neither had answering machines nor computers. The county government office confirmed that many Vermont offices didn’t have computers, but were in the process of receiving them as of October 2002.

Site Report 5: Kewaunee County, Wisconsin

A. Project Description

The regional topography has slight elevation changes with some rolling hills, but is mostly cleared agricultural land with intermittent groves. The two major wind farm projects occupy three sites that are all within five miles of each other, two in Lincoln Township and one in Red River Township. There are several small communities in Red River and Lincoln Townships that primarily work the agricultural lands.

The projects, installed in 1999, consist of 31 turbines with hub heights of 65 meters (213 feet). The nearest incorporated towns are Algoma to the east, Kewaunee to the southeast, and Luxemburg to the southwest. The wind farms are roughly 15 miles from the center of the Green Bay metropolitan area, and 10 miles from the outer edges of the city. The area is defined as a non-metro area adjacent to a metro area, though not completely rural and with a population between 2,500 and 19,999. See Appendix 1 for a definition of rural urban continuum codes. The view shed has a population of approximately 3,000.

Figure 5.1 Wind Projects in Red River and Lincoln Townships

Photo Courtesy Wisconsin Public Service Corporation

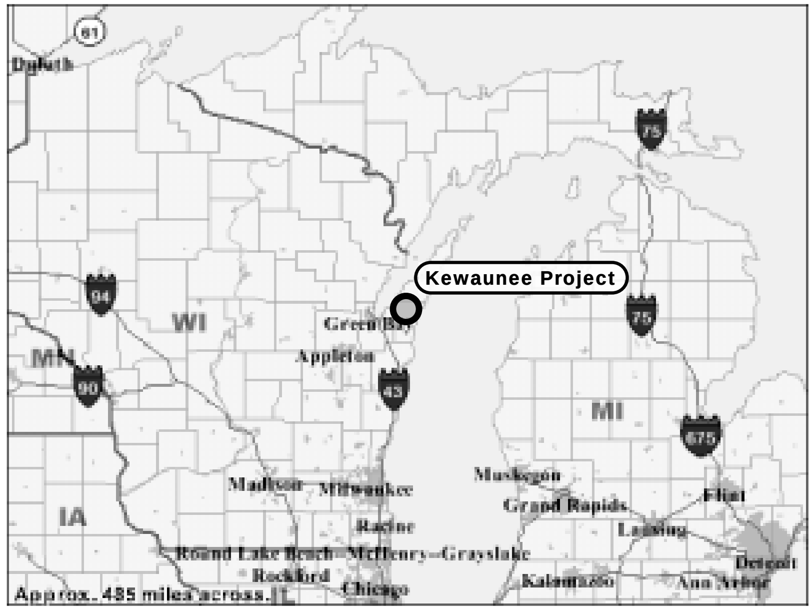

Figure 5.2 Location of Kewaunee County wind projects

Base map image source: U.S. Census Bureau

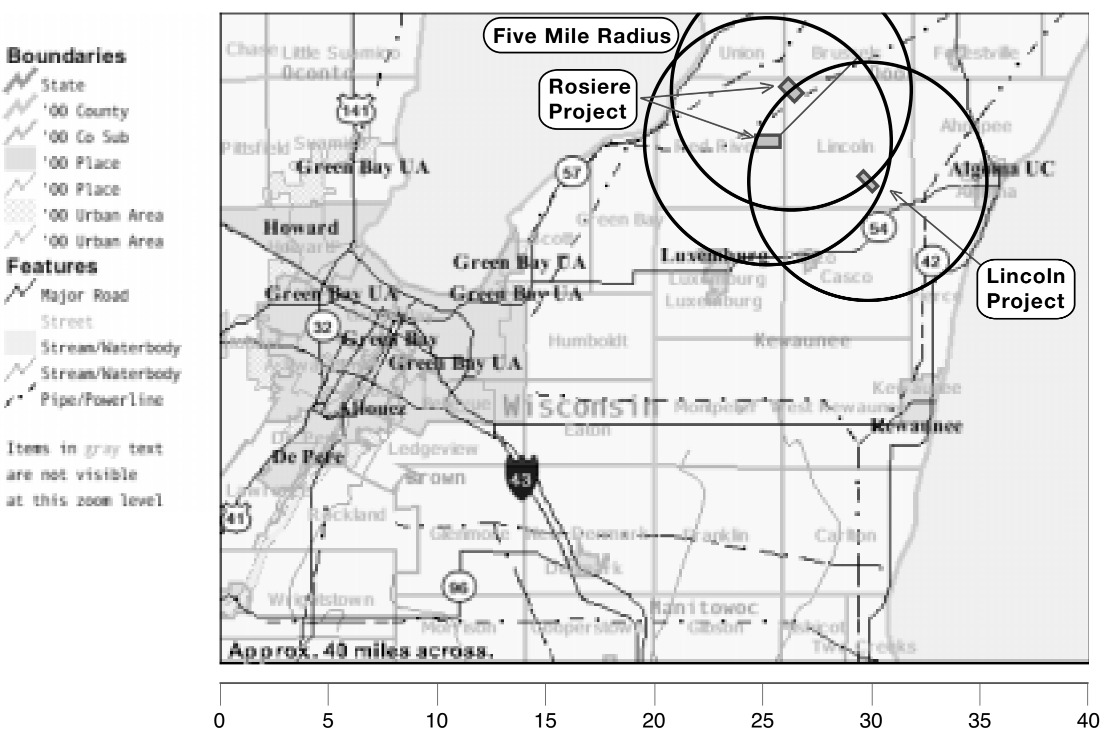

Figure 5.3. Kewaunee County View shed

Location Source: Kewaunee County Assessors Office

Base Map Source: U.S. Census Bureau

B. Project Timeline

Table 5.4 Wind Project History, Kewaunee County, WI

Project Name	Completion Date	Capacity (MW)
Lincoln (Gregorville, Lincoln Township)	1999	9.2
Rosiere (Lincoln and Red River Townships)	1999	11.2

C. Analysis

i. Data

Real property sales data for 1996 to 2002 was purchased in paper and electronic form from the State of Wisconsin Department of Revenue Bureau of Equalization Green Bay Office. Sales data was obtained for the townships and cities encompassing the wind farm area and surrounding communities, and was provided in two separate datasets. The first dataset consisted of paper copy of Detailed Sales Studies for residential properties from 1994 to 1999. These contained individual property sales by month, year, and township or district. Parcel numbers were included, but no other locational data or property attributes were available. The second dataset consisted of electronic files containing residential property sales data for 2000 to 2002. This dataset contained no detailed property attributes, and only partial street addresses. The units of analysis for the combined dataset are townships and villages. After discussion with the Property Assessment Specialist, three unusually high value sales were removed from the view shed dataset. The final dataset included 624 sales from 1996 to 2002.

The Lincoln wind farm near Gregorville and the Rosiere wind farm on the Lincoln/Red River Township Border both went on-line June 1999, with capacities of 9.2 MW and 11.2 MW, respectively.

ii. View Shed Definition

The view shed is defined by a five-mile radius around the wind farms. Because the view sheds of the individual wind farm sites overlap, and because all wind farms went on-line at the same time, a single view shed was defined. It encompasses all of Lincoln and Red River Townships, and the incorporated town of Casco in Casco Township. To assist in the view shed definition, detailed Plat maps for Lincoln and Red River Townships were obtained from the State of Wisconsin Bureau of Equalization Green Bay Office. These maps indicated every block and parcel in each township, and provided a one square mile grid to allow distance measurements. The location of each wind farm was marked on the map by the Bureau, and detailed aerial photos of each wind farm were also provided. This information allowed concise definition of the view shed area. Because only portions of Ahnapee, Luxemborg, and Casco Townships are in the view shed, these townships were excluded from consideration for either the view shed or comparable. The final view shed dataset contained 329 sales from 1996 to 2002.

Interviews with Kewaunee County Assessors were conducted by phone to determine what percentage of residential properties in the view shed can see all or a portion of the wind turbines. Assessor Dave Dorschner said 20 to 25 percent of Red River Township properties have views of the turbines. No one interviewed was able to estimate the percentage of properties in Lincoln Township or Casco Village with a view of the wind farms.

iii. Comparable Selection

The comparable community was selected through interviews with James W. Green, Bureau of Equalization Property Assessment Specialist, and analysis of demographic data from the 1990 and 2000 U.S. Census for communities near but outside of the view shed. Tables 5.2 and 5.3 summarize the Census data reviewed. In order to determine the most appropriate comparable community, we looked at the demographics of eight surrounding areas. Upon examination of Census data, sales data availability, and review of interview comments, Carlton, Montpelier, and West Kewaunee Townships were selected as the comparable. The final comparable dataset contained 295 sales from 1996 to 2002.

Table 5.2 Kewaunee County, Wisconsin: 1999 Census Data

Year	View shed	Location	Population	Median household income	% Population below poverty level	Number housing units	Median value-owner-occupied housing unit
1990	Y	Casco village	544	$25,313	6%	223	$54,200
1990	Y	Lincoln town	996	$28,958	7%	338	$44,800
1990	Y	Red River town	1,407	$32,614	3%	552	$60,600
VIEW SHED DEMOGRAPHICS			2,947	$28,962	6%	1,113	$53,200
1990	COMP	Carlton town	1,041	$30,385	8%	383	$42,600
1990	COMP	Montpelier town	1,369	$31,600	8%	457	$61,300
1990	COMP	West Kewaunee town	1,215	$31,094	8%	451	$51,300
COMPARABLE DEMOGRAPHICS			3,625	$31,026	8%	1,291	$51,733
1990	N	Ahnapee town	941	$26,850	7%	406	$47,500
1990	N	Algoma City	3,353	$21,393	8%	1,564	$44,000
1990	N	Casco town	1,010	$33,807	4%	344	$57,200
1990	N	Franklin town	990	$32,625	14%	360	$53,300
1990	N	Kewaunee City	2,750	$22,500	14%	1,213	$46,600
1990	N	Luxemburg town	1,387	$35,125	5%	424	$60,600
1990	N	Luxemburg village	1,151	$24,702	6%	460	$58,200
1990	N	Pierce town	724	$25,812	12%	369	$60,400

Table 5.3 Kewaunee County, Wisconsin: 2000 Census Data

Year	View shed	Location	Population	Median household income	% Population below poverty level	Number housing units	Median value-owner-occupied housing unit
2000	Y	Casco village	572	$44,583	4%	236	$88,700
2000	Y	Lincoln town	957	$42,188	9%	346	$100,000
2000	Y	Red River town	1,476	$47,833	6%	601	$117,900
VIEW SHED DEMOGRAPHICS			3,005	$44,868	6%	1,183	$102,200
2000	COMP	Carlton town	1,000	$50,227	3%	383	$98,900
2000	COMP	Montpelier town	1,371	$51,000	4%	492	$112,000
2000	COMP	West Kewaunee town	1,287	$47,059	6%	485	$101,300
COMPARABLE DEMOGRAPHICS			3,658	$49,429	4%	1,360	$104,067
2000	N	Ahnapee town	977	$47,500	3%	426	$95,200
2000	N	Algoma City	3,357	$35,029	5%	1,632	$74,500
2000	N	Casco town	1,153	$46,250	4%	404	$107,800
2000	N	Franklin town	997	$52,019	2%	359	$114,900
2000	N	Kewaunee City	2,806	$36,420	11%	1,237	$79,700
2000	N	Luxemburg town	1,402	$54,875	1%	459	$121,600
2000	N	Luxemburg village	1,935	$45,000	6%	754	$105,100
2000	N	Pierce town	897	$43,000	15%	407	$98,900

iv. Analytical Results and Discussion

In all three of the regression models, monthly average sales prices grew faster in the view shed than in the comparable area, indicating that there is no significant evidence that the presence of the wind farms had a negative effect on residential property values. However, the fit of the linear regression is poor for all cases analyzed. Very low sales volumes, averaging 3.6 sales per month from 1996 to 1999, lead to large fluctuations in average sales prices from individual property sales. This contributes to the low R2 values.

In Case I, the monthly sales price change in the view shed is 3.7 times the monthly sales price change of the comparable over the study period. However, the Case I model provides a poor fit to the view shed data, with 26 percent and 5 percent of the variance in the data explained by the linear regression in the view shed and comparable, respectively. In Case II, sales prices decreased in the view shed prior to the on-line date, and increased after the on-line date. The average view shed sales price after the on-line date increased at 3.5 times the rate of decrease in the view shed before the on-line date. The Case II model provides a poor fit to the data, with 32 percent of the variance in the data for the view shed after the on-line date and 2 percent of the variance in the data before the on-line date explained by the linear regression. In Case III, average monthly sales prices increase in the view shed after the on-line date, but decrease in the comparable region. The average view shed sales price after the on-line date increases 33 percent quicker than the comparable sales price decreases after the on-line date. The Case III model describes approximately a third of the variance in the data. The data for the full study period is graphed in Figure 5.4, and regression results for all cases are summarized in Table 5.4 below.

Table 5.4 Regression Results, Kewaunee County, WI
Projects: Red River (Rosiere), Lincoln (Rosiere), Lincoln (Gregorville)

Model	Dataset	Dates	Rate of Change ($/month)	Model Fit (R2)	Result
Case 1	View shed, all data Comparable, all data	Jan 96 - Sep 02 Jan 96 - Sep 02	$434.48 $118.18	0.26 0.05	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.
Case 2	View shed, before View shed, after	Jan 96 - May 99 Jun 99 - Sep 02	-$238.67 $840.03	0.02 0.32	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.
Case 3	View shed, after Comparable, after	Jun 99 - Sep 02 Jun 99 - Sep 02	$840.03 -$630.10	0.32 0.37	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.

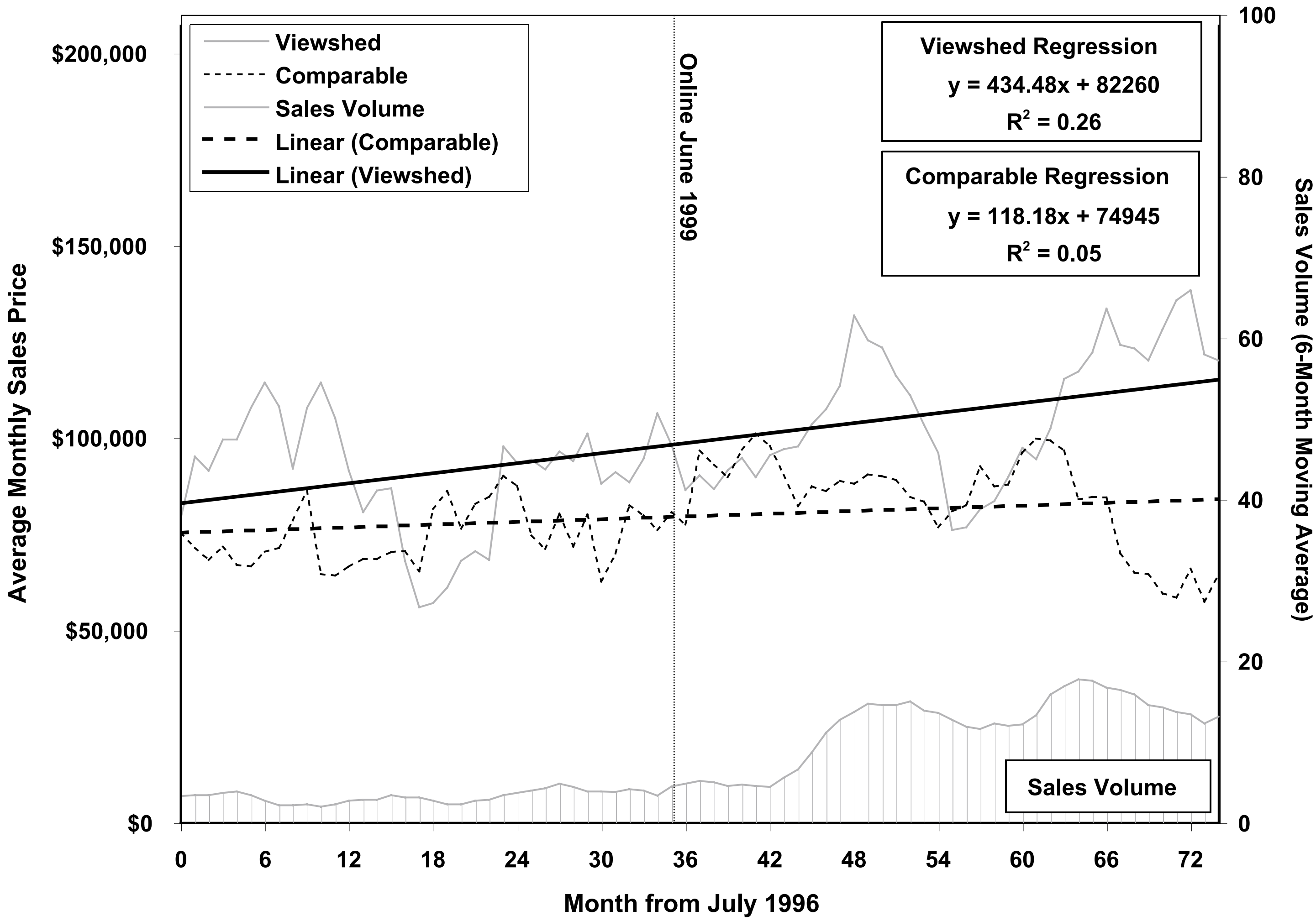

Figure 5.4 Average Residential Housing Sales Price

Kewaunee County, Wisconsin 1996-2002

D. Additional Interviewee Comments

Assessor Dave Dorschner said he has not seen an impact on property values except for those immediately neighboring the project sites. In the cases of neighboring property, he said some homes were sold because of visual and/or auditory distraction, but some of the properties were purchased speculatively in hope that a tower might be built on the property.

James W. Green, Wis. Bureau of Equalization property assessment specialist, also said he has not seen any impact of the turbines on property values. He added that he has seen greater property value increases in the rural areas than in the city because people were moving out of the Green Bay area opting for rural developments or old farmhouses.

Site Report 6: Somerset County, Pennsylvania

A. Project Description

There are two major wind farms in Somerset County, Somerset and Green Mountain. They are about 20 miles due east of the wind farm in Fayette County, PA. The Somerset project has six turbines 64 meters (210 feet) high along a ridge crest east Somerset town. The Green Mountain project has eight turbines at 60 meters (197 feet). They are about 10 miles southwest of the Somerset project, and a mile west of Garret town.

The area is almost the same as Fayette County, but slightly less hilly – dense populations of tall trees, frequent overcast, and primarily rural development. The area is classified as a "county in a metro area with fewer than 250,000." See Appendix 1 for a definition of rural urban continuum codes. The view shed has a population of approximately 19,000.

Figure 6.1 Somerset wind tower

Photo courtesy GE Wind Energy © 2002

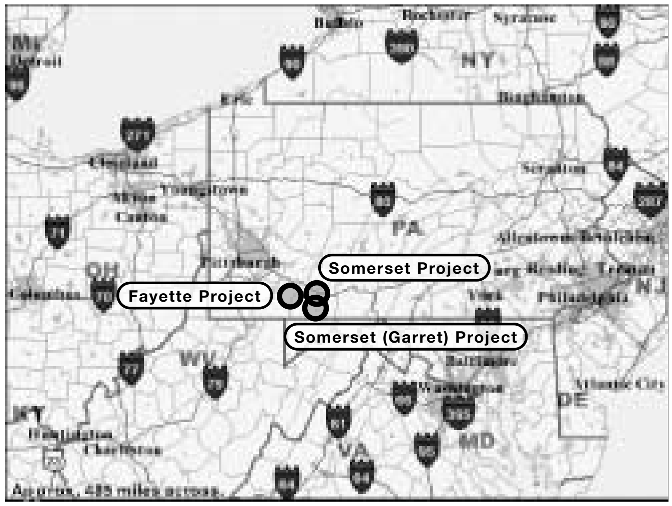

Figure 6.2 General location of Somerset and Fayette County wind projects
Base map image source: U.S. Census Bureau

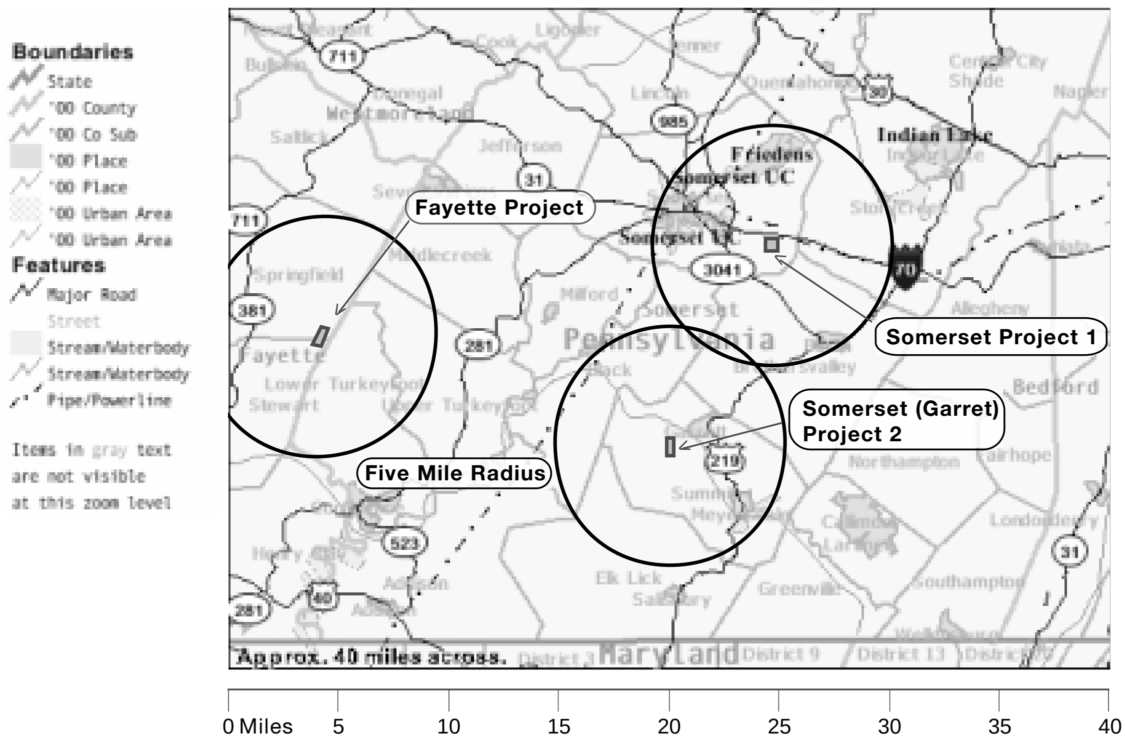

Figure 6.3. Somerset County, Pennsylvania View shed
Location Source: Somerset County Assessors office

Base Map Source: U.S. Census Bureau

B. Project Timeline

Table 6.1 Wind Project History, Somerset County, PA

Project Name	Completion Date	Capacity (MW)
Somerset	2001	9.0
Green Mountain Wind Farm	2000	10.4

C. Analysis

i. Data

Real property sales data for 1997 to 2002 was obtained in electronic form from the State of Pennsylvania Somerset County Assessment Office in Somerset, PA. Sales data was obtained for the townships and cities encompassing the wind farm area and surrounding communities. The electronic files contain residential property sales data for 2000 to 2002. Residential types included in the analysis are homes, homes converted to apartments, mobile homes with land, condominiums, townhouses, and one mobile home on leased land. The dataset contained lot acreages and brief building descriptions, and some, but not all, records provided additional property attributes. As street addresses were not provided, the units of analysis for the dataset are townships and villages. The final dataset included 1,506 residential property sales from 1997 to 2002.

The Somerset wind farm went on-line October 2001 and the Green Mountain wind farm near Garrett went on-line May 2000, with capacities of 9.0 MW and 10.4 MW, respectively.

ii. View Shed Definition

The view shed is defined by a five-mile radius around the wind farms. Because the view sheds of the individual wind farm sites overlap, a single view shed was defined. It encompasses all of Somerset and Summit Townships, and the Garrett and Somerset Boroughs within these townships. Locational data for the wind farms was obtained from utility and wind industry web sites, and used in conjunction with maps and interviews with the Somerset County Mapping Department to identify the exact location and extent of the wind farms and view shed. Townships only partially within the view shed were excluded from consideration for either the view shed or comparable. The final view shed dataset contains 962 sales from 1997 to 2002.

Interviews with Somerset County Assessors were conducted by phone to determine what percentage of residential properties in the view shed can see all or a portion of the wind turbines. In Assessor Hudack's opinion, 10 percent of Somerset properties can see the turbines, and roughly 20 percent of Garrett properties have a view.

iii. Comparable Selection

The comparable community was selected through interviews with Assessors John Riley and Joe Hudack of the State of Pennsylvania Somerset County Assessment Office, and analysis of demographic data from the 1990 and 2000 U.S. Census for communities near but outside of the view shed. Tables 6.2 and 6.3 summarize the Census data reviewed. In order to determine the most appropriate comparable community we looked at the demographics of three surrounding areas. Upon examination of Census data, sales data availability, and review of interview comments, Conemaugh Township was selected as the comparable. The final comparable dataset contained 422 sales from 1997 to 2002.

iv. Analytical Results and Discussion

In all three of the regression models, monthly average sales prices grew faster in the view shed than in the comparable area, indicating that there is no significant evidence that the presence of the wind farms had a negative effect on residential property values.

In Case I, the monthly sales price change in the view shed is 90 percent greater than the monthly sales price change of the comparable over the study period. The Case I model provides a poor fit to the view shed data, with 30 percent of the variance in the data for the view shed and 7 percent of the variance in the data for the comparable explained by the linear regression. In Case II, the monthly sales price change in the view shed is 3.5 times greater after the on-line date than before the on-line date. The Case II model provides a poor fit to the data prior to the on-line date, with 37 percent, of the variance in the data explained by the linear regression, but a reasonable fit after the on-line date, with 62 percent of the variance explained. In Case III, average monthly sales prices increase in the view shed after the on-line date, but decrease in the comparable region. The 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. The Case III model describes 62 percent of the variance in the view shed, but only 23 percent of the variance in the comparable. The data for the full study period is graphed in Figure 6.4, and regression results for all cases are summarized in Table 6.4 below.

Table 6.2 Somerset County, Pennsylvania: 1990 Census Data

Year	View shed	Location	Population	Median household income	% Population below poverty level	Number housing units	Median value-owner-occupied housing unit
1990	Y	Garrett Borough	520	$16,071	26%	218	$27,100
1990	Y	Somerset Borough	6,454	$19,764	18%	3,100	$58,800
1990	Y	Somerset Twsp	8,732	$25,631	10%	3,296	$57,100
1990	Y	Summit Twsp	2,495	$22,868	17%	942	$40,800
VIEW SHED DEMOGRAPHICS			18,201	$21,084	18%	7,556	$45,950
1990	COMP	Conemaugh Twsp	7,737	$25,025	8%	3,070	$43,100
COMPARABLE DEMOGRAPHICS			7,737	$25,025	8%	3,070	$43,100
1990	N	Boswell Borough	1,485	$16,128	29%	670	$39,700
1990	N	Milford Twsp	1,544	$24,821	9%	666	$47,400

Table 6.3 Somerset County, Pennsylvania: 2000 Census Data

Year	View shed	Location	Population	Median household income	% Population below poverty level	Number housing units	Median value-owner-occupied housing unit
2000	Y	Garrett Borough	449	$24,609	16%	180	$38,600
2000	Y	Somerset Borough	6,762	$29,050	12%	3,313	$87,200
2000	Y	Somerset Twsp	9,319	$33,391	9%	3,699	$76,300
2000	Y	Summit Twsp	2,368	$32,115	17%	930	$67,700
VIEW SHED DEMOGRAPHICS			18,898	$29,791	13%	8,122	$67,450
2000	COMP	Conemaugh Twsp	7,452	$30,530	7%	3,089	$61,800
COMPARABLE DEMOGRAPHICS			7,452	$30,530	7%	3,089	$61,800
2000	N	Boswell Borough	1,364	$20,875	29%	681	$54,000
2000	N	Milford Twsp	1,561	$34,458	14%	658	$75,300

Table 6.4 Regression Results, Somerset County, PA
Projects: Somerset, Green Mountain

Model	Dataset	Dates	Rate of Change ($/month)	Model Fit (R2)	Result
Case 1	View shed, all data Comparable, all data	Jan 97 - Oct 02 Jan 97 - Oct 02	$190.07 $100.06	0.30 0.07	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.
Case 2	View shed, before View shed, after	Jan 97 - Apr 00 May 00 - Oct 02	$277.99 $969.59	0.37 0.62	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.
Case 3	View shed, after Comparable, after	May 00 - Oct 02 May 00 - Oct 02	$969.59 -$418.73	0.62 0.23	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.

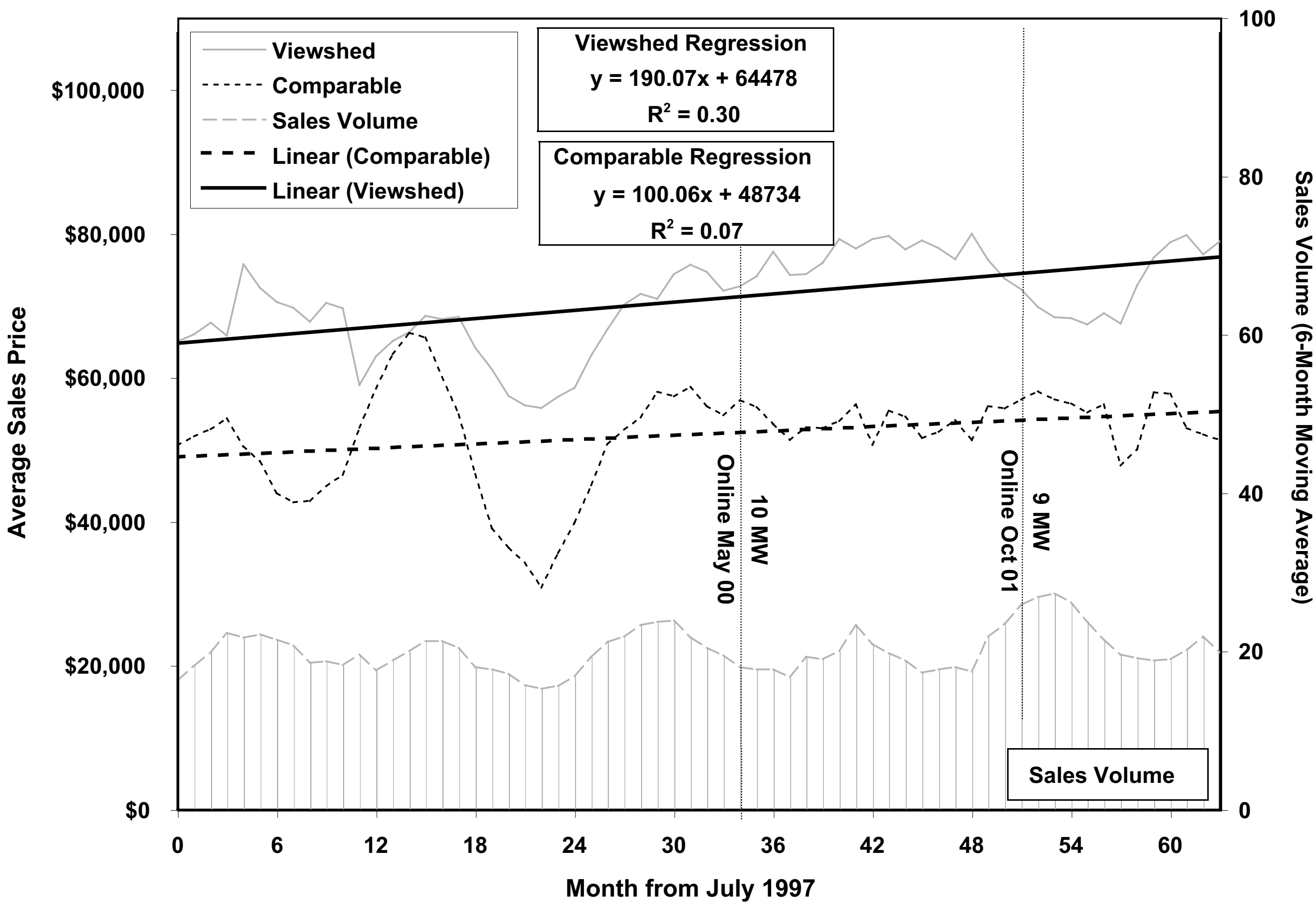

Figure 6.4 Average Residential Housing Sales Price

Somerset County, Pennsylvania 1997-2002

D. Additional Interviewee Comments

Assessor Joe Hudack said he has not seen any impact on property values from wind farms. The turbines outside Somerset were also "not glaring," but could be seen from the PA Turnpike. The Green Mountain turbines outside Garret were noticeable, but because there were so few people residing there, he hasn't seen much housing turnover to base an opinion, he said.

Site Report 7: Buena Vista County, Iowa

A. Project Description

The geography of the view shed and comparable regions is flat with minimal elevation changes. The region is mostly cleared land for agricultural production, with trees along irrigation ditches or planted around homes for shade and wind dampening.

Figure 7.1 750 kW Zond wind turbines 1.5 miles east of Alta, Iowa
Photo Courtesy: Waverly Light and Power © 2002

Surrounding Alta, Iowa and west of the town along the Buena Vista and Cherokee counties' border, 257 towers with 63 meter [207 ft] hub heights stand among agricultural farms and scattered homes. Project Storm Lake I comprises 150 towers around Alta extending 1.5-2.5 miles east and west, 1.5 miles south, and five miles north. Throughout the project, the turbines are consistently spaced 3.6 rotor diameters, or about 180 m (590 ft) apart. Project Storm Lake II comprises 107 towers, eight miles northwest of Alta, with several towers over the county border into neighboring Cherokee County. The exact location of all turbines was obtained from the Waverly Power and Light website. All towers have white color blades and hubs with either grey, trussed towers or white solid towers. Solid red lights are required by the FAA on the nacelles of alternate turbines.

Buena Vista County is classified as an "urban population with 2,500 to 19,999 not adjacent to a metro area." See Appendix 1 for a definition of rural urban continuum codes. This analysis defines two possible view sheds, depending on whether Storm Lake City is included in the analysis. Accordingly, the view shed has a population of either 4,000 or 14,000, depending on its definition.

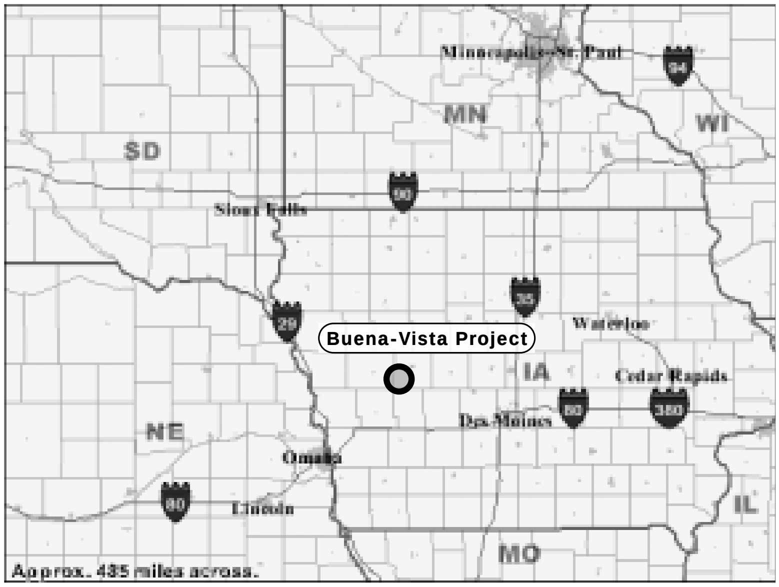

Figure 7.2 Regional Wind Project Location
(Dot approximate wind farm locations)

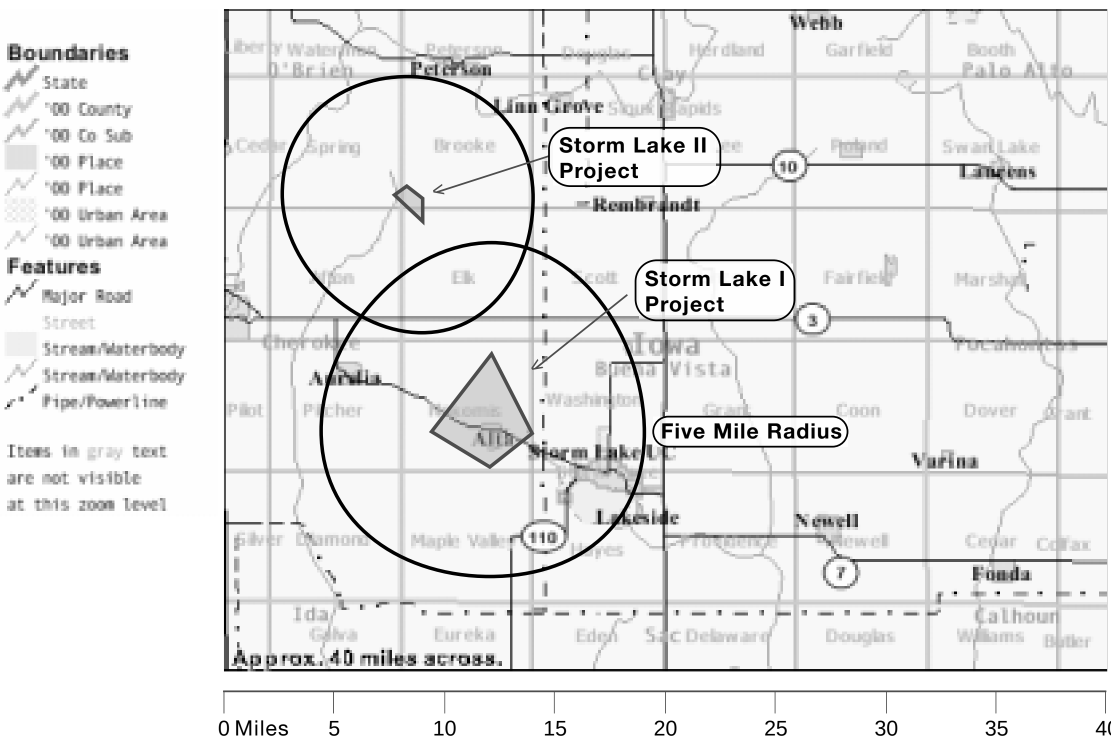

Figure 7.3. Buena-Vista, County, Iowa View shed
Location Source: Buena-Vista County Assessors Office

Base Map Source: U.S. Census Bureau

B. Project Timeline

Table 7.1 Wind Project History, Somerset County, PA

Project Name	Completion Date	Capacity (MW)
Storm Lake I	1999	112.5
Storm Lake II	1999	80.2

C. Analysis

i. Data

Real property sales data for 1996 to 2002 was obtained in electronic form from the Iowa State Assessors Office Website at www.iowaassessors.com. Sales data was obtained for the townships and cities encompassing the wind farm area and surrounding communities. The electronic data gathered contains residential property sales prices, parcel numbers, street addresses, year built and square footage. The unit of analysis for this dataset is defined by either township or incorporated city boundaries. Though street addresses are included in the dataset, this analysis lacked the resources to identify the location of properties by street address. The final dataset included 3,213 residential property sales from 1996 to 2002.

The Storm Lake II wind farm went on-line June 1999 and the Storm Lake I wind farm went on-line May 1999, with capacities of 112.5 MW and 80.2 MW, respectively.

ii. View Shed Definition

The view shed is defined by a five-mile radius around the wind farms. Because the view sheds of the individual wind farm sites overlap, and the on-line dates are within a month of each other, a single view shed was defined. Locational data for the wind farms was obtained from utility and wind industry web sites, and used in conjunction with maps and phone interviews to identify the exact location and extent of the wind farms and view shed. Townships only partially within the view shed were excluded from consideration for either the view shed or comparable.

Interviews with Somerset County Assessors were conducted by phone to determine what percentage of residential properties in the view shed can see all or a portion of the wind turbines. In Buena Vista County Assessor Ted Van Groteest's opinion, 100 percent of the properties in Alta have views of turbines, 75 percent of Nokomis Township have views, and five to 10 percent of Storm Lake City properties have views. However, he estimated that all the waterfront properties on the southeast side of Storm Lake can see turbines when looking northwest. Storm Lake City has a population of approximately 10,000, while Nokomis Township and Alta City have a combined population of approximately 2,000.

This report examines two cases for Buena Vista County.

Analysis #1: Storm Lake City Excluded from View Shed

For the first analysis, the view shed consists only of the village and township in which the wind turbines are located. In this case approximately 75 to 100 percent of the residential properties sold are within view of the wind farm, and are at most 3.5 miles from wind turbines, and in most cases much closer. We believe that if wind farms negatively effect property values, this effect would be strongest in this smaller radius view shed. The Analysis #1 view shed dataset contains 288 sales from 1996 to 2002.

Analysis #2: Storm Lake City Included in View Shed

For the second analysis, the view shed contains Storm Lake City, which is mainly within the five-mile view shed radius, in addition to Alta City and Nokomis Township as included in Analysis #1. Because Storm Lake City's population is five times larger than that of the Alta and Nokomis combined, and because estimates are that roughly 5 percent of Storm Lake City properties can see the wind farms, we believe that any negative property value effects from the wind farms may be overshadowed by economic and demographic trends in Storm Lake City that are distinct from any effect the wind farms may have. The Analysis #2 view shed dataset contains 1,557 sales from 1996 to 2002.

iii. Comparable Selection

The comparable community was selected through interviews with Buena Vista County Assessor Ted Van Groteest, and analysis of demographic data from the 1990 and 2000 U.S. Census for communities near but outside of the view shed. Tables 7.2 and 7.3 summarize the Census data reviewed. In order to determine the most appropriate comparable community, we looked at the demographics of five comparable communities. Upon examination of Census data, sales data availability, and review of interview comments, one city and four townships in Clay County, just to the north of Buena Vista County, were selected as the comparable. The comparables are Spencer City, and Meadow, Riverton, Sioux, and Summit Townships. The final comparable dataset contained 1,656 sales from 1996 to 2002.

Table 7.2 Buena Vista County, Iowa: 1990 Census Data

Year	View shed	Location	Population	Median household income	% Population below poverty level	Number housing units	Median value-owner-occupied housing unit
1990	Y	Nokomis Township, Buena Vista County	2,174	$24,915	10%	872	$41,300
1990	Y	Alta City, Buena Vista County	1,824	$23,043	12%	754	$40,400
VIEW SHED DEMOGRAPHICS #1			3,998	$23,979	11%	1,626	$40,850
1990	Y	Nokomis Township, Buena Vista County	2,174	$24,915	10%	872	$41,300
1990	Y	Storm Lake City, Buena Vista County	8,769	$23,755	9%	3,557	$47,000
1990	Y	Alta City, Buena Vista County	1,824	$23,043	12%	754	$40,400
VIEW SHED DEMOGRAPHICS #2			12,767	$23,904	11%	5,183	$42,900
1990	COMP	Meadow Township, Clay County	432	$24,000	12%	142	$60,500
1990	COMP	Riverton Township, Clay County	323	$26,875	19%	115	$47,500
1990	COMP	Sioux Township, Clay County	348	$35,417	2%	134	$42,100
1990	COMP	Spencer City, Clay County	11,066	$24,573	10%	4,824	$45,200
1990	COMP	Summit Township, Clay County	409	$27,266	5%	201	$30,400
COMPARABLE DEMOGRAPHICS			12,578	$27,626	9%	5,416	$45,140

Table 7.3 Buena Vista County, Iowa: 2000 Census Data

Year	View shed	Location	Population	Median household income	% Population below poverty level	Number housing units	Median value-owner-occupied housing unit
2000	Y	Nokomis Township, Buena Vista County	2,261	$33,533	11%	922	$69,800
2000	Y	Alta City, Buena Vista County	1,848	$31,941	11%	791	$66,700
VIEW SHED DEMOGRAPHICS #1			4,109	$32,737	11%	1,713	$68,250
2000	Y	Nokomis Township, Buena Vista County	2,261	$33,533	11%	922	$69,800
2000	Y	Storm Lake City, Buena Vista County	10,150	$35,270	12%	3,732	$70,300
2000	Y	Alta City, Buena Vista County	1,848	$31,941	11%	791	$66,700
VIEW SHED DEMOGRAPHICS #2			14,259	$33,581	11%	5,445	$68,933
2000	COMP	Meadow Township, Clay County	323	$49,167	2%	129	$82,900
2000	COMP	Riverton Township, Clay County	323	$49,200	3%	116	$124,100
2000	COMP	Sioux Township, Clay County	324	$37,417	0%	144	$107,400
2000	COMP	Spencer City, Clay County	11,420	$32,970	10%	5,177	$80,700
2000	COMP	Summit Township, Clay County	411	$36,500	1%	179	$68,000
COMPARABLE DEMOGRAPHICS			12,801	$41,051	3%	5,745	$92,620

iv. Analytical Results and Discussion

Analysis #1: Storm Lake City Excluded from View Shed

In all three of the regression models, monthly average sales prices grew faster in the view shed than in the comparable area, indicating that there is no significant evidence that the presence of the wind farms had a negative effect on residential property values.

In Case I, the monthly sales price change in the view shed is 18 percent greater than the monthly sales price change of the comparable over the study period. The Case I model provides a good fit to the data, with over two-thirds of the variance in the data explained by the linear regression. In Case II, the monthly sales price change in the view shed is 70 percent greater after the on-line date than before the on-line date. The Case II model provides a reasonable fit to the data, with over half of the variance in the data explained by the linear regression. In Case III, average view shed sales prices after the on-line date are 2.7 times greater than in the comparable. The Case III model describes over half of the variance in the data for the view shed, but only 23 percent of the variance for the comparable. The data for the full study period is graphed in Figure 7.4, and regression results for all cases are summarized in Table 7.4 below.

Analysis #2: Storm Lake City Included in View Shed

In all three of the regression models, monthly average sales prices grew slower in the view shed than in the comparable area.

In Case I, the monthly sales price change in the view shed is 34 percent less than the monthly sales price change of the comparable over the study period. The Case I model provides a good fit to the data, with over 60 percent of the variance in the data explained by the linear regression. In Case II, the monthly sales price change in the view shed is 59 percent less after the on-line date than before the on-line date. The Case II model explains over half of the variance in the data prior to the on-line date explained, but only 27 percent of the variance after the on-line date. In Case III, average view shed sales prices after the on-line date are 22 percent lower than in the comparable.

The Case III model provides a poor fit to the data, explaining less than 30 percent of the variance for the data. The data for the full study period is graphed in Figure 7.5, and regression results for all cases are summarized in Table 7.5 below.

Table 7.4 Regression Results, Buena Vista County, IA
Projects: Storm Lake I & II (Without Storm Lake City)

Model	Dataset	Dates	Rate of Change ($/month)	Model Fit (R2)	Result
Case 1	View shed, all data Comparable, all data	Jan 96 - Oct 02 Jan 96 - Oct 02	$401.86 $341.87	0.67 0.72	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.
Case 2	View shed, before View shed, after	Jan 96 - Apr 99 May 99 - Oct 02	$370.52 $631.12	0.51 0.53	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.
Case 3	View shed, after Comparable, after	May 99 - Oct 02 May 99 - Oct 02	$631.12 $234.84	0.53 0.23	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.

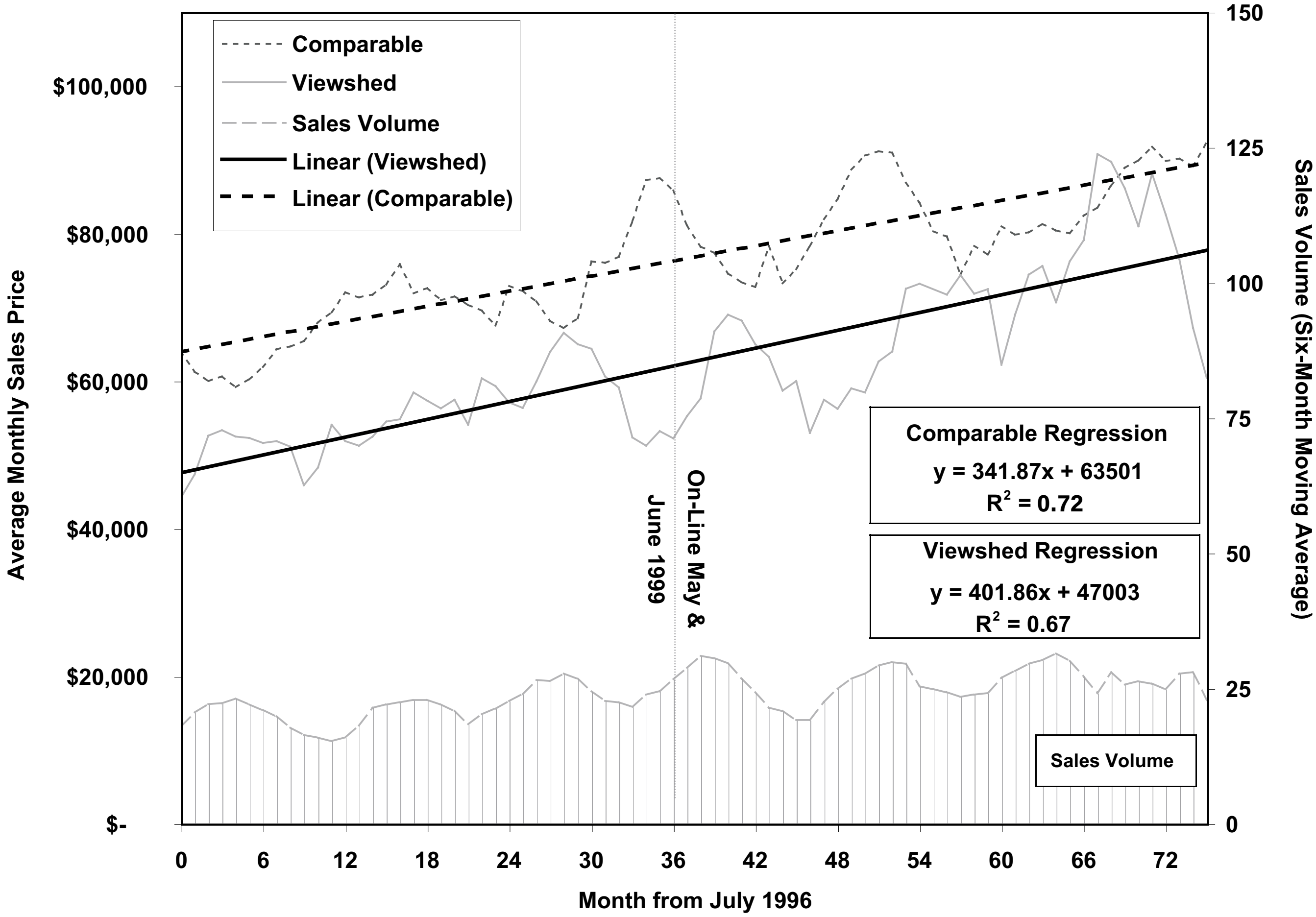

Figure 7.4 Average Residential Housing Sales Price
Analysis #1: Storm Lake City Excluded from View Shed
Buena Vista County, Iowa 1996-2002

Table 7.5 Regression Results, Buena Vista County, IA
Project: Storm Lake I & II (With Storm Lake City)

Model	Dataset	Dates	Rate of Change ($/month)	Model Fit (R2)	Result
Case 1	View shed, all data Comparable, all data	Jan 96 - Oct 02 Jan 96 - Oct 02	225.97 341.87	0.60 0.72	The rate of change in average view shed sales price is 34% less than the rate of change of the comparable over the study period.
Case 2	View shed, before View shed, after	Jan 96 - Apr 99 May 99 - Oct 02	450.11 183.92	0.59 0.27	The rate of change in average view shed sales price is 59% less after the on-line date than before the on-line date.
Case 3	View shed, after Comparable, after	May 99 - Oct 02 May 99 - Oct 02	183.92 234.84	0.27 0.23	The rate of change in average view shed sales price after the on-line date is 22% lower than the rate of change of the comparable after the on-line date.

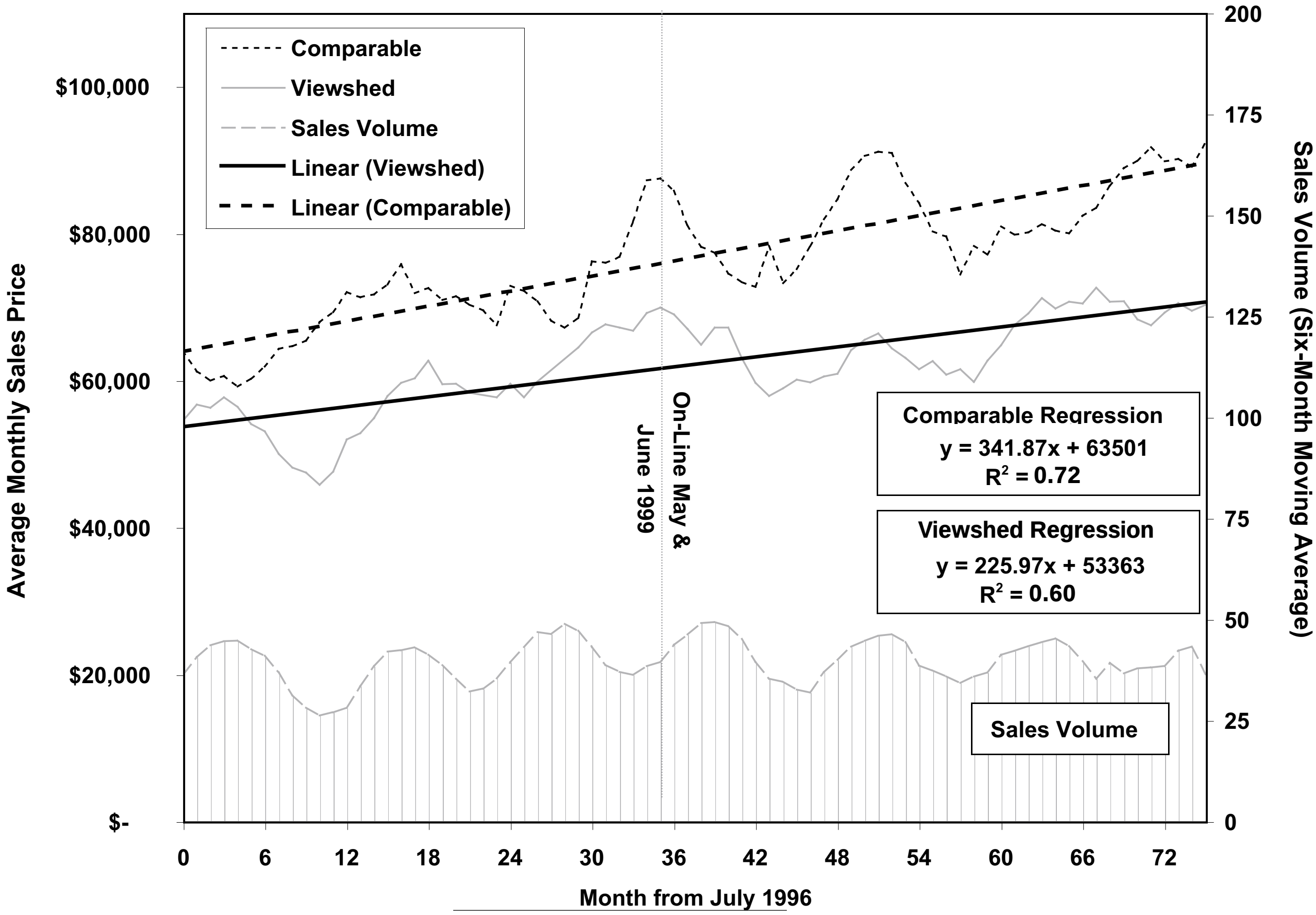

Figure 7.5 Average Residential Housing Sales Price
Analysis #2: Storm Lake City Included in View Shed

Buena Vista County, Iowa 1996-2002

D. Additional Interviewee Comments

Buena Vista County Assessor Ted Van Groteest said the comparable area around Spencer City in the northern neighboring county, Clay, would have higher property values because of its proximity to recreational lakes to the north, but that the two areas' property values rose at equal rates. He added that the predominate business mix was similar, but that the productive value of the land in Clay might be a little higher.

Between October 2002 and March 2003 the following information was obtained through other interviews with Groteest:

- Most of the residences at the Lake Creek Country Club, a golf course community located just west of Storm Lake City (between the city and the wind farms), have views of the towers. Several towers are one-half mile north and southwest of the Country Club. The assessor owns a home at the Country Club.
- In the assessor's opinion, the wind projects have no impact on property values. According to the assessor, the only issue that influences prices is the school district.
- There is also a hog farm on the west side of Storm Lake – the same direction as the wind projects. Groteest said the property values did not change around the hog farm.

Site Report 8: Kern County, California

A. Project Description

The Tehachapi Mountains stretch northeast and southwest with Tehachapi City and neighboring communities seated within a flat valley inside the range. Despite the arid climate, Tehachapi's elevation of 4,000 feet affords it four seasons. This region is known for its extensive wind farm development, which has been ongoing for over two decades.

Figures 8.1 – 8.2: Views of the Tehachapi region wind farms
Top Photo Courtesy Jean-Claude Criton © 2000 ~ Bottom Photo Courtesy Windland Inc. © 2003

Between 1981 and 2002 developers installed 3,569 towers with varied hub heights up to 55 meters (180.5 feet), and repowered six sites with 199 towers between 1997 and2002. The projects nestle within the Tehachapi pass five miles east of Tehachapi City, through the Tehachapi mountains, and scatter along the east-face just as Highway 58 drops sharply southeast toward Mojave and California cities bordering the Mojave Desert. The wind farm locations are shown in the regional area map, Figure 8.3, and view shed map, Figure 8.4, below.

To the east of the mountains are the cities of Mojave, California, and Rosamond. The incorporated limits of these cities are all approximately three to four miles from the base of the range, where the Mojave Desert begins.

Foliage is patchy with many areas covered in wild, dry grasses, Juniper, and Cottonwood much like the terrain between Albuquerque and Santa Fe, New Mexico. However, there are some green portions with dense grasses allowing for cattle grazing or equestrian spreads.

Although Kern County is classified as a "county in a metro area with 250,000 to 1 million population," the view shed has a population of less than 15,000. See Appendix 1 for a definition of rural urban continuum codes. Also, Tehachapi is 40 miles to the nearest metro area of Bakersfield, and 115 miles to Los Angeles.

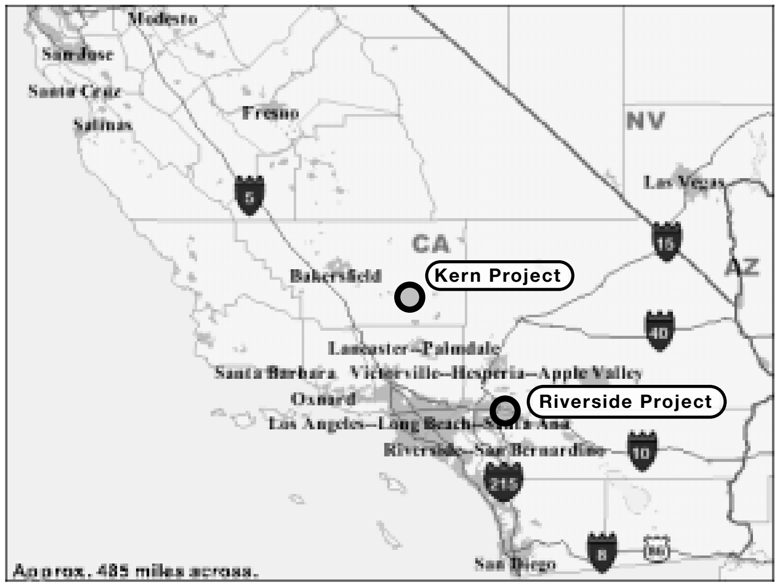

Figure 8.3. Regional Wind Project Location

(Dots approximate wind farm locations)

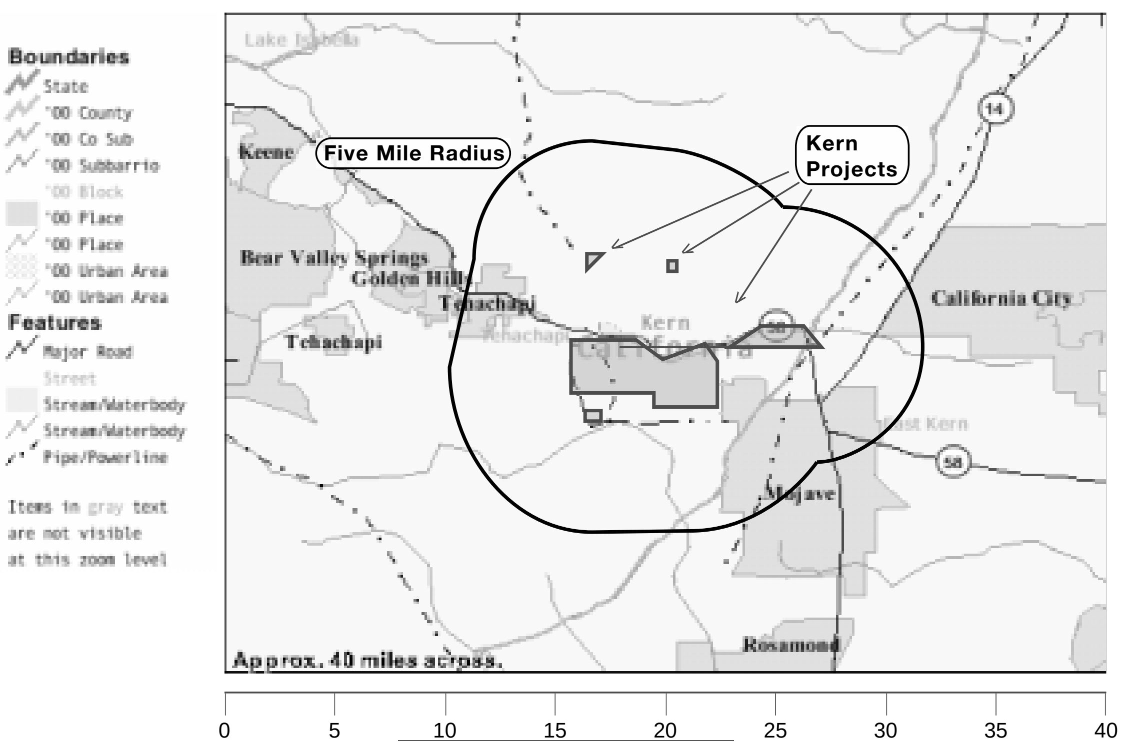

Figure 8.4. Kern County, California View shed

Project Location Source: Kern County Assessors Office

Base Map Source: U.S. Census Bureau

B. Project Timeline

Table 8.1 Wind Project History, Tehachapi, CA

Project Name	Completion Date	Capacity (MW)	Project Name	Completion Date	Capacity (MW)
Oak Creek	2002	2.5	Coram Energy Group	1981-1995	6.8
Oak Creek-Phase 2A-Repower	1999	0.8	Cannon (various)	1981-1995	4.5
Pacific Crest-Repower	1999	45.5	Mogul Energy	1981-1995	4.0
Cameron Ridge-Repower	1999	56.0	Coram Energy Group	1981-1995	4.0
Oak Creek Phase 2-Repower	1999	23.1	Windridge	1981-1995	2.3
Victory Gardens -Repower	1999	6.7	Coram Energy Group	1981-1995	1.9
Oak Creek Phase 1-Repower	1997	4.2	Victory Gardens I & IV	1981-1995	1.0
Mojave 16, 17 & 18	1981-1995	85.0	Sky River	1993	77.0
Mojave 3, 4 & 5	1981-1995	75.0	Victory Gardens Phase IV	1990	22.0
Ridgetop Energy	1981-1995	32.6	Various Names	1982-87	64.0
Calwind Resources	1981-1995	14.1	Various Names	1982-87	24.0
Cannon	1981-1995	13.5	Various Names	1986	0.2
Calwind Resources	1981-1995	8.7	Windland (Boxcar II	Mid-1980s	14.3
AB Energy-Tehachapi	1981-1995	7.0			

C. Analysis

i. Data

Real property sales data for 1996 to 2002 was obtained from First American Real Estate Solutions in Anaheim, CA. The dataset is quite detailed and contains many property and locational attributes, among them 9-digit zip code (ZIP+4) locations. Sales data was purchased for two zip codes encompassing the wind farm area and surrounding communities. These zip codes are Mohave (93501) and Tehachapi (93561).

Sales for the following residential property types were included in the analysis: single-family residences, condominiums, apartments, duplexes, mobile homes, quadruplexes, and triplexes. Of 21 apartment sales in the database, five in the view shed had unusually high sales prices. After discussion with the local Assessor, it was determined that these did not represent single sale data points, and they were eliminated from the analysis. A total of 2,867 properties are used in the analysis.

Projects that went on-line during the study period are the Cameron Ridge, Pacific Crest, and Oak Creek Wind Power Phase II sites. All three are repowering projects, with installed capacities of 56, MW, 45 MW, and 23 MW, respectively. Cameron Ridge went on-line March 1999, and the other two came on-line June 1999.

ii. View Shed Definition

All ZIP+4 regions within 5 miles of the wind turbines define the view shed. The location of the ZIP+4 regions were derived from the latitude and longitude of the ZIP+4 areas obtained from the U.S. Census TIGER database. Because the view sheds of the individual wind farm sites overlap, and because all projects went on-line within three months of each other, a single composite view shed is defined. The view shed is approximated by two rectangles that overlap the combined area swept out by a five-mile radius from each wind farm location.

Locational data for the wind farms was obtained from utility and wind industry web sites, and used in conjunction with detailed block maps, wind farm site maps, topographic maps and interviews to identify the exact location and extent of the wind farms and the composite view shed. The final view shed dataset contains 745 sales from 1996 to 2002.

Interviews with Kern County Assessors were conducted by phone to determine what percentage of residential properties in the view shed can see all or a portion of the wind turbines. Assessor Ron Stout said 50 to 60 percent of residents within Tehachapi City could see the turbines, but the Golden Hills area was too far and had views only if one intentionally tried to see them. He said about 30 percent of residents in the northwest corner of Mojave (north of Purdy Avenue and West of the Airport) could see turbines.

iii. Comparable Selection

The comparable community was selected through extensive interviews with Assessor Ron Stout of the State of California Kern County Assessment Office and analysis of topographic and site maps. Because the U.S. Census does not provide Census data at the resolution of individual ZIP+4 regions, we were unable to use Census data as part of the comparable selection process in this case. Based on review of the Assessor interviews, the ZIP+4 regions in Golden Hills, Bear Valley Springs, Stallion Springs and the central and southeastern portions of Mohave, all within Mohave zip code 93501 and Tehachapi zip code 93561, were selected as the comparable. The final comparable dataset contained 2,122 sales from 1996 to 2002.

iv. Analytical Results and Discussion

In one of the regression models, monthly average sales prices grew faster in the view shed than in the comparable area, and in two of the regression models it did not.

In Case I, the monthly sales price change in the view shed is 28 percent less than the monthly sales price change of the comparable over the study period. The Case I model provides a good fit to the view shed data, with over 70 percent of the variance in the data explained by the linear regression. In Case II, the monthly sales price change in the view shed is 38 percent greater after the on-line date than before the on-line date. The Case II model provides a good fit to the post on-line data, with 75 percent of the variance in the data explained by the linear regression. For the pre-on-line period, the regression explains 44 percent of the variance in the data. In Case III, average view shed sales prices after the on-line date are 29 percent less than in the comparable. The Case III model provides a good fit to the data, with 75 percent of the variance in the view shed data and 95 percent of the variance in the comparable data explained by the regression. The data for the full study period is graphed in Figure 8.4, and regression results for all cases are summarized in Table 8.2 below.

D. Additional Interviewee Comments

Assessor Stout also said that Mojave has not seen any new residential development in eight years. Both Stout and Assessor James Maples said they have not seen any impact of the farms on property values. However, Maples said the area was so agricultural or lightly populated that it would be hard to isolate price changes due to the wind projects. Maples, added that over 30 years of wind project development an industrial cement manufacturer, among other projects, was built close to Tehachapi on the east. The cement plant spewed out dust for 10 years or more until county and federal government inspectors required upgrades 15 years ago, said Stout.

Tehachapi is the busiest single-tracked [locomotive] mainline in the world, according to the Tehachapi Chamber of Commerce. It runs through the Tehachapi Mountains between Mojave and Bakersfield. Of other notable businesses, Tehachapi has a manufacturing plant for GE Wind Energy (formerly Zond) wind turbines.

Table 8.2 Regression Results, Kern County, CA
Projects: 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 Comparable, all data	Jan 96 - Dec 02 Jan 96 - Dec 02	$492.38 $684.16	0.72 0.74	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.
Case 2	View shed, before View shed, after	Jan 96-Feb 99 Mar 99 - Dec 02	$568.15 $786.60	0.44 0.75	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.
Case 3	View shed, after Comparable, after	Mar 99 - Dec 02 Mar 99 - Dec 02	$786.60 $1,115.10	0.75 0.95	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.

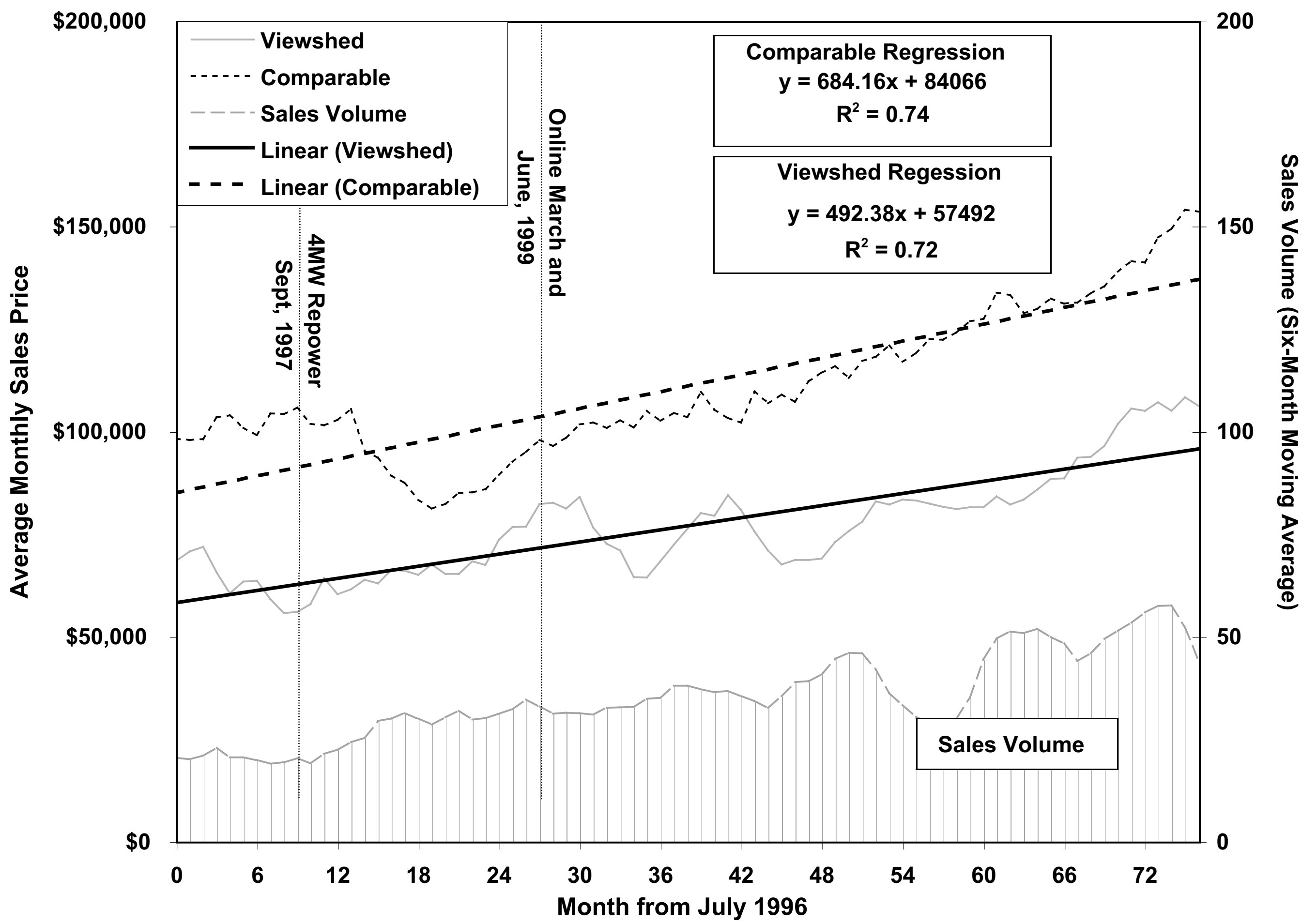

Figure 8.4 Average Residential Housing Sales Price

Kern County, California 1996-2002

Site Report 9: Fayette County, Pennsylvania

A. Project Description

Although the area is famous for being the home of Frank Lloyd Wright's Falling Water House built for a wealthy Pittsburg family, much of the area is low-income and rural. The 10 turbines rising 70 meters (230 feet) were built along a ridge on the border of Stewart and Springfield Townships, and run north/south against the county border with Somerset. The land is owned primarily by one family who rents some of the acreage to a petroleum pumping company and for the turbines.

The area is very hilly with densely populated tall trees. The project site is approximately 62 miles from Pittsburg with several ski lodges in the vicinity. The local economy is primarily agricultural or tourism related.

The view shed area of Springfield and Stewart Townships is rural with a combined population less than 2,000 although the county is classified as a "fringe county of a metro area with 1 million population or more." See Appendix 1 for a definition of rural urban continuum codes. This discrepancy is because the southeastern periphery of suburban Pittsburg creeps a little into northwest Fayette. The view shed is at least 62 miles from downtown Pittsburg.

Figure 9.1 View of a Mill Run Turbines
Photo Courtesy GE Wind Energy © 2002

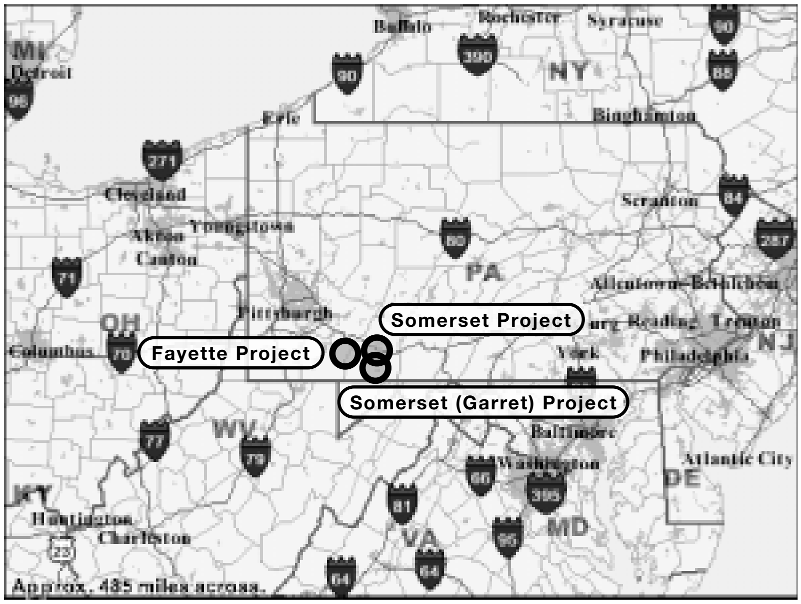

Figure 9.2. Regional Wind Project Location
(Dots approximate wind farm locations)

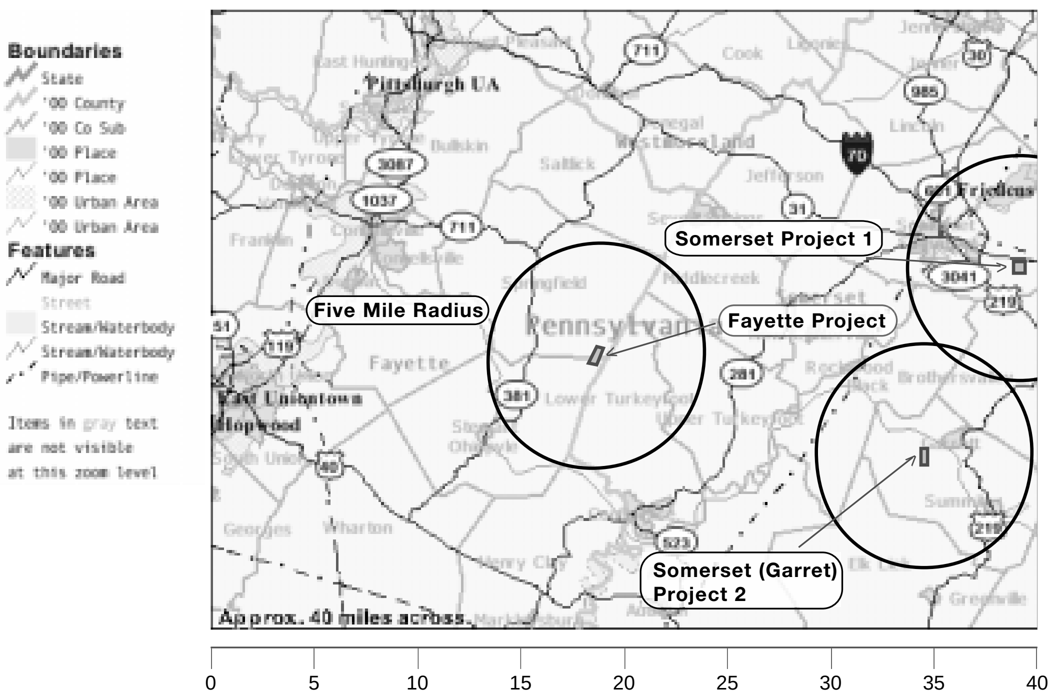

Figure 9.3. Fayette County, Pennsylvania View shed
Project Location Source: Fayette County Assessors Office
Base Map Source: U.S. Census Bureau

B. Project Timeline

Table 9.1 Wind Project History, Fayette County, PA

Project Name	Completion Date	Capacity (MW)
Mill Run Windpower LLC	2001	15.0

C. Analysis

i. Data Source

Real property sales data for 1998 to 2002 was obtained electronically from the Fayette County Assessment Office Website, www.fayetteproperty.org/assessor. The dataset contains all property sales in Stewart and Springfield Townships. The sales volume is the smallest of all sites analyzed, with only 89 sales over the five-year period studied. The wind farm went on-line October 2001, with an installed capacity of 15 MW.

Complete addresses and detailed sales data are available on the website only by clicking on each parcel individually. However, there is no parcel map of the entire township to help identify parcel locations. We combined over 50 local parcel maps into one composite parcel map for the view shed, and used this in combination with street maps to identify the view shed and non-view shed areas.

ii. View Shed Definition

The view shed is defined by a five-mile radius around the wind farm. The view shed covers the eastern portion of both Springfield and Stewart Townships in Fayette County. The five-mile radius also covers portions of Lower Turkey Foot, Upper Turkey Foot, and Middlecreek Townships in Somerset County. Because the Somerset County Townships are only partially in the view shed, and because the Somerset data we obtained is identified primarily by township or city, these areas are not included in the analysis. The view shed is therefore defined as the portions of Springfield and Stewart Townships falling within the five-mile radius. The view shed accounts for 39 sales over the study period.

Interviews with the State of Pennsylvania Fayette County Assessors Office were conducted by phone to determine what percentage of residential properties in the view shed can see all or a portion of the wind turbines. In Fayette County Chief Assessor James A. Hercik's opinion, 10 to 20 percent of residents have views of the turbines.

iii. Comparable Selection

The comparable community was selected based on the availability of parcel-level data and through interviews with Fayette County Chief Assessor James A. Hercik. Assessor James Hercik said properties to the west of the view shed had no views of the wind turbines. Upon examination of sales data availability and review of Assessor comments, the western portions of Springfield and Stewart Townships, outside the five-mile view shed radius, were selected as the comparable, with a total of 50 sales from 1997 to 2002.

Demographic data from the 1990 and 2000 U.S. Census for Springfield and Stewart Townships was gathered, but not used because both the view shed and comparable are in the same township. Tables 9.2 and 9.3 summarize the Census data reviewed.

Table 9.2 Fayette County, Pennsylvania: 1990 Census Data

Year	View shed	Location	Population	Median household income	% Population below poverty level	Number housing units	Median value-owner-occupied housing unit
1990	partial	Springfield Township	2,968	$15,686	28%	1,137	$40,200
1990	partial	Stewart Township	734	$18,235	24%	331	$42,500
VIEW SHED DEMOGRAPHICS			3,702	$16,961	26%	1,468	$41,350

Table 9.3 Fayette County, Pennsylvania: 2000 Census Data

Year	View shed	Location	Population	Median household income	% Population below poverty level	Number housing units	Median value-owner-occupied housing unit
2000	partial	Springfield Township	3,111	$29,133	22%	1,283	$57,400
2000	partial	Stewart Township	743	$32,917	11%	338	$64,000
VIEW SHED DEMOGRAPHICS			3,854	$31,025	16%	1,621	$60,700

iv. Analytic Results and Discussion

In two of the three regression models, monthly average sales prices grew faster or declined slower in the view shed than in the comparable area. However, in the case of the underperformance of the view shed, the explanatory power of the model is very poor. Thus, there is no significant evidence in these cases that the presence of the wind farms had a negative effect on residential property values.

In Case I, the monthly sales price increase in the view shed is only 24 percent that of the comparable over the study period. However, the Case I model provides a poor fit to the view shed data, with only two percent of the variance in the data for the view shed and 24 percent of the variance in the data for the comparable explained by the linear regression. In Case II, sales prices decreased in the view shed prior to the on-line date, and increased after the on-line date. The average view shed sales price after the on-line date increased at 3.8 times the rate of decrease in the view shed before the on-line date. The Case II model provides a poor fit to the data, with less than one-third of the variance in the data explained by the linear regression. In Case III, average view shed sales prices after the on-line date are 13.5 times greater than in the comparable. However, the Case III model describes only 32 percent of the variance in the view shed data, and none of the variance in the comparable data. The data for the full study period is graphed in Figure 9.4, and regression results for all cases are summarized in Table 9.4 below.

The poor fit of the model, as evidenced by the low R2 values, is partly due to the very small sales volume, on average only 2.1 sales per month in the view shed and comparable combined. As can be seen from Figure 9.4, the small sales volume leads to very high variability in average sale price from month to month. In addition, for regressions fit to data after the on-line date, only 13 months' sales data was available, accounting for 18 sales total, which leads to the caveat that these results should be viewed carefully.

Table 9.4 Fayette County, Pennsylvania: Regression Results
Project: Mill Run

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

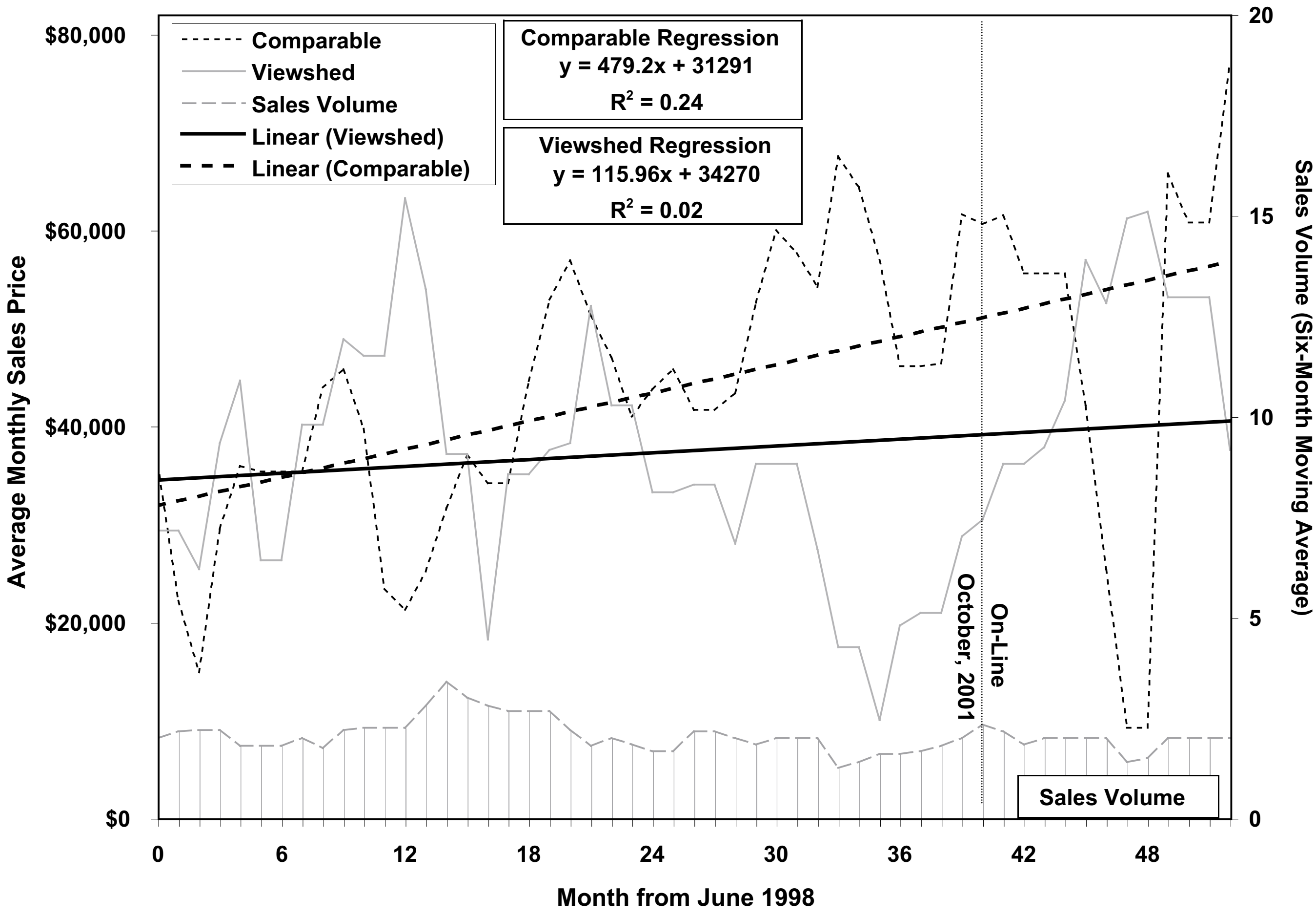

Figure 9.4 Average Residential Housing Sales Price
Fayette County, Pennsylvania 1998-2002

D. Additional Assessor Comments

James A. Hercik, Fayette County chief assessor/director of assessments, said he has not seen any impact of the wind farms on property values, with the exception that the assessed value of properties with turbines went up. He also noted that on the same property as the turbines are on, there are natural gas wells, which additionally impact valuations. Finally, Hercik said that often, sales in the view shed were family-to-family sales that may reflect sales prices lower than assessed value.

Site Report:
Projects Excluded From Analyses

Of the 27 projects selected for analysis, four were excluded from analysis because there were not enough sales in the view shed for statistical analysis; one was excluded because comparable data was not available at time of publication of this report; and an additional 12 projects were excluded because property sales data was unavailable, not readily available, or because there were not enough sales in the view shed for statistical analysis. Table S1 below summarizes the reasons for project exclusion from analysis.

Table S1: Summary of Projects Excluded from Analyses

I. Data acquired, but insufficient for analysis

County	State	Reason for Exclusion
Logan	CO	Not enough sales to make a valid judgment (5 Sales)
Worth	IA	Not enough sales to make a valid judgment (38 sales over 7 years)
Umatilla	OR	Not enough sales to make a valid judgment (28 sales)
Howard	TX	Comparable data not acquired at time of publication (1,896 view shed sales)
Upton	TX	Not enough sales to make a valid judgment (7 sales)

II. Data not acquired

County	State	Reason for Exclusion
Weld	CO	Not enough sales to make a valid judgment
Cerro Gordo	IA	No electronic data - accessible in office on paper only
Gray	KS	State law prohibits access to information
Pipestone	MN	No electronic data - accessible in office on paper only - and not enough sales
Lincoln	MN	No electronic data - accessible in office on paper only
Gilliam	OR	No electronic data - accessible in office on paper only
Culberson	TX	No electronic data - accessible in office on paper only
Pecos	TX	No electronic data - accessible in office on paper only - and no sales in view shed
Taylor	TX	No electronic data - accessible in office on paper only
Benton	WA	Not enough sales to make a valid judgment (Project came on-line in 2002)
Walla Walla	WA	No sales in the view shed since project completion
Iowa	WI	No electronic data - accessible in office on paper only
Carbon	WY	State law prohibits access to information

I. Data Acquired, but Insufficient for Analysis

County State Reason for Exclusion

Logan CO Not enough sales to make a valid judgment (Five Sales)

Years Reviewed: 1996 to 2002

Assessor comments: Assessor Ann Rogers-Ridnour said her office has seen no impact from the wind project, and that it was hard gauge because there are so few sales.

Worth IA Not enough sales to make a valid judgment (38 sales over seven years)

Years Reviewed: 1996 to 2002

Assessor comments: Assessor said the project was surrounded only by agricultural land, that it was hard to pinpoint home locations on farms if any because addresses are vague, and that they felt the wind projects have been welcomed.

Umatilla OR Not enough sales to make a valid judgment (28 sales)

Years Reviewed: 1995 to 2002

Assessor comments: Assessor Lee Butler said there were only 28 sales in view shed.

Howard TX Comparable not available at time of publication

Years Reviewed: 1996 to 2002

The exact location of the Big Spring wind farm in Howard County, TX, and thus definition of the view shed, was elusive. While site maps with individual turbine locations were obtained, they were hand drawn and not to scale. Interviews with county Assessors and on-site operations staff yielded conflicting descriptions of the exact location of the turbines. In the end, the wind farm location was fixed in an interview with one of the original site developers, Mark Haller of Zilkha Inc. According to Mr. Haller, the turbine towers reach out far away from the Big Spring, but the closest one is only 100 yards or so from the third tee of a golf course on the south side of town – close enough for golfers often take chip shots at it.

The view shed covers portions, but not all of, the three school districts in the county: Coahoma, Big Spring, and Forsan. Approximately 70 percent of Big Spring City, all of Coahoma City, and none of Forsan City are within the view shed. Because this project lacks the resources to identify every property by street address, the view shed is defined to include all of Big Spring City, which is equivalent to using a six-mile radius view shed instead of a five-mile radius view shed for this case only. The final view shed dataset contains 1,896 sales from 1996 to 2002.

Interviews with Howard County Assessors were conducted by phone to determine what percentage of residential properties in the view shed can see all or a portion of the wind turbines. In Chief Assessor Keith Toomire's opinion, 30 percent of Big Spring City properties can see the turbines. Mr. Haller added that due to the various plateaus surrounding Big Spring, there are portions of the town that cannot see the turbines.

The selection of an appropriate comparable for Big Spring is difficult because the area has experienced an economic downturn and loss of jobs for a number of years. According to Howard County Chief Assessor Keith Toomire, the two major employment categories in the Big Spring are agriculture and petroleum extraction. Due to a 10-year draught in the region, crop yields are severely reduced, with significant economic impacts for the city. Additionally, depletion of petroleum resources has led to the closing of wells and economic downturn in the local petroleum industry.

Because the view shed for Big Spring was defined very late in the process of producing this report, data for a comparable has not yet been obtained.

Upton TX Not enough sales to make a valid judgment (Seven sales)

Years Reviewed: 1996 to 2002

Assessor comments: Chief Appraiser Shari Stevens said no sales near southwest Mesa, and only seven sales near the King Mountain project.

II. Data Not Acquired

County State Reason for Exclusion

Weld CO Not enough sales to make a valid judgment

Years Reviewed: 1996 to 2002

Assessor comments: Office staff said there were very few people in the project area and didn't think anybody could see it.

Cerro Gordo IA No electronic data - accessible in office on paper only

Years Reviewed: 1996 to 2002

Assessor comments: Assessor said we were the third group to call them about the same question and that they've looked into every way they could to parse their data, and could find no proof that there was any impact on county property values.

Gray KS State law prohibits access to information

Years Reviewed: 1996 to 2002

Assessor comments: Assessor Jerry Dewey said area had only small populations and that most land was agricultural; therefore he said they have seen no impact, primarily because the land is assessed for productive use.

Pipestone MN No electronic data - accessible in office on paper only – and not enough sales

Years Reviewed: 1991 to 2002

Assessor comments: Interim Assessor "Farley" said he's not seen any impact on property values. Also, he added that there haven't been enough sales to make a judgment call, and all property surrounding the project is agricultural land which is valued on productive use (so unless the turbines were on the property itself, then the property value would not go up).

Lincoln MN No electronic data - accessible in office on paper only

Years Reviewed: 1991 to 2002

Assessor comments: Assessor "Bruce" (last name unavailable) said the project was a "non-issue" and has not seen any impact on values. Specifically, the projects were welcomed and some people tried to have the turbines built on their land.

Gilliam OR No electronic data - accessible in office on paper only

Years Reviewed: 1997 to 2002

Assessor comments: Assessor Pat Shaw said area around project had a population less than 700 all living dispersed among agricultural land. Also, he expressed no sense of impact on property values

Culberson TX No electronic data - accessible in office on paper only

Years Reviewed: 1992 to 2002

Assessor comments: Appraiser Sally Carrasco said they've been very happy with the wind farms. She added that because they have a terrible economy, she wasn't sure if they would even have a town were it not for the revenue from turbines that support the schools.

Pecos TX No electronic data - accessible in office on paper only – and no sales in view shed

Years Reviewed: 1997 to 2002

Assessor comments: Assessor Santa S. Acosta said there were no residences with a view, and that there are so few sales in general that the area wasn't due for re-appraisal until 2003.

Taylor TX No electronic data - accessible in office on paper only

Years Reviewed: 1997 to 2002

Assessor comments: Assessor Ralf Anders said no homes had a view.

Benton WA Not enough sales to make a valid judgment

(Project came on-line in 2002)

Years Reviewed: 1996 to 2002

Assessor comments: Office clerk "Harriet" said they only have the past three months of data in electronic form; everything else is in paper and a person must go to office to search records.

Walla Walla WA No sales in the view shed since project completion

Years Reviewed: 1996 to 2002

Assessor comments: Walla-Walla County Assessor Larry Shelley said there have been no sales since the wind project was built.

Iowa WI No electronic data - accessible in office on paper only

Years Reviewed: 1996 to 2002

Assessor comments: Assessor said only small village areas had views, but that the wind projects were welcomed. –Assessor specifically made a comment that a bowling alley has built a small tourist attraction around the project.

Carbon WY State law prohibits access to information

Years Reviewed: 1996 to 2002

Assessor comments: Assessor Darrell Stubbs said that although it is illegal to release individual property information, he has seen no impact on values. Specifically, he noted if any impact occurred, property values have risen because the population is so small that the infusion of a few jobs from the project in the area is enough to raise prices.

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Appendix 1. County Classification Descriptions

U.S. Department of Agriculture, Economic Research Service Rural-Urban Continuum Codes

Metro counties:	
0	Central counties of metro areas of 1 million population or more.
1	Fringe counties of metro areas of 1 million population or more.
2	Counties in metro areas of 250,000 to 1 million population.
3	Counties in metro areas of fewer than 250,000 population.
Nonmetro counties:	
4	Urban population of 20,000 or more, adjacent to a metro area.
5	Urban population of 20,000 or more, not adjacent to a metro area.
6	Urban population of 2,500 to 19,999, adjacent to a metro area.
7	Urban population of 2,500 to 19,999, not adjacent to a metro area.
8	Completely rural or less than 2,500 urban population, adjacent to a metro area.
9	Completely rural or less than 2,500 urban population, not adjacent to a metro area.

Note: New Rural-Urban Continuum Codes based on the 2000 Census are not expected to be available until 2003. The development of the updated codes requires journey-to-work commuting data from the long form of the 2000 Census and delineation of the new metropolitan area boundaries by the Office of Management and Budget. OMB's work is not scheduled to be completed until 2003. www.ers.usda.gov/briefing/rurality/RuralUrbCon/

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Impact of wind farms on the value of residential property and agricultural land

An RICS survey

Background

In the past century, the global average temperature has increased by approximately 0.6 ^{o}C while sea levels have risen by 10 – 20 cm. Climate change, as described by the UK's Prime Minister, is "the most important environmental issue facing the world today". There is a broad scientific consensus that the acceleration in the rate of climate change is due largely to the emission of greenhouse gases such as carbon dioxide (CO_2) and methane.

The UK government has ratified the Kyoto Protocol and is committed to reducing carbon dioxide emissions by 20% by 2020. To achieve this target, the UK government published the Energy White Paper[i] in February 2003 and recommended that 20% of the UK's electricity should be generated by renewable energy by 2020. To pave the way for this the Government updated planning advice (Planning Policy Statement 22) on renewable energy earlier this year. One of the major components of its strategy is an increase in wind-generated energy.

As the windiest country in Europe the UK is uniquely well placed to exploit this form of renewable energy. According to the British Wind Energy Association (BWEA), there are currently 90 wind farm projects in operation in the UK, adding up to a total of 1125 turbines and supplying enough energy for 440,000 homes. 15 projects are due to come online in 2004, adding a further 222 turbines. By 2005, it is predicted that the total installed wind energy generators will be enough to meet 1.3% of total supply (i.e. just under 1 million homes).

Whilst wind farm technologies offer many advantages, questions are being asked about the potential impact of this expansion on property values, particularly in the residential sphere. In order to examine whether there is any substance in these concerns, and to monitor the effects on land and residential property affected by wind farm developments, RICS (The

Royal Institution of Chartered Surveyors) has carried out an initial study to examine the impact of wind farm development. The purpose of the study is not to endorse or criticise wind technology, but rather to gauge professional property opinion about its impact on both residential property and agricultural land values.

Executive Summary

- 60% of the sample suggested that wind farms decrease the value of residential properties where the development is within view

- 67% of the sample indicated that the negative impact on property prices starts when a planning application to erect a wind farm is made

- The main factors cited for the negative impact on property values are:
  - visual impact of wind farm after completion
  - fear of blight
  - the proximity of a property to a wind farm

- Once a wind farm is completed, the negative impact on property values continues but becomes less severe after two years or so after completion

- A significant minority of surveyors with experience of residential sales affected by wind farm developments (40%) indicated that there is no negative price impact

- Only 28% suggested wind farm development negatively influences the value of agricultural land, while 63% suggested there is no impact at all (either positive or negative). The remaining 9% suggest a positive impact

- The survey suggests that wind farms do not impact on residential property values in a uniform way. The circumstances of each development can be different

- This report points to a need for further research to track the impact of wind farms and to examine in particular whether the nature of any adverse impact diminishes as wind farms become an increasingly familiar part of the rural scene.

Research methods

RICS conducted an initial questionnaire-based survey among its members at the beginning of September 2004. At the time of sampling for the survey, there were no onshore wind farm developments in the South East region connected to the national grid. This region was therefore excluded from the study. A total of 1,942 questionnaires were sent out and 405 responses received. Approximately a fifth of those persons responding say they have dealt with residential transactions affected by wind farm developments.

The study focused on those responses from surveyors with experiences of transactions affected by wind farms, analysing the data at both national and regional levels (i.e. five regions: Scotland, Wales, Midlands & Eastern Regions, Northern England and South West)[ii]. RICS conducted a follow-up survey with this specific group of respondents in October 2004 on the reasons behind any price impact. The response rate for the follow-up survey was 34% and therefore only national results are provided for this part of the survey.

Survey results

Experience of Chartered Surveyors in transactions affected by wind farms

Only 20% of the surveyors who responded to this survey have dealt with transactions affected by wind farms and their experiences vary.

In interpreting the results of the survey no attempt has been made to make a quantitative assessment of the impact of wind farm developments on the residential property market. The sample size of responses at a regional level is low and the distribution of responses by region in the main reflects the concentration of wind farms in particular locations around the country.

The largest responses were received from Scotland and Wales (representing 25% and 20% of the sample that have dealt with wind farm affected transactions respectively). Information obtained from the BWEA website (www.bwea.org) indicates that Scotland and Wales account for 43% of all wind farm projects in the UK. We have used information from the BWEA regarding the regional distribution of wind farms to derive weightings for the national results.

Impact of wind farms on the value of residential property and agricultural land

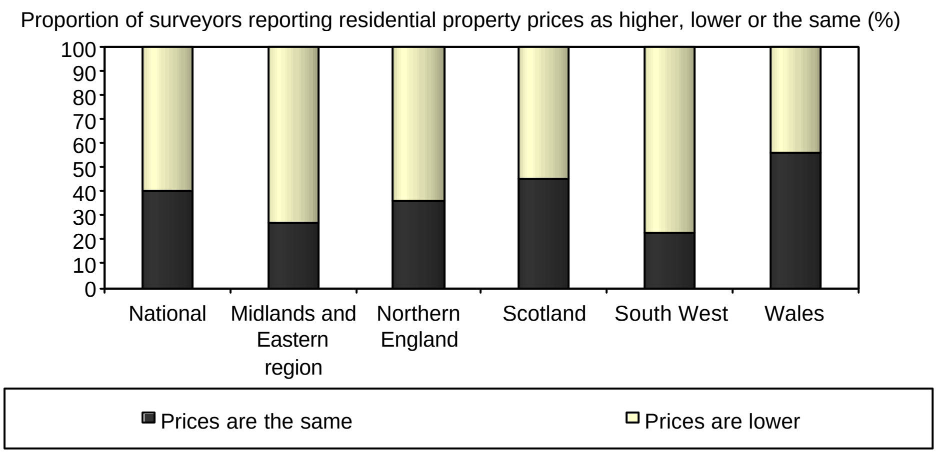
Actual effect

The findings suggest three effects of wind farms on the value of residential property and agricultural land:

- there are negative influences on the value of residential properties, though a sizeable minority report no impact on prices
- the influence is much less on agricultural land values, to the point that the majority of responses suggested the impact was nil
- nowhere is it considered that wind farms positively affect residential property values, although there was evidence of some positive impact on agricultural land

More than half (60%) of those surveyors involved in residential property transactions affected by a wind farm development (i.e where a wind farm is visible from the property), reported that values were lower than for comparable properties which were unaffected (Figure 1). However, this still leaves a sizeable minority of 40% of surveyors reporting no impact from wind farm developments on values.

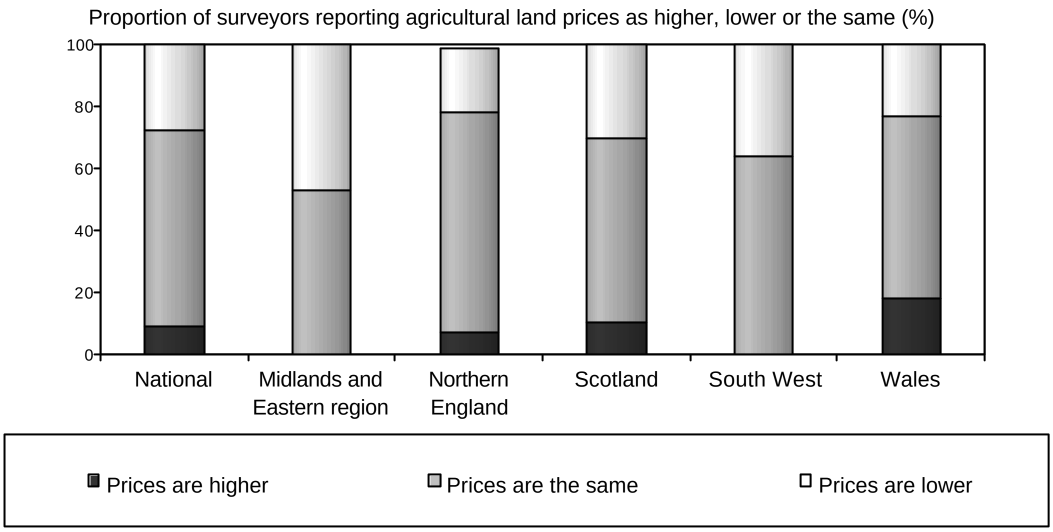
Figure 1 : Impact of wind farms on residential property values relative to comparable properties which are not affected



The regional results vary from 44% of surveyors in Wales reporting that residential property values are lower as a result of wind farm developments to a high of 77% in the South West.

Separately, we asked surveyors what impact wind farm developments had on agricultural land values. Of the sample, 28% indicated that wind farms have a negative impact on the value of agricultural land, whilst a majority (63%) suggest there is no impact. A small proportion, (9%) indicated that wind farms enhanced agricultural land values (Figure 2).

Figure 2 : Impact of wind farms on agricultural land values relative to comparable land which is not affected

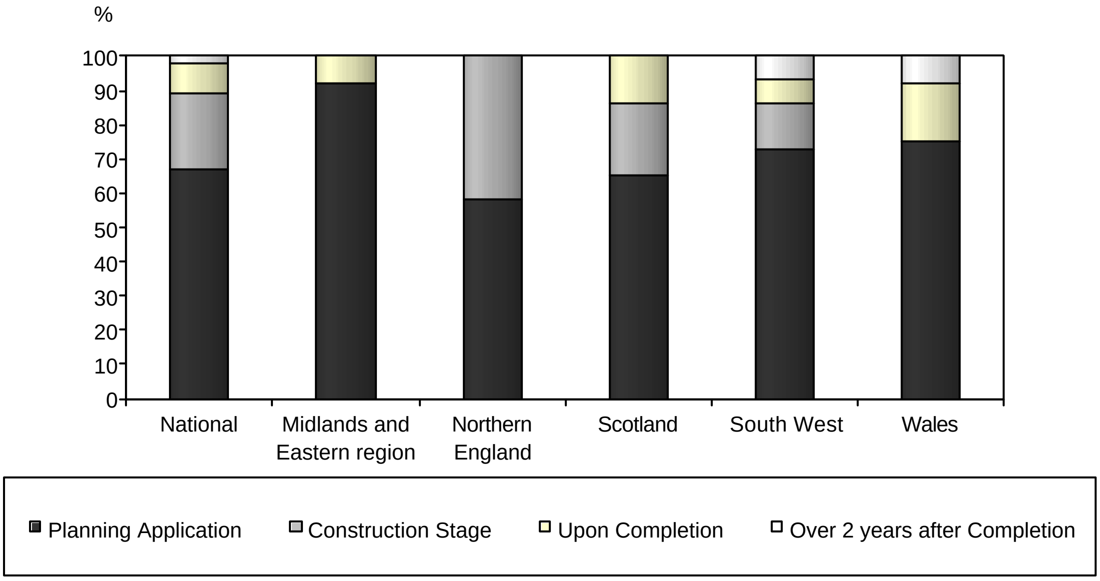


At what stage do wind farm developments start to impact on property values

For those surveyors who believe that residential property values are lower as a result of wind farm developments, a majority (67%) believe that there is an impact on values as early as the planning application stage. A further 22% report that the impact is first evident at the construction phase of development (Figure 3).

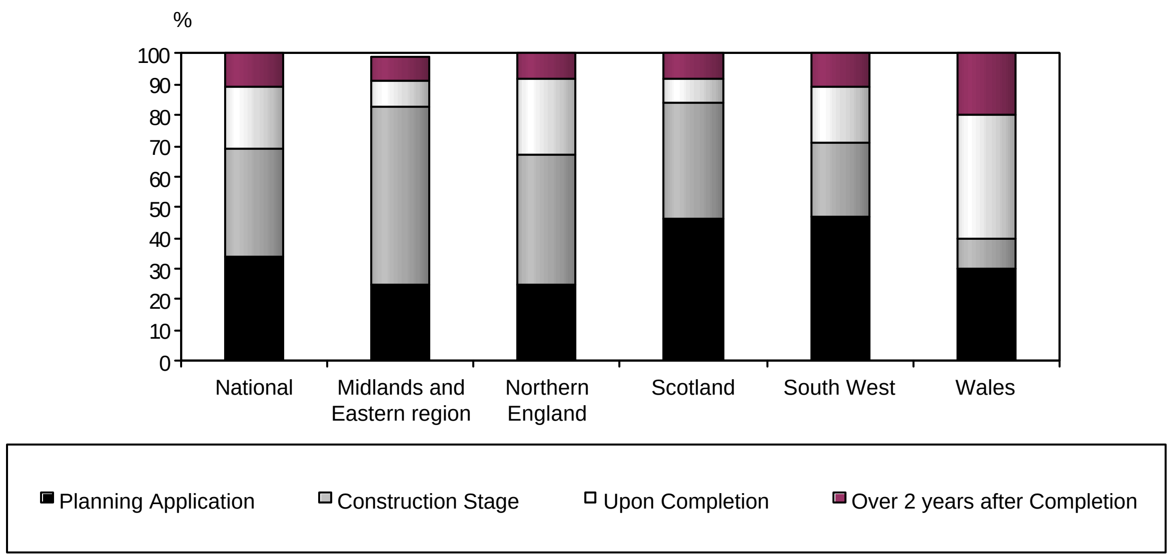
The results suggest that buyers are wary of potential developments at a very early stage in anticipation of a negative impact because of uncertainty over the size and location of a proposed wind farm.

Figure 3 : At what stage do wind farm developments start to negatively influence the value of residential property relative to unaffected comparable properties



The survey also asked at what point in time the negative impact of wind farm developments on residential property values is the greatest. Whilst the results highlight significant variations between the regions, from a national perspective the greatest impact comes at the planning application and construction stages (Figure 4). The results imply that the discount in property values (relative to comparable properties which are unaffected) reduces over time as buyers become aware of the specific characteristics of a development.

Figure 4 : At what stage do wind farm developments have their greatest influence on the value of residential property compared to property which is not affected



Reasons for the impact of wind farms on the value of residential property values

A follow-up survey asked surveyors who reported that wind farm developments had a negative impact on property values, to assign a degree of importance to various factors which may explain the existence of a price discount (Figure 5). Some of these factors may not be mutually exclusive but provide a guide to issues which may be impacting upon the market.

The most important reason for a negative impact of wind farms on the value of residential property is the visual impact after completion, closely followed by the fear of blight. The proximity of a property to a wind farm is also deemed fairly significant. The size of a wind farm is viewed as less important than the above issues, though its impact is likely to depend upon the distance from the development.

Figure 5: Reasons for negative impact on residential property values from a wind farm development

	Scale of 1-5 of importance; 1 = least important, 5 = most important					
% response for each issue	**1**	**2**	**3**	**4**	**5**	**Don't know**
Fear of blight	11	0	17	11	56	6
Construction disturbance	22	17	22	28	6	6
Visual impact after completion	11	0	11	21	58	0
Size of wind farm	6	18	35	6	35	0
Proximity to wind farm	11	22	6	11	50	0
Other environmental damage	25	31	19	6	6	13
Health risk	36	21	7	21	0	14

NB: figures may not sum up to 100% due to rounding errors for each issue

Conclusion

- The wind farm industry is still relatively new compared to other renewable energy industries. The number of surveyors who deal with property affected by wind farms will always be relatively low
- Among those respondents with experience in dealing with residential property transactions affected by wind farms, the survey results suggest that wind farm development reduces property values to some extent and that this impact starts at the planning application stage
- The three main reasons for this negative impact on property values are the visual impact after completion, the fear of blight and the proximity of residential property to a wind farm development
- A significant minority of surveyors (40%) reported no impact from wind farm developments on residential property values
- The negative impact of wind farms on property values appears to decline over time. This may suggest that the impact lessens as wind farms become a more established part of the rural landscape
- There is a need for more work to provide a better understanding of the way in which wind farms impact on property, thereby enabling strategies to be developed to minimise any deleterious effects

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[i] DTI (2003) Our Energy Future – Creating A Low Carbon Economy. Energy White Paper, www.dti.gov.uk/energy/whitepaper

[ii] Surveyors in Northern Ireland were included in the questionnaire survey, but due to the low response rate, the analysis did not cover Northern Ireland.

6. Property Values

The European Commission has conducted a research project investigating the externalities of renewable energy production. Their study on wind energy stated that the hedonic price method could be used to quantify the impact of noise from wind farms upon housing prices. However as there have been no previous studies on the impact of noise upon property values in Australia this method can not be used and instead examples of other wind farms are used.

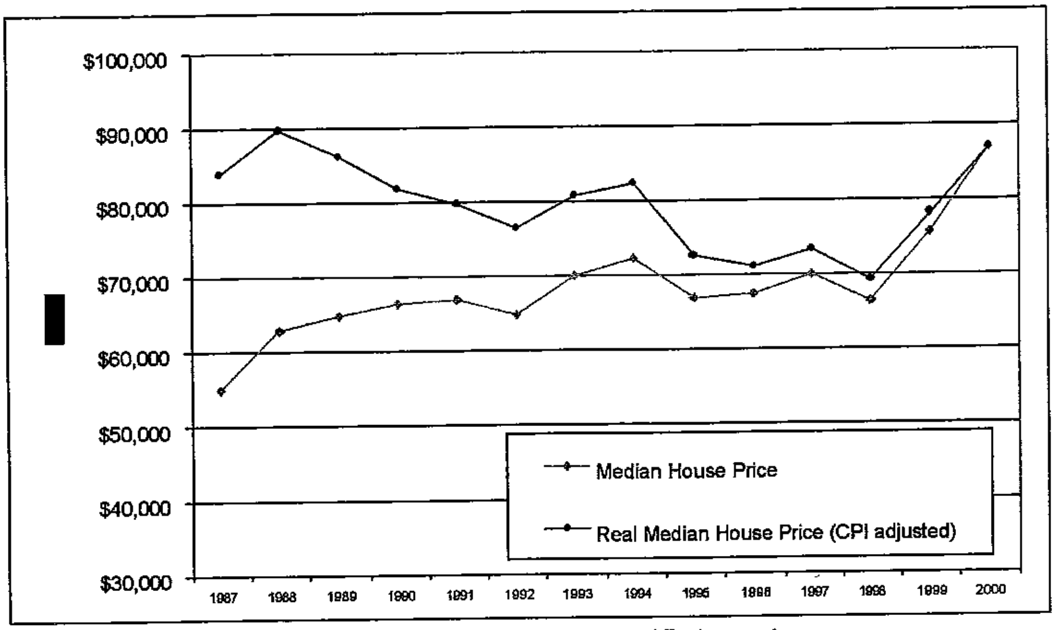
As with many impacts from wind generators there are examples of both positive and negative impacts. There is a general conception that wind farms decrease property values of surrounding land. This is of course supplemented by the increase in property values of the land that the generators are actually located on. Within the US there are a number of 'shires' that have targeted the placement of wind farms so that ranchers who own marginal agricultural land have their income supplemented by an annual 'wind farm usage' payment. This means that properties that have wind generators on them will receive an annual payment and this may increase property value of those properties.

Especially within populated areas there is a perception of decreasing property values around wind farms. The Milwaukee Journal Sentinel (October 15, 1999) stated that 'opponents to the wind farm, state that rising towers over 300 feet and associated noise could hurt property values'. Energy Online Daily News (30 May 2001) states that the Royal Institute of British Architects has proposed placing two wind generators on top of their building in the London Borough of Westminster. It is said that the heritage-listed building will experience a decrease in value, as with surrounding properties due to the ability to see the wind generators from the ground. These statements highlight the perceptions of both the noise and visual amenity and their impact upon property values.

In Australia there is little released data on the impact of wind farms on property prices. In Esperance there are two farms, Ten Mile Lagoon which is surrounded by a nature reserve, and the Salmon Beach site which is extremely close (<200m) to highly sought after residential properties. The general consensus among local real estate agents was that property prices next to generators have stayed the same or increased after installation.

The Glenelg Shire has had a significant nominal movement in property prices between 1987 and 2000, however overall there has been little real change (as shown by CPI adjusted values) revealed in Figure 6-1. The CPI adjusted figures have used 2000 as the base year. In general the Shire's property prices were decreasing from 1988 until 1998. In 1998 for a variety of reasons, signalling significant economic development of the region - including; the expansion of government departments within the shire and the Codrington Wind Farm within Moyne - there was an increased demand for houses and hence an increase in property prices in the region.

- **Figure 6-1 Glenelg Shire Housing Prices, 1987-2000**



Source: Valuer General of Victoria, Department of Natural Resources and Environment.

Portland has experienced a similar trend with the median house price presently some $85,000 to $90,000, which is a 10% increase from 18 months to two years ago (mid 1999). This increase is mainly due to the GST and the Federal Governments $7,000 First Home Buyers Grant. These estimates are for houses that are within Portland, land and house prices on Cape Nelson have not changed, mainly because they are still agricultural and are not subdivided for development.

Land prices on Cape Bridgewater have increased in the last five years by two to three-fold; in 1998 a land block was about $45-65,000 and now they are selling for about $120-150,000. This trend is based upon the increased interest by buyers to own property with sea views and, with the property market at Port Fairy and other coastal places already too high for many buyers, these buyers are moving further east and west from Melbourne.

In general real estate agents and those that work within the property market, feel that the wind farms will have little impact upon house prices in both the Cape Nelson and Portland areas. It is recognised that houses east of Portland already have a view of the Codrington Wind farm and there seems to have been no impact upon prices (though it is too early to tell). The majority of houses on Cape Bridgewater look North and North-east- meaning that the closest wind generators will be to the back of the house whilst they have a view of the generators on the horizon at Cape Nelson. It is estimated that there may be a slight negative impact upon house prices in Cape Bridgewater and on the cape, due to a perceived change in ambience of the area. This should be placed in the context of other wind farms, such as Salmon Beach in WA, which initially had a stable land price and then normal growth was experienced.

It is estimated that a wind generator manufacturing industry in Portland could lead to an increase in the demand for houses.

New employees who receive a higher income, or have been unemployed or receive more regular employment, could be induced to purchase a house, or upgrade their house, increasing the demand for housing and building services. Some employment is likely to be taken up by people moving into town, again potentially increasing the demand for housing.

Due to the present housing market being stable without excessive growth an influx of workers could create a demand on the present housing market. If so, the market could respond by both increasing in price, as happened when the Portland Aluminium Smelter was built, and by increasing the amount of house construction.

In conclusion we can estimate that there are two types of property price impacts. The properties that have the generators actually located on them *will* increase in value. Other properties *may* be adversely affected if they are within either sight or audible distance of the generators. While there has been no conclusive study to show that property prices decrease or increase in value, the available evidence suggests that any reduction in the growth or even a fall in property prices should be temporary.

The discussion above suggests that there could be some differentiated changes in value, with house prices in Portland rising to reflect the increased demand, while house prices at Cape Bridgewater and those that adjoin wind farm sites could fall, particularly in the short term while the details of the wind farm are being determined.

7. Mitigation (Development) Strategies

Property

Property values in Portland are expected to increase with the establishment of a manufacturing base. This will require little management from Pacific Hydro.

Property values in Cape Nelson are not expected to be affected, - mainly due to the type of properties that are on the Cape, ie. agricultural. There are a few tourist ventures that may experience a decrease in tourist numbers and hence a potential decrease in property values in the short term.

Cape Bridgewater is expecting to have stable property values and then continue to rise, though at a lower rate than was previously witnessed. There are some tourist operators that believe their livelihood will be negatively impacted by the wind generators and have stated that they will be seeking compensation if the wind farm is to proceed.

The development of an interpretive centre, particularly with an associated wind generator viewing platform, together with input from Pacific Hydro in upgrading the GSWW as discussed below, should mitigate any adverse impact on the local operators.

Manufacturing

The key issue related to manufacturing is securing the maximum scale of industry that the region can sustain. The development of strategies that ensure there is sufficient capacity, on-going skills and capability to build towers and as much of the nacelle assembly as possible, is important to the region's development.

From a regional point of view, the local manufacture of blades is also important. This would enable Portland to move into a new technology area as well as extending its existing capability in metal fabrication and machinery and equipment assembly. At this stage, development of this side of the industry seems less likely. As such, there could be merit in local industry, the community and the Shire Council combining to develop a strategy to attract this activity including ensuring appropriate skills are available, training in place and there is access to appropriate land, facilities and, if necessary, incentives.

The region has the potential to develop a capability in site construction; tower erection and on-going maintenance based on the scale of the PWEP. These skills could be marketed to projects in other areas of Australia and overseas. Again a strategy could be developed to encourage appropriate local organisations to develop the relevant skills and services.

Tourism

There are a variety of mitigation strategies that can be suggested if the wind farms were to be implemented. These suggestions are a conglomeration of the previous analysis and they highlight the issues raised by Tourism Victoria and Western Power with their dealings with the issue of the Bibbulmun Track. The mitigation strategies include;

- Inclusion of an interpretive centre as proposed by Pacific Hydro, which allows tourists to experience the wind generators in action. The centre would need to:
  - Be integrated within the present regional tourist strategies
  - Include a range of interpretation, focusing upon 'green energy sources', with interpretation of other site features, such as the volcanic origins, Aboriginal heritage and seal colony
  - Be run by green energy sources
  - Include a Restaurant or café area
  - Perhaps provide guided tours and walks
  - Be supported by the local tourism organisations
- Pacific Hydro could discuss means of supporting the Friends of the GSWW with:
  - Track maintenance
  - Viewing platforms
  - Promotion facilitation
  - Rework business and marketing plan
  - Provide interpretation to guides on wind farms to be included within the GSWW experience
- Pacific Hydro could support the existing tourist market by:
  - Increasing promotion of the area in conjunction with Portland Tourist Association
  - Providing education information for schools and users in the region on wind power
  - Providing facilities (toilets, etc.)
  - Increasing the interpretation and facilities of the walk to the seals
  - Collecting information on tourists for better local targeting of promotion material
  - Ensuring the safety of all people

It should be noted, as discussed earlier, that Pacific Hydro has agreed to provide up to $200,000 per annum in matching funds with the Portland Tourism Association for five years. These funds would enable mitigation initiatives, as discussed above, to be implemented.

8. Summary of Findings and Conclusions

Overall, the development of the project should lead to significant economic and employment benefits to the region. Based on the information provided by the pre-tenderers for the project there is scope to attract between $44m and $92m in new income to the region for manufacturing activities. The development of a regional strategy to attract a higher proportion of the manufacturing to the region could increase expenditure even further.

This expenditure could generate between 300 and 800 new jobs into the region.

Development of a domestic manufacturing capacity reduces the need to import wind energy plant and equipment. This provides scope for some $180 million per annum in import substitution for Victoria over a five year development contract proposed by Pacific Hydro.

Establishment of a strong capability in the region based on the current PWEP should lead to on-going manufacturing activity from other projects, both in Australia and overseas. Jobs in the tourism sector could increase by between 30 and 80 jobs over the first 5 years of the project.

The region also has the opportunity to develop an expertise in construction and maintenance of wind farms that could be 'exported' to other projects in Australia and overseas. In this case, Portland could become the 'home base' for companies supplying specialist construction, commissioning, operating and maintaining wind farms.

In addition to the creation of jobs in the region, there is also scope to generate up to a further 1,300 to 1,700 new jobs in other parts of Victoria.

In general the report concludes that:

- there is significant potential to develop a wind energy manufacturing sector in the Portland region and more generally in Victoria including opportunities to supply wind generator units across coastal Australia and throughout the Pacific Rim;

- the development of a wind energy manufacturing sector will provide a significant opportunity for import substitution;

- Victoria and Australia as a whole have a relatively short window of opportunity to develop the sector. The scale of the Portland Power Energy Project provides a catalyst for this development including the opportunity to develop a significant part of the industry in Portland and the South and Western parts of Victoria;

- the net impact of the proposed wind generators and information centre is likely to be positive in terms of tourist numbers and expenditure. The development may cause a few eco-tourists (that is, people whose sole motivation is to experience the undisturbed natural landscapes), not to visit. However, the combination of renewable energy and 'natural', albeit significantly modified, areas is more likely to appeal to the market segment that currently seek a 'nature based' experience along the Great Ocean Road;

- the wind farm development is unlikely to impact adversely on the traditional family market who visit the region for a more traditional beach holiday. Many of these currently stay closer to Portland and have accepted the Alcoa Smelter and Port setting over many years. On the evidence from other wind energy developments, the Portland project is more likely to provide an additional attraction for this market segment;

- the PWEP is likely to increase business and conference market visitors improving accommodation statistics for the hotel/motel market and potentially providing a stimulus for the restaurant sector and café sector;

- the proposed development of an interpretive centre if combined with a viewing area enabling visitors to experience an operating wind generator from close range could become an important new attraction for the region. Furthermore the interpretive centre could be used to identify the Portland region with renewable energy and sustainable development;

- the net impact of the project is likely to be negligible upon property prices within the Shire as a whole. The prices within Portland are likely to increase with the new demand from workers moving into the region. Property prices on houses on the Cape that adjoin the wind farm sites and those within Cape Bridgewater may be slightly negatively impacted in the medium to longer term, though this is expected to be small.

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Appendix A Contact list

Name	Affiliation
Phil Arnold	Sea View B&B
Lyn Murrell	Murrell's B&B
Alan Smith	Bridgewater Camp
Cathy Ezad	B&B associated with Bridgewater Camp
John McNeal	Cape Nelson Lighthouse B&B
Leon Frankcom	Nelson Berry
Terese Dolman	The Studio (Holiday house)
Marilyn Williamson	True Wallace Springs Farm (Holiday house)
Paul Jensen	Holiday house
Phillip Oakley	B&B
Paul Albone	Tourism Victoria, Industry Development
Bill Fox	Tourism Victoria, Manager Regional Marketing
Melissa Rogers	Tourism Victoria
Roger Grant	Geelong Otway Tourism and the Great Ocean Road Marketing
Kerry Jennings	Glenelg Shire Tourism Officer
Philip Kelly	Portland Progress Association
Robert Hunt	Portland Tourism Association

Plate 6.1a: View of the wind farm from SwatchfieldRoad.

Plate 6.1b: Close up view of the wind farm from Swatchfield Road.

Plate 6.2: View of the wind farm from Campbells River Road.

Plate 6.3: View towards the wind farm from the intersection of Campbells River Road and Swatchfield Road.

Plate 6.4: View towards the wind farm from the Abercrombie Road and Campbells River Road, Black Springs.

Plate 6.5: View looking west towards the wind farm from Abercrombie Road.

Plate 6.6: View looking west towards the wind farm from Abercrombie Road.

Plate 6.7: View looking south west towards the wind farm from Dog Rocks Road, Black Springs Village.

Plate 6.8: View looking south towards the wind farm from Dogs Rocks Road.

Plate 6.9a: View looking east towards the wind farm from a track entrance adjacent to Campbells River Road.

Plate 6.9b: View looking south east towards the wind farm from a track entrance adjacent to Campbells River Road.

Plate 6.10: View looking east towards the wind farm across a new pine plantation from the State Forest unnamed road adjacent to Campbell's River Road.

Plate 6.11: View looking east towards the wind farm from Campbell's River Road.

Plate 6.12: View looking south east towards the wind farm across a pine plantation within the Vulcan State Forest adjacent to Dog Rocks Road.

Plate 6.13: Photomontage location map