Figure A - 1: Map of Study Areas

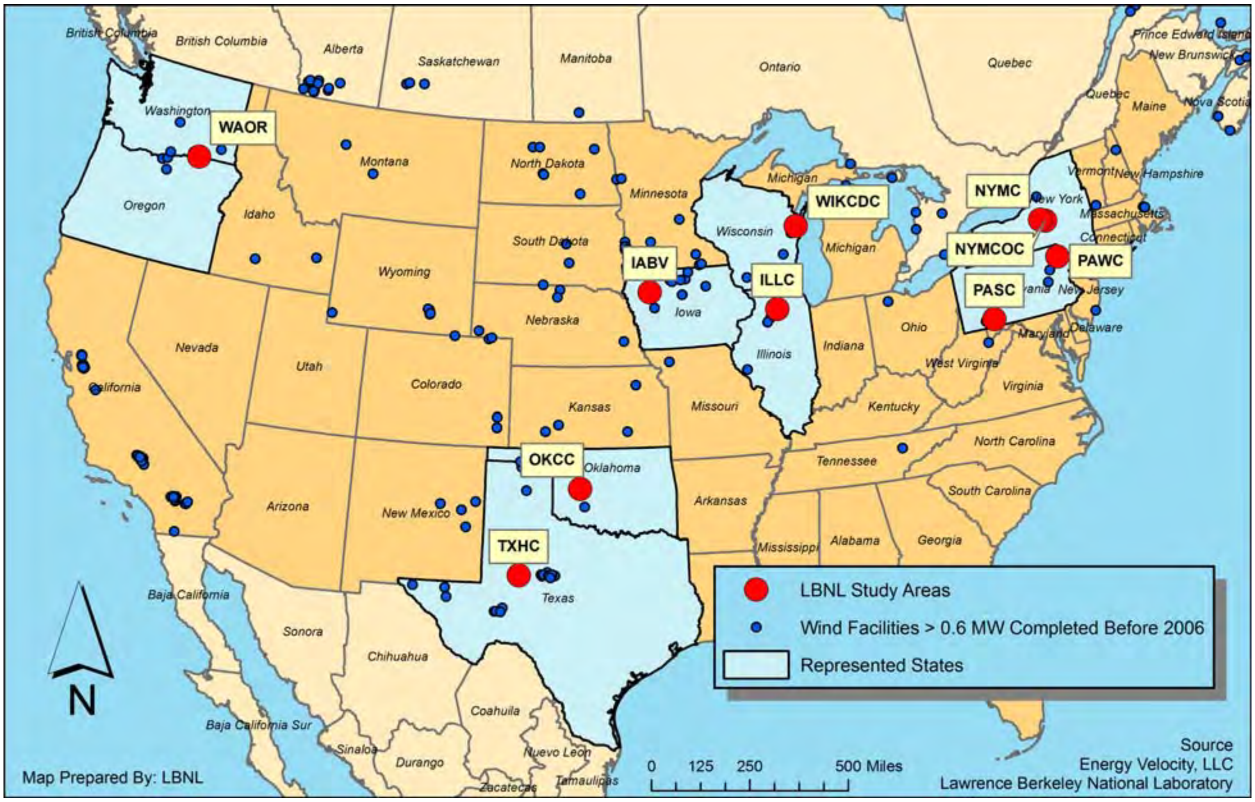
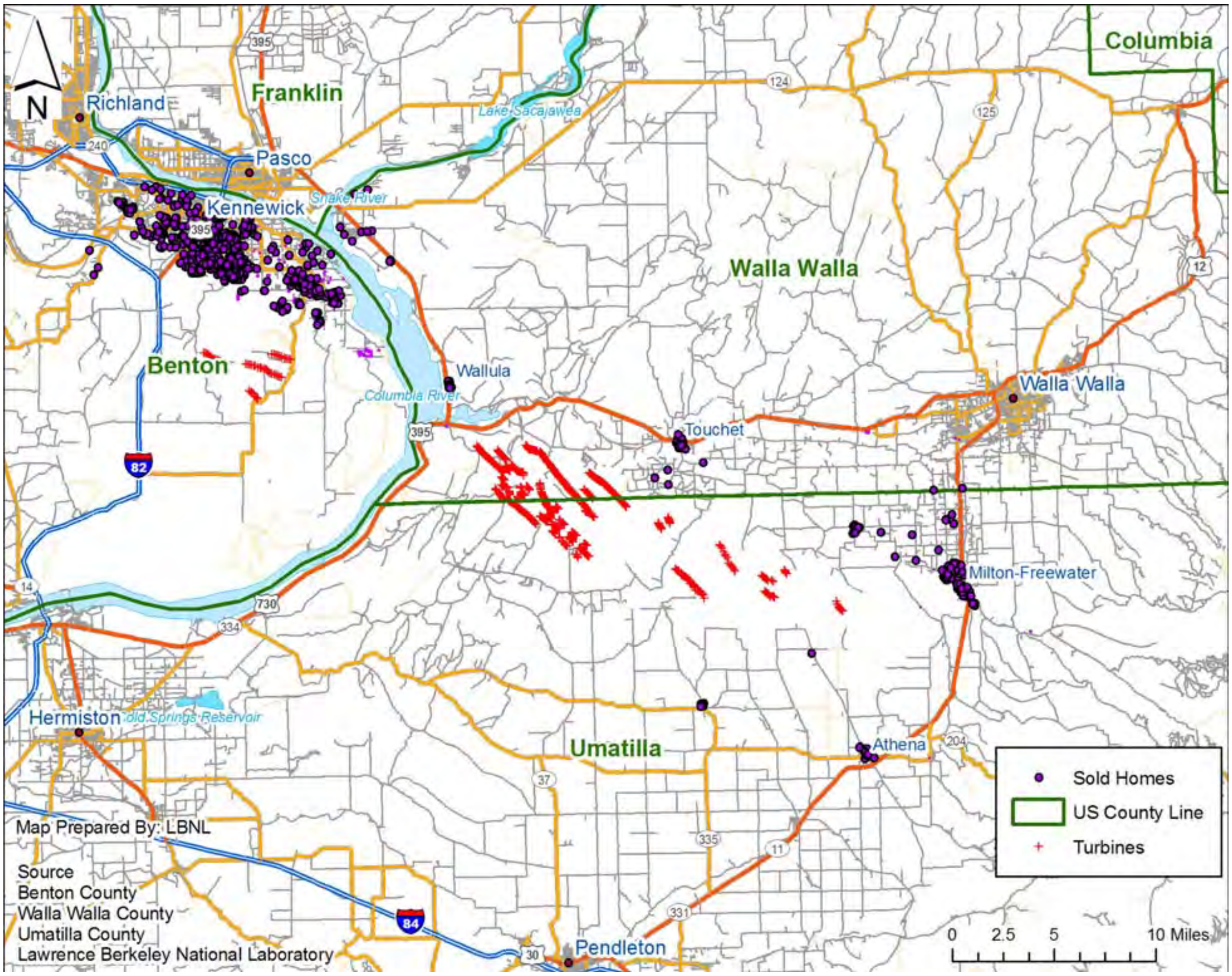


Table A - 1: Summary of Study Areas

Study Area Code	Study Area Counties, States	Facility Names	Number of Turbines	Number of MW	Max Hub Height (meters)	Max Hub Height (feet)
WAOR	Benton and Walla Walla Counties, WA and Umatilla County, OR	Vansycle Ridge, Stateline, Nine Canyon I & II, Combine Hills	582	429	60	197
TXHC	Howard County, TX	Big Spring I & II	46	34	80	262
OKCC	Custer County, OK	Weatherford I & II	98	147	80	262
IABV	Buena Vista County, IA	Storm Lake I & II, Waverly, Intrepid I & II	381	370	65	213
ILLC	Lee County, IL	Mendota Hills, GSG Wind	103	130	78	256
WIKCDC	Kewaunee and Door Counties, WI	Red River, Lincoln	31	20	65	213
PASC	Somerset County, PA	Green Mountain, Somerset, Meyersdale	34	49	80	262
PAWC	Wayne County, PA	Waymart	43	65	65	213
NYMCOC	Madison and Oneida Counties, NY	Madison	7	12	67	220
NYMC	Madison County, NY	Fenner	20	30	66	218
		TOTAL	**1345**	**1286**		

A.1 WAOR Study Area: Benton and Walla Walla Counties (Washington), and Umatilla County (Oregon)

Figure A - 2: Map of WAOR Study Area



Note: "Sold Homes" include all sold homes both before and after construction.

<u>Area Description</u>

This study area combines data from the three counties - Benton and Walla Walla in Washington, and Umatilla in Oregon - that surround the Vansycle Ridge, Stateline, Combine Hills, and Nine Canyon wind projects. Wind development began in this area in 1997 and, within the sample of wind projects, continued through 2003. In total, the wind facilities in this study area include 582 turbines and 429 MW of nameplate capacity, with hub heights that range from 164 feet to almost 200 feet. The wind facilities are situated on an East-West ridge that straddles the Columbia River, as it briefly turns South. The area consists of undeveloped highland/plateau grassland, agricultural tracks for winter fruit, and three towns: Kennewick (Benton County), Milton-Freewater (Umatilla County), and Walla Walla (Walla Walla County). Only the first two of these towns are represented in the dataset because Walla Walla is situated more than 10 miles from the nearest wind turbine. Also in the area are Touchet and Wallula, WA, and Athena, OR, all very small communities with little to no services. Much of the area to the North and South of the ridge, and outside of the urban areas, is farmland, with homes situated on small parcels adjoining larger agricultural tracts.

Data Collection and Summary

Data for this study area were collected from a myriad of sources. For Benton County, sales and home characteristic data and GIS parcel shapefiles were collected with the assistance of county officials Eric Beswick, Harriet Mercer, and Florinda Paez, while state official Deb Mandeville (Washington Department of State) provided information on the validity of the sales. In Walla Walla County, county officials Bill Vollendorff and Tiffany Laposi provided sales, house characteristic, and GIS data. In Umatilla County, county officials Jason Nielsen, Tracie Diehl, and Tim McElrath provided sales, house characteristic, and GIS data.

Based on the data collection, more than 8,500 homes are found to have sold within ten miles of the wind turbines in this study area from January 1996 to June 2007. Completing field visits to this number of homes would have been overly burdensome; as a result, only a sample of these home sales was used for the study. Specifically, all valid sales within three miles of the nearest turbine are used, and a random sample of those homes outside of three miles but inside of five miles in Benton County and inside ten miles in Walla Walla and Umatilla Counties. This approach resulted in a total of 790 sales, with prices that ranged from $25,000 to $647,500, and a mean of $134,244. Of those 790 sales, 519 occurred after wind facility construction commenced, and 110 could see the turbines at the time of sale, though all but four of these homes had MINOR views. No homes within this sample were located within one mile of the nearest wind turbine, with the majority occurring outside of three miles.

Area Statistics

Study Period Begin	Study Period End	Number of Sales	Median Price	Mean Price	Minimum Price	Maximum Price
1/23/1996	6/29/2007	790	$ 125,803	$ 134,244	$ 25,000	$ 647,500

Facility Statistics

Facility Name	Number of MW	Number of Turbines	Announce Date	Construction Begin Date	Completion Date	Turbine Maker	Hub Height (Meters)
Vansycle Ridge	25	38	Aug-97	Feb-98	Aug-98	Vestas	50
Stateline Wind Project, Phase I (OR)	83	126	Jun-00	Sep-01	Dec-01	Vestas	50
Stateline Wind Project, Phase I (WA)	177	268	Jun-00	Feb-01	Dec-01	Vestas	50
Stateline Wind Project, Phase II	40	60	Jan-02	Sep-02	Dec-02	Vestas	50
Nine Canyon Wind Farm	48	37	Jun-01	Mar-02	Sep-02	Bonus	60
Combine Hills Turbine Ranch I	41	41	Apr-02	Aug-03	Dec-03	Mitsubishi	55
Nine Canyon Wind Farm II	16	12	Jun-01	Jun-03	Dec-03	Bonus	60

Source: AWEA & Ventyx Inc.

Variables of Interest Statistics

Development Period	Pre Announcement	Post Announcement Pre Construction	1st Year After Construction	2nd Year After Construction	2+ Years After Construction	Total
Benton/Walla Walla, WA & Umatilla, OR (WAOR)	226	45	76	59	384	790

View of Turbines	Pre Construction	None	Minor	Moderate	Substantial	Extreme	Total
Benton/Walla Walla, WA & Umatilla, OR (WAOR)	271	409	106	4	0	0	790

Distance to Nearest Turbine	Pre Construction	< 0.57 Miles	0.57 - 1 Miles	1 - 3 Miles	3 - 5 Miles	> 5 Miles	Total
Benton/Walla Walla, WA & Umatilla, OR (WAOR)	271	0	0	20	277	222	790

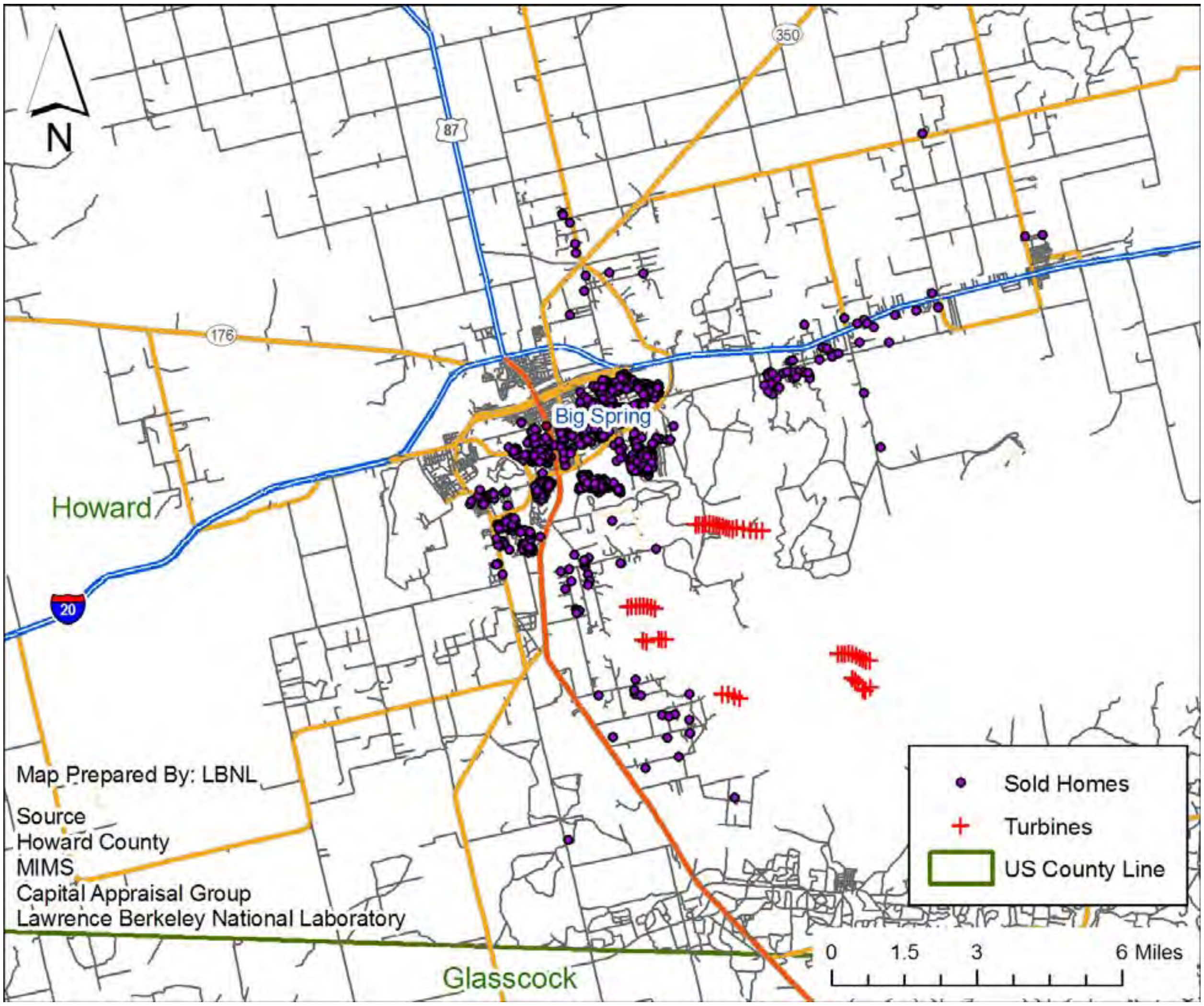
Census Statistics

Name	Type	2007 Population	% Change Since 2000	Population Per Mile^2	Median Age	Median Income	Median House 2007	% Change Since 2000
Kennewich, WA	City	62,182	12.5%	2,711	32.3	$ 45,085	$ 155,531	46%
Walla Walla, WA	City	30,794	4.0%	2,847	33.8	$ 38,391	$ 185,706	91%
Milton Freewater, OR	Town	6,335	-2.0%	3,362	31.7	$ 30,229	$ 113,647	47%
Touchet, WA	Town	413	n/a	340	33.6	$ 47,268	$ 163,790	81%
Benton	County	159,414	3.6%	94	34.4	$ 51,464	$ 162,700	46%
Walla Walla	County	57,709	1.0%	45	34.9	$ 43,597	$ 206,631	89%
Umatilla	County	73,491	0.6%	23	34.6	$ 38,631	$ 138,200	47%
Washington	State	6,488,000	10.1%	89	35.3	$ 55,591	$ 300,800	79%
Oregon	State	3,747,455	9.5%	36	36.3	$ 48,730	$ 257,300	69%
US	Country	301,139,947	6.8%	86	37.9	$ 50,233	$ 243,742	46%

Source: City-Data.com & Wikipedia. "% Change Since 2000" refers to the percentage change between 2000 and 2007 for the figures in the column to the left (population or median house price). "Town" signifies any municipality with less than 10,000 inhabitants. "n/a" signifies data not available.

A.2 TXHC Study Area: Howard County (Texas)

Figure A - 3: Map of TXHC Study Area



Note: "Sold Homes" include all sold homes both before and after construction.

<u>Area Description</u>

This study area is entirely contained within Howard County, Texas, and includes the city of Big Spring, which is situated roughly 100 miles South of Lubbock and 275 miles West of Dallas in West Texas. On top of the Northern end of the Edwards Plateau, which runs from the Southeast to the Northwest, sits the 46 turbine (34 MW) Big Spring wind facility, which was constructed in 1998 and 1999. Most of the wind turbines in this project have a hub height of 213 feet, but four are taller, at 262 feet. The plateau and the wind facility overlook the city of Big Spring which, when including its suburbs, wraps around the plateau to the South and East. Surrounding the town are modest farming tracks and arid, undeveloped land. These lands, primarily to the South of the facility towards Forsan (not shown on map), are dotted with small oil rigs. Many of the homes in Big Spring do not have a view of the wind facility, but others to the South and East do have such views.

Data Collection and Summary

County officials Brett McKibben, Sally Munoz, and Sheri Proctor were extremely helpful in answering questions about the data required for this project, and the data were provided by two firms that manage it for the county. Specifically, Erin Welch of the Capital Appraisal Group provided the sales and house characteristic data and Paul Brandt of MIMS provided the GIS data.

All valid single-family home sales transactions within five miles of the nearest turbine and occurring between January 1996 and March 2007 were included in the dataset, resulting in 1,311 sales.[106] These sales ranged in price from $10,492 to $490,000, with a mean of $74,092. Because of the age of the wind facility, many of the sales in the sample occurred after wind facility construction had commenced (*n* = 1,071). Of those, 104 had views of the turbines, with 27 having views more dramatic than MINOR. Four homes sold within a mile of the facility, with the rest falling between one and three miles (*n* = 584), three to five miles (*n* = 467), and outside of five miles (*n* = 16).

Area Statistics

Study Period Begin	Study Period End	Number of Sales	Median Price	Mean Price	Minimum Price	Maximum Price
1/2/1996	3/30/2007	1,311	$66,500	$74,092	$10,492	$490,000

Facility Statistics

Facility Name	Number of MW	Number of Turbines	Announce Date	Construction Begin Date	Completion Date	Turbine Maker	Hub Height (Meters)
Big Spring I	27.7	42	Jan-98	Jul-98	Jun-99	Vestas	65
Big Spring II	6.6	4	Jan-98	Jul-98	Jun-99	Vestas	80

Source: AWEA & Ventyx Inc.

Variables of Interest Statistics

Development Period	Pre Announcement	Post Announcement Pre Construction	1st Year After Construction	2nd Year After Construction	2+ Years After Construction	Total
Howard, TX (TXHC)	169	71	113	131	827	1311

View of Turbines	Pre Construction	None	Minor	Moderate	Substantial	Extreme	Total
Howard, TX (TXHC)	240	967	77	22	5	0	1311

Distance to Nearest Turbine	Pre Construction	< 0.57 Miles	0.57 - 1 Miles	1 - 3 Miles	3 - 5 Miles	> 5 Miles	Total
Howard, TX (TXHC)	240	0	4	584	467	16	1311

[106] If parcels intersected the five mile boundary, they were included in the sample, but were coded as being outside of five miles.

Census Statistics

Name	Type	2007 Population	% Change Since 2000	Population Per Mile^2	Median Age	Median Income	Median House 2007	% Change Since 2000
Big Spring	City	24,075	-5.4%	1,260	35.1	$ 32,470	$ 54,442	50%
Forsan	Town	220	-4.0%	758	36.8	$ 50,219	$ 64,277	84%
Howard	County	32,295	-1.9%	36	36.4	$ 36,684	$ 60,658	58%
Texas	State	23,904,380	14.6%	80	32.3	$ 47,548	$ 120,900	47%
US	Country	301,139,947	6.8%	86	37.9	$ 50,233	$ 243,742	46%

Source: City-Data.com & Wikipedia. "% Change Since 2000" refers to the percentage change between 2000 and 2007 for the figures in the column to the left (population or median house price). "Town" signifies any municipality with less than 10,000 inhabitants.

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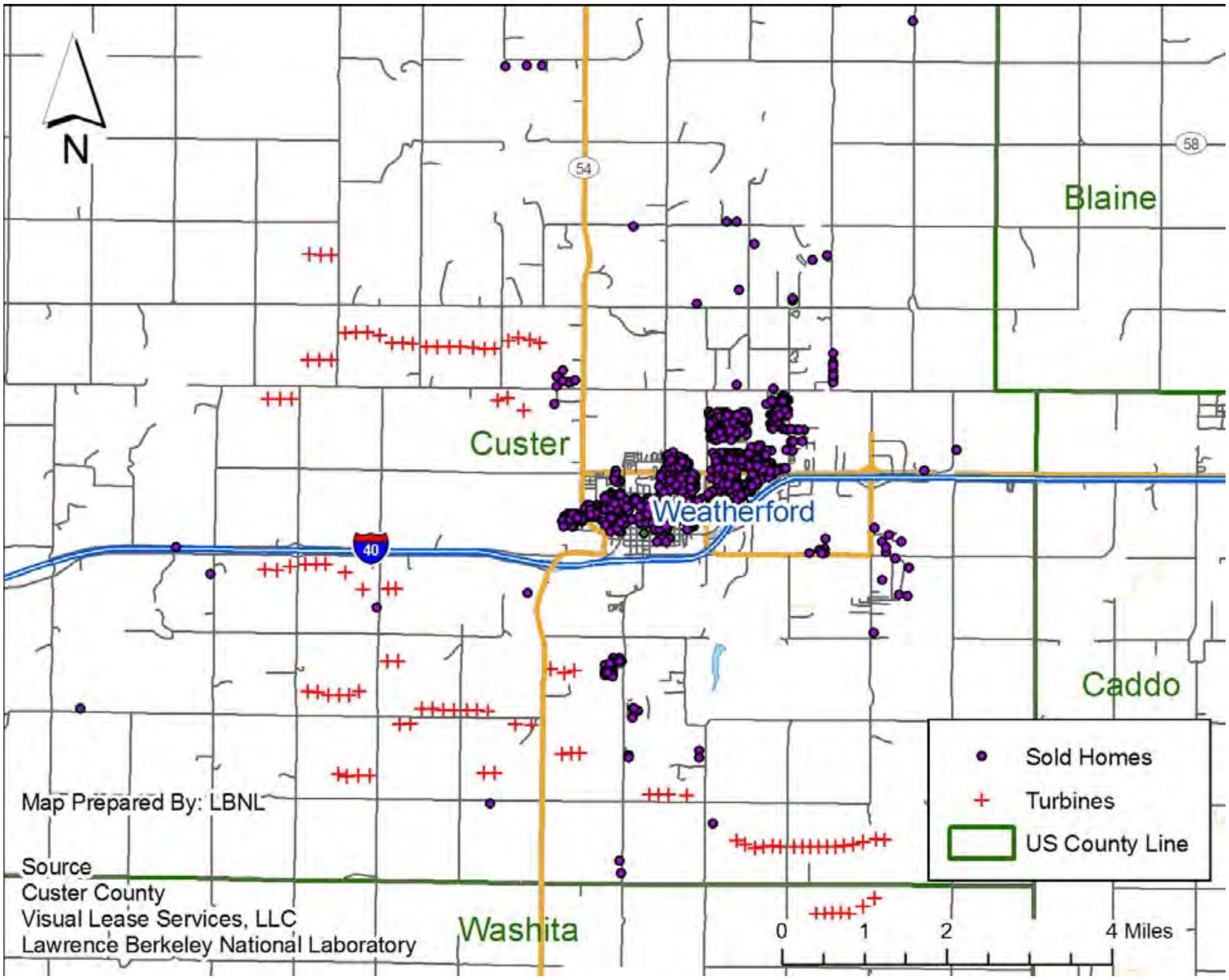
A.3 OKCC Study Area: Custer County (Oklahoma)

Figure A - 4: Map of OKCC Study Area



Note: "Sold Homes" include all sold homes both before and after construction.

<u>Area Description</u>

This study area is entirely contained within Custer County, Texas, and includes the Weatherford wind facility, which is situated near the city of Weatherford, 70 miles due west of Oklahoma City and near the western edge of the state. The 98 turbine (147 MW) Weatherford wind facility straddles Highway 40, which runs East-West, and U.S. County Route 54, which runs North-South, creating an "L" shape that is more than six miles long and six miles wide. Development began in 2004, and was completed in two phases ending in 2006. The turbines are some of the largest in the sample, with a hub height of 262 feet. The topography of the study area is mostly flat plateau, allowing the turbines to be visible from many parts of the town and the surrounding rural lands. There are a number of smaller groupings of homes that are situated to the North and South of the city, many of which are extremely close to the turbines and have dramatic views of them.

Data Collection and Summary

County Assessor Debbie Collins and mapping specialist Karen Owen were extremely helpful in gathering data and answering questions at the county level. Data were obtained directly from the county and from Visual Lease Services, Inc and OKAssessor, where representatives Chris Mask, Terry Wood, Tracy Leniger, and Heather Brown helped with the request.

All valid single-family residential transactions within five miles of the nearest wind turbine and occurring between July 1996 and June 2007 were included in the dataset, resulting in 1,113 sales.[107] These sales ranged in price from $11,000 to $468,000, with a mean of $100,445. Because of the relatively recent construction of the facility, 58% of the sales (*n* = 637) occurred before construction, leaving 476 sales with possible views of the turbines. Of those 476 sales, 25 had more-dramatic view ratings than MINOR and 17 sales occurred inside of one mile.

Area Statistics

Study Period Begin	Study Period End	Number of Sales	Median Price	Mean Price	Minimum Price	Maximum Price
7/7/1996	6/29/2007	1,113	$91,000	$100,445	$11,000	$468,000

Facility Statistics

Facility Name	Number of MW	Number of Turbines	Announce Date	Construction Begin Date	Completion Date	Turbine Maker	Hub Height (Meters)
Weatherford Wind Energy Center	106.5	71	Mar-04	Dec-04	May-05	GE Wind	80
Weatherford Wind Energy Center Expansion	40.5	27	May-05	Oct-05	Jan-06	GE Wind	80

Source: AWEA & Ventyx Inc.

Variables of Interest Statistics

Development Period	Pre Announcement	Post Announcement Pre Construction	1st Year After Construction	2nd Year After Construction	2+ Years After Construction	Total
Custer, OK (OKCC)	484	153	193	187	96	1113

View of Turbines	Pre Construction	None	Minor	Moderate	Substantial	Extreme	Total
Custer, OK (OKCC)	637	375	76	6	7	12	1113

Distance to Nearest Turbine	Pre Construction	< 0.57 Miles	0.57 - 1 Miles	1 - 3 Miles	3 - 5 Miles	> 5 Miles	Total
Custer, OK (OKCC)	637	16	1	408	50	1	1113

[107] Portions of the town of Weatherford, both North and South of the town center, were not included in the sample due to lack of available data. The homes that were mapped, and for which electronic data were provided, however, were situated on all sides of these unmapped areas and were similar in character to those that were omitted. None of the unmapped homes were within a mile of the nearest wind turbine.

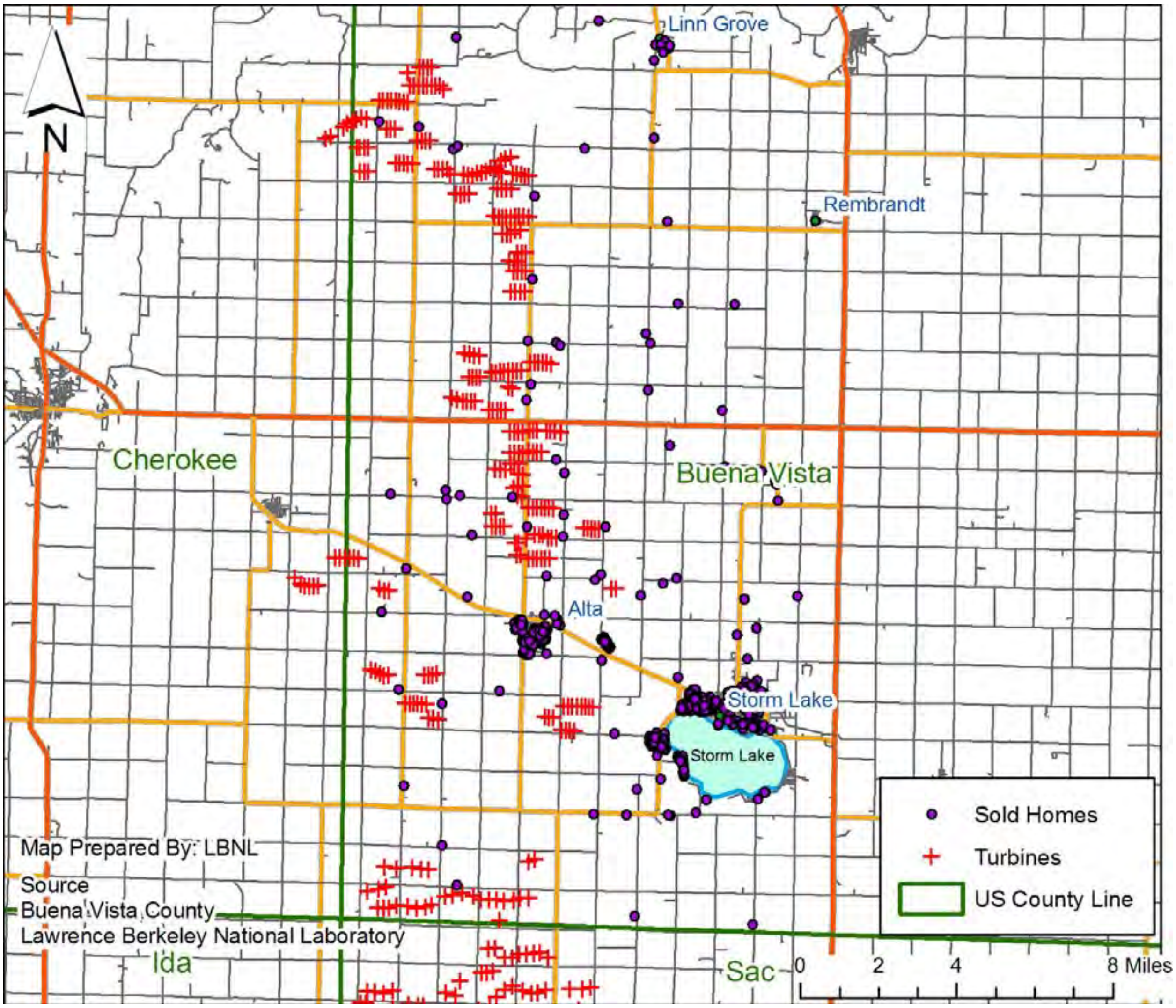
Census Statistics

Name	Type	2007 Population	% Change Since 2000	Population Per Mile^2	Median Age	Median Income	Median House 2007	% Change Since 2000
Weatherford	City	10,097	1.2%	1,740	24.1	$ 32,543	$ 113,996	45%
Hydro	Town	1,013	-3.7%	1,675	39.2	$ 35,958	$ 66,365	68%
Custer	County	26,111	3.6%	26	32.7	$ 35,498	$ 98,949	52%
Oklahoma	State	3,617,316	4.8%	53	35.5	$ 41,567	$ 103,000	46%
US	Country	301,139,947	6.8%	86	37.9	$ 50,233	$ 243,742	46%

Source: City-Data.com & Wikipedia. "% Change Since 2000" refers to the percentage change between 2000 and 2007 for the figures in the column to the left (population or median house price). "Town" signifies any municipality with less than 10,000 inhabitants.

A.4 IABV Study Area: Buena Vista County (Iowa)

Figure A - 5: Map of IABV Study Area



Note: "Sold Homes" include all sold homes both before and after construction.

<u>Area Description</u>

This study area includes the sizable Storm Lake and Intrepid wind facilities, which are mostly situated in Buena Vista County, located in Northwestern Iowa, 75 miles East of Sioux City. The facilities also stretch into Sac County to the South and Cherokee County to the West. The facilities total 381 turbines (370 MW) and are more than 30 miles long North to South and eight miles wide East to West. Development began on the first Storm Lake facility in 1998 and the last of the Intrepid development was completed in 2006. The largest turbines have a hub height of 213 feet at the hub, but most are slightly smaller at 207 feet. The majority of the homes in the sample surround Storm Lake (the body of water), but a large number of homes are situated on small residential plots located outside of the town and nearer to the wind facility. Additionally, a number of sales occurred in Alta - a small town to the East of Storm Lake -thatis straddled by the wind facilities and therefore provides dramatic views of the turbines. In general, except for the depression in which Storm Lake sits, the topography is very flat, largely made up corn fields, and the turbines are therefore visible from quite far away. The housing market is driven, to some extent, by the water body, Storm Lake, which is a popular recreational tourist destination, and therefore development is occurring to the East and South of the lake. Some development is also occurring, to a lesser degree, to the East of Alta.

Data Collection and Summary

County Assessor Kathy A. Croker and Deputy Assessor Kim Carnine were both extremely helpful in answering questions and providing GIS data. Sales and home characteristic data were provided by Vanguard Appraisals, Inc., facilitated by the county officials. David Healy from MidAmerican provided some of the necessary turbine location GIS files.

The county provided data on valid single-family residential transactions between 1996 and 2007 for 1,743 homes inside of five miles of the nearest wind turbine. This sample exceeded the number for which field data could reasonably be collected; as a result, only a sample of these homes sales was used for the study. Specifically, all transactions that occurred within three miles of the nearest turbine were used, in combination with a random sample (totaling roughly 10%) of those homes between three and five miles. This approach resulted in 822 sales, with prices that ranged from $12,000 to $525,000, and a mean of $94,713. Development of the wind facilities in this area occurred relatively early in the sample period, and therefore roughly 75% of the sales (*n* = 605) occurred after project construction had commenced. Of those 605 sales, 105 had views of the turbines, 37 of which were ranked with a view rating more dramatic than MINOR, and 30 sales occurred within one mile of the nearest wind turbine.

Area Statistics

Study Period Begin	Study Period End	Number of Sales	Median Price	Mean Price	Minimum Price	Maximum Price
1/2/1996	3/30/2007	822	$79,000	$94,713	$12,000	$525,000

Facility Statistics

Facility Name	Number of MW	Number of Turbines	Announce Date	Construction Begin Date	Completion Date	Turbine Maker	Hub Height (Meters)
Storm Lake I	112.5	150	Feb-98	Oct-98	Jun-99	Enron	63
Storm Lake II	80.3	107	Feb-98	Oct-98	Apr-99	Enron	63
Waverly	1.5	2	Feb-98	Oct-98	Jun-99	Enron	65
Intrepid	160.5	107	Mar-03	Oct-04	Dec-04	GE Wind	65
Intrepid Expansion	15.0	15	Jan-05	Apr-05	Dec-05	Mitsubishi	65

Source: AWEA & Ventyx Inc.

Variables of Interest Statistics

Development Period	Pre Announcement	Post Announcement Pre Construction	1st Year After Construction	2nd Year After Construction	2+ Years After Construction	Total
Buena Vista, IA (IABV)	152	65	80	70	455	822

View of Turbines	Pre Construction	None	Minor	Moderate	Substantial	Extreme	Total
Buena Vista, IA (IABV)	217	500	68	18	8	11	822

Distance to Nearest Turbine	Pre Construction	< 0.57 Miles	0.57 - 1 Miles	1 - 3 Miles	3 - 5 Miles	> 5 Miles	Total
Buena Vista, IA (IABV)	217	22	8	472	101	2	822

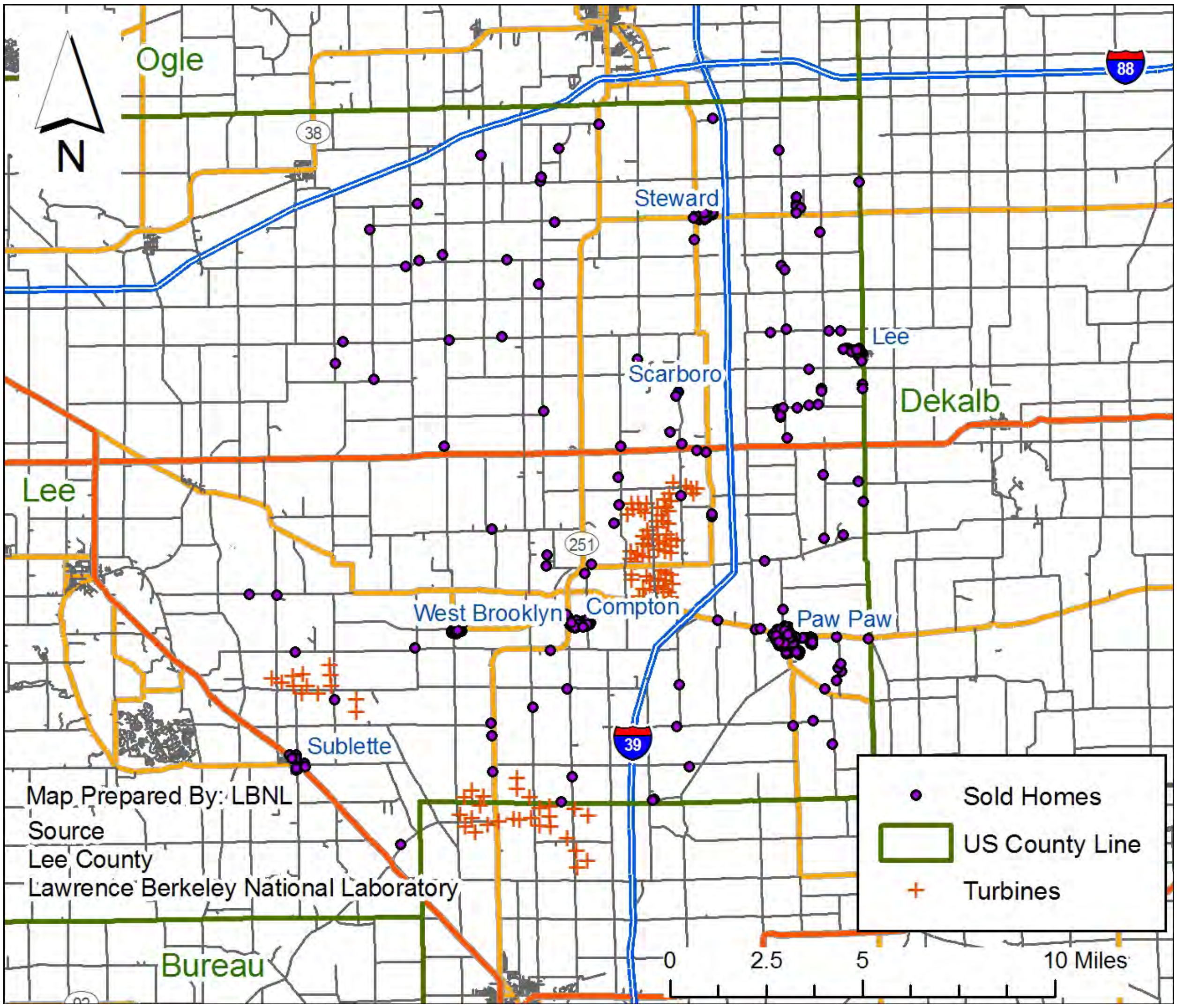
Census Statistics

Name	Type	2007 Population	% Change Since 2000	Population Per Mile^2	Median Age	Median Income	Median House 2007	% Change Since 2000
Storm Lake	City	9,706	-3.9%	2,429	31.7	$ 39,937	$ 99,312	41%
Alta	Town	1,850	-1.0%	1,766	35.1	$ 40,939	$ 98,843	48%
Buena Vista	County	19,776	-3.1%	36	36.4	$ 42,296	$ 95,437	45%
Iowa	State	3,002,555	2.6%	52	36.6	$ 47,292	$ 117,900	43%
US	Country	301,139,947	6.8%	86	37.9	$ 50,233	$ 243,742	46%

Source: City-Data.com & Wikipedia. "% Change Since 2000" refers to the percentage change between 2000 and 2007 for the figures in the column to the left (population or median house price). "Town" signifies any municipality with less than 10,000 inhabitants.

A.5 ILLC Study Area: Lee County (Illinois)

Figure A - 6: Map of ILLC Study Area



Note: "Sold Homes" include all sold homes both before and after construction.

<u>Area Description</u>

This study area is situated roughly 80 miles due West of Chicago, in Lee County, Illinois, and includes two wind facilities. The 63 turbine (53 MW) Mendota Hills Wind Project sits just West of North-South Highway 39, and 10 miles South of East-West Highway 88. Development began on the facility in 2001 and was completed in 2003. The second facility, the 40 turbine (80 MW) GSG Wind Farm is South and West of the Mendota Hills facility, and is broken into two parts: roughly one third of the turbines are situated two miles due north of the small town of Sublette, with the remainder located roughly six miles to the southeast and spanning the line separating Lee from La Salle County. Development began on this project in the fall of 2006 and was completed in April of the following year. The town of Paw Paw, which is East of Highway 38 and both facilities, is the largest urban area in the study area, but is further away from the facilities than the towns of Compton, West Brooklyn, Scarboro, and Sublette. Also, to the North of the facilities are the towns of Lee, to the East of Highway 38, and Steward, just to the West. Although many home sales occurred in these towns, a significant number of additional sales occurred on small residential tracts in more-rural areas or in small developments. The topography of the area is largely flat, but falls away slightly to the East towards Paw Paw. The area enjoyed significant development during the real estate boom led by commuters from the Chicago metropolitan area, which was focused in the Paw Paw area but was also seen in semi-rural subdivisions to the Southwest and North of the wind facility.

Data Collection and Summary

County Supervisor Wendy Ryerson was enormously helpful in answering questions and providing data, as were Carmen Bollman and GIS Director, Brant Scheidecker, who also work in the county office. Wendy and Carmen facilitated the sales and home characteristic data request and Brant provided the GIS data. Additionally, real estate brokers Neva Grevengoed of LNG Realtor, Alisa Stewart of AC Corner Stone, and Beth Einsely of Einsely Real Estate were helpful in understanding the local market.

The county provided information on 412 valid single-family transactions that occurred between 1998 and 2007 within 10 miles of the nearest wind turbine, all of which were included in the sample.[108] These sales ranged in price from $14,500 to $554,148, with a mean of $128,301. Of those sales, 213 occurred after construction commenced on the wind facility and, of those, 36 had views of the turbines – nine of which were rated more dramatically than MINOR. Only two sales occurred within one mile of the nearest wind turbine.

Area Statistics

Study Period Begin	Study Period End	Number of Sales	Median Price	Mean Price	Minimum Price	Maximum Price
5/1/1998	3/2/2007	412	$113,250	$128,301	$14,500	$554,148

Facility Statistics

Facility Name	Number of MW	Number of Turbines	Announce Date	Construction Begin Date	Completion Date	Turbine Maker	Hub Height (Meters)
Mendota Hills	50.4	63	Nov-01	Aug-03	Nov-03	Gamesa	65
GSG Wind Farm	80	40	Dec-05	Sep-06	Apr-07	Gamesa	78

Source: AWEA & Ventyx Inc.

[108] This county was not able to provide data electronically back to 1996, as would have been preferred, but because wind project development did not occur until 2001, there was ample time in the study period to establish pre-announcement sale price levels.

Variables of Interest Statistics

Development Period	Pre Announcement	Post Announcement Pre Construction	1st Year After Construction	2nd Year After Construction	2+ Years After Construction	Total
Lee, IL (ILLC)	**115**	**84**	**62**	**71**	**80**	**412**

View of Turbines	Pre Construction	None	Minor	Moderate	Substantial	Extreme	Total
Lee, IL (ILLC)	**199**	**177**	**27**	**7**	**1**	**1**	**412**

Distance to Nearest Turbine	Pre Construction	< 0.57 Miles	0.57 - 1 Miles	1 - 3 Miles	3 - 5 Miles	> 5 Miles	Total
Lee, IL (ILLC)	**199**	**1**	**1**	**85**	**69**	**57**	**412**

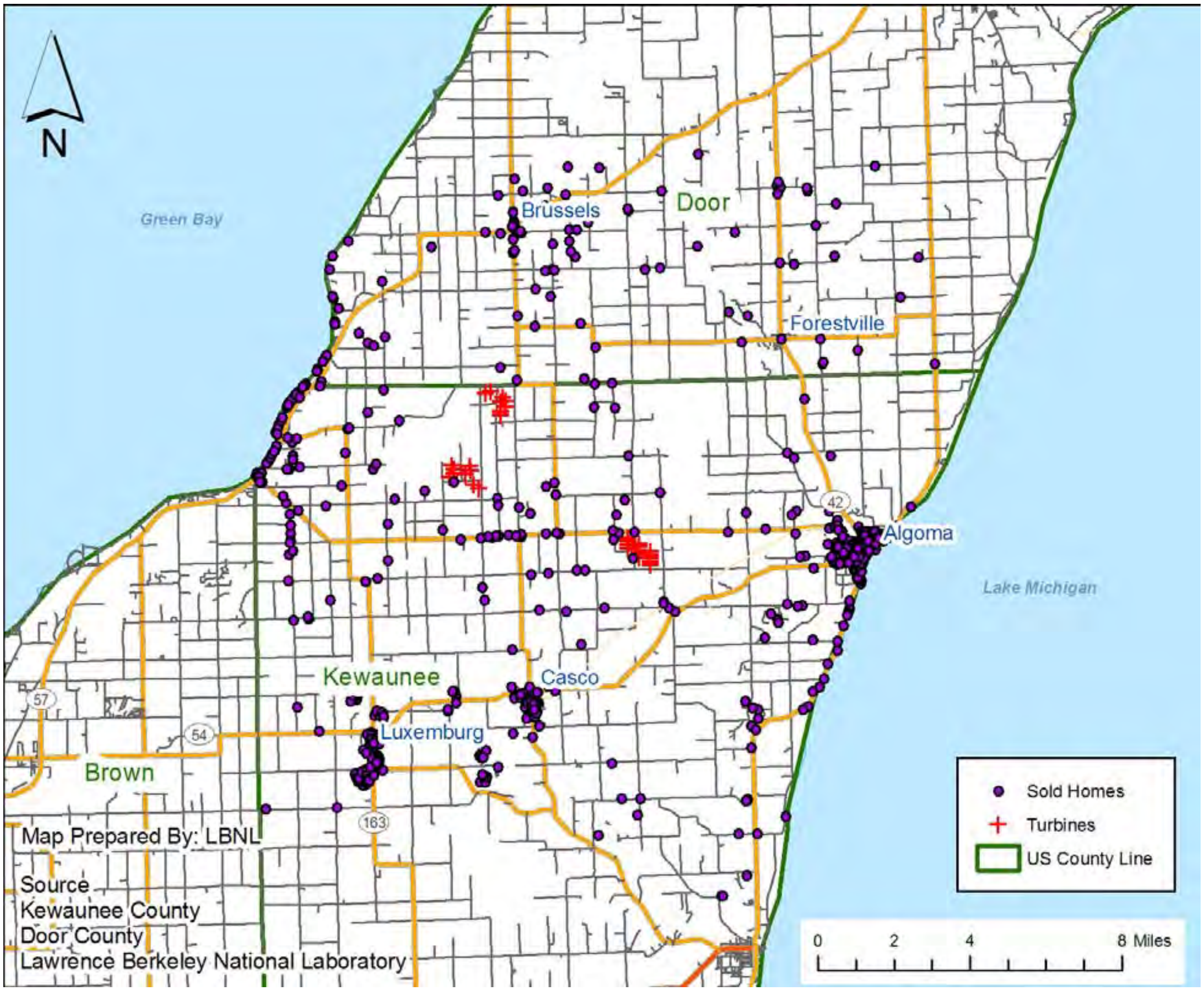
Census Statistics

Name	Type	2007 Population	% Change Since 2000	Population Per Mile^2	Median Age	Median Income	Median House 2007	% Change Since 2000
Paw Paw	Town	884	2.6%	1,563	38.0	$ 48,399	$ 151,954	n/a
Compton	Town	337	-2.9%	2,032	32.8	$ 44,023	$ 114,374	n/a
Steward	Town	263	-3.0%	2,116	35.2	$ 59,361	$ 151,791	n/a
Sublette	Town	445	-2.4%	1,272	37.7	$ 55,910	$ 133,328	n/a
Lee	County	35,450	-1.7%	49	37.9	$ 47,591	$ 136,778	64%
Illinois	State	12,852,548	3.5%	223	34.7	$ 54,124	$ 208,800	60%
US	Country	301,139,947	7.0%	86	37.9	$ 50,233	$ 243,742	46%

Source: City-Data.com & Wikipedia. "% Change Since 2000" refers to the percentage change between 2000 and 2007 for the figures in the column to the left (population or median house price). "Town" signifies any municipality with less than 10,000 inhabitants. "n/a" signifies data not available.

A.6 WIKCDC Study Area: Kewaunee and Door Counties (Wisconsin)

Figure A - 7: Map of WIKCDC Study Area



Note: "Sold Homes" include all sold homes both before and after construction.

<u>Area Description</u>

This study area includes the Red River (17 turbines, 14 MW) and Lincoln (14 turbines, 9 MW) wind facilities. It is situated on the "thumb" jutting into Lake Michigan, Northeast of Green Bay, Wisconsin, and spans two counties, Kewaunee and Door. There is a mix of agricultural, small rural residential, waterfront, and urban land use in this area. The three largest towns are Algoma to the East of the facilities and on the lake, Casco, which is six miles due South of the turbines, and Luxemburg, four miles West of Casco. There is a smaller village, Brussels, to the North in Door County. The remainder of the homes is situated on the water or in small rural residential parcels between the towns. Topographically, the "thumb" is relatively flat except for a slight crown in the middle, and then drifting lower to the edges. The East edge of the "thumb" ends in bluffs over the water, and the western edge drops off more gradually, allowing those parcels to enjoy small beaches and easy boat access. There is some undulation of the land, occasionally allowing for relatively distant views of the wind turbines, which stand at a hub height of 213 feet.

Data Collection and Summary

Kewaunee and Door Counties did not have a countywide system of electronic data storage for either sales or home characteristic data. Therefore, in many cases, data had to be collected directly from the town or city assessor. In Kewaunee County, Joseph A. Jerabek of the town of Lincoln, Gary Taicher of the town of Red River, Melissa Daron of the towns of Casco, Pierce, and West Kewaunee, Michael Muelver of the town of Ahnapee and the city of Algoma, William Gerrits of the town of Casco, Joseph Griesbach Jr. of the town of Luxemburg, and David Dorschner of the city of Kewaunee all provided information. In Door County, Scott Tennessen of the town of Union and Gary Maccoux of the town of Brussels were similarly very helpful in providing information. Additionally, Andy Pelkey of Impact Consultants, Inc., John Holton of Associated Appraisal Consultants, Andy Bayliss of Dash Development Group, and Lue Van Asten of Action Appraisers & Consultants all assisted in extracting data from the myriad of storage systems used at the town and city level. The State of Wisconsin provided additional information on older sales and sales validity, with Mary Gawryleski, James Bender, and Patrick Strabala from the Wisconsin Department of Revenue being extremely helpful. GIS data were obtained from Steve Hanson from Kewaunee County and Tom Haight from Door County.

After collecting data from each municipality, a total of 810 valid single-family home sales transactions were available for analysis, ranging in time from 1996 to 2007. These sales ranged in price from $20,000 to $780,000, with a mean of $116,698. Because development of the wind facilities occurred relatively early in the study period, a large majority of the sales transactions, 75% (*n* = 725), occurred after project construction had commenced. Of those, 64 had views of the turbines, 14 of which had more dramatic than MINOR views, and 11 sales occurred within one mile.

Area Statistics

Study Period Begin	Study Period End	Number of Sales	Median Price	Mean Price	Minimum Price	Maximum Price
2/2/1996	6/30/2007	810	$98,000	$116,698	$20,000	$780,000

Facility Statistics

Facility Name	Number of MW	Number of Turbines	Announce Date	Construction Begin Date	Completion Date	Turbine Maker	Hub Height (Meters)
Red River	11.2	17	Apr-98	Jan-99	Jun-99	Vestas	65
Lincoln	9.2	14	Aug-98	Jan-99	Jun-99	Vestas	65

Source: AWEA & Ventyx Inc.

Variables of Interest Statistics

Development Period	Pre Announcement	Post Announcement Pre Construction	1st Year After Construction	2nd Year After Construction	2+ Years After Construction	Total
Kewaunee/Door, WI (WIKCDC)	44	41	68	62	595	810

View of Turbines	Pre Construction	None	Minor	Moderate	Substantial	Extreme	Total
Kewaunee/Door, WI (WIKCDC)	85	661	50	9	2	3	810

Distance to Nearest Turbine	Pre Construction	< 0.57 Miles	0.57 - 1 Miles	1 - 3 Miles	3 - 5 Miles	> 5 Miles	Total
Kewaunee/Door, WI (WIKCDC)	85	7	4	63	213	438	810

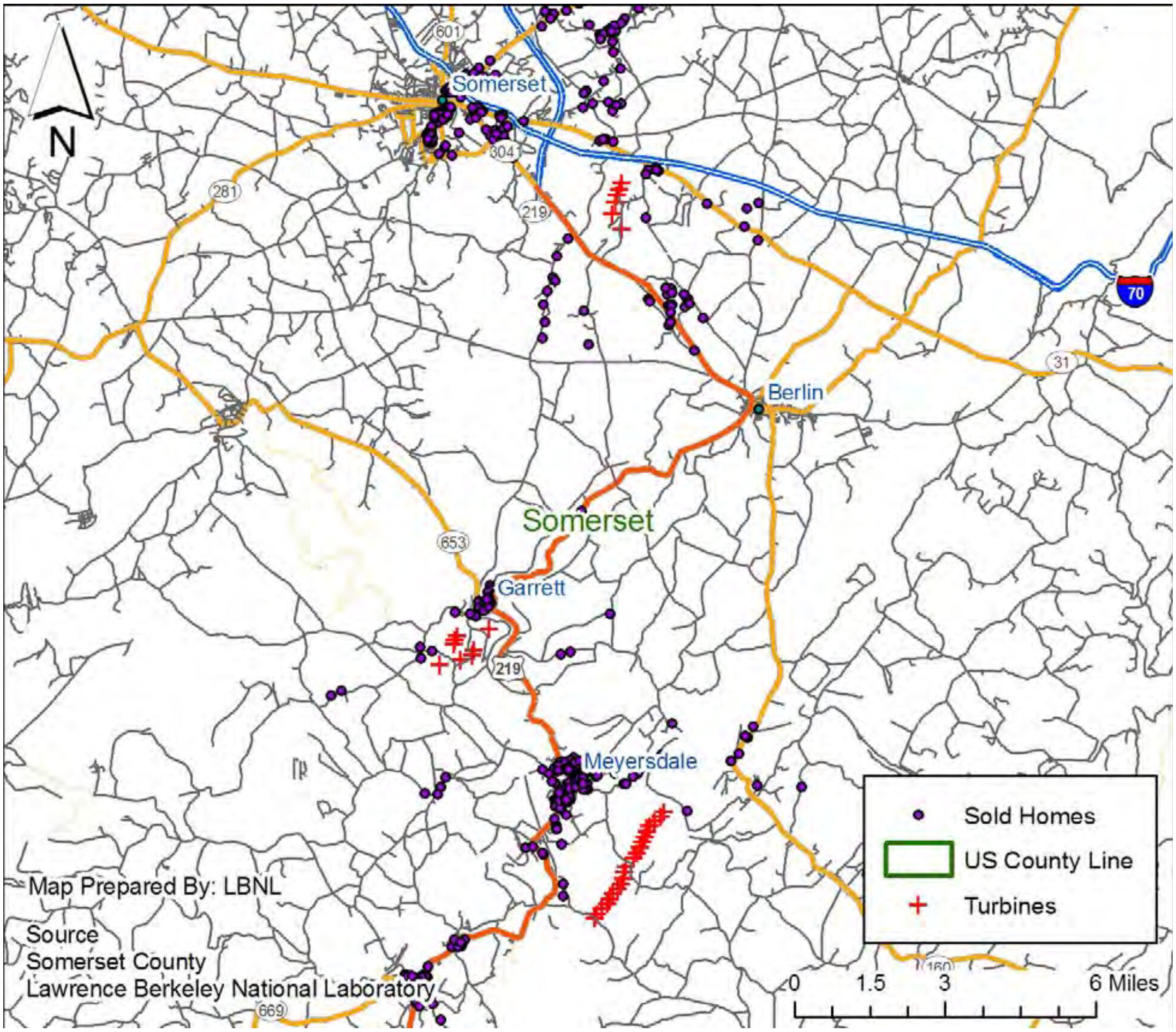
Census Statistics

Name	Type	2007 Population	% Change Since 2000	Population Per Mile^2	Median Age	Median Income	Median House 2007	% Change Since 2000
Algoma	Town	3,186	-4.7%	1,305	41.8	$ 39,344	$ 112,295	51%
Casco	Town	551	-2.8%	985	35.6	$ 53,406	$ 141,281	n/a
Luxemburg	Town	2,224	15.3%	1,076	32.0	$ 53,906	$ 167,403	n/a
Kewaunee	County	20,533	1.4%	60	37.5	$ 50,616	$ 148,344	57%
Door	County	27,811	2.4%	58	42.9	$ 44,828	$ 193,540	57%
Wisconsin	State	5,601,640	0.3%	103	36.0	$ 50,578	$ 168,800	50%
US	Country	301,139,947	6.8%	86	37.9	$ 50,233	$ 243,742	46%

Source: City-Data.com & Wikipedia. "% Change Since 2000" refers to the percentage change between 2000 and 2007 for the figures in the column to the left (population or median house price). "Town" signifies any municipality with less than 10,000 inhabitants. "n/a" signifies data not available.

A.7 PASC Study Area: Somerset County (Pennsylvania)

Figure A - 8: Map of PASC Study Area



Note: "Sold Homes" include all sold homes both before and after construction.

<u>Area Description</u>

This study area includes three wind facilities, Somerset (6 turbines, 9 MW, 210 ft hub height) to the North, Meyersdale (20 turbines, 30 MW, 262 ft hub height) to the South, and Green Mountain (8 turbines, 10 MW, 197 ft hub height) between them. All of the projects are located in Somerset County, roughly 75 miles southeast of Pittsburg in the Southwest section of Pennsylvania. None of the three facilities are separated by more than 10 miles, so all were included in one study area. To the North of the facilities is East-West U.S. Highway 70, which flanks the city of Somerset. Connecting Somerset with points South is County Route 219, which zigzags Southeast out of Somerset to the smaller towns of Berlin (not included in the data), Garret to the Southwest, and Meyersdale, which is Southeast of Garret. These towns are flanked by two ridges that run from the Southwest to the Northeast. Because of these ridges and the relatively high elevations of all of the towns, this area enjoys winter recreation, though the coal industry, which once dominated the area, is still an integral part of the community with mining occurring in many places up and down the ridges. Although many of the home sales in the sample occurred in the towns, a number of the sales are for homes situated outside of town corresponding to either rural, rural residential, or suburban land uses.

Data Collection and Summary

The County Assessor, Jane Risso, was extremely helpful, and assisted in providing sales and home characteristic data. Glen Wagner, the IT director, worked with Gary Zigler, the county GIS specialist, to extract both GIS and assessment data from the county records. Both Gary and Jane were extremely helpful in fielding questions and providing additional information as needs arose.

The county provided a total of 742 valid residential single-family home sales transactions within four miles of the nearest wind turbine. All of the sales within three miles were used (*n* = 296), and a random sample (~ 44%) of those between three and four miles were used, yielding a total of 494 sales that occurred between May 1997 and March 2007. These sales ranged in price from $12,000 to $360,000, with a mean of $69,770. 291 sales (~ 60% of the 494) occurred after construction commenced on the nearest wind facility. Of these 291 sales, 73 have views of the turbines, 18 of which are more dramatic than MINOR, and 35 sales occurred within one mile.[109]

Area Statistics

Study Period Begin	Study Period End	Number of Sales	Median Price	Mean Price	Minimum Price	Maximum Price
5/1/1997	3/1/2007	494	$62,000	$69,770	$12,000	$360,000

Facility Statistics

Facility Name	Number of MW	Number of Turbines	Announce Date	Construction Begin Date	Completion Date	Turbine Maker	Hub Height (Meters)
GreenMountain Wind Farm	10.4	8	Jun-99	Dec-99	May-00	Nordex	60
Somerset	9.0	6	Apr-01	Jun-01	Oct-01	Enron	64
Meyersdale	30.0	20	Jan-03	Sep-03	Dec-03	NEG Micon	80

Source: AWEA & Ventyx Inc.

[109] This study area was one of the earliest to have field work completed, and therefore the field data collection process was slower resulting in a lower number of transactions than many other study areas.

Variables of Interest Statistics

Development Period	Pre Announcement	Post Announcement Pre Construction	1st Year After Construction	2nd Year After Construction	2+ Years After Construction	Total
Somerset, PA (PASC)	175	28	46	60	185	494

View of Turbines	Pre Construction	None	Minor	Moderate	Substantial	Extreme	Total
Somerset, PA (PASC)	203	218	55	15	2	1	494

Distance to Nearest Turbine	Pre Construction	< 0.57 Miles	0.57 - 1 Miles	1 - 3 Miles	3 - 5 Miles	> 5 Miles	Total
Somerset, PA (PASC)	203	17	18	132	124	0	494

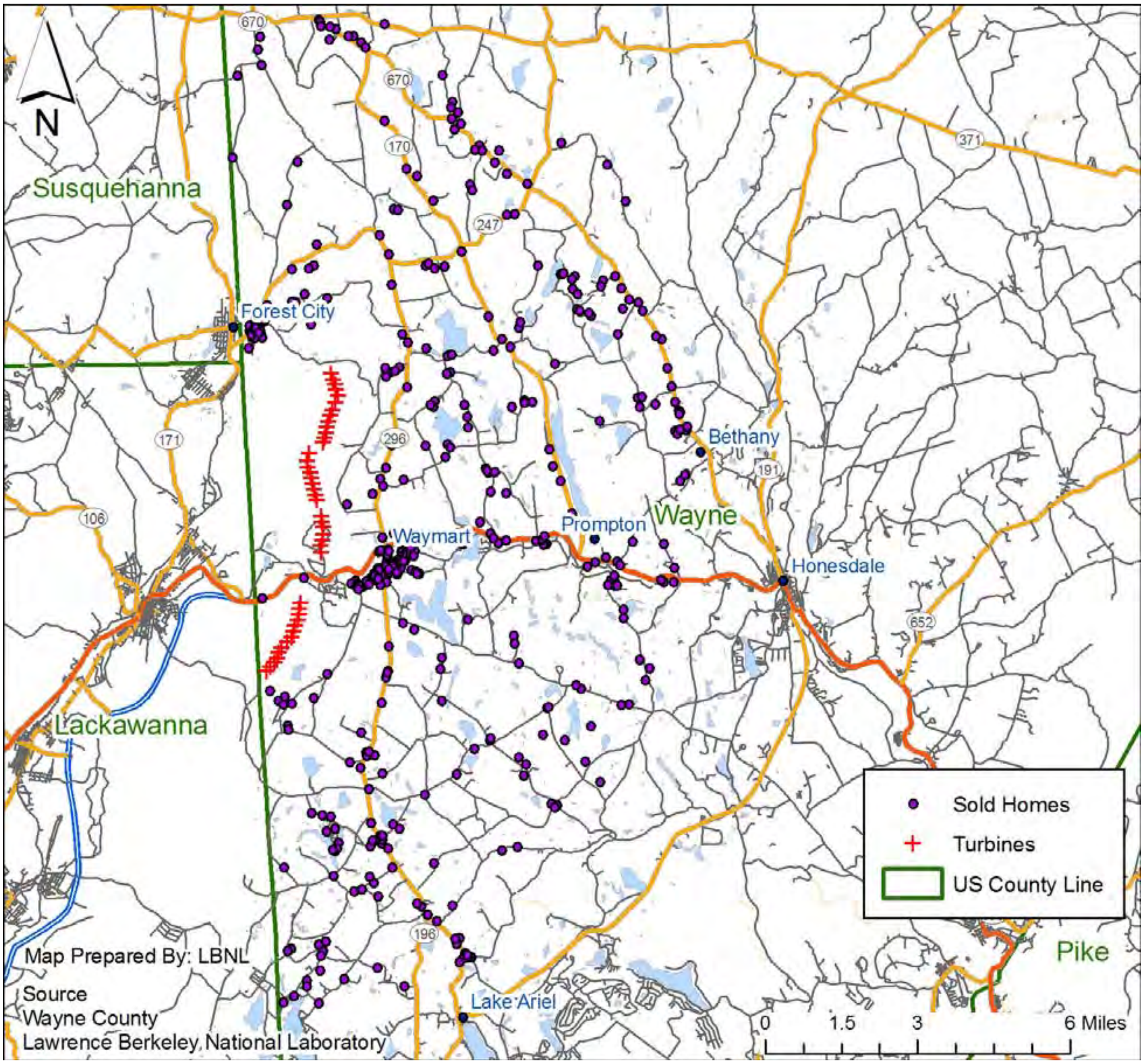
Census Statistics

Name	Type	2007 Population	% Change Since 2000	Population Per Mile^2	Median Age	Median Income	Median House 2007	% Change Since 2000
Somerset	Town	6,398	-4.8%	2,333	40.2	$ 35,293	$ 123,175	n/a
Berlin	Town	2,092	-4.0%	2,310	41.1	$ 35,498	$ 101,704	n/a
Garrett	Town	425	-4.7%	574	34.5	$ 29,898	$ 54,525	n/a
Meyersdale	Town	2,296	-6.6%	2,739	40.9	$ 29,950	$ 79,386	n/a
Somerset Co	County	77,861	-2.7%	72	40.2	$ 35,293	$ 94,500	41%
Pennsylvania	State	12,440,621	1.3%	277	38.0	$ 48,576	$ 155,000	60%
US	Country	301,139,947	6.8%	86	37.9	$ 50,233	$ 243,742	46%

Source: City-Data.com & Wikipedia. "% Change Since 2000" refers to the percentage change between 2000 and 2007 for the figures in the column to the left (population or median house price). "Town" signifies any municipality with less than 10,000 inhabitants. "n/a" signifies data not available.

A.8 PAWC Study Area: Wayne County (Pennsylvania)

Figure A - 9: Map of PAWC Study Area



Note: "Sold Homes" include all sold homes both before and after construction.

<u>Area Description</u>

This study area includes the Waymart wind facility, which sits atop the North-South ridge running along the line separating Wayne County from Lackawanna and Susquehanna Counties in Northeast Pennsylvania. The 43 turbine (65 MW, 213 ft hub height) facility was erected in 2003, and can be seen from many locations in the study area and especially from the towns of Waymart, which sits East of the facility, and Forest City, which straddles Wayne and Susquehanna Counties North of the facility. The study area is dominated topographically by the ridgeline on which the wind turbines are located, but contains rolling hills and many streams, lakes, and natural ponds. Because of the undulating landscape, views of the wind facility can be maintained from long distances, while some homes relatively near the turbines have no view of the turbines whatsoever. The area enjoys a substantial amount of second home ownership because of the bucolic scenic vistas, the high frequency of lakes and ponds, and the proximity to larger metropolitan areas such as Scranton, roughly 25 miles to the Southwest, and Wilkes-Barre a further 15 miles Southwest.

Data Collection and Summary

John Nolan, the County Chief Assessor, was very helpful in overseeing the extraction of the data from county records. GIS specialist Aeron Lankford provided the GIS parcel data as well as other mapping layers, and Bruce Grandjean, the IT and Data Specialist, provided the sales and home characteristic data as well as fielding countless questions as they arose. Additionally, real estate brokers Dotti Korpics of Bethany, Kent Swartz of Re Max, and Tom Cush of Choice #1 Country Real Estate were instrumental providing context for understanding the local market.

The county provided data on 551 valid single-family transactions that occurred between 1996 and 2007, all of which were included in the sample. These sales ranged in price from $20,000 to $444,500, with a mean of $111,522. Because of the relatively recent development of the wind facility, only 40% (*n* = 222) of the sales transaction occurred after the construction of the facility had commenced. Of those sales, 43 (19%) had views of the turbines, ten of which had more dramatic than MINOR views, and 11 were situated within one mile.

Area Statistics

Study Period Begin	Study Period End	Number of Sales	Median Price	Mean Price	Minimum Price	Maximum Price
7/12/1996	9/25/2006	551	$96,000	$111,522	$20,000	$444,500

Facility Statistics

Facility Name	Number of MW	Number of Turbines	Announce Date	Construction Begin Date	Completion Date	Turbine Maker	Hub Height (Meters)
Waymart Wind Farm	64.5	43	Feb-01	Jun-03	Oct-03	GE Wind	65

Source: AWEA & Ventyx Inc.

Variables of Interest Statistics

Development Period	Pre Announcement	Post Announcement Pre Construction	1st Year After Construction	2nd Year After Construction	2+ Years After Construction	Total
Wayne, PA (PAWC)	223	106	64	71	87	551

View of Turbines	Pre Construction	None	Minor	Moderate	Substantial	Extreme	Total
Wayne, PA (PAWC)	329	179	33	8	2	0	551

Distance to Nearest Turbine	Pre Construction	< 0.57 Miles	0.57 - 1 Miles	1 - 3 Miles	3 - 5 Miles	> 5 Miles	Total
Wayne, PA (PAWC)	329	1	10	95	55	61	551

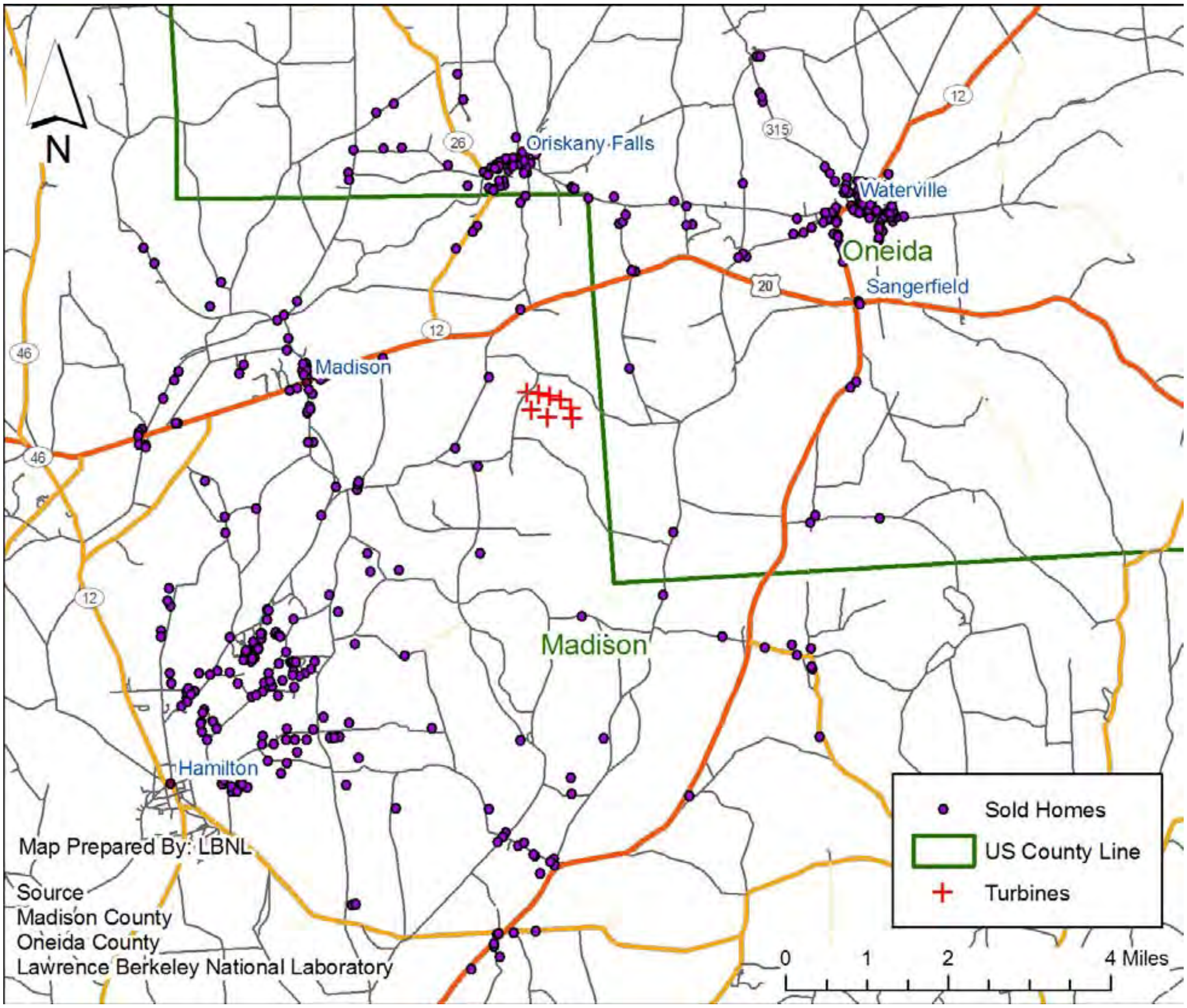
Census Statistics

Name	Type	2007 Population	% Change Since 2000	Population Per Mile^2	Median Age	Median Income	Median House 2007	% Change Since 2000
Waymart	Town	3,075	116.0%	1,111	41.7	$ 43,797	$ 134,651	56%
Forest City	Town	1,743	-5.2%	1,929	45.6	$ 32,039	$ 98,937	67%
Prompton	Town	237	-1.6%	149	41.9	$ 30,322	$ 162,547	56%
Wayne	County	51,708	5.9%	71	40.8	$ 41,279	$ 163,060	57%
Lackawanna	County	209,330	-1.9%	456	40.3	$ 41,596	$ 134,400	48%
Pennsylvania	State	12,440,621	1.3%	277	38.0	$ 48,576	$ 155,000	60%
US	Country	301,139,947	6.8%	86	37.9	$ 50,233	$ 243,742	46%

Source: City-Data.com & Wikipedia. "% Change Since 2000" refers to the percentage change between 2000 and 2007 for the figures in the column to the left (population or median house price). "Town" signifies any municipality with less than 10,000 inhabitants.

A.9 NYMCOC Study Area: Madison and Oneida Counties (New York)

Figure A - 10: Map of NYMCOC Study Area



Note: "Sold Homes" include all sold homes both before and after construction.

<u>Area Description</u>

This study area surrounds the seven turbine (12 MW, 220 ft hub height) Madison wind facility, which sits atop an upland rise in Madison County, New York. The area is roughly 20 miles Southwest of Utica and 40 miles Southeast of Syracuse. The facility is flanked by the towns moving from the Southwest, clockwise around the rise, from Hamilton and Madison in Madison County, NY, to Oriskany Falls, Waterville, and Sangerfield in Oneida County, NY. Hamilton is the home of Colgate University, whose staff lives throughout the area around Hamilton and stretching up into the town of Madison. Accordingly, some development is occurring near the college. To the Northeast, in Oneida County, the housing market is more depressed and less development is apparent. The study area in total is a mix of residential, rural residential, and rural landscapes, with the largest portion being residential homes in the towns or immediately on their outskirts. The topography, although falling away from the location of the wind facility, does not do so dramatically, so small obstructions can obscure the views of the facility.

Data Collection and Summary

Data were obtained from both Madison and Oneida Counties for this study area. In Madison County, Kevin Orr, Mike Ellis, and Carol Brophy, all of County's Real Property Tax Services Department, were extremely helpful in obtaining the sales, home characteristic, and GIS data. In Oneida County, Jeff Quackenbush and Richard Reichert in the Planning Department were very helpful in obtaining the county data. Additionally, discussions with real estate brokers Susanne Martin of Martin Real Estate, Nancy Proctor of Prudential, and Joel Arsenault of Century 21 helped explain the housing market and the differences between Madison and Oneida Counties.

Data on 463 valid sales transactions of single family residential homes that occurred between 1996 and 2006 were obtained, all of which were located within seven miles of the wind facility. These sales ranged in price from $13,000 to $380,000, with a mean of $98,420. Roughly 75% (*n* = 346) of these sales occurred after construction commenced on the wind facility, of which 20 could see the turbines, all of which were rated as having MINOR views, except one which had a MODERATE rating; only two sales involved homes that were situated inside of one mile.

Area Statistics

Study Period Begin	Study Period End	Number of Sales	Median Price	Mean Price	Minimum Price	Maximum Price
1/6/1996	12/26/2006	463	$77,500	$98,420	$13,000	$380,000

Facility Statistics

Facility Name	Number of MW	Number of Turbines	Announce Date	Construction Begin Date	Completion Date	Turbine Maker	Hub Height (Meters)
Madison Windpower	11.6	7	Jan-00	May-00	Sep-00	Vestas	67

Source: AWEA & Ventyx Inc.

Variables of Interest Statistics

Development Period	Pre Announcement	Post Announcement Pre Construction	1st Year After Construction	2nd Year After Construction	2+ Years After Construction	Total
Madison/Oneida, NY (MYMCOC)	108	9	48	30	268	463

View of Turbines	Pre Construction	None	Minor	Moderate	Substantial	Extreme	Total
Madison/Oneida, NY (MYMCOC)	117	326	19	1	0	0	463

Distance to Nearest Turbine	Pre Construction	< 0.57 Miles	0.57 - 1 Miles	1 - 3 Miles	3 - 5 Miles	> 5 Miles	Total
Madison/Oneida, NY (MYMCOC)	117	1	1	80	193	71	463

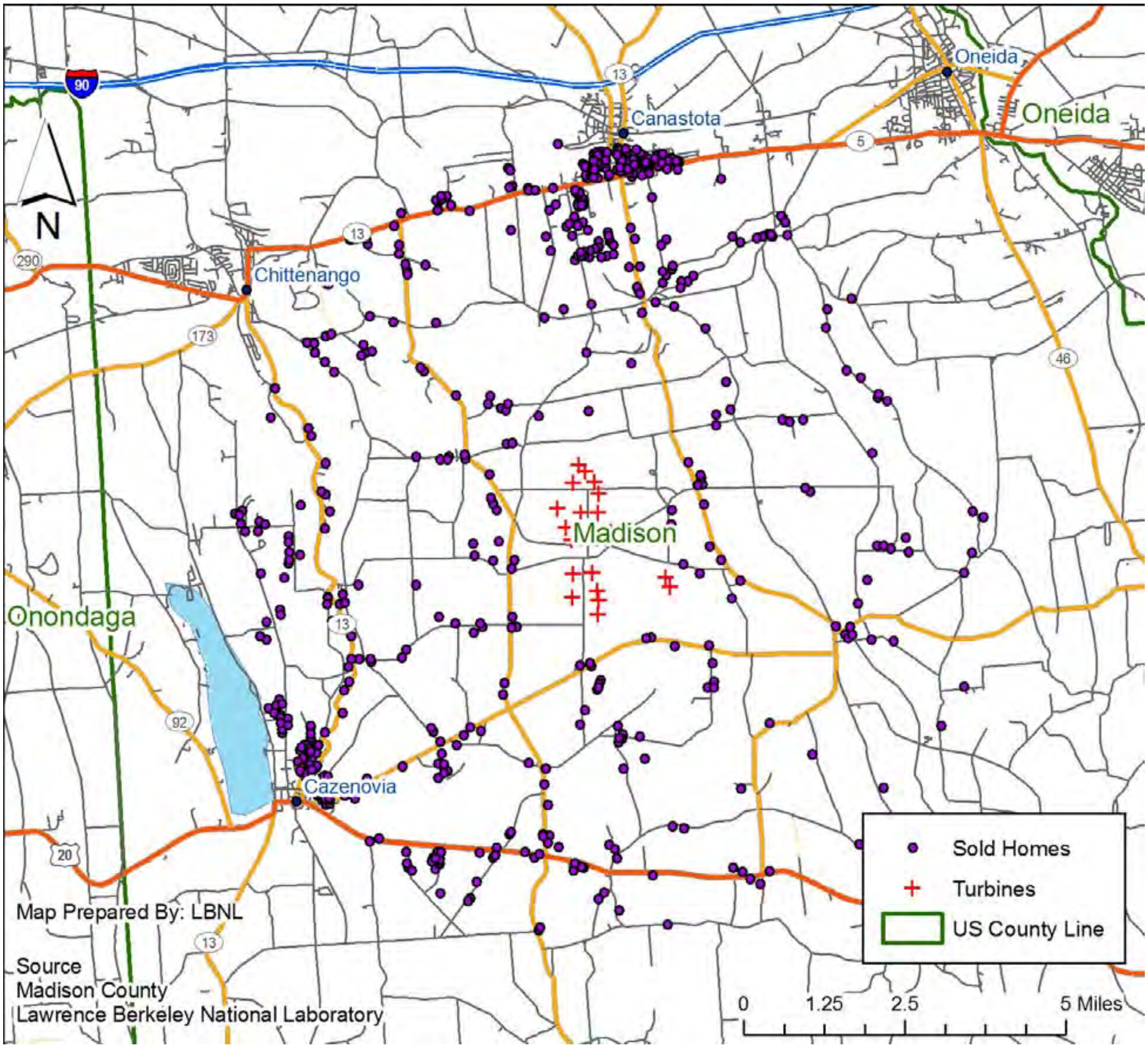
Census Statistics

Name	Type	2007 Population	% Change Since 2000	Population Per Mile^2	Median Age	Median Income	Median House 2007	% Change Since 2000
Madison	Town	304	-2.9%	605	38.1	$ 36,348	$ 94,734	n/a
Hamilton	Town	3,781	7.9%	1,608	20.8	$ 48,798	$ 144,872	n/a
Orinkany Fal	Town	1,413	-2.9%	1,703	40.8	$ 47,689	$ 105,934	n/a
Waterville	Town	1,735	-3.2%	1,308	37.8	$ 46,692	$ 104,816	n/a
Sangerfield	Town	2,626	-1.4%	85	37.6	$ 47,563	$ 106,213	n/a
Madison	County	69,829	0.6%	106	36.1	$ 53,600	$ 109,000	39%
Oneida	County	232,304	-1.3%	192	38.2	$ 44,636	$ 102,300	40%
New York	State	19,297,729	1.7%	408	35.9	$ 53,514	$ 311,000	109%
US	Country	301,139,947	6.8%	86	37.9	$ 50,233	$ 243,742	46%

Source: City-Data.com & Wikipedia. "% Change Since 2000" refers to the percentage change between 2000 and 2007 for the figures in the column to the left (population or median house price). "Town" signifies any municipality with less than 10,000 inhabitants. "n/a" signifies data not available.

A.10 NYMC Study Area: Madison County (New York)

Figure A - 11: Map of NYMC Study Area



Note: "Sold Homes" include all sold homes both before and after construction.

<u>Area Description</u>

This study area surrounds the 20 turbine (30 MW, 218 ft hub height) Fenner wind facility in Madison County, New York, roughly 20 miles East of Syracuse and 40 miles West of Utica in the middle of New York. The study area is dominated by two roughly parallel ridges. One, on which the Fenner facility is located, runs Southeast to Northwest and falls away towards the town of Canastota. The second ridge runs roughly North from Cazenovia, and falls away just South of the town of Chittenango. Surrounding these ridges is an undulating landscape with many water features, including the Chittenango Falls and Lake Cazenovia. A number of high-priced homes are situated along the ridge to the North of Cazenovia, some of which are afforded views of the lake and areas to the West, others with views to the East over the wind facility, and a few having significant panoramic views. The west side of the study area has a number of drivers to its real estate economy: it serves as a bedroom community for Syracuse, is the home to Cazenovia College, and enjoys a thriving summer recreational population. Canastota to the North, and Oneida to the East, are older industrial towns, both of which now serve as feeder communities for Syracuse because of easy access to Highway 90. Between the towns of Cazenovia and Canastota are many rural residential properties, some of which have been recently developed, but most of which are homes at least a half century old.

Data Collection and Summary

Data were obtained from the Madison County Real Property Tax Services department directed by Carol Brophy. As the first study area that was investigated, IT and mapping specialists Kevin Orr and Mike Ellis were subjected to a large number of questions from the study team and were enormously helpful in helping shape what became the blueprint for other study areas. Additionally, real estate brokers Nancy Proctor of Prudential, Joel Arsenault of Century 21, Don Kinsley of Kingsley Real Estate, and Steve Harris of Cazenovia Real Estate were extremely helpful in understanding the local market.

Data on 693 valid sales transactions of single family residential structures that occurred between 1996 and 2006 were obtained, most of which were within five miles of the wind facility. These sales ranged in price from $26,000 to $575,000, with a mean of $124,575. Roughly 68% of these sales (n = 469) occurred after construction commenced on the wind facility, 13 of which were inside of one mile, and 74 of which had views of the turbines. Of that latter group, 24 have more dramatic than MINOR views of the turbines.

Area Statistics

Study Period Begin	Study Period End	Number of Sales	Median Price	Mean Price	Minimum Price	Maximum Price
1/31/1996	9/29/2006	693	$109,900	$124,575	$26,000	$575,000

Facility Statistics

Facility Name	Number of MW	Number of Turbines	Announce Date	Construction Begin Date	Completion Date	Turbine Maker	Hub Height (Meters)
Fenner Wind Power Project	30	20	Dec-98	Mar-01	Nov-01	Enron	66

Source: AWEA & Ventyx Inc.

Variables of Interest Statistics

Development Period	Pre Announcement	Post Announcement Pre Construction	1st Year After Construction	2nd Year After Construction	2+ Years After Construction	Total
Madison, NY (NYMC)	**59**	**165**	**74**	**70**	**325**	**693**

View of Turbines	Pre Construction	None	Minor	Moderate	Substantial	Extreme	Total
Madison, NY (NYMC)	**224**	**395**	**50**	**16**	**8**	**0**	**693**

Distance to Nearest Turbine	Pre Construction	< 0.57 Miles	0.57 - 1 Miles	1 - 3 Miles	3 - 5 Miles	> 5 Miles	Total
Madison, NY (NYMC)	**224**	**2**	**11**	**80**	**374**	**2**	**693**

Census Statistics

Name	Type	2007 Population	% Change Since 2000	Population Per Mile^2	Median Age	Median Income	Median House 2007	% Change Since 2000
Cazenovia	Town	2,835	8.6%	1,801	32.3	$ 58,172	$ 159,553	n/a
Chittenango	Town	4,883	-0.5%	2,000	36.0	$ 58,358	$ 104,845	n/a
Canastota	Town	4,339	-1.7%	1,306	37.3	$ 45,559	$ 93,349	n/a
Oneida	City	10,791	-1.7%	490	36.9	$ 47,173	$ 99,305	n/a
Morrisville	Town	2,155	0.6%	1,869	20.4	$ 45,852	$ 102,352	n/a
Madison	County	69,829	0.6%	106	36.1	$ 53,600	$ 109,000	39%
New York	State	19,297,729	1.7%	408	35.9	$ 53,514	$ 311,000	109%
US	Country	301,139,947	6.8%	86	37.9	$ 50,233	$ 243,742	46%

Source: City-Data.com & Wikipedia. "% Change Since 2000" refers to the percentage change between 2000 and 2007 for the figures in the column to the left (population or median house price). "Town" signifies any municipality with less than 10,000 inhabitants. "n/a" signifies data not available.

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Appendix B: Methodology for Calculating Distances with GIS

For each of the homes in the dataset, accurate measurements of the distance to the nearest wind turbine at the time of sale were needed, and therefore the exact locations of both the turbines and the homes was required. Neither of these locations was available from a single source, but through a combination of techniques, turbine and home locations were derived. This section describes the data and techniques used to establish accurate turbine and home locations, and the process for then calculating distances between the two.

There were a number of possible starting points for mapping accurate wind turbine locations. First, the Energy Velocity data, which covered all study areas, provided a point estimate for project location, but did not provide individual turbine locations. The Federal Aviation Administration (FAA), because of permitting and aviation maps, maintains data on turbine locations, but at the time of this study, that data source did not cover all locations, contained data on structures that no longer exist, and was difficult to use.[110] Finally, in some cases, the counties had mapped the wind turbines into GIS.

In the end, because no single dataset was readily available to serve all study areas, instead the variety of data sources described above was used to map and/or confirm the location of every turbine in the 10 study areas. The process began with high-resolution geocoded satellite and aerial ortho imagery that the United States Department of Agriculture (USDA) collects and maintains under its National Agriculture Imagery Program (NAIP), and which covers virtually all of the areas in this investigation. Where needed, older ortho imagery from the USDA was used. Combining these data with the Energy Velocity data, and discussions with local officials, and maps provided by the county or the developer, locating and mapping all of the turbines in each study area was possible.

Home locations were provided directly by some counties; in other cases, a parcel centroid was created as a proxy.[111] In some situations, the centroid did not correspond to the actual house location, and therefore required further refinement. This refinement was only required and conducted if the parcel was near the wind turbines, where the difference of a few hundred feet, for example, could alter its distance rating in a meaningful fashion, or when the parcel included a considerable amount of acreage, where inaccuracy in home location could be considerable. Therefore, parcels inside of 1.5 miles of the nearest wind turbine and of any size, and parcels outside of 1.5 miles and larger than 5 acres, were both examined using the USDA NAIP imagery to determine the exact home location. In cases where the parcel centroid was not centered over the home, the location was adjusted, using the ortho image as a guide, to the actual house location.

With both turbine and home locations identified, the next step was to determine distances between the two. To do so, the date when each transaction in the sample occurred was taken into

[110] A newer FAA database is now available that clears up many of these earlier concerns.

[111] A "parcel centroid" is the mathematical center point of a polygon, and was determined by XTools Pro (www.xtoolspro.com).

account, combined with the determination of which turbines were in existence at what time.[112] This required breaking the transactions in the sample into three categories: 1) those occurring before any wind facility was announced in the study area, 2) those occurring after the first wind facility was announced in the area but before all development was complete in the area, and 3) those occurring after all wind development in the area was complete. Any sale that occurred before wind development was announced in the study area was coded with a distance to the nearest turbine derived from the actual turbine locations after all wind development had occurred.[113] Homes that sold after all wind development had occurred were treated similarly, with distances derived from the set of turbines in place after all development had taken place. The final set of homes - those that sold after announcement of the first facility, but before the construction of the last - had to be treated, essentially, on a case by case basis. Some homes were located within five miles of one wind facility but more than five miles from another wind facility in the same study area (e.g., many homes in PASC). In this case the distance to that closer facility could be applied in a similar fashion as would be the case if only one facility was erected (e.g., NYMC or PAWC). Another group of homes, those that sold during the development of the first facility in the study area, were given the distance to that facility, regardless of distance to the other facilities in the study area. The final and most complicated group of homes consisted of those that were within five miles of multiple wind facilities, and that sold after the first facility had been erected. In those cases, the exact configuration of turbines was determined for each stage of the development process. In study areas with multiple facilities that were developed over multiple periods, there might be as many as six possible configurations (e.g., IABV). In this final scenario, the distance to the closest turbine was used, assuming it had been "announced" at the time of sale.

Once the above process was complete, the mechanics of calculating distances from the turbines to the homes was straightforward. After establishing the location of a set of turbines, for instance those constructed in the first development in the area, a euclidian distance raster was derived that encompassed every home in the study area.[114] The calculations were made using a 50-foot resolution state-plane projection and North American Datum from 1983 (NAD83). As discussed above, similar rasters were created for each period in the development cycle for each study area, depending on the turbine configuration at that time. Ultimately, a home's sale date was matched to the appropriate raster, and the underlying distance was extracted. Taking everything into account discussed above, it is expected that these measurements are accurate to

[112] It is recognized that the formal date of sale will follow the date at which pricing decisions were made. It is also recognized, as mentioned in Section 3, that wind facility announcement and construction dates are likely to be preceded by "under the radar" discussions in the community. Taken together, these two factors might have the effect, in the model, of creating some apparent lag in when effects are shown, compared to the earlier period in which effects may begin to occur. For this to bias the results, however, effects would have to disappear or dramatically lesson with time (e.g., less than one year after construction) such that the effects would not be uncovered with the models in later periods. Based on evidence from other potentially analogous infrastructure (e.g., HVTL), any fading of effects would likely occur over many years, so it is assumed that any bias is likely minimal.

[113] These distances were used to compare homes sold, for instance, within 1 mile of where the turbines were eventually erected with similar homes sold after the turbines were erected (see, for example, the Temporal Aspects Model).

[114] A "Raster" is a grid of, in this case, 50 feet by 50 feet squares, each of which contains a number representing the number of feet from the center of the square to the nearest turbine.

within roughly 150 feet inside of 1.5 miles and within a maximum of roughly 1150 feet outside of 1.5 miles.[115]

[115] The resolution of the raster is 50 feet, so the hypotenuse is 70 feet. If the home is situated in the top left of a raster cell and the turbine is situated in the bottom right of a diagonally adjacent cell, they could be separated by as much as 140 feet, yet the raster distance would only be 50 feet, a difference of 90 feet. Moreover, the resolution of the Ortho image is 40 feet so that location could additionally be off by another 55 feet along the diagonal. These two uncertainties total to roughly 150 feet for homes inside of 1.5 miles. Outside of 1.5 miles the variation between centroid and house location for parcels smaller than 5 acres could be larger still. If a 4.9 acre parcel had a highly irregular rectangular shape of 102 by 2100 feet, for instance, the centroid could be as much as 1050 feet from the property line. If the home was situated 50 feet from the property line then the actual house location could be off by as much as 1000 feet. Adding this to the 150 feet from above leads to a total discrepancy of 1150 feet (0.22 miles) for homes outside of 1.5 miles on parcels smaller than 5 acres. Of course, these extreme scenarios are highly unlikely to be prevalent.

Appendix C: Field Data Collection Instrument

Figure A - 12: Field Data Collection Instrument

House # (Control/ Key #)			County		
House Address					
Home Characteristics			**House Photo Number(s)**		
Cul-De-Sac?	No(0) / Yes(1)		Waterfront?		No(0) / Yes(1)
Scenic Vista Characteristics			**Vista Photo Numbers**		
Overall Quality of Scenic Vista: Poor (1), Below Average (2), Average (3), Above Average (4), Premium (5)					
View of Turbines Characteristics			**View Photo Numbers**		
Total # of Turbines visible			Orientation of Home to View: See Below		
# of Turbines- blade tips only visible			Side (S), Front (F), Back (B), Angled (A)		
# of Turbines- nacelle/hub visible					
# of Turbines- tower visible			View Scope: Narrow(1), Medium(2), Wide(3)		
The Degree to which the View of Turbines Dominate the Site? Non-Existent (0), Minor (1), Moderate (2), Substantial (3), Extreme (4)					
Degree to which the Turbines Overlap the Prominent Scenic Vista? Not at all (0), Barely (1), Somewhat (2), Strongly (3), Entirely (4)					
Notes:					

Figure A - 13: Field Data Collection Instrument - Instructions - Page 1

Home Characteristics

Cul-De-Sac? No(0)/Yes(1)	Is the home situated on a cul-de-sac?
Waterfront? No(0)/Yes(1)	Is the home situated on the waterfront?

"Vista" Characteristics

Overall Quality of Scenic Vista: Poor (1)	This rating is reserved for vistas of unmistakably poor quality. These vistas are often dominated by visually discordant man-made alterations (not considering turbines), or are uncomfortable spaces for people, lack interest, or have virtually no recreational potential.
Overall Quality of Scenic Vista: Below Average (2)	The home's vista is of the below average quality. These vistas contain visually discordant man-made alterations (not considering turbines) but are not dominated by them. They are not inviting spaces for people, but are not uncomfortable. They have little interest, mystery and have minor recreational potential.
Overall Quality of Scenic Vista: Average (3)	The home's vista is of the average quality. These vistas include interesting views which can be enjoyed often only a narrow scope. These vistas may contain some visually discordant man-made alterations (not considering turbines), are moderately comfortable spaces for people, have some interest, and have minor recreational potential.
Overall Quality of Scenic Vista: Above Average (4)	The vista from the home is of above average quality. These vistas include interesting views which often can be enjoyed in a medium to wide scope. They might contain some man made alterations (not considering turbines), yet still possess significant interest and mystery, are moderately balanced and have some potential for recreation.
Overall Quality of Scenic Vista: Premium (5)	This rating is reserved for vistas of unmistakably premium quality. These vistas would include "picture post card" views which can be enjoyed in a wide scope. They are often free or largely free of any discordant man made alterations (not considering turbines), possess significant interest, memorable qualities, mystery and are well balanced and likely have a high potential for recreation.
Degree Turbines Overlap Prominent Vista? Not at all (0))	The vista does not contain any view of the turbines.
Degree Turbines Overlap Prominent Vista? Barely (1)	A small portion (~ 0 - 20%) of the vista is overlapped by the view of turbines therefore the vista might contain a view of a few turbines, only a few of which can be seen entirely (from below the sweep of the blades to the top of their tips).
Degree Turbines Overlap Prominent Vista? Somewhat (2)	A moderate portion (~20-50%) of the vista contains turbines, and likely contains a view of more than one turbine, some of which are likely to be seen entirely (from below the sweep of the blades to the top of their tips).
Degree Turbines Overlap Prominent Vista? Strongly (3)	A large portion (~50-80%) of the vista contains a view of turbines, many of which likely can be seen entirely (from below the sweep of the blades to the top of their tips).
Degree Turbines Overlap Prominent Vista? Entirely (4)	This rating is reserved for situations where the turbines overlap virtually the entire (~80-100%) vista from the home. The vista likely contains a view of many turbines, virtually all of which can be seen entirely (from below the sweep of the blades to the top of their tips).

Figure A - 14: Field Data Collection Instrument - Instructions - Page 2

View of Turbines Characterist

House Orientation to View of Turbines: Side (S)	Orientation of home to the view of the turbines is from the side.
House Orientation to View of Turbines: Front (F)	Orientation of home to the view of the turbines is from the front.
House Orientation to Vista of Turbines: Back (B)	Orientation of home to the view of the turbines is from the back.
House Orientation to Vista of Turbines: Angled (A)	Orientation of home to the view of the turbines is from an angle.
View of Turbines Scope: Narrow(1)	The view of the turbines is largely blocked by trees, large shrubs or man made features in the foreground (0-300 feet) allowing 0 - 30 degrees of view of the wind facility
View of Turbines Scope: Medium(2)	The view of turbines is partially blocked by trees, large shrubs or man made features in the foreground (0-300 feet) allowing only 30-90 degrees of view of the wind facility.
View of Turbines Scope: Wide(3)	The view of the turbines is free or almost free from blockages by trees, large shrubs or man made features in the foreground (0-300 feet) allowing at least 90 degrees of view of the wind facility.
Degree to which View of Turbines Dominates the Site? None (0)	The turbines are not visible at all frrom this home.
Degree to which View of Turbines Dominates the Site? Minor (1)	The turbines are visible but either the scope is narrow, there are many obstructions, or the distance between the home and the facility is large.
Degree to which View of Turbines Dominates the Site? Moderate (2)	The turbines are visible but the scope is either narrow or medium, there might be some obstructions, and the distance between the home and the facility is most likely a few miles.
Degree to which View of Turbines Dominates the Site? Substantial (3)	The turbines are dramatically visible from the home. The turbines are likely visible in a wide scope, and most likely the distance between the home and the facility is short.
Degree to which View of Turbines Dominates the Site? Extreme (4)	This rating is reserved for sites that are unmistakably dominated by the presence of the windfarm. The turbines are dramatically visible from the home and there is a looming quality to their placement. The turbines are often visible in a wide scope, or the distance to the facility is very small.

Appendix D: Vista Ratings with Photos

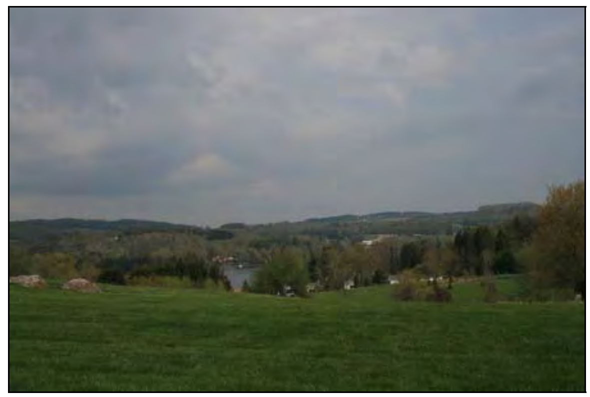
POOR VISTA

BELOW AVERAGE VISTA

AVERAGE VISTA

ABOVE AVERAGE VISTA

PREMIUM VISTA



Appendix E: View Ratings with Photos

MINOR VIEW

3 turbines visible from front orientation, nearest 1.4 miles (TXHC)

5 turbines visible from front orientation, nearest 0.9 miles (NYMC)

MODERATE VIEW

18 turbines visible from back orientation, nearest 1.6 miles (ILLC)

6 turbines visible from back orientation, nearest 0.8 miles (PASC)

SUBSTANTIAL VIEW

90 turbines visible from all orientations, nearest 0.6 miles (IABV)

27 turbines visible from multiple orientations, nearest 0.6 miles (TXHC)

EXTREME VIEW

6 turbines visible from multiple orientations, nearest 0.2 miles (WIKCDC)

212 turbines visible from all orientations, nearest 0.4 miles (IABV)

Appendix F: Selecting the Primary ("Base") Hedonic Model

Equation (1) as described in Section 4.2 is presented in this report as the primary (or "Base") model to which all other models are compared. As noted earlier, in the Base Hedonic Model and in all subsequent models presented in Section 5 all variables of interest, spatial adjustments, and home and site characteristics are pooled, and therefore their estimates represent the average across all study areas. Ideally, one would have enough data to estimate a model at the study area level - a fully unrestricted model - rather than pooled across all areas. In this appendix, alternative model forms are presented that unrestrict these variables at the level of study areas. As shown here, these investigations ultimately encouraged the selection of the somewhat simpler pooled Base Model as the primary model, and to continue to use restricted or pooled models in the alternative hedonic analyses.

F.1 Discussion of Fully Unrestricted Model Form

The Base Model described by equation (1) has variables that are pooled, and the coefficients for these variables therefore represent the average across all study areas (after accounting for study area fixed effects). An alternative (and arguably superior) approach would be to estimate coefficients at the level of each study area, thereby allowing coefficient values to vary among study areas.[116] This fully interacted – or unrestricted – model would take the following form:

$$\ln(\mathrm{P}) = \beta_0 + \sum_{s}\beta_1(\mathrm{N}\cdot\mathrm{S}) + \sum_{c}\beta_2(\mathrm{Y}) + \sum_{k}\beta_3(\mathrm{X}\cdot\mathrm{S}) + \sum_{v}\beta_4(\mathrm{VIEW}\cdot\mathrm{S}) + \sum_{d}\beta_5(\mathrm{DISTANCE}\cdot\mathrm{S}) + \varepsilon \quad \text{(F13)}$$

where

P represents the inflation-adjusted sale price,

N is the spatially weighted neighbors' predicted sale price,

S is a vector of *s* study areas (e.g., WAOR, OKCC, etc.),

Y is a vector of *c* study area locational characteristics (e.g., census tract, school district, etc.),

X is a vector of k home and site characteristics (e.g., acres, square feet, number of bathrooms, condition of the home, age of home, VISTA, etc.),

VIEW is a vector of v categorical view of turbine variables (e.g., MINOR, MODERATE, etc.),

DISTANCE is a vector of d categorical distance to turbine variables (e.g., less than 3000 feet, between one and three miles, etc.),

β_0 is the constant or intercept across the full sample,

β_1 is a vector of *s* parameter estimates for the spatially weighted neighbor's predicted sale price for S study areas,

β_2 is a vector of *c* parameter estimates for the study area locational fixed effect variables,

β_3 is a vector of *k* parameter estimates for the home and site characteristics for S study areas,

β_4 is a vector of *v* parameter estimates for the VIEW variables as compared to homes sold with no view of the turbines for S study areas,

[116] For instance, the marginal contribution of Acres (the number of acres) to the selling price would be estimated for each study area (i.e., Acres_WAOR, Acres_TXHC etc.), as would the variables of interest: VIEW and DISTANCE.

β_5 is a vector of *d* parameter estimates for the DISTANCE variables as compared to homes sold situated outside of five miles for S study areas, and
ε is a random disturbance term.

To refresh, the fully restricted equation (1) takes the following form:

$$\ln(\mathrm{P}) = \beta_0 + \beta_1 \mathrm{N} + \sum_s \beta_2 \mathrm{S} + \sum_k \beta_3 \mathrm{X} + \sum_v \beta_4 \mathrm{VIEW} + \sum_d \beta_5 \mathrm{DISTANCE} + \varepsilon \qquad (1)$$

where
P represents the inflation-adjusted sale price,
N is the spatially weighted neighbors' predicted sale price,
S is the vector of *s* Study Area fixed effects variables (e.g., WAOR, OKCC, etc.),
X is a vector of *k* home and site characteristics (e.g., acres, square feet, number of bathrooms, condition of the home, age of home, VISTA, etc.),
VIEW is a vector of *v* categorical view of turbine variables (e.g., MINOR, MODERATE, etc.),
DISTANCE is a vector of *d* categorical distance to turbine variables (e.g., less than 3000 feet, between one and three miles, etc.),
β_0 is the constant or intercept across the full sample,
β_1 is a parameter estimate for the spatially weighted neighbor's predicted sale price,
β_2 is a vector of *s* parameter estimates for the study area fixed effects as compared to homes sold in the Washington/Oregon (WAOR) study area,
β_3 is a vector of *k* parameter estimates for the home and site characteristics,
β_4 is a vector of *v* parameter estimates for the VIEW variables as compared to homes sold with no view of the turbines,
β_5 is a vector of *d* parameter estimates for the DISTANCE variables as compared to homes sold situated outside of five miles, and
ε is a random disturbance term.

The significant change between equations (1) and (F13) is that each of the primary groups of variables in equation (F13) is interacted with the study areas (S) so that parameters can be estimated at the study area level. For example, whereas ACRES is estimated in equation (1) across all study areas, in equation (F13) it is estimated for each study area (i.e., Acres_WAOR, Acres_TXHC, etc).[117] Similarly, when considering the possible impact of wind facilities on residential sales prices, equation (1) seeks average effects that exist over the entire sample, while equation (F13) instead looks for differential effects in each individual study area. Additionally, in equation (F13), instead of estimating fixed effects using inter-study area parameters alone (e.g., WAOR, TXHC), a set of intra-study area effects (Y) - school district and census tract delineations - are added.[118] These latter coefficients represent not only effects that are presumed

[117] This change is made because, theoretically, the contribution to sales prices of home or site characteristics may differ between study areas – for instance Central_AC in Texas vs. New York – and therefore estimating them at the study area level may increase the explanatory power of the model.

[118] In the evaluation and selection of the best model to use as the "Base Model" a set of census tract and school district delineations were used instead of the study area fixed effects. These more-granular fixed effects were extracted from GIS using house locations and census tract and school district polygons. Often, the school district and census tract delineations were not mutually exclusive. For example, in Wisconsin the WIKCDC study area contains four school districts and six census tracts, none of which completely overlap. Alternatively, in some study

to exist over each entire study area (inter-study area effects), but also intra-study area effects such as differences in home valuation due to school districts, distances to amenities, and other locationally bound influences. As with the inter-study area coefficients, because of the myriad influences captured by these variables, interpretation of any single coefficient can be difficult. However, it is expected that such coefficients would be influential, indicating significant differences in value between homes in each study area and across study areas due to school district quality and factors that differ between census tracts (e.g., crime rates).

Although the fully unrestricted model described by equation (F13) is arguably superior to the fully restricted model described in equation (1) because of its ability to resolve differences between and within study areas that are not captured by the Base Model, there are three potential drawbacks:

- Model parsimony and performance;
- Standard error magnitudes; and
- Parameter estimate stability.

Each of these potential drawbacks is discussed in turn below:

Model parsimony and performance: In general, econometricians prefer a simpler, more parsimonious statistical model. In this instance, variables should be added to a model only if their addition is strongly supported by theory and if the performance of the model is substantially improved by their inclusion. As such, if a model with a relatively small number of parameters performs well, it should be preferred to a model with more parameters unless the simple model can be "proven to be inadequate" (Newman, 1956). To prove the inadequacy of a simpler model requires a significant increase in performance to be exhibited from the more complex model. In this case, as presented later, performance is measured using the combination of Adjusted R^2, Modified R^2, and the Schwarz information criterion (see footnote 119 on page 127).

Standard error magnitudes: The magnitude of the standard errors for the variables of interest, as well as the other controlling variables, are likely to increase in the unrestricted model form because the number of cases for each variable will decrease when they are estimated at the study area level. Within each study area, there are a limited number of home transactions that meet the criteria for inclusion in the model, but even more limiting is the number of home transactions within each study area that have the characteristics of interest. For example, in Lee County, IL (ILLC), there are 205 post-construction home sales, while in Wayne County, PA (PAWC) there are 222. More importantly, in those areas, the data include a total of one and eleven sales inside of one mile, respectively, and a total of one and two homes with either EXTREME or SUBSTANTIAL rated views of turbines. With so few observations, there is increased likelihood that a single or small group of observations will strongly influence the sample mean of an independent variable. Since the standard error is derived from the variance of the parameter estimate, which in turn is derived from the summed deviation of each observation's actual level relative to its sample mean, this standard error is more likely to be larger than if a larger sample were considered. If the presence of wind facilities does have a detrimental effect on property

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areas the school district and census tracts perfectly overlapped, and in those cases either both were omitted as the reference category or one was included and the other withdrawn from the model to prevent perfect collinearity.

values, that effect seems likely to be relatively small, at least outside of the immediate vicinity of the wind turbines. The smaller sample sizes for the independent variables that come with the unrestricted model, which may decrease statistical precision by producing larger standard errors, would likely decrease the ability to accurately identify these possible effects statistically. To explore the magnitude of this concern, the difference in standard errors of the variables of interest is investigated among the restricted and unrestricted models.

Parameter estimate stability: In an unrestricted model, parameter estimates are more likely to be unstable because the sample of home transactions with any particular characteristic may be small and thus not representative of the population as a whole. As mentioned above, there are a limited number of transactions within each study area that have the characteristics of interest. Restricting the sample size by using an unrestricted model increases the likelihood that a limited number of observations, which in the population as a whole represent a very small segment, will drive the results in one direction or another, thereby leading to erroneous conclusions. The difference in parameter estimates is investigated by comparing the coefficients for the unrestricted variables of interest to those for the restricted variables of interest. Additionally, the sign of any significant variables will be investigated for the unrestricted models, which might help uncover potentially spurious results.

F.2 Analysis of Alterative Model Forms

Here the spectrum of alternative models is explored, from the fully restricted equation (1) to the fully unrestricted equation (F13). To do so, not only are these two ends of the spectrum estimated, but also 14 intermediate models are estimated that consist of every combination of restriction of the four variable groups (i.e., variables of interest, spatial adjustments, study area delineations, and home and site characteristics). This produces a total of 16 models over which to assess model parsimony and performance, standard error size, and coefficient stability. This process allows for an understanding of model performance but, more importantly, to ultimately define a "Base Model" that is parsimonious (i.e., has the fewest parameters), robust (i.e., high adjusted R^2), and best fits the purpose of investigating wind facility impacts on home sales prices.

Table A - 2 presents the performance statistics for each of the 16 models defined above, moving from the fully restricted model equation (1) ("Model 1") to the fully unrestricted model equation (F13) ("Model 16"). In columns 2 – 5 of the table, the "R" represents a restriction for this variable group (i.e., not crossed with the study areas) and the "U" represents the case when the variable group is unrestricted (i.e., crossed with the study areas). Also shown are summary model statistics (i.e., Adjusted R^2, Modified R^2, and Schwarz information criterion - "SIC"), as well as the number of estimated parameters (*k*).[119] All models were run using the post-construction data subset of the sample of home sales transactions (*n* = 4,937).

[119] Goldberger (1991), as cited by Gujarati (2003), suggests using a Modified $R^2 = (1 – k/n) * R^2$ to adjust for added parameters. For example, Models 1 and 14 have Modified R^2 of 0.76, yet Adjusted R^2 of 0.77 and 0.78 respectively. Therefore the Modified R^2 penalizes their measure of explanatory power more than the Adjusted R^2 when taking into account the degrees of freedom. Similarly, the Schwarz information criterion penalizes the models for increased numbers of parameters (Schwarz, 1978). More importantly, practitioners often rely on the Schwarz criterion – over the Modified or Adjusted R^2 statistics - to rank models with the same dependent variable by their relative parsimony (Gujarati, 2003). Therefore it will be used for that purpose here.

Model Parsimony and Performance
Overall, the fully restricted model (1) performs well with only 37 independent variables, producing an Adjusted R^2 of 0.77. Despite the limited number of explanatory variables, the model explains ~77% of the variation in home prices in the sample. When the fully unrestricted model 16 (equation F13) is estimated, which lies at the other end of the spectrum, it performs only slightly better, with an Adjusted R^2 of 0.81, but with an additional 285 explanatory variables. It is therefore not surprising that the Modified R^2 is 0.76 for Model 1 and is only 0.77 for Model 16. Similarly, the Schwarz information criterion (SIC) increases from 0.088 to 0.110 when moving from model 1 to model 16 indicating relatively less parsimony. Combined, these metrics show that the improvement in the explanatory power of model 16 over model 1 is not enough to overcome the lack of parsimony. Turning to the 14 models that lie between Models 1 and 16, in general, little improvement in performance is found over Model 1, and considerably less parsimony, providing little initial justification to pursue a more complex specification than equation (1).

Table A - 2: Summarized Results of Restricted and Unrestricted Model Forms

Model [1]	Study Area [2]	Spatial Adjustment	Home and Site Characteristics	Variables of Interest	Adj R^2	Modified R^2	SIC	*k* †
1	R	R	R	R	0.77	0.76	0.088	37
2	U	R	R	R	0.74	0.73	0.110	111
3	R	U	R	R	0.77	0.76	0.088	46
4	R	R	U	R	0.80	0.78	0.095	188
5	R	R	R	U	0.77	0.76	0.093	88
6	U	U	R	R	0.78	0.76	0.094	120
7	R	U	U	R	0.80	0.77	0.096	197
8	R	R	U	U	0.80	0.77	0.101	239
9	U	R	U	R	0.80	0.77	0.107	262
10	U	R	R	U	0.76	0.75	0.107	162
11	R	U	R	U	0.77	0.76	0.094	97
12	U	U	U	R	0.81	0.77	0.103	271
13	R	U	U	U	0.80	0.77	0.103	248
14	U	U	R	U	0.78	0.76	0.100	171
15	U	R	U	U	0.80	0.76	0.113	313
16	U	U	U	U	0.81	0.77	0.110	322

"R" indicates parameters are pooled ("restricted") across the study areas.
"U" indicates parameters are not pooled ("unrestricted"), and are instead estimated at the study area level.
1 **-** *Model numbers do not correspond to equation numbers listed in the report; equation (1) is Model 1, and equation (F1) is Model 16.*
2 **-** *In its restricted form "Study Area" includes only inter-study area delineations, while unrestricted "Study Area" includes intra-study area delineations of school district and census tract.*
† **-** *Numbers of parameters do not include intercept or omitted variables.*

The individual contributions to model performance from unrestricting each of the variable groups in turn (as shown in Models 2-5) further emphasizes the small performance gains that are earned despite the sizable increases in the number of parameters. As a single group, the unrestricted Home and Site Characteristics model (Model 4) makes the largest impact on model performance, at least with respect to the Adjusted R^2 (0.80), but this comes with the addition of 151 estimated parameters a slight improvement in the Modified R^2 (0.78) and a worsening SIC (0.095). Adding unrestricted Study Area delineations (Model 2), on the other hand, adversely affects performance (Adj. R^2 = 0.74, Modified R^2 = 0.73) and adds 74 estimated parameters (SIC = 0.110). Similarly, unrestricting the Spatial Adjustments (Model 3) offers little improvement in performance (Adj. R^2 = 0.77, Modified R^2 = 0.76) despite adding nine additional variables (SIC = 0.088). Finally, unrestricting the Variables of Interest (Model 5) does not increase model performance (Adj. R^2 = 0.77, Modified R^2 = 0.76) and adds 51 variables to the model (SIC = 0.093). This pattern of little model improvement yet considerable increases in the number of estimated parameters (i.e., less parsimony) continues when pairs or trios of variable groups are unrestricted. With an Adjusted R^2 of 0.77, the fully restricted equation (1) performs more than adequately, and is, by far, the most parsimonious.

Standard Error Magnitudes

Table A - 3 summarizes the standard errors for the variables of interest for all of the 16 models, grouped into restricted and unrestricted model categories. The table specifically compares the medians, minimums, and maximums of the standard errors for the models with restricted variables of interest (1, 2, 3, 4, 6, 7, 9 and 12) to those with unrestricted variables of interest (5, 8, 10, 11, 13, 14, 15 and 16).[120] The table demonstrates that the unrestricted standard errors for the variables of interest are significantly larger than the restricted standard errors. In fact, the minimum standard errors in the unrestricted models are often higher than the maximum standard errors produced in the restricted models. For example, the maximum standard error for an EXTREME VIEW in the restricted models is 0.09, yet the minimum in the unrestricted models is 0.12, with a maximum of 0.34. To put this result in a different light, a median standard error for the unrestricted EXTREME VIEW variable of 0.25 would require an effect on house prices larger than 50% to be considered statistically significant at the 90% level. Clearly, the statistical power of the unrestricted models is weak.[121] Based on other disamenities, as discussed in Section 2.1, an effect of this magnitude is very unlikely. Therefore, based on these standard errors, there is no apparent reason to unrestrict the variables of interest.

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[120] For the restricted models, the medians, minimums, and maximums are derived across all eight models for each variable of interest. For the unrestricted models, they are derived across all study areas and all eight models for each variable of interest.

[121] At 90% confidence a standard error of 0.25 would produce a confidence interval of roughly +/- 0.42 (0.25 * 1.67). An effect of this magnitude represents a 52% change in sales prices because sales price is in a natural log form (*e* ^ 0.42-1 = 0.52).

Table A - 3: Summary of VOI Standard Errors for Restricted and Unrestricted Models

Standard Errors	Restricted Models Standard Errors			Unrestricted Models Standard Errors		
	Median	Min	Max	Median	Min	Max
Minor View	0.01	0.01	0.02	0.05	0.03	0.07
Moderate View	0.03	0.03	0.03	0.10	0.06	0.18
Substantial View	0.05	0.05	0.06	0.19	0.10	0.29
Extreme View	0.08	0.08	0.09	0.25	0.12	0.34
Inside 3000 Feet	0.05	0.05	0.06	0.21	0.09	0.33
Between 3000 Feet and 1 Mile	0.04	0.04	0.05	0.13	0.08	0.40
Between 1 and 3 Miles	0.02	0.02	0.02	0.05	0.02	0.11
Between 3 and 5 Miles	0.01	0.01	0.02	0.05	0.02	0.10

Parameter Estimate Stability

Table A - 4 summarizes the coefficient estimates for the variables of interest for all of the 16 models. The table specifically compares the medians, minimums, and maximums of the coefficients for the models with restricted variables of interest (1, 2, 3, 4, 6, 7, 9 and 12) to those with unrestricted variables of interest (5, 8, 10, 11, 13, 14, 15 and 16). As shown, the coefficients in the unrestricted models diverge significantly from those in the restricted models. For example, in the restricted models, the median coefficient for homes inside of 3000 feet is -0.03, with a minimum of -0.06 and a maximum of -0.01, yet in the unrestricted models the median coefficient is 0.06, with a minimum of -0.38 and a maximum of 0.32. Similarly, a MODERATE VIEW in the restricted models has a median of 0.00, with a minimum of -0.01 and a maximum of 0.03, whereas the unrestricted models produce coefficients with a median of -0.05 and with a minimum of -0.25 and a maximum of 0.35.

Table A - 4: Summary of VOI Coefficients for Restricted and Unrestricted Models

Parameters	Restricted Models Coefficients			Unrestricted Models Coefficients		
	Median	Min	Max	Median	Min	Max
Minor View	-0.02	-0.03	0.00	-0.02	-0.16	0.24
Moderate View	0.00	-0.01	0.03	-0.05	-0.25	0.35
Substantial View	-0.01	-0.04	0.02	-0.08	-0.31	0.13
Extreme View	0.03	0.02	0.05	-0.03	-0.23	0.09
Inside 3000 Feet	-0.03	-0.06	-0.01	0.06	-0.38	0.32
Between 3000 Feet and 1 Mile	-0.04	-0.06	-0.01	-0.10	-0.44	0.52
Between 1 and 3 Miles	-0.01	-0.03	0.02	0.00	-0.23	0.40
Between 3 and 5 Miles	0.02	0.01	0.04	0.05	-0.05	0.32

Turning from the levels of the coefficients to the stability of their statistical significance and sign across models more reasons for concern are found. Table A - 5 summarizes the results of the unrestricted models, and presents the number of statistically significant variables of interest as a percent of the total estimated. The table also breaks these results down into two groups, those with coefficients above zero and those with coefficients below zero.[122] It should be emphasized here that it is the *a priori* expectation that, if effects exist, all of these coefficients would be less than zero, indicating an adverse effect on home prices from proximity to and views of wind turbines. Despite that expectation, when the variables of interest are unrestricted it is found that they are as likely to be above zero as they are below.[123] In effect, the small numbers of cases available for analysis at the study area level produce unstable results, likely because the estimates are being unduly influenced by either study area specific effects that are not captured by the model or by a limited number of observations that represents a larger fraction of the overall sample in that model.[124]

Table A - 5: Summary of Significant VOI Above and Below Zero in Unrestricted Models

Significant Variables	Unrestricted Models		
	Total	Below Zero	Above Zero
Minor View	32%	14%	18%
Moderate View	23%	11%	13%
Substantial View	4%	4%	0%
Extreme View	0%	0%	0%
Inside 3000 Feet	23%	15%	8%
Between 3000 Feet and 1 Mile	30%	14%	16%
Between 1 and 3 Miles	56%	32%	24%
Between 3 and 5 Miles	45%	3%	43%

F.3 Selecting a Base Model

To conclude, it was found that all three concerns related to the estimation and use of an unrestricted model form are borne out in practice. Despite experimenting with 16 different combinations of interactions, little overall improvement in performance is discovered. Where performance gains are found they are at the expense of parsimony as reflected in the lack of increase in the Modified R^2 and the relatively higher Schwartz information criterion. Further, divergent and spurious coefficients of interest and large standard errors are associated with those coefficients. Therefore the fully restricted model, equation (1), is used in this report as the "Base Model".

[122] The "Total" percentage of significant coefficients is calculated by counting the total number of significant coefficients across all 8 unrestricted models for each variable of interest, and dividing this total by the total number of coefficients. Therefore, a study area that did not have any homes in a group (for example, homes with EXTREME VIEWS) was not counted in the "total number of coefficients" sum. Any differences between the sum of "above" and "below" zero groups from the total are due to rounding errors.

[123] The relatively larger number of significant variables for the MINOR rated view, MODERATE rated view, Mile 1 to 3, and Mile 3 to 5 parameters are likely related to the smaller standard errors for those categories, which result from larger numbers of cases.

[124] Another possible explanation for spurious results in general is measurement error, when parameters do not appropriately represent what one is testing for. In this case though, the VIEW variables have been adequately "ground truthed" during the development of the measurement scale, and are similar to the VISTA variables, which were found to be very stable across study areas. DISTANCE, or for that matter, distance to any disamenity, has been repeatedly found to be an appropriate proxy for the size of effects. As a result, it is not believed that measurement error is a likely explanation for the results presented here.

Appendix G: OLS Assumptions, and Tests for the Base Model

A number of criteria must be met to ensure that the Base Model and Alternative Hedonic Models produce unbiased coefficient estimates and standard errors: 1) appropriate controls for outliers and influencers; 2) homoskedasticity; 3) absence of serial or spatial autocorrelation; and 4) reasonably limited multicollinearity. Each of these criteria, and how they are addressed, is discussed below.

Outliers and Influencers: Home sale prices that are well away from the mean, also called outliers and influencers, can cause undue influence on parameter estimates. A number of formal tests are available to identify these cases, the most common being Mahalanobis' Distance ("M Distance") (Mahalanobis, 1936) and standardized residual screening. M Distance measures the degree to which individual observations influence the mean of the residuals. If any single observation has a strong influence on the residuals, it should be inspected and potentially removed. An auxiliary, but more informal, test for identifying these potentially influential observations is to see when the standardized absolute value of the residual exceeds some threshold. Both the Base Model and the All Sales Model were run using the original dataset of 7,464 transactions and the 4,940 transactions which occurred post-construction respectively. For both models the standardized residuals and the M Distance statistics were saved.[125] The histograms of these two sets of statistics from the two regressions are shown in Figure A - 15 through Figure A - 18.

[125] For the M Distance statistics all variables of interest were removed from the model. If they were left in the M-Distance statistics could be influenced by the small numbers of cases in the variables of interest. If these parameters were strongly influenced by a certain case, it could drive the results upward. Inspecting the controlling variables in the model, and how well they predicted the sale prices of the transactions in the sample, was of paramount importance therefore the variables of interest were not included.

Figure A - 15: Histogram of Standardized Residuals for Base Model

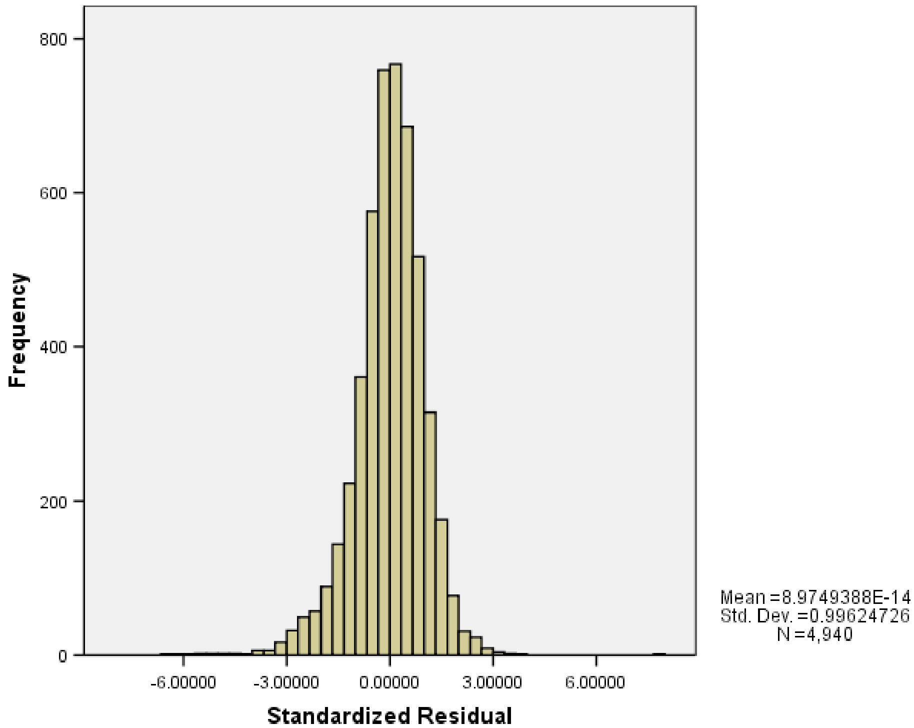


Figure A - 16: Histogram of Mahalanobis Distance Statistics for Base Model

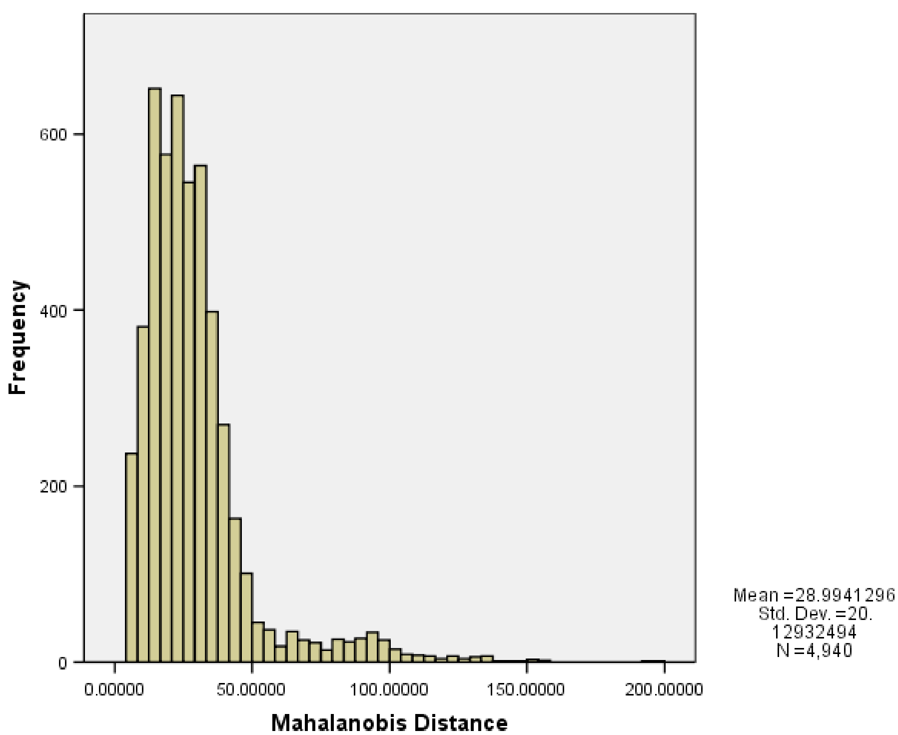


Figure A - 17: Histogram of Standardized Residuals for All Sales Model

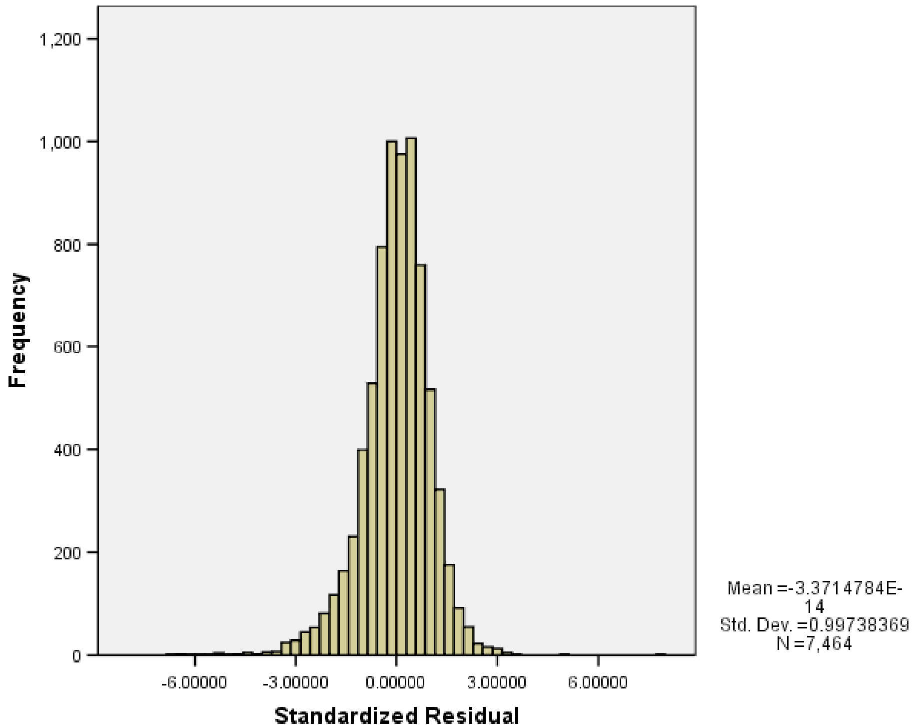
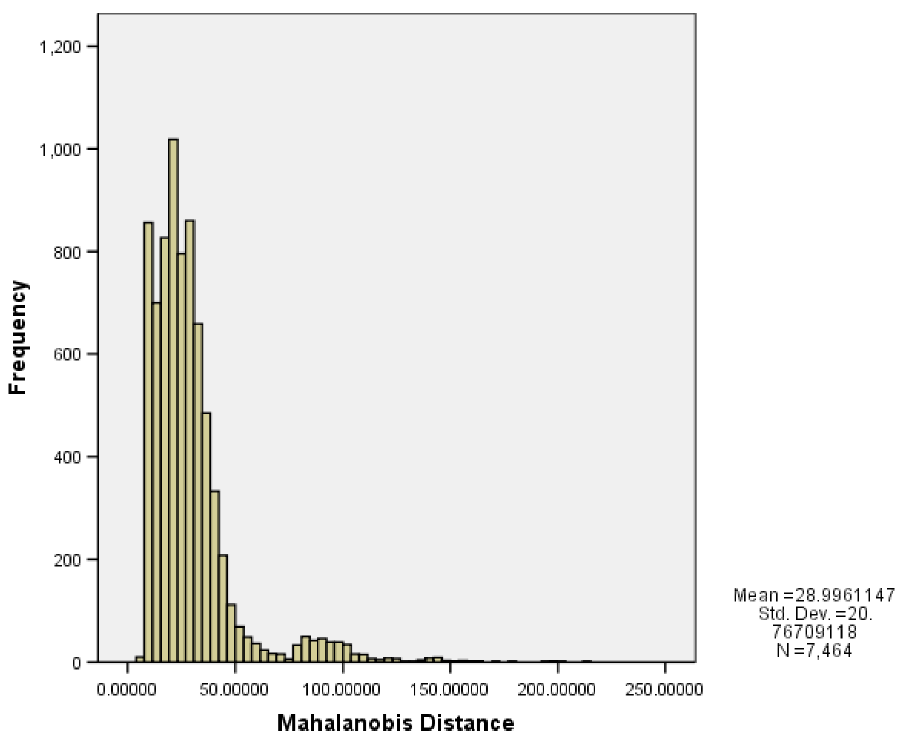


Figure A - 18: Histogram of Mahalanobis Distance Statistics for All Sales Model



The M Distance histograms suggested that a cutoff of 150 may be appropriate, which would exclude 15 cases from the All Sales Model and seven cases from the Base Model (all of the latter of which were among the 15 outliers in the All Sales Model). The Standardized Residual histograms suggested a cutoff of 4, 5, or 6, which would exclude 13, 8, and 3 cases from the Base Model, and 22, 12, and 5 cases from the All Sales Model. A case-by-case investigation of each of these sales transactions was then conducted by comparing their home characteristics (e.g., square feet, baths, age, etc.) against their study area and panel model cohorts to ensure that none had been inappropriately coded. None of the M Distance flagged cases seemed to be inappropriately coded, and none of those cases were removed from the final dataset as a result. Five cases that were flagged from the All Sales Model (which corresponded to three cases in the Base Model) with a Standardized Residual greater than six, however, were clearly outliers. One had a sale price that was more than $200,000 more than any other transaction in the model, and the other four had exceptionally low prices, yet high numbers of corresponding characteristics that would suggest higher home sales prices (such as over 2000 square feet – all four cases – or more than two bathrooms – three cases).

As a result of these investigations, these five cases were removed from the model. One of the five cases occurred prior to announcement, one occurred after announcement and before construction, and the other three occurred after construction began. None were within three miles of the nearest wind turbine except one, which was 0.6 miles from the nearest turbine and had a MINOR view of the wind facility. The other two had no views of the turbines. Although there was hesitancy in removing any cases from the model, these transactions were considered appropriately influential and keeping them in the model would bias the results inappropriately. Further, the one home that was situated inside of one mile was surrounded by five other transactions in the same study area that also occurred after construction began and were a similar distance from the turbines, but that were not flagged by the outliers screen. Therefore, its removal was considered appropriate given that other homes in the sample would likely experience similar effects.

After removing these five cases, the sensitivity of the model results were tested to the inclusion or exclusion of the “greater than five” and “greater than four” Standardized Residuals observations and the cases flagged by the M Distance screen, finding that parameter estimates for the variables of interest moved slightly with these cases removed but not enough to change the results significantly. Because they did not show a unique grouping across the variables of interest, nor any unusual potentially inappropriate coding, and, more importantly, did not substantially influence the results, no substantive reason was found to remove any additional transactions from the sample. Therefore, the final dataset included a total of 7,459 cases, of which 4,937 occurred post-construction.

Homoskedasticity: A standard formal test for the presence of homoskedastic error terms is the White's statistic (White, 1980). However, the requirements to perform this test were overly burdensome for the computing power available. Instead, an informal test was applied, which plots the regression errors against predicted values and various independent variables to observe whether a "heteroskedastic pattern" is in evidence (Gujarati, 2003). Although no evidence of heteroskedasticity was found using this method, to be conservative, nonetheless all models were run with White's heteroskedasticity correction to the parameter estimates' standard errors (which will not adversely influence the errors if they are homoskedastic).

Serial Autocorrelation: A standard formal test for the presence of serial autocorrelation in the error term is the Durbin-Watson statistic (Durbin and Watson, 1951). Applying this test as proposed by Durbin and Watson to the full panel dataset was problematic because the test looks at the error structure based on the order that observations are included in the statistical regression model. Any ordering choice over the entire panel data set invariably involves mixing home transactions from various study areas. Ideally, one would segment the data by study area for purposes of calculating this test, but that method was not easily implemented with the statistical software package used for this analysis (i.e., SAS). Instead, study area specific regression models were run with the data chronologically ordered in each to produce twelve different Durbin-Watson statistics, one for each study area specific model. The Durbin-Watson test statistics ranged from 1.98–2.16, which are all within the acceptable range.[126] Given that serial autocorrelation was not found to be a significant concern for each study area specific model, it is assumed that the same holds for the full dataset used in the analysis presented in this report.

Spatial Autocorrelation: It is well known that the sales price of a home can be systematically influenced by the sales prices of those homes that have sold nearby (Dubin, 1998; LeSage, 1999). Both the seller and the buyer use information from comparable surrounding sales to inform them of the appropriate transaction price, and nearby homes often experience similar amenities and disamenities. Therefore, the price for any single home is likely to be weakly dependent of the prices of homes in close temporal and spatial proximity. This lack of independence of home sale prices could bias the hedonic results (Dubin, 1998; LeSage, 1999), if not adequately addressed. A number of techniques are available to address this concern (Case et al., 2004; Espey et al., 2007), but because of the large sample and computing limits, a variation of the Spatial Auto Regressive Model (SAR) was chosen (Espey et al., 2007).

Specifically, an independent variable is included in the models: the predicted values of the weighted nearest neighbor's natural log of sales price in 1996 dollars.[127] To construct this vector of predicted prices, an auxiliary regression is developed using the spatially weighted average natural log of sales price in 1996 dollars as the independent variable and the spatially weighted average set of home characteristics as the dependent variables. This regression was used to produce the predicted weighted nearest neighbor's natural log of sales price in 1996 dollars that is then included in the Base and Alternative Models. This process required the following steps:

1) Selecting the neighbors for inclusion in the calculation;
2) Calculating a weighted sales price from these neighbors' transactions;
3) Selecting and calculating the weighted neighbors home characteristics; and
4) Forecasting the weighted average neighbor's sales price.

- **Selecting the neighbors**: To select the neighbors whose home transactions would most likely have affected the sales price of the subject home under review, all of the homes that

[126] The critical values for the models were between 1.89 and 2.53, assuming 5% significance, greater than 20 variables, and more than 200 cases (Gujarati, 2003).

[127] The predicted value was used, instead of the actual value, to help correct for simultaneity or endogeneity problems that might otherwise exist.

sold within the preceding six months of a subject home's sale date in the same study area are identified and, from those, the five nearest neighbors based on Euclidian distance are selected. The inverse of each selected nearest neighbors' distance (in quarter miles) to the subject home was then calculated. Each of these values was then divided by the sum of the five nearest neighbor's inverse distance values to create a neighbor's distance weight (NDW) for each of the five nearest neighbors.[128]

- **Creating the weighted sales price**: Each of the neighbor's natural log of sales price in 1996 dollars (LN_Saleprice96) is multiplied by its distance weight (NDW). Then, each weighted neighbor's LN_Saleprice96 is summed to create a weighted nearest neighbor LN_Saleprice96 (Nbr_LN_Saleprice96).

- **Selecting and calculating the weighted neighbors home characteristics**: Nine independent variables are used from each of the neighbor's homes: square feet, age of the home at the time of sale, age of the home at the time of sale squared, acres, number of full baths, and condition (1-5, with Poor = 1, Below Average = 2, etc.). A weighted average is created of each of the characteristics by multiplying each of the neighbor's individual characteristics by their NDW, and then summing those values across the five neighbors to create the weighted average nearest neighbors' home characteristic.[129] Then each of the independent variables is interacted with the study area to allow each one to be independently estimated for each study area.

- **Forecasting the weighted average neighbors sales price**: To create the final predicted neighbor's price, the weighted nearest neighbor LN_Saleprice96 is regressed on the weighted average nearest neighbors' home characteristics to produce a predicted weighted nearest neighbor LN_Saleprice96 (Nbr_LN_SalePrice96_hat). These predicted values are then included in the Base and Alternative Models as independent variables to account for the spatial and temporal influence of the neighbors' home transactions.

In all models, the coefficient for this spatial adjustment parameter meets the expectations for sign and magnitude and is significant well above the 99% level, indicating both the presence of spatial autocorrelation and the appropriateness of the control for it.

Multicollinearity: There are several standard formal tests for detecting multicollinearity within the independent variables of a regression model. The Variance-Inflation Factor and Condition Index is applied to test for this violation of OLS assumptions. Specifically, a Variance-Inflation Factor (VIF) greater than 4 and/or a Condition Index of greater than 30 (Kleinbaum et al., 1988) are strong indicators that multicollinearity may exist. Multicollinearity is found in the model using both tests. Such a result is not uncommon in hedonic models because a number of characteristics, such as square feet or age of a home, are often correlated with other characteristics, such as the number of acres, bathrooms, and fireplaces. Not surprisingly, age of the home at the time of sale (AgeofHome) and the age of the home squared (AgeatHome_Sqrd)

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[128] Put differently, the weight is the contribution of that home's inverse distance to the total sum of the five nearest neighbors' inverse distances.

[129] Condition requires rounding to the nearest integer and then creating a dummy from the 1-5 integers.

exhibited some multicollinearity (VIF equaled 11.8 and 10.6, respectively). Additionally, the home condition shows a fairly high Condition Index with square feet, indicating collinearity. More importantly, though, are the collinearity statistics for the variables of interest. The VIF for the VIEW variables range from 1.17 to 1.18 and for the DISTANCE variables they range from 1.2 to 3.6, indicating little collinearity with the other variables in the model. To test for this in another way, a number of models are compared with various identified highly collinear variables removed (e.g., AgeatSale, Sqft) and found that the removal of these variables had little influence on the variables of interest. Therefore, despite the presence of multicollinearity in the model, it is not believed that the variables of interest are inappropriately influenced. Further, any corrections for these issues might cause more harm to the model's estimating efficiency than taking no further action (Gujarati, 2003); as such, no specific adjustments to address the presence of multicollinearity are pursued further.

Appendix H: Alternative Models: Full Hedonic Regression Results

Table A - 6: Full Results for the Distance Stability Model

	Coef.	SE	p Value	*n*
Intercept	7.61	0.18	0.00	
Nbr_LN_SalePrice96_hat	0.29	0.02	0.00	4,937
AgeatSale	-0.006	0.0004	0.00	4,937
AgeatSale_Sqrd	0.00002	0.000003	0.00	4,937
Sqft_1000	0.28	0.01	0.00	4,937
Acres	0.02	0.00	0.00	4,937
Baths	0.09	0.01	0.00	4,937
ExtWalls_Stone	0.21	0.02	0.00	1,486
CentralAC	0.09	0.01	0.00	2,575
Fireplace	0.11	0.01	0.00	1,834
FinBsmt	0.08	0.02	0.00	673
Cul_De_Sac	0.10	0.01	0.00	992
Water_Front	0.33	0.04	0.00	87
Cnd_Low	-0.45	0.05	0.00	69
Cnd_BAvg	-0.24	0.02	0.00	350
Cnd_Avg	Omitted	Omitted	Omitted	2,727
Cnd_AAvg	0.13	0.01	0.00	1,445
Cnd_High	0.23	0.02	0.00	337
Vista_Poor	-0.21	0.02	0.00	310
Vista_BAvg	-0.08	0.01	0.00	2,857
Vista_Avg	Omitted	Omitted	Omitted	1,247
Vista_AAvg	0.10	0.02	0.00	448
Vista_Prem	0.13	0.04	0.00	75
WAOR	Omitted	Omitted	Omitted	519
TXHC	-0.75	0.03	0.00	1,071
OKCC	-0.44	0.02	0.00	476
IABV	-0.24	0.02	0.00	605
ILLC	-0.08	0.03	0.00	213
WIKCDC	-0.14	0.02	0.00	725
PASC	-0.30	0.03	0.00	291
PAWC	-0.07	0.03	0.01	222
NYMCOC	-0.20	0.03	0.00	346
NYMC	-0.15	0.02	0.00	469
Mile_Less_0_57	-0.04	0.04	0.29	67
Mile_0_57to1	-0.06	0.05	0.27	58
Mile_1to3	-0.01	0.02	0.71	2,019
Mile_3to5	0.01	0.01	0.26	1,923
Mile_Gtr5	Omitted	Omitted	Omitted	870

"Omitted" = reference category for fixed effects variables

"n" indicates number of cases in category when category = "1"

Model Information

Model Equation Number	**2**
Model Name	**Distance Stability**
Dependent Variable	**LN_SalePrice96**
Number of Cases	**4937**
Number of Predictors (k)	**33**
F Statistic	**496.7**
Adjusted R Squared	**0.77**

Table A - 7: Full Results for the View Stability Model

	Coef.	SE	Sig	*n*
Intercept	7.64	0.18	0.00	
Nbr LN SalePrice96 hat	0.29	0.02	0.00	4,937
AgeatSale	-0.006	0.0004	0.00	4,937
AgeatSale Sqrd	0.00002	0.000003	0.00	4,937
Sqft 1000	0.28	0.01	0.00	4,937
Acres	0.02	0.00	0.00	4,937
Baths	0.09	0.01	0.00	4,937
ExtWalls Stone	0.21	0.02	0.00	1,486
CentralAC	0.09	0.01	0.00	2,575
Fireplace	0.11	0.01	0.00	1,834
FinBsmt	0.08	0.02	0.00	673
Cul De Sac	0.10	0.01	0.00	992
Water Front	0.34	0.04	0.00	87
Cnd Low	-0.45	0.05	0.00	69
Cnd BAvg	-0.24	0.02	0.00	350
Cnd Avg	Omitted	Omitted	Omitted	2,727
Cnd AAvg	0.13	0.01	0.00	1,445
Cnd High	0.23	0.02	0.00	337
Vista Poor	-0.21	0.02	0.00	310
Vista BAvg	-0.08	0.01	0.00	2,857
Vista Avg	Omitted	Omitted	Omitted	1,247
Vista AAvg	0.10	0.02	0.00	448
Vista Prem	0.13	0.04	0.00	75
WAOR	Omitted	Omitted	Omitted	519
TXHC	-0.75	0.02	0.00	1,071
OKCC	-0.45	0.02	0.00	476
IABV	-0.25	0.02	0.00	605
ILLC	-0.09	0.03	0.00	213
WIKCDC	-0.14	0.02	0.00	725
PASC	-0.31	0.03	0.00	291
PAWC	-0.08	0.03	0.00	222
NYMCOC	-0.20	0.03	0.00	346
NYMC	-0.15	0.02	0.00	469
Post Con NoView	Omitted	Omitted	Omitted	4,207
View Minor	-0.02	0.01	0.25	561
View Mod	0.00	0.03	0.90	106
View Sub	-0.04	0.06	0.56	35
View Extrm	-0.03	0.06	0.61	28

"Omitted" = reference category for fixed effects variables

"n" indicates number of cases in category when category = "1"

Model Information

Model Equation Number	**3**
Model Name	**View Stability**
Dependent Variable	**LN_SalePrice96**
Number of Cases	**4937**
Number of Predictors (k)	**33**
F Statistic	**495.9**
Adjusted R Squared	**0.77**

Table A - 8: Full Results for the Continuous Distance Model

	Coef.	SE	p Value	*n*
Intercept	7.64	0.18	0.00	
Nbr_LN_SalePrice96_hat	0.29	0.02	0.00	4,937
AgeatSale	-0.006	0.0004	0.00	4,937
AgeatSale_Sqrd	0.00002	0.000003	0.00	4,937
Sqft_1000	0.28	0.01	0.00	4,937
Acres	0.02	0.00	0.00	4,937
Baths	0.09	0.01	0.00	4,937
ExtWalls_Stone	0.21	0.02	0.00	1,486
CentralAC	0.09	0.01	0.00	2,575
Fireplace	0.11	0.01	0.00	1,834
FinBsmt	0.08	0.02	0.00	673
Cul_De_Sac	0.10	0.01	0.00	992
Water_Front	0.34	0.04	0.00	87
Cnd_Low	-0.45	0.05	0.00	69
Cnd_BAvg	-0.24	0.02	0.00	350
Cnd_Avg	Omitted	Omitted	Omitted	2,727
Cnd_AAvg	0.13	0.01	0.00	1,445
Cnd_High	0.23	0.02	0.00	337
Vista_Poor	-0.21	0.02	0.00	310
Vista_BAvg	-0.08	0.01	0.00	2,857
Vista_Avg	Omitted	Omitted	Omitted	1,247
Vista_AAvg	0.10	0.02	0.00	448
Vista_Prem	0.13	0.04	0.00	75
WAOR	Omitted	Omitted	Omitted	519
TXHC	-0.75	0.02	0.00	1,071
OKCC	-0.44	0.02	0.00	476
IABV	-0.25	0.02	0.00	605
ILLC	-0.09	0.03	0.00	213
WIKCDC	-0.14	0.02	0.00	725
PASC	-0.31	0.03	0.00	291
PAWC	-0.07	0.03	0.00	222
NYMCOC	-0.20	0.03	0.00	346
NYMC	-0.15	0.02	0.00	469
No View	Omitted	Omitted	Omitted	4,207
Minor View	-0.01	0.01	0.33	561
Moderate View	0.01	0.03	0.77	106
Substantial View	-0.02	0.07	0.72	35
Extreme View	0.01	0.10	0.88	28
InvDISTANCE	-0.01	0.02	0.46	4,937

"Omitted" = reference category for fixed effects variables
"n" indicates number of cases in category when category = "1"

Model Information

Model Equation Number	**5**
Model Name	**Continuous Distance Model**
Dependent Variable	**LN_SalePrice96**
Number of Cases	**4937**
Number of Predictors (k)	**34**
F Statistic	**481.3**
Adjusted R Squared	**0.77**

Table A - 9: Full Results for the All Sales Model

	Coef.	SE	p Value	*n*
Intercept	9.08	0.14	0.00	
Nbr_LN_SP96_hat_All_OI	0.16	0.01	0.00	7,459
AgeatSale	-0.007	0.0003	0.00	7,459
AgeatSale_Sqrd	0.00003	0.000002	0.00	7,459
Sqft_1000	0.28	0.01	0.00	7,459
Acres	0.02	0.00	0.00	7,459
Baths	0.08	0.01	0.00	7,459
ExtWalls_Stone	0.21	0.01	0.00	2,287
CentralAC	0.12	0.01	0.00	3,785
Fireplace	0.11	0.01	0.00	2,708
FinBsmt	0.09	0.01	0.00	990
Cul_De_Sac	0.09	0.01	0.00	1,472
Water_Front	0.35	0.03	0.00	107
Cnd_Low	-0.43	0.04	0.00	101
Cnd_BAvg	-0.21	0.02	0.00	519
Cnd_Avg	Omitted	Omitted	Omitted	4,357
Cnd_AAvg	0.13	0.01	0.00	2,042
Cnd_High	0.22	0.02	0.00	440
Vista_Poor	-0.25	0.02	0.00	470
Vista_BAvg	-0.09	0.01	0.00	4,301
Vista_Avg	Omitted	Omitted	Omitted	1,912
Vista_AAvg	0.10	0.01	0.00	659
Vista_Prem	0.09	0.03	0.00	117
WAOR	Omitted	Omitted	Omitted	790
TXHC	-0.82	0.02	0.00	1,311
OKCC	-0.53	0.02	0.00	1,113
IABV	-0.31	0.02	0.00	822
ILLC	-0.05	0.02	0.02	412
WIKCDC	-0.17	0.01	0.00	810
PASC	-0.37	0.03	0.00	494
PAWC	-0.15	0.02	0.00	551
NYMCOC	-0.25	0.02	0.00	463
NYMC	-0.15	0.02	0.00	693
Pre-Construction Sales	Omitted	Omitted	Omitted	2,522
No View	0.02	0.01	0.06	4,207
Minor View	0.00	0.02	0.76	561
Moderate View	0.03	0.03	0.38	106
Substantial View	0.03	0.07	0.63	35
Extreme View	0.06	0.08	0.43	28
Inside 3000 Feet	-0.06	0.05	0.23	80
Between 3000 Feet and 1 Mile	-0.08	0.05	0.08	65
Between 1 and 3 Miles	0.00	0.01	0.79	2,359
Between 3 and 5 Miles	0.01	0.01	0.58	2,200
Outside 5 Miles	0.00	0.02	0.76	1,000
Pre-Announcement Sales	Omitted	Omitted	Omitted	1,755

"Omitted" = reference category for fixed effects variables
"n" indicates number of cases in category when category = "1"

Model Information

Model Equation Number	**6**
Model Name	**All Sales Model**
Dependent Variable	**LN_SalePrice96**
Number of Cases	**7459**
Number of Predictors (k)	**39**
F Statistic	**579.9**
Adjusted R Squared	**0.75**

Table A - 10: Full Results for the Temporal Aspects Model

	Coef.	SE	p Value	*n*
Intercept	9.11	0.14	0.00	
Nbr LN SP96 hat All OI	0.16	0.01	0.00	7,459
AgeatSale	-0.007	0.0003	0.00	7,459
AgeatSale Sqrd	0.00003	0.000002	0.00	7,459
Sqft 1000	0.28	0.01	0.00	7,459
Acres	0.02	0.00	0.00	7,459
Baths	0.08	0.01	0.00	7,459
ExtWalls Stone	0.21	0.01	0.00	2,287
CentralAC	0.12	0.01	0.00	3,785
Fireplace	0.12	0.01	0.00	2,708
FinBsmt	0.09	0.01	0.00	990
Cul De Sac	0.09	0.01	0.00	1,472
Water Front	0.35	0.03	0.00	107
Cnd Low	-0.43	0.04	0.00	101
Cnd BAvg	-0.21	0.02	0.00	519
Cnd Avg	Omitted	Omitted	Omitted	4,357
Cnd AAvg	0.13	0.01	0.00	2,042
Cnd High	0.22	0.02	0.00	440
Vista Poor	-0.25	0.02	0.00	470
Vista BAvg	-0.09	0.01	0.00	4,301
Vista Avg	Omitted	Omitted	Omitted	1,912
Vista AAvg	0.10	0.01	0.00	659
Vista Prem	0.09	0.03	0.00	117
WAOR	Omitted	Omitted	Omitted	790
TXHC	-0.82	0.02	0.00	1,311
OKCC	-0.52	0.02	0.00	1,113
IABV	-0.30	0.02	0.00	822
ILLC	-0.04	0.02	0.05	412
WIKCDC	-0.17	0.02	0.00	810
PASC	-0.37	0.03	0.00	494
PAWC	-0.14	0.02	0.00	551
NYMCOC	-0.25	0.02	0.00	463
NYMC	-0.15	0.02	0.00	693

"Omitted" = reference category for fixed effects variables
"n" indicates number of cases in category when category = "1"

Note: Results for variables of interest shown on following page

	Coef.	SE	p Value	*n*
No View	Omitted	Omitted	Omitted	6,729
Minor View	-0.02	0.01	0.20	561
Moderate View	0.00	0.03	0.97	106
Substantial View	0.01	0.07	0.87	35
Extreme View	0.04	0.07	0.59	28
Pre_Anc_Gtr2Yr_Lt1Mile	-0.13	0.06	0.02	38
Pre_Anc_2Yr_Lt1Mile	-0.10	0.05	0.06	40
Post_Anc_Pre_Con_Lt1Mile	-0.14	0.06	0.02	21
Post_Con_2Yr_Lt1Mile	-0.09	0.07	0.15	39
Post_Con_2_4Yr_Lt1Mile	-0.01	0.06	0.86	44
Post_Con_Gtr5Yr_Lt1Mile	-0.07	0.08	0.37	42
Pre_Anc_Gtr2Yr_1_3Mile	-0.04	0.03	0.19	283
Pre_Anc_2Yr_1_3Mile	0.00	0.03	0.91	592
Post_Anc_Pre_Con_1_3Mile	-0.02	0.03	0.53	342
Post_Con_2Yr_1_3Mile	0.00	0.03	0.90	807
Post_Con_2_4Yr_1_3Mile	0.01	0.03	0.78	503
Post_Con_Gtr5Yr_1_3Mile	0.00	0.03	0.93	710
Pre_Anc_Gtr2Yr_3_5Mile	0.00	0.04	0.93	157
Pre_Anc_2Yr_3_5Mile	0.00	0.03	0.98	380
Post_Anc_Pre_Con_3_5Mile	0.00	0.03	0.93	299
Post_Con_2Yr_3_5Mile	0.02	0.03	0.56	574
Post_Con_2_4Yr_3_5Mile	0.01	0.03	0.66	594
Post_Con_Gtr5Yr_3_5Mile	0.01	0.03	0.68	758
Pre_Anc_Gtr2Yr_Gtr5Mile	Omitted	Omitted	Omitted	132
Pre_Anc_2Yr_Gtr5Mile	-0.03	0.04	0.39	133
Post_Anc_Pre_Con_Gtr5Mile	-0.03	0.03	0.36	105
Post_Con_2Yr_Gtr5Mile	-0.03	0.03	0.44	215
Post_Con_2_4Yr_Gtr5Mile	0.03	0.03	0.42	227
Post_Con_Gtr5Yr_Gtr5Mile	0.01	0.03	0.72	424

"Omitted" = reference category for fixed effects variables
"n" indicates number of cases in category when category = "1"

Model Information

Model Equation Number	**7**
Model Name	**Temporal Aspects Model**
Dependent Variable	**LN_SalePrice96**
Number of Cases	**7459**
Number of Predictors (k)	**56**
F Statistic	**404.5**
Adjusted R2	**0.75**

Table A - 11: Full Results for the Orientation Model

	Coef.	SE	p Value	*n*
Intercept	7.62	0.18	0.00	
Nbr_LN_SalePrice96_hat	0.29	0.02	0.00	4,937
AgeatSale	-0.006	0.0004	0.00	4,937
AgeatSale_Sqrd	0.00002	0.000003	0.00	4,937
Sqft_1000	0.28	0.01	0.00	4,937
Acres	0.02	0.00	0.00	4,937
Baths	0.09	0.01	0.00	4,937
ExtWalls_Stone	0.21	0.02	0.00	1,486
CentralAC	0.09	0.01	0.00	2,575
Fireplace	0.11	0.01	0.00	1,834
FinBsmt	0.08	0.02	0.00	673
Cul_De_Sac	0.10	0.01	0.00	992
Water_Front	0.33	0.04	0.00	87
Cnd_Low	-0.44	0.05	0.00	69
Cnd_BAvg	-0.24	0.02	0.00	350
Cnd_Avg	Omitted	Omitted	Omitted	2,727
Cnd_AAvg	0.13	0.01	0.00	1,445
Cnd_High	0.24	0.02	0.00	337
Vista_Poor	-0.21	0.02	0.00	310
Vista_BAvg	-0.08	0.01	0.00	2,857
Vista_Avg	Omitted	Omitted	Omitted	1,247
Vista_AAvg	0.10	0.02	0.00	448
Vista_Prem	0.13	0.04	0.00	75
WAOR	Omitted	Omitted	Omitted	519
TXHC	-0.75	0.03	0.00	1,071
OKCC	-0.44	0.02	0.00	476
IABV	-0.24	0.02	0.00	605
ILLC	-0.08	0.03	0.00	213
WIKCDC	-0.14	0.02	0.00	725
PASC	-0.31	0.03	0.00	291
PAWC	-0.07	0.03	0.01	222
NYMCOC	-0.20	0.03	0.00	346
NYMC	-0.15	0.02	0.00	469
No View	Omitted	Omitted	Omitted	4,207
Minor View	-0.01	0.06	0.92	561
Moderate View	0.00	0.06	0.97	106
Substantial View	-0.01	0.09	0.87	35
Extreme View	0.02	0.17	0.89	28
Inside 3000 Feet	-0.04	0.07	0.55	67
Between 3000 Feet and 1 Mile	-0.05	0.05	0.37	58
Between 1 and 3 Miles	0.00	0.02	0.83	2,019
Between 3 and 5 Miles	0.02	0.01	0.22	1,923
Outside 5 Miles	Omitted	Omitted	Omitted	870
Front Orientation	-0.01	0.06	0.82	294
Back Orientation	0.03	0.06	0.55	280
Side Orientation	-0.03	0.06	0.55	253

"Omitted" = reference category for fixed effects variables
"n" indicates number of cases in category when category = "1"

Model Information

Model Equation Number	**8**
Model Name	**Orientation Model**
Dependent Variable	**LN_SalePrice96**
Number of Cases	**4937**
Number of Predictors (k)	**40**
F Statistic	**410.0**
Adjusted R Squared	**0.77**

Table A - 12: Full Results for the Overlap Model

	Coef.	SE	p Value	*n*
Intercept	7.61	0.18	0.00	
Nbr LN SalePrice96 hat	0.29	0.02	0.00	4,937
AgeatSale	-0.006	0.0004	0.00	4,937
AgeatSale Sqrd	0.00002	0.000003	0.00	4,937
Sqft 1000	0.28	0.01	0.00	4,937
Acres	0.02	0.00	0.00	4,937
Baths	0.09	0.01	0.00	4,937
ExtWalls Stone	0.21	0.02	0.00	1,486
CentralAC	0.09	0.01	0.00	2,575
Fireplace	0.11	0.01	0.00	1,834
FinBsmt	0.08	0.02	0.00	673
Cul De Sac	0.10	0.01	0.00	992
Water Front	0.34	0.04	0.00	87
Cnd Low	-0.45	0.05	0.00	69
Cnd BAvg	-0.24	0.02	0.00	350
Cnd Avg	Omitted	Omitted	Omitted	2,727
Cnd AAvg	0.13	0.01	0.00	1,445
Cnd High	0.24	0.02	0.00	337
Vista Poor	-0.21	0.02	0.00	310
Vista BAvg	-0.08	0.01	0.00	2,857
Vista Avg	Omitted	Omitted	Omitted	1,247
Vista AAvg	0.10	0.02	0.00	448
Vista Prem	0.13	0.04	0.00	75
WAOR	Omitted	Omitted	Omitted	519
TXHC	-0.75	0.03	0.00	1,071
OKCC	-0.44	0.02	0.00	476
IABV	-0.24	0.02	0.00	605
ILLC	-0.09	0.03	0.00	213
WIKCDC	-0.14	0.02	0.00	725
PASC	-0.31	0.03	0.00	291
PAWC	-0.07	0.03	0.00	222
NYMCOC	-0.20	0.03	0.00	346
NYMC	-0.15	0.02	0.00	469
No View	Omitted	Omitted	Omitted	4,207
Minor View	-0.03	0.02	0.10	561
Moderate View	-0.02	0.04	0.67	106
Substantial View	-0.05	0.09	0.57	35
Extreme View	-0.03	0.10	0.77	28
Inside 3000 Feet	-0.05	0.06	0.41	67
Between 3000 Feet and 1 Mile	-0.05	0.05	0.38	58
Between 1 and 3 Miles	0.00	0.02	0.82	2,019
Between 3 and 5 Miles	0.02	0.01	0.22	1,923
Outside 5 Miles	Omitted	Omitted	Omitted	870
View Does Not Overlap Vista	Omitted	Omitted	Omitted	320
View Barely Overlaps Vista	0.05	0.03	0.09	150
View Somewhat Overlaps Vista	0.01	0.03	0.67	132
View Strongly Overlaps Vista	0.05	0.05	0.31	128

"Omitted" = reference category for fixed effects variables

"n" indicates number of cases in category when category = "1"

Model Information

Model Equation Number	**9**
Model Name	**Overlap Model**
Dependent Variable	**LN_SalePrice96**
Number of Cases	**4937**
Number of Predictors (k)	**40**
F Statistic	**409.7**
Adjusted R Squared	**0.77**

Canadian Electricity Association

perspectives

February 2006 | Facts on EMF

Electric and Magnetic Fields

On a daily basis, most of us are exposed to electric and magnetic fields (EMF) generated by household wiring, lighting, computers and other electrical appliances, such as hair dryers, coffee makers, televisions and power tools.

Since the 1970s, scientists have been researching possible human health effects of EMF, particularly certain cancers including brain cancer, lymphoma, breast cancer and leukemia. This extensive research has not proven a link between health risks and EMF.

Canadian electric utilities are committed to supporting EMF research to resolve ongoing questions, as well as to providing educational materials and facilitating magnetic field measurement for the public and employees.

What are electric and magnetic fields?

Power frequency (also referred to as extremely low frequency or ELF) electric and magnetic fields are present everywhere that electricity flows. All electrical wires – and the lighting, appliances and other electrical devices they supply – are sources of electric and magnetic fields. Although they are often referred to together as EMF, electric fields and magnetic fields are actually distinct components of electricity *(See "Electric vs. Magnetic Fields" sidebar).* Most of the interest regarding possible health effects is related to magnetic fields. So usually, when the term EMF level is used, it is the magnetic field strength that is being referred to or measured.

X-rays, visible light, radio waves, microwaves and power frequency EMF are all forms of electromagnetic energy making up an electromagnetic spectrum. On the next page there is a chart of the electromagnetic spectrum.

As the chart shows, one property that distinguishes different forms of electromagnetic energy is the frequency, measured in hertz (Hz). These frequencies are plotted on the right side of the spectrum chart. At the lowest end is static or direct current (DC) electricity with a frequency of 0 Hz. At the

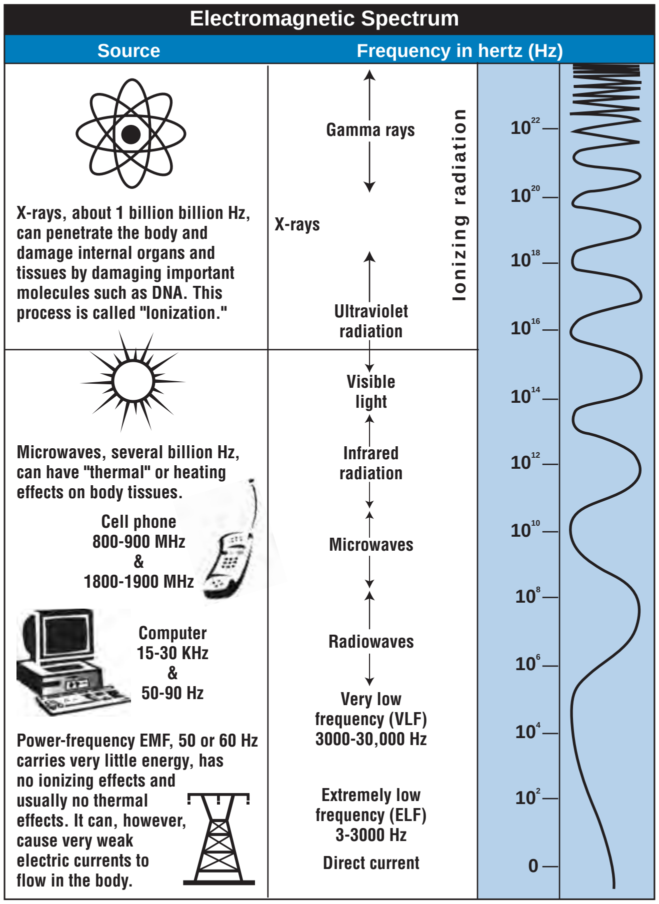
Electric vs. Magnetic Fields

Electric fields are produced by voltage or electric charge. An electric field is present, for example, when an appliance is plugged into an outlet, even if it is not turned on. Electric fields are measured in Volts per metre (V/m); the higher the voltage, the greater the electric field.

Magnetic fields are created by the flow of current in a wire or an appliance. As a result, they are only present in an appliance when it is switched on. As the flow (current) increases, so does the strength of the field.

In North America, magnetic fields in electrical wiring are most commonly measured in milligauss or mG (one thousand milligauss equal 1 gauss). Elsewhere magnetic fields are measured in microtesla or μT (one thousand μT equal 1 mT, one million μT equal 1 tesla). One μT equals 10 mG.

upper end (above 10^{16} Hz - that's 10,000,000,000 MHz) is ionizing radiation produced by ultraviolet, X-ray and gamma ray radiation.



The wavy line at the right illustrates the concept that the higher the frequency, the more rapidly the field varies. The fields do not vary at 0 Hz (direct current) and vary trillions of times per second near the top of the spectrum. Note that 10^4 means 10x10x10x10 or 10,000 Hz. 1 kilohertz (kHz) = 1,000 Hz. 1 megahertz (MHz) = 1,000,000 Hz.

Courtesy of NIEHS booklet EMF Questions and Answers at: (http://www.niehs.nih.gov/emfrapid/booklet/intro.htm)

Power frequency EMF has a frequency of 60 Hz. It is at the lower end of the spectrum near DC electricity and well below the microwave or RF (radio frequency) radiation emitted by cellular phones and radio broadcast transmitters. As noted on the chart, unlike x-rays and gamma rays, power frequency EMFs have little energy and no ionizing or thermal effects on the body.

Exposure and guidelines

Both electric and magnetic fields are strongest at the source – whether it is a power line or an appliance such as a hair dryer, dishwasher or microwave oven – and decrease rapidly when you move away from the source. Magnetic field exposure from power lines depends primarily on the current the wires carry and an individual's distance from the lines. And while electric fields are easily shielded by trees, fences and other building materials, magnetic fields pass through most objects.

In Canada, there are no guidelines or standards on acceptable levels of residential EMF exposure. Health Canada's *It's Your Health* fact sheet on EMF states, "At this time, Health Canada does not consider guidelines [on EMF exposure levels] necessary because scientific evidence is not strong enough to conclude that typical exposures cause health problems." Health Canada goes on to state, "You do not need to take action regarding typical daily exposures to electric and magnetic fields at extremely low frequencies." (Health Canada, April 2004) *(See the sidebar for other information on EMF standards)*

Research

Scientists around the world have been researching possible human health effects of EMF since the 1970s. There are two main types of research which make up the body of scientific knowledge around EMF: epidemiological studies and laboratory studies. These epidemiological studies and laboratory studies provide pieces of the puzzle but no single study can give us the whole picture.

Epidemiological Studies

In epidemiological studies, researchers try to establish whether there is a statistical association (mathematical link) between selected groups of people with certain types of exposure and certain kinds of disease. The stronger the statistical association, the greater the probability that the particular exposure may cause the disease. However, epidemiological studies cannot establish a cause and effect relationship because other possible causes that could explain the statistical relationship cannot be ruled out. Some epidemiological studies have suggested a possible statistical association between exposure to magnetic fields and some diseases, including childhood leukemia.

Laboratory Studies

Laboratory studies involve exposing cells, tissues, humans and/or animals to EMF under controlled conditions. These studies allow researchers to closely control EMF exposure and provide information about any small scale biological changes that EMFs may cause.

Laboratory studies have not confirmed that magnetic fields are the cause of any disease.

Conclusions to date

In light of the evidence and research to date, a number of conclusions have been drawn by international research organizations on the health risks associated with EMF:

- Health Canada's 2004 *It's Your Health* fact sheet on EMF states:

  "Research has shown that EMFs from electrical devices and power lines can induce weak electric currents to flow through the human body. However, these currents are much smaller than those produced naturally by your brain, nerves and heart, and are not associated with any known health risks.

  There have been many studies about the effects of exposure to electric and magnetic fields at extremely low frequencies. Scientists at Health Canada are aware that some studies have suggested a possible link between exposure to ELF fields and certain types of childhood cancer. However, when all of the studies are evaluated, the evidence appears to be very weak."

- Following a 10-year review of scientific research on effects from exposure to electromagnetic fields, the World Health Organization's International EMF Project states:

  "In the area of biological effects and medical applications of non-ionizing radiation approximately 25,000 articles have been published over the past 30 years. Despite the feeling of some people that more research needs to be done, scientific knowledge in this area is now more extensive than for most chemicals. Based on a recent in-depth review of the scientific literature, the WHO concluded that current evidence does not confirm the existence of any health consequences from exposure to low level electromagnetic fields. However, some gaps in knowledge about biological effects exist and need further research."

- The Federal-Provincial-Territorial Radiation Protection Committee (FPTRPC), organized under Health Canada's Radiation Protection Bureau, issued a Position Statement in January, 2005 stating that adverse health effects from exposure to power-frequency EMFs at levels normally encountered in homes, schools and offices have not been established.

  "…FPTRPC is of the opinion that moderate measures and the participation in the process of acquiring new

EMF Exposure Guidelines

In the absence of sufficient data to allow a long-term EMF exposure guideline to be established, the International Commission on Non-Ionizing Radiation Protection (ICNIRP) and the Institute of Electrical and Electronics Engineers (IEEE) have proposed exposure guidelines which protect workers and the general public from well-documented immediate biological effects that can result from direct exposure to fields well above those typically found in living environments. These immediate biological effects could include: stimulation of nerves and muscles, functional changes in the nervous system, hair stimulation and other tissues, shocks, burns, and elevated tissue temperatures.

Typical Canadian exposures fall well below these international guidelines.

- **The International Commission on Non-Ionizing Radiation Protection (ICNIRP) published "Guidelines for Limiting Exposure to Time Varying Electric, Magnetic, and Electromagnetic Fields (up to 300 GHz)" in April 1998. It is available at http://www.icnirp.de/documents/emfgdl.pdf.**
- **The Institute of Electrical and Electronics Engineers, Inc. (IEEE) recently produced "C95.6-2002 IEEE Standard for Safety Levels with Respect to Human Exposure to Electromagnetic Fields 0 to 3 kHz 2002". This technical document is available for purchase at http://shop.ieee.org/store/product.asp?prodno=SH95034**
- **The Health Canada summary of health effects and exposure guidelines is available at http://www.hc-sc.gc.ca/hecs-sesc/ccrpb/publication/elf_guidelines/toc.htm**

knowledge are sufficient. These types of activity are consistent with the Canadian government framework on precaution."

- A 1999 report by the U.S. National Institute of Environmental Health Sciences (NIEHS) following a seven-year EMF research programme concluded:

  "The NIEHS believes that the probability that EMF exposure is truly a health hazard is currently small. The weak epidemiological associations and lack of any laboratory support for these associations provide only marginal scientific support that exposure to this agent is causing any degree of harm"

- The World Health Organization International Agency for Research on Cancer (IARC) has classified power frequency EMF as a 2B carcinogen – a possible carcinogen based on unanswered questions of the statistical association between magnetic field exposure and childhood leukemia. IARC found no consistent evidence that childhood EMF exposures are associated with other types of cancers or that adult EMF exposures are associated with increased risk of any kind of cancer. Other 2B Possible Carcinogens include coffee, pickled vegetables and gasoline engine exhaust.

What Lies Ahead for EMF Research and Policy

EMF research is on-going, and from time to time health agencies and organizations, such Health Canada and the World Health Organization, review the new studies and confirm or update their position statements on EMF.

As well, these agencies are looking to "precaution-based policies" to possibly guide their actions on EMF and other issues. Precaution-based policies are intended to address issues where there is some basis for concern, but no scientific certainty of a cause and effect relationship. Generally a precaution–based policy requires that there is enough evidence to do a risk analysis or a cost/benefit analysis when considering policy options. It is not intended to be a replacement for scientific understanding. The Government of Canada document on precaution is available at: http://www. pco-bcp.gc.ca/default.asp?Language=E&page=publications& doc=precaution/precaution_e.htm. The World Health organization website also contains information of precaution.

What are Canadian utilities doing?

The Canadian electricity industry continues to support scientific research on EMF and possible long-term effects on people. CEA member companies also work to communicate accurate and up-to-date information to the public and employees about EMF.

For more information on EMF and the Canadian electricity industry, please visit our website at www.canelect.ca/emf.html.

To Learn More

For more information on EMF, contact your local electricity provider. For a list of quick links, visit: http://www.canelect.ca/english/managing_issues_environment_emf_library.html

To find out more about what Health Canada has to say on EMF you can visit: http://www.hc-sc.gc.ca. For the Health Canada summary of health effects and exposure guidelines, visit: http://www.hc-sc.gc.ca/hecs-sc/ccrpb/publication/elf_guidelines/toc.htm

The FPTRPC, a joint committee of federal and provincial agencies has prepared position statements on EMF and health effects: http://www.bccdc.org/content.php?item=196

The Electric and Magnetic Fields Research and Public Information Dissemination (EMF RAPID) Programme, led by the U.S. National Institute of Environmental Health Sciences (NIEHS), has produced an informative booklet, available online at: http://www.niehs.nih.gov/emfrapid/booklet/home.htm

The World Health Organization (WHO) is conducting its International EMF Project to evaluate EMF research and risks: http://www.who.int/peh-emf/en/

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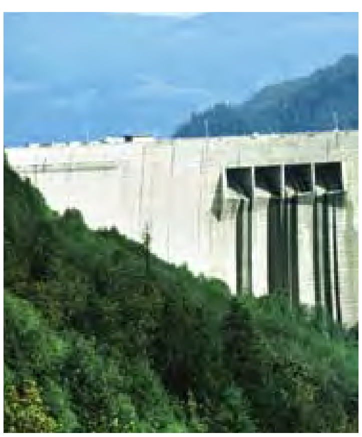
Wind power is here.

Wind power is determined by more than just how and when the wind blows. Wind energy is the culmination of years of studying the wind and perfecting the technology that harnesses it.

Wind is reliable and has the power to make a significant contribution to Canada's energy needs. In Denmark, 20% of electricity demand is currently met by wind energy. With our abundant resource, there's no reason why we couldn't follow their lead – and the Canadian wind energy industry is here to capture that potential.

photo courtesy of Vision Quest

"Wind has an availability factor of 98% – much higher than conventional forms of energy production."[1]



As long as there is wind, there will be wind power.

Changing winds.

Everyone knows that the wind is variable. Sometimes it blows, other times it doesn't. So how can wind power be a reliable source of energy? The answer to that lies in how we plan for variability.

Most turbines are located in sites where there's enough wind to produce electricity 70-80% of the time. Naturally, the amount of electricity produced varies with the wind. The way we manage for this variability is to locate wind farms in different geographical areas so that turbines can take advantage of different prevailing winds. The fact is, the wind will never stop blowing everywhere at once – even within a single wind farm, it's unlikely that all the turbines stop spinning at one time. With Canada's large and varied wind resource, there's no doubt that the wind can power us well into the future.

The power of two.

In Canada, we would never rely on wind turbines alone to meet the entire country's electricity needs. Instead, we use wind in conjunction with other forms of compatible energy production.

One example is wind and hydro-electric. These two sources of energy are a natural fit. In the winter, wind is at its peak, allowing hydro to store energy for use when wind productivity is lower. Hydro dams can be closed relatively quickly allowing water reserves to build when peak wind is in full swing.

In the spring and fall, hydro is at its peak production and wind energy serves as its supplement. It's interesting to note how wind energy can help us better manage our precious water resources.

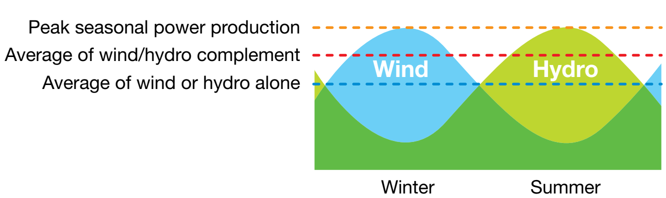


photo courtesy of Vision Quest

> *"The variability of wind matches the variability of demand. Generally wind is strongest in cold-weather months when our demand for electricity is highest."* [2]

Capturing the energy of wind.

Estimating energy productivity is done through a calculation called capacity factor. If a power plant produced at full capacity 100% of the time, it would have a capacity factor of 100%. Of course, wind is variable, so it doesn't have a 100% capacity factor – but neither does any other form of energy. No energy source, conventional or otherwise, works 100% of the time. It's simply impossible.

There are periods when power plants shut down for maintenance and repairs. There are times when resources run low or when unexpected outages occur.

One of the greatest attributes of wind is that it blows hardest – and therefore generates more electricity – in the winter. Wind power offers an opportunity to add more green energy to the grid and to add it during the coldest months of the year, when demand is heavy.

Yes, it's true; the wind blows some of the places all of the time, and all of the places some of the time – but it can't blow everywhere at once.

Wind is variable, but with good site selection, wind farms have access to strong and steady winds.

As of June, 2006, Canada's installed capacity was 1,049 MW – enough to power about 315,000 Canadian homes.

Wind turbines are reliable.

Wind-generated power is a reliable source of electricity. Wind turbines have one of the highest availability factors – a term that refers to the reliability of the turbines and the percentage of time that a plant is ready to generate energy. Wind has an availability factor of 98% – much higher than conventional forms of energy production.

Maintenance issues are also much smaller on a wind farm. At some conventional power plants, the entire plant may have to be shut down for repairs whereas at a wind farm maintenance takes place one turbine at a time.

Enhanced technology and design improvements have also played a part in increasing the reliability of wind power allowing turbines to generate electricity in all but the most extreme weather conditions. Plus wind forecasting technology has the potential to make wind energy more predictable and more reliable than ever before.

CASE STUDY

North Cape Wind Farm, PEI

Owner/operator:
PEI Energy Corporation

photo courtesy of PEI Energy Corporation

On line since 2001, PEI Energy Corporation's North Cape Wind Farm – sited in one of Canada's windiest locations – has an installed capacity of 10.56 MW. With a capacity factor of 40%, it generates about 35,000 MWh annually – enough to supply 3% of PEI's electricity requirements, or about 5,000 PEI homes.

Together, with other wind farms, PEI will have 52 MW of installed wind capacity by mid 2007.

It's estimated that PEI could develop 200 MW of wind energy by 2015. PEI currently imports over 90% of its electricity from New Brunswick. By exporting excess wind energy during periods when production exceeds demand, it's feasible that PEI could net out as an energy self-sufficient province.

Purchasing agreement: North Cape Wind Farm's power is sold to Maritime Electric Company Limited for distribution. Maritime Electric can sell the power through their Green Power Program, which allows customers to purchase it at a premium price. This green power premium is passed along to PEI Energy Corporation. If the electricity available under this program becomes fully subscribed, then additional wind powered generators may be installed on PEI.

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CanWEA acknowledges the contribution of Natural Resources Canada.

1: Source: http://www.awea.org/faq/tutorial/wwt_basics.html
2: Source: http://www.windpower.org/en/tour/grid/season.htm

ABOUT STRAY VOLTAGE

STRAY VOLTAGE FACT SHEET

WHAT IS STRAY VOLTAGE?

Stray – or 'tingle' voltage – is a low-level electrical current or shock (typically under 10 volts) that results primarily from an improperly grounded or, in some cases an ungrounded, electrical distribution system.

Stray voltage can be found in any electrical system and is strictly a power distribution issue – improper grounding causes low voltage current to travel along a neutral wire. An electrical wiring system is grounded in order to keep voltage potential differences between the neutral wire and the ground, below levels that could be considered harmful.

While potential exists for stray voltage in residential areas, it is most commonly found at agricultural operations and is often attributed to poor grounding of the neutral wiring system in an environment where the presence of water increases conductivity between points of contact.

Stray voltage is unwanted electricity that in some cases can pose a safety risk to animals – and to lesser degree, humans – that come in contact with it.

Farming operations are especially susceptible to incidences of stray voltage for two key reasons:

1) Many working farms have electrical systems and wiring that have not been fully updated to current electrical codes and standards

2) Farms have a higher number of potential contact points (e.g., metal), water and wet conditions, i.e. feed bowls and wet concrete floors

WHAT'S IN A TERM?

The term 'stray voltage' is often misused due to poor understanding of its cause.

Stray voltage has incorrectly been called ‘dirty electricity’, implying that some forms of electricity are better or cleaner than others. Electricity from all sources is equally ‘clean’. Stray voltage has also been confused with electricomagnetic fields (EMF), grounding systems or even naturally-occurring current found in the earth.

ANIMAL REACTION TO STRAY VOLTAGE

Stray voltage may affect farm animals through nerve stimulation, causing a ‘tingling’ effect.

This so-called ‘tingle’ can occur when the animal comes in contact with two points that have a voltage potential – such as a metal dish filled with water and a wet concrete floor - creating a path for current (electricity) to flow through the animal.

This nerve stimulation may have an effect on an animal’s behaviour directly – in the form of involuntary muscle contractions and/or pain; or indirectly in the form of behavioral responses such as reduced food and water intake, or proving difficult to handle.

All electrical current must be respected as potentially harmful and stray voltage, although present in low amounts, is no different. Based on research, levels below 1 V are considered to be inconsequential, and generally not believed to cause behavioral changes in farm animals.

DETECTING AND REPAIRING INCIDENCES OF STRAY VOLTAGE

In most cases the source of stray voltage can be identified, allowing it to be either mitigated or eliminated.

Suspected cases of stray voltage should be investigated by an inspector from a local utility operator such as Hydro One, Toronto Hydro, etc., as it is a common distribution issue for farm operators as a result of inconsistent wiring quality. A utility inspector will investigate the farm’s existing wiring system to ensure proper installation, wire condition and code compliance. An inspector will seek to isolate the source of neutral-to-earth (ground) voltage through measurement of voltage at various points within the electrical system. This helps to determine whether the issue is related to on-farm wiring and distribution or whether the issue is related to the electrical distribution system off the farm.

COUNTERING INCIDENCES OF STRAY VOLTAGE IN ONTARIO

In 2007, the province of Ontario began an extensive research and consultation process into the phenomenon of stray voltage and its effects on the farm sector. In 2009, the Ontario Energy Board (OEB) enacted code amendments detailing procedures and methodology for dealing with incidences of stray voltage.

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CANADIAN WIND ENERGY ASSOCIATION | ASSOCIATION CANADIENNE DE L'ÉNERGIE ÉOLIENNE

As part of its two-year research and consultation process, the OEB employed Dr. Douglas J. Reinemann, a Professor of Biological Systems Engineering and a leading authority on stray voltage to review studies and literature on the subject.

Recognizing stray voltage's connection to farming operations, Dr. Reinemann sought to further clarify the term 'stray voltage' by further defining it as "…a low-level electrical shock that can produce sensation or annoyance in farm animals". He also further specifies the term as "a special case of voltage developed on the grounded neutral system of a farm".

STRAY VOLTAGE AND WIND ENERGY

There has been much confusion on the topic of stray voltage, and wind turbines have at times been inappropriately linked as direct sources of stray voltage.

Stray voltage is a potential symptom in *any* system of electrical distribution, regardless of source and is especially prevalent on working farms. Wind turbines are often located in agricultural areas, connecting to the provincial electricity grid with farm operators leasing the land on which the turbines sit. Through improved regulation and electrical code enforcement, incidences of stray voltage will be increasingly detected and eliminated.

WIND FACTS

WIND BY THE NUMBERS: **ECONOMIC BENEFITS OF WIND ENERGY**

Wind energy is generating affordable, clean electricity while creating new jobs and economic development opportunities in communities across the country. Here are some of the economic benefits being realized today – and opportunities for tomorrow.

- Canada is now the ninth largest producer of wind energy in the world with current installed capacity at **5,403 MW** – representing about **2.3 per cent** of Canada's total electricity demand.
- Canada enjoyed a record year in 2011 the addition of **1,267 MW** of new wind energy capacity to provincial grids, representing an investment of **$3.1 billion** and creating **13,000 person-years** of employment.
- 2011 was also a record year for new wind energy installations in Ontario with more than **500 MW** installed by the end of year.
- More than **6,000 MW** of wind energy projects are already contracted to be built in Canada over the next five years.
- Ontario is expected to install more than **5,600 MW** of new wind energy capacity by 2018, creating **80,000 person-years** of employment, attracting **$16.4 billion of private investments** (with more than half of that invested in the province), and contributing more than **$1.1 billion of revenue to municipalities** and landowners in the form of taxes and lease payments over the 20-year lifespan of the projects.[1]
- Wind energy drives jobs and local benefits at prices that are competitive with other new sources of electricity. According to new research from Bloomberg New Energy Finance: "The cost of electricity from onshore wind turbines will **drop 12 per cent in the next five years** thanks to a mix of lower-cost equipment and gains in output efficiency."
- CanWEA believes that wind energy can satisfy **20 per cent** of Canada's electricity demand **by 2025**. The benefits of achieving this vision are many:
  - $79 billion in new investment
  - 52,000 new high quality jobs
  - $165 million in annual revenues for municipalities
  - Reducing Canada's annual greenhouse gas emissions by 17 megatonnes

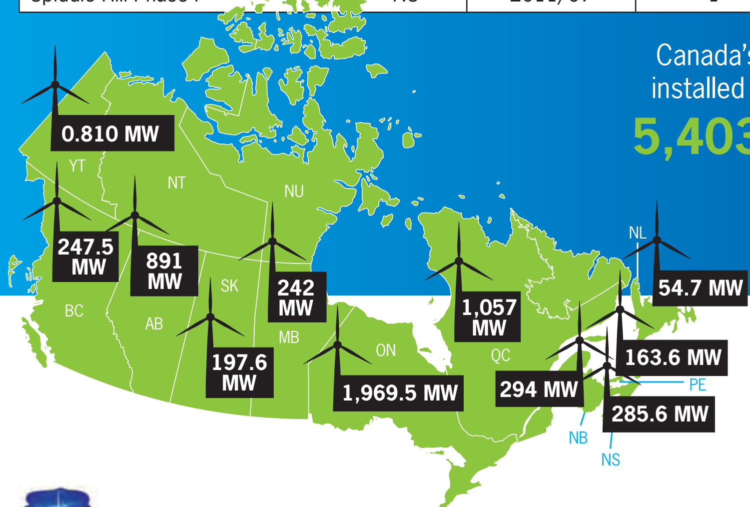
1 The Economic Impacts of the Wind Energy Sector in Ontario 2011 – 2018, by ClearSky Advisors, http://www.canwea.ca/wind-energy/talkingaboutwind_e.php

- CanWEA released a wind vision for British Columbia which called on the BC government to install **5,250 MW** of cost-competitive and low-impact wind power capacity **by 2025**. This would generate **$16 billion in new investment** with **$3.7 billion** flowing directly to **BC communities** and meet **17 per cent** of BC's total electricity demand. Download *CanWEA's WindVision 2025 – A Strategy for British Columbia* at: www.canwea.ca/windvision_bc_e.php

- CanWEA's *WindVision 2025 – A Strategy for Quebec* proposes that an average of **800 MW** of wind energy capacity be added each year between 2016 and 2025 – for a **total of 8,000 MW** – increasing wind energy to 20 per cent of Quebec's overall installed capacity for electricity generation. This long-term objective would stimulate **$25 billion in industry investment** and create nearly **91,000 new construction jobs**. Download the report at: www.canwea.ca/windvision_quebec_e.php.

New wind farms built in 2011

Wind Farm	Province	Date Installed	# of Turbines	Total Capacity (Megawatts)	Developer/Operator
Dokie Wind Project	BC	2011/02	48	144.00	Dokie General Partnership
Wintering Hills	AB	2011/12	55	88.00	Suncor
Red Lilly Wind Energy Project	SK	2011/02	16	26.40	Red Lily Wind Energy Partnership/ Algonquin Power
St. Joseph	MB	2011/02	60	138.00	Pattern Energy
North Maiden Wind Farm	ON	2011/01	5	10.00	Boralex Inc.
Kruger Energy Chatham Wind	ON	2011/01	44	101.20	Kruger Energy
Raleigh Wind Energy Centre	ON	2011/01	52	78.00	Invenergy LLC
Kent Breeze Wind Farm	ON	2011/05	8	20.00	Suncor Energy Inc.
Greenwich Renewable Energy Project	ON	2011/11	43	98.9	Enbridge & RES Canada
Pointes Aux Roches	ON	2011/12	27	48.60	International Power/GDF Suez
Comber East	ON	2011/12	36	82.80	Brookfield
Comber West	ON	2011/12	36	82.80	Brookfield
Mont Louis	QC	2011/09	67	100.50	Northland Power
Montagne-Sèche Wind Farm	QC	2011/11	39	58.5	Cartier Énergie Éolienne
Gros Morne Phase I	QC	2011/12	67	100.50	Cartier Énergie Éolienne
Lameque Wind Power Project	NB	2011/03	30	45.00	Acciona Lameque GP Inc.
Glen Dhu (2011 commissioned)	NS	2011/03	18	41.40	Shear Wind
Watts Wind	NS	2011/03	1	1.50	Watts Wind Inc.
Spiddle Hill Phase I	NS	2011/07	1	0.80	Colchester-Cumberland Wind Field Inc.



Canada's current installed capacity:

5,403 MW

Current as of March 2012

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WIND FACTS

PRICING

Wind energy is generating clean electricity, new jobs and economic development opportunities in communities across the country. While wind energy has enjoyed growing success in many countries for several decades, it is a relatively new contributor to the power system here in Canada. As such, it is natural for people to ask questions. As a responsible industry, we are committed to ensuring Canadians have the most up-to-date factual information on wind energy.

Wind Energy: A Reliable and Affordable Source of Power

Wind is an affordable source of new energy supply that protects against unpredictable fuel and carbon costs.

Any new source of electricity generation is going to cost more than the current generating plants, built and paid for decades ago, that now supply most of Canada's electricity. Among today's options, wind energy stacks up well. Wind is extremely competitive with new installations of coal, hydro, and nuclear power, when the cost of health and environmental impacts are considered.[1, 2]

The price we pay for wind today, though, is only one part of its value proposition.

Wind turbines do not use fossil fuels for producing electricity; this means that once a wind farm is built, the price of the electricity it produces is set and remains at that level for the entire life of the wind farm. In a time of increasing price volatility of traditional sources of energy, the price stability from wind farms

(continued on next page)

provides important protection for consumers. There is no guarantee, for example, that natural gas will remain at today's low prices over the long term. Natural gas prices vary over time with changes in supply and demand – just a few years ago electricity from natural gas-fired projects was more expensive than electricity from wind.

Because wind requires no fuel, produces very little waste and consumes barely any water during operation, it also provides a hedge against the risk and uncertain costs of complying with future greenhouse gas emission restrictions and other environmental regulations.

Jurisdictions in Canada and around the world have developed strategies for capturing the value that wind energy brings to a power system. Feed-in tariffs (FIT), used successfully in countries like Germany, Spain, and France, are a well-established way of creating a stable market for renewable energy investment by providing predictable revenue to wind producers and increasing their access to financing. Ontario's FIT program is the first of its kind in North America, and is helping attract billions of dollars in new investment to the province.

WHAT DO THE EXPERTS SAY?

In 2010, the Ontario Power Authority paid electricity resource costs of $317 million for conservation programs, and $269 million for renewables. That is a lot of money – but you must realize that it is recovered over a total Ontario consumption in 2010 of 142 terawatt hours (that's 142,000,000,000 kWh), which amounts to 0.4 cents per kWh (split roughly equally between conservation and renewable subsidies). So the cost of conservation and all the renewable subsidies in 2010 amounted to 0.4 cents of the 13 cents we paid for a kWh in our homes.[3]

"Once the investment is made, you have a secure price for that power over many, many years. So we're looking for certainty in the electricity supply. This is one way to take out some of the volatility in the marketplace."

Nova Scotia Premier Darrell Dexter, March 2010

The California Energy Commission calculates that a new gas-fired combined cycle power plant has a levelized cost of operation of $115 per MWh.[4] Add $20/MWh to cover the estimated cost of environmental and health damages[5] and the total is $135/MWh – exactly the same as Ontario's feed-in tariff rate for onshore, non-community based wind energy.

Interested in learning more?

The Oil Drum, an energy information website, analyzes the cost of wind, the price of wind, the value of wind (**www.theoildrum.com/node/5354**). Lazard's Levelized Cost of Energy Analysis (**www.blog.cleanenergy.org/files/2009/04/lazard2009_levelizedcostofenergy.pdf**) and the World Economic Forum's report on Green Investing 2011 (**www.weforum.org/reports/green-investing-2011**) compare the cost of some generating technologies.

Sources:

1. Mining coal, mounting costs: The life cycle consequences of coal. Centre for Health and The Global Environment, Harvard Medical School, January 2011
2. Behind the switch: pricing Ontario electricity options, The Pembina Institute, July 2011
3. The True Cost of Renewable Energy and Conservation, Environmental Commissioner of Ontario, March 2011. http://www.eco.on.ca/blog/2011/03/22/the-true-cost-of-renewable-energy-and-conservation/
4. Comparative Costs of California Central Station Electricity Generation. (California Energy Commission, January 2010). Table 4, page 3
5. Cost Benefit Analysis: Replacing Ontario's Coal-Fired Electricity Generation. (DSS Management Consultants, RWDI Air Inc; April 2005), page ii.

WIND FACTS

PROPERTY VALUES

Wind energy is generating clean electricity, new jobs and economic development opportunities in communities across the country. While wind energy has enjoyed growing success in many countries for several decades, it is a relatively new contributor to the power system here in Canada. As such, it is natural for people to ask questions. As a responsible industry, we are committed to ensuring Canadians have the most up-to-date factual information on wind energy.

Wind Energy: Providing Significant Local Economic Benefits

There are a number of factors that impact property values and it is difficult to isolate the potential impact of any single variable. What we do know is that multiple studies have consistently found no evidence that wind energy projects around the world are negatively impacting property values. In fact, wind energy projects provide new sources of stable revenue for municipalities and landowners in the form of taxes and lease payments.

A 2010 study conducted in Chatham-Kent, Ontario, found there was no statistically relevant relationship between the presence of a wind project and negative effects on property values.[1]

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A similar analysis by the US Department of Energy's Lawrence Berkeley National Laboratory found that proximity to wind energy facilities does not have a pervasive or widespread adverse effect on the value of nearby homes. Researchers examined 7,500 single-family property sales between 1996 and 2007, covering a time span from before the wind farms were announced to well after construction and operation. [2]

A 2010 study looking at property values near the 396 MW Twin Groves Wind Farm in Illinois found prices were negatively affected ***before*** the wind farm was built, but rebounded ***after*** it was in place.[3]

WHAT DO THE EXPERTS SAY?

"In the study area, where wind farms were clearly visible, there was no empirical evidence to indicate that rural residential properties realized lower sales prices than similar residential properties within the same area that were outside the viewshed of a wind turbine."

Wind Energy Study – Effect on Real Estate Values in the Municipality of Chatham-Kent

"Based on the data sample and analysis presented here, no evidence is found that home prices surrounding wind facilities are consistently, measurably, and significantly affected by either the view of wind facilities or the distance of the home to those facilities."

The Impact of Wind Power Projects on Residential Property Values in the United States: A Multi-Site Hedonistic Analysis

"During the operational stage of the wind farm project, when property owners living close to the wind turbines actually had a chance to see if any of their concerns materialized, property values rebounded."

Wind Farm Proximity and Property Values: A Pooled Hedonistic Regression Analysis of Property Values in Central Illinois

Sources:

1. Wind Energy Study - Effect on Real Estate Values in the Municipality of Chatham-Kent (Canning Consultants Inc. and John Simmons Realty Services Ltd., February 2010)

2. The Impact of Wind Power Projects on Residential Property Values in the United States: A Multi-Site Hedonistic Analysis (Ben Hoen, Ryan Wiser, Peter Cappers, Mark Thayer, and Gautam Sethi, December 2009)

3. Wind Farm Proximity and Property Values: A Pooled Hedonistic Regression Analysis of Property Values in Central Illinois (Jennifer L. Hinman, May 2010)

The Economic Impacts of the Wind Energy Sector in Ontario 2011-2018

May 27, 2011

Prepared by ClearSky Advisors Inc.

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Table of Contents

1 Executive Summary

1.1 Key Highlights

The wind energy sector in Ontario will generate a significant amount of both electricity and economic activity over the course of 2011 through 2018. Specifically, during this timeframe, the sector is expected to:

- Install over 5.6 GW of wind energy capacity, bringing Ontario's total wind energy capacity to 7.1 GW by 2018;
- Create 80,328 job years (Person-Years of Employment or PYE);
- Attract $16.4billion of private investments of which $8.5billion will be invested locally in Ontario; this investment is entirely private investment, and is only to be paid back upon the production of power over the lifespan of the turbines; and
- Contribute more than $1.1billion of revenue to local Ontario municipalities and landowners in the form of taxes and lease payments over the 20-year lifespan of projects installed in 2011 - 2018.

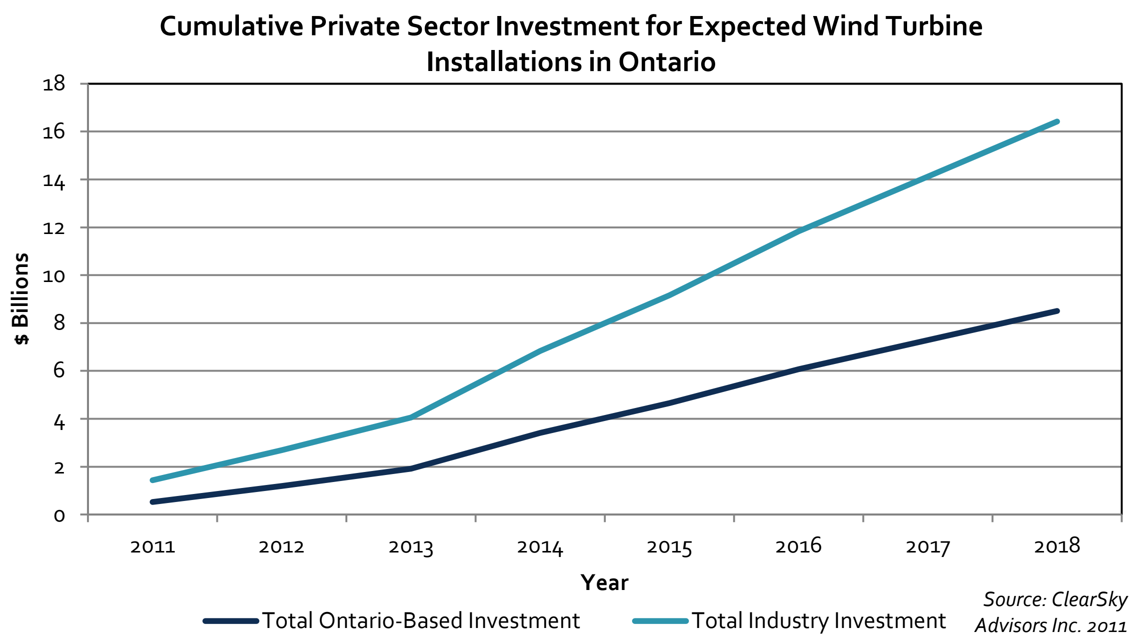


Figure 1.1: Cumulative Private Sector Investment for Wind Turbine Installations in Ontario, Expected Scenario 2011-2018

Of the over 5.6 GW of wind energy capacity installed from 2011 to 2018:

- On average 709 MW will be installed per year; and
- The market will have a capacity for up to 900 – 1,000 MW of installations per year.

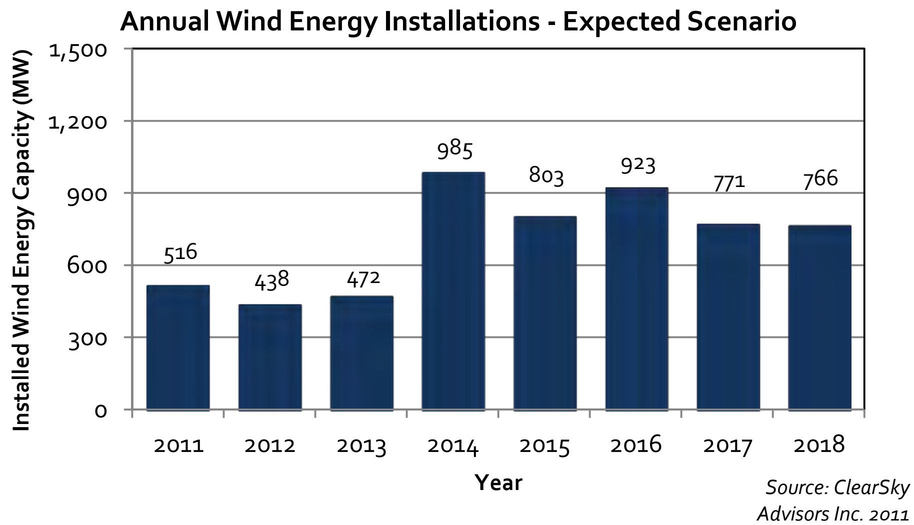


Figure 1.2: Annual Wind Energy Installations in Ontario (in MW), Expected Scenario (2011-2018)

The $1.1billion of revenue to local Ontario municipalities will be paid out over the 20-year lifespan of projects and will consist of:

- Over $1billion in lease payments paid to landowners
- Over $145million in taxation paid to local municipalities

The 80,328 PYE corresponds to 14.1 PYE per MW of nameplate capacity, split between:

- 10.5 PYE per MW in the construction phase; and
- 3.6 PYE per MW for ongoing operations and maintenance.

Note: These figures are ONLY for the projects forecast for installation in 2011 through 2018. The actual number of jobs is likely to be higher because no jobs are included for export, pre-contract development, or any ongoing installations after 2018. Furthermore, we have only considered direct and indirect jobs and not induced jobs. Therefore, these numbers are conservative for all years. The drop-off in employment after 2017 would only occur if exports and continued project awards beyond 2018 did not materialize.

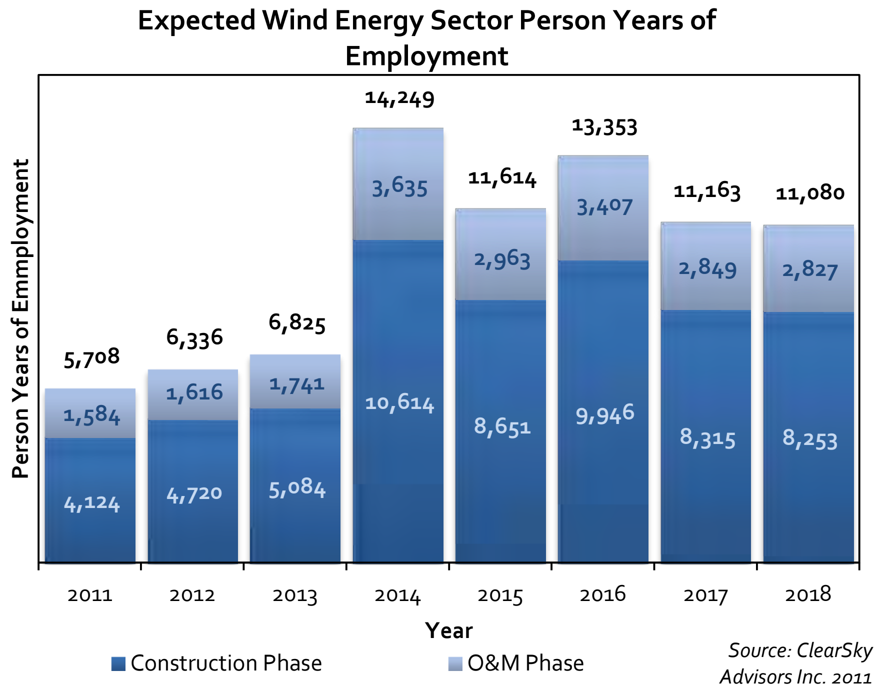


Figure 1.3: Person Years of Employment Created by the Wind Energy Sector in Ontario, Expected Scenario 2011-2018

To illustrate, for a sample 100 MW nameplate capacity wind energy generation project installed in Ontario:

Table 1.1: Summary of 100 MW Project Sample Costs, Benefits, and Employment

100 MW Project Sample Costs, Benefits, and Employment		
Expected Cost	*Total Lifetime Cost (in 2011 $)*	$337,530,679
	Total 20 Year O&M Cost	$68,501,669
	Total Expected Installation Cost	$269,029,010
20 Year Economic Benefits to Landowners and Municipalities	*Total 20 Year Economic Benefits*	$41,271,945
	20 Year Lease Payments	$38,668,407
	20 Year Tax Payments	$2,603,538
Expected PYE	*Total*	1,416
	Construction Phase	1,052
	O&M Phase	363

Source: ClearSky Advisors 2011

1.2 Methodology for Data Collection and Analysis

Primary data was collected through interviews with a wide range of industry stakeholders. In total, ClearSky Advisors conducted 43in-depth interviews to develop a comprehensive understanding of the economics of the wind energy sector in Ontario. Occasionally, the in-depth interviews would be complemented by emails to ensure that all necessary details were obtained from the interviewees. Overall, we interviewed:

- Large and small project developers, representing over 92% of the MW volume of connected projects and contracts offered to date;
- Leading independent engineering, construction, and consulting firms; and
- Manufacturers (both at the OEM and Tier 1 level), representing over 99% of the installed wind capacity in the province of Ontario.

The high rate of participation by interviewees in this study means that we are very comfortable that the data collected is representative of the current wind industry in Ontario.

In conjunction with the in-depth interviews, research from secondary resources was conducted to further inform interviews, cross-check interview findings, compare Ontario-based findings in a global perspective, and generally to enhance the understanding of the intricacies of the economics of the Ontario wind energy sector. Notable examples of secondary sources include:

- Publications by the Ontario Power Authority (OPA) including Ontario's Long-Term Energy Plan (LTEP), Integrated Power System Plan (IPSP) and quarterly updates;
- Peer-reviewed studies from academic sources and publications; and
- Statements and plans by the Ministry of Energy, IESO, and OPG.

Forecasts for job creation and ratepayer impact were generated through a ClearSky Advisors model that incorporates established and recognized 3rd party tools (Jobs and Economic Development Impact Model-W1.10.2)[1] with in-house modelling. Inputs for the model were taken from ClearSky Advisors' market modeling as well as trusted 3rd party sources. In particular, economic multipliers specific to Ontario were obtained from Statistics Canada, job creation data was taken from peer reviewed publications, and price data was taken from sources such as the Ontario Power Authority, Ontario's Ministry of Energy and Moody`s Investment Service. Cost data for fossil fuels includes environmental and health externalities where they have been quantified by either peer reviewed publications or government data. Given the controversy around including externalities, we have used conservative and verifiable estimates and identified where we have used them wherever possible. Additional costs for nuclear (including waste management and insurance) are not included.

Job creation outcomes are tailored to reflect domestic content requirements in the province and other characteristics of Ontario's Feed-in Tariff program. Person-years of employment (PYE) include only direct and indirect jobs (induced jobs would be additional to figures reported here).

[1] National Renewable Energy Laboratory (NREL), Jobs and Economic Development Impact (JEDI) Model.

2 Introduction

2.1 Background

The purpose of this study is to provide an understanding of the economic impact of Ontario's wind energy industry for the period 2011 – 2018. Specifically, the report considers the wind industry within the context of and parameters laid out by the Ontario Government in the Long Term Energy Plan (LTEP) that was released in November 2010. In the LTEP, the Ontario Government covers both demand for and supply of energy for the period 2011 to 2030, including the supply mix, conservation plans and the transmission system.

Based on the targets laid out in the LTEP, the wind energy industry is entering a period of strong growth. By 2018, the Ontario Government is targeting a wind energy generation capacity of 7.1 GW, a number that amounts to an almost five-fold increase from the capacity of 1,428 MW which was in-service at the end of 2010[2].

This study is concerned with quantifying the economic impacts of this growth from 2011 to 2018 on the Ontario economy and for a range of different stakeholders including:

- Wind energy project developers;
- Wind energy equipment design, supply and manufacturing firms;
- Construction and transportation firms;
- Job seekers;
- Municipalities and landowners that host wind farms; and
- Equity and debt providers.

The study was commissioned by the Canadian Wind Energy Association (CanWEA) and has been conducted by ClearSky Advisors on an independent basis. Our mandate has been to produce facts, analysis, and forecasts but not to offer any recommendations.

2.2 Scope

There are three primary areas of focus for this report:

1. Ontario wind energy market economics from 2011-2018
2. Ontario wind energy market labour forecast from 2011-2018
3. Job multipliers for both the construction and operations phases of wind energy projects in Ontario

Specifically, this report examines the following:

1. Ontario wind energy generation market economics from 2011-2018
    - Annual and total forecast (in MWh) for the Ontario electricity market;
    - Annual and total forecast (both in MW and dollar value) for the wind energy market in Ontario, including both the construction and operations phases;

[2] Ontario Power Authority. (2010). Progress Report on Electricity Supply, 4th Quarter 2010.

- Analysis of the market opportunity for each major service and supply segment during the construction phase as identified in the Ontario Power Authority's domestic content grid;
- Forecast for the annual and total value of the operations and maintenance market to support wind energy generation during the operations phase;
- Forecast for the share of the market to be captured by the Ontario supply and value chain; and
- Forecast for the dollar value of benefits to landowners and communities in Ontario.

2. Ontario wind energy generation market labour forecast from 2011-2018:
    - Annual direct and indirect employment during both the construction and operations phases; and
    - Employment breakdown by supply and value chain segments.
3. Job multipliers for the construction and operations phases of wind energy generation in Ontario

3 Market Forecast

The wind energy sector in Ontario is expected to grow significantly from 2011-2018. Specifically, the market is expected to:

- Install an additional 5.6 GW of wind energy capacity by 2018, bringing Ontario's total wind energy capacity to 7.1 GW by 2018.
- Provide 3.11% of the required electricity in Ontario in 2011, increasing to 10.99% by 2018.

While the past decade has seen growth for the wind industry in Ontario, the LTEP targets continued capacity growth through 2018, as shown in Figure 3.1.

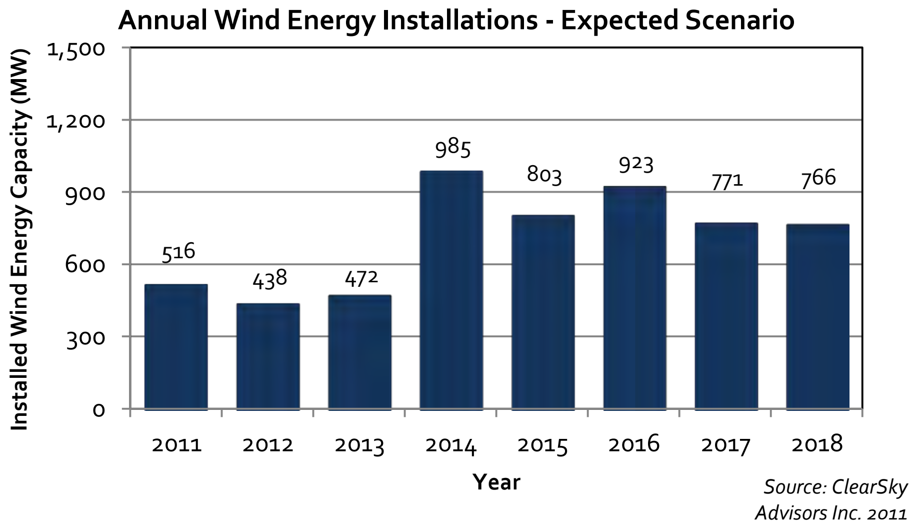


Figure 3.1: Expected Ontario Annual Wind Energy Installations Forecast From 2011-2018 (in MW)

Ontario's energy market is driven by the province's energy procurement policy, as implemented by the Ontario Power Authority (OPA). For wind energy specifically, the procurement policy has been implemented through a series of programs since 2003, beginning with Renewable Energy Supply (RES) I-III, followed by the Renewable Energy Standard Offer Program (RESOP) and finally the current Feed-In Tariff Program (FIT) which was launched in October 2009.

3.1 Market Overview

3.1.1 Ontario Electricity Market Forecast

Ontario's Long-Term Energy Plan (LTEP) clearly outlines that the years 2011 through 2018 will be a period of change in the energy supply mix in Ontario.

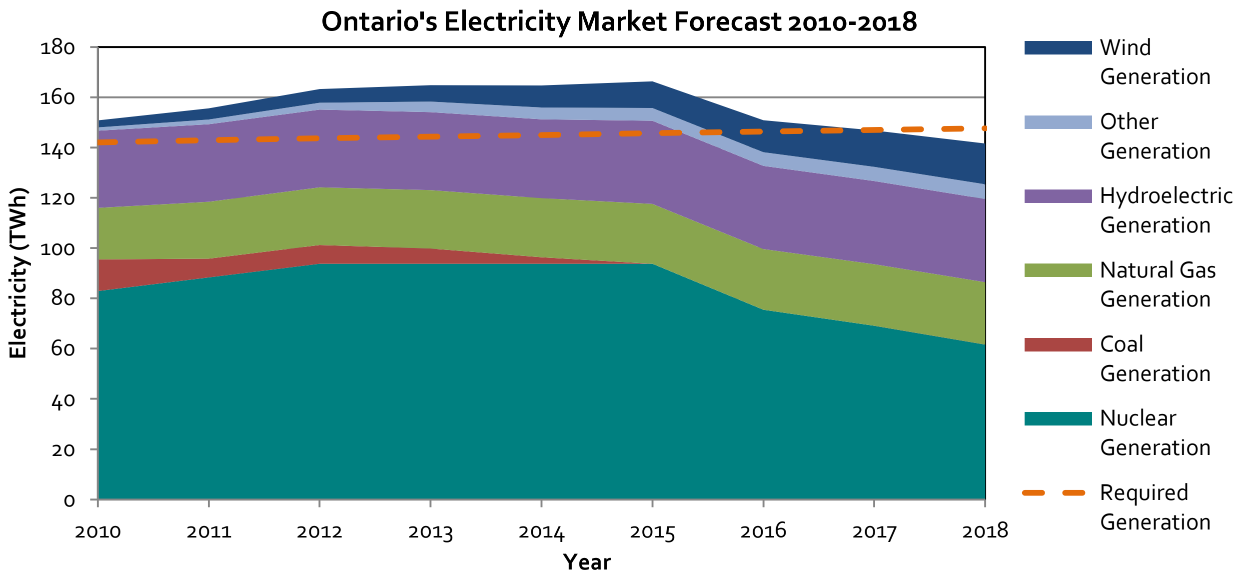
- There is significant investment planned into transmission and energy conservation in Ontario.
- Electricity demand is anticipated to grow at a CAGR of 0.46%[3] from 2010 through 2018.

[3] Ontario Power Authority. (2010). Ontario's Long Term Energy Plan 2010-2030; Independent Electricity System Operator (IESO). 2010. 18 Month Outlook From December 2010 to May 2012 http://www.ieso.ca/imoweb/pubs/marketReports/18Month_ODF_2010dec.pdf; and Ontario Power Authority. (2011). IPSP Planning and Consultation Overview.

- Coal-fired generation will be phased out in the province by 2014.
- By 2025, 10,000 MW of existing nuclear generation capacity will be refurbished.

From 2011 to 2018, it is anticipated that total electricity demand in Ontario will increase from 142.4 TWh to 147.6 TWh, though by 2018, with an additional 17.8 TWh offset by energy conservation in Ontario.

As the province aims to phase out coal by 2014, wind energy generation will increasingly become an important part of the energy supply mix. In 2011, wind is anticipated to provide 3% of the required electricity in Ontario, increasing to just under 11% by 2018[4].



Sources: ClearSky Advisors Inc. 2011; OPA, IPSP Planning and Consultation Overview 2011; OPA, Ontario's Long Term Energy Plan 2010; IESO, 18 Month Outlook December 2010

Figure 3.2: Ontario's Electricity Market Forecast

3.1.2 Implications of Long Term Energy Plan for Renewable Energy Capacity and Generation

Ontario's LTEP outlines that 10,700 MW of renewable energy generation capacity (including wind, solar, and biomass) is to come online by 2018 in the province of Ontario. This capacity is expected to yield an annual electricity generation of 24.96 TWh, where:

- 78% is anticipated to come from wind energy;
- 12% is anticipated to come from solar PV; and
- 10% is anticipated to come from biomass sources.

[4] Generation is calculated as the difference between gross demand and energy conservation.

3.1.3 Wind Energy Capacity in Ontario: Existing, Contracted, and Targeted

By 2018, the LTEP targets over 7 GW of installed wind energy generation capacity in Ontario. Table 3.1 illustrates that while the pace of development has been significant in the past, the next several years will require a high pace of project awards if the province is to meet the LTEP target.

Table 3.1: Wind Energy Generation Contracts in Ontario: Existing, Contracted, and Targeted

Wind Energy Capacity in Ontario: Existing, Contracted, and Targeted							
	RES Program	RESOP Program	On-Shore FIT Program	Samsung & KEPCO	Total	Target	Additional Required
Existing installed capacity (MW)*	1,233.1	193.8	0.8	-	1,427.7	N/A	N/A
Contracts under development (MW)*	276.3	131.5	1,228.8	2,000	3,636.6	N/A	N/A
Total (MW)	1,509.4	325.3	1,229.6	2,000	5,064.3	7,101.2	2,036.9

*As of December 31st, 2010[5].

Sources: ClearSky Advisors 2011; OPA, Progress Report on Electricity Supply, 4th Quarter 2010

Table 3.2: Expected Wind Energy Generation Capacity Installations in Ontario by Program Type, 2011-2018

Expected Wind Energy Generation Capacity Installations in Ontario by Program Type, 2011-2018									
	2011	2012	2013	2014	2015	2016	2017	2018	Total
RES	132	-	-	-	-	-	-	-	132
RESOP	276	-	-	-	-	-	-	-	276
On-Shore FIT	109	38	72	585	403	523	771	766	3,266
Samsung & KEPCO	-	400	400	400	400	400	-	-	2,000

Sources: ClearSky Advisors 2011; OPA, Progress Report on Electricity Supply, 4th Quarter 2010

3.1.3.1 Wind Energy in Ontario: Pre-contract Development

Currently, there are more than enough FIT applications for wind energy projects awaiting approval by the OPA to satisfy the targets of the LTEP.

- The LTEP calls for 7.1 GW of installed wind energy capacity;
- As of Dec 31st, 2010, 1,428 MW of wind energy capacity are installed in the province; and
- This leaves a requirement of 5.6 GW of additional capacity to be installed.

[5] Ontario Power Authority. (2010). Progress Report on Electricity Supply, 4th Quarter 2010.

Consider the above facts in light of the wind pipeline in the on-shore FIT program and Samsung and Korea Electric Power Corporation (KEPCO) agreement as of Q4, 2010:

- 0.8 MW of FIT projects already connected in the province;
- 1,229 MW of FIT projects with contracts awarded and were under development;
- 2,000 MW of projects under development by the Samsung and KEPCO; and
- 5,153 MW of FIT project applications awaiting the economic connection test (ECT).
- In total, the above numbers represent over 8.3 GW of potential wind energy capacity, from just the FIT program and the Samsung & KEPCO agreements– far surpassing the 5.6 GW of additional capacity required to meet the LTEP targets for wind energy.

It is not impossible for new project applications to be submitted, accepted, constructed, and connected during the forecast period. After all, it is highly unlikely that all of the contracted and applied-for projects will come to fruition for a variety of reasons. For example, some projects will not find financing, while others are not located where there is likely to be an economic connection to the grid. However, the chances of new project applications making it through to construction at this point are much lower than just two years ago. As such, developers we interviewed have confirmed that their pre-contract development activity will be greatly reduced over the near term.

3.2 Supply of Wind Energy Equipment

Compared to other renewable energy sources, the wind industry enjoys a relatively mature supply chain at the global level. However, as part of the province's FIT program, an increasing amount of the equipment must be made in Ontario. For FIT projects with a commercial operation date (COD) before December 31, 2011, the level of domestic content as defined by the OPA is 25% while for FIT projects with a later COD, the level of domestic content is 50%. Projects under development by Samsung must adhere to domestic content requirements similar to those under the FIT program. In short, this increase in domestic content requirements means that a wind supply chain will need to be significantly augmented in Ontario.

For this report, the supply chain for the wind energy sector is broken down into the construction phase and the operations and maintenance phase. The construction phase is further divided into equipment and balance of plant.

Table 3.3: Breakdown of Total Installed System Cost for a Wind Turbine in Ontario (by Percent)

Breakdown of Total Installed System Cost for Wind Turbines in Ontario[6]	
Component	**Percent of Total Installed System Cost**
Nacelle	40%
Blades	9%
Towers	12%
Transportation	10%
Balance of Plant (BOP)	29%*
General Materials	52% of BOP
Labour	33% of BOP
Development	15% of BOP

* *In Ontario, the BOP for wind turbine installations can range between 20-40%.*
Source: ClearSky Advisors 2011

The equipment portion of the construction phase is broken down into 4 components; nacelle, blades, towers, and balance of plant.

3.2.1 Nacelle

For wind turbines installed in Ontario, on average, the nacelle accounts for 40% of the total installed system cost. For this report, the nacelle is defined as including (where applicable):

- Nacelle frame and shell;
- Pitch system;
- Yaw system;
- Hub (and hub casing);
- Gearbox;

[6] From the interviews we conducted the average wind turbine in Ontario ranged from 2-2.3 MW.

- Generator and brake;
- Heat exchanger;
- Drive shaft; and
- Power converter.

3.2.2 Blades

Blades installed on wind turbines in Ontario account on average for 9% of the total installed system cost. For the purpose of this report, blades are defined as cast/moulded wind turbine blades.

3.2.3 Towers

On average, wind turbine towers installed in Ontario account for 12% of the total installed system cost. For the purpose of this report, towers are defined as (where applicable):

- Materials for wind turbine towers (typically either steel or concrete); and
- Manufacturing/forming of materials into wind turbine towers.

3.2.4 Transportation

Transportation of the nacelle, towers, and blades from manufacturers to the installation site accounts for 10% of the total installed system cost for wind turbines built in Ontario.

3.2.5 Balance of Plant

Balance of plant (BOP) accounts for an average of 29% of total installed system cost for wind turbines installed in Ontario. For the purpose of this report, the balance of plant is defined as:

- General materials and equipment (52% of the BOP cost), including:
  - Construction (roads, bulldozers, cranes, etc.);
  - Transformers;
  - Control panels and electronics (such as cables and wiring); and
  - HV electrical systems.
- Labour (33% of the BOP cost), including:
  - Foundation;
  - Tower erection;
  - Electrical; and
  - Management/supervision.
- Development (15% of the BOP cost), including:
  - Interconnection;
  - Legal consulting; and
  - Engineering.

Table A.2 in the appendix shows how the supply chain classifications match the OPA's domestic content grid.

3.3 Pricing

Though relatively new in North America, particularly in Ontario, electricity generation from wind turbines is a mature technology with well-established global manufacturers and developers. For the purposes of this report, we have assumed that the rate of innovation and cost-reduction will only slightly outpace inflation, thus leaving equipment costs essentially flat over the forecast period.

The installation cost of wind turbines has been fairly well insulated against inflation. Variation in total system price and O&M cost of wind turbines in Ontario depends primarily on the following factors:

- Wind regime conditions;
- Choice of turbine technology;
- Project specific geography (Crown land, location of interconnection, road access, etc.);
- Topology/geo-morphology (type of soil/rock on which the project is built, the slope/grade of the land on which the project is built, etc.);
- Project implementation schedule; and
- First Nations agreements.

Table 3.4: Wind Turbine Installation and Service Pricing in Ontario

Wind Turbine Installation and Service Pricing in Ontario (in Real 2011 $CAD)				
		Average Price ($/MW)	**High Price ($/MW)***	**Low Price ($/MW)**
Total All-In Installed Cost	*Pre-50% Domestic Content Requirements (2011)*	$2,630,000	$3,430,000	$2,110,000
	Post-50% Domestic Content Requirements (2012-2018)	$2,690,000	$3,500,000	$2,110,000
Annual Operations & Maintenance Cost		$34,300	$40,600	$20,800

* *Projects at the high end of the price range would only be financially viable in very unique circumstances.*
Source: ClearSky Advisors 2011

ClearSky Advisors has reported an average value, high-price, and low-price for total installation and O&M wind turbine system costs for pre- and post-50% domestic content requirements to reflect the variability of these factors. This is shown above in Table 3.4. Turbine prices are expected to increase due to domestic content requirements. Our research has found, however, that the reported ranges for all-in system costs and O&M costs have more to do with the variable nature of balance of plant costs (20-40% of the total installed cost) and the aforementioned project-specific location characteristics in Ontario and less to do with impact of changing domestic content requirements on turbine costs. Projects at the high end of the price range would only be financially viable in very unique circumstances.

As the OPA's mandated 50% domestic content requirement for wind turbines installed in Ontario comes into effect after January 1st, 2012, we expect an increase of just over 2% to the all-in installed system cost. In terms of O&M costs, the accumulated 20-year costs are anticipated to stay around 20% of the total lifetime cost (all-in installed price plus 20-year O&M costs), irrespective of the domestic content requirements.

3.4 Wind Energy Sector Installed Capacity Forecast Scenarios

The potential market outcomes for the wind energy sector over the next few years are based on three pairs of wind energy demand and supply scenarios, with the assumptions for each outlined in Table 3.5.

Table 3.5: Wind Energy Sector in Ontario Scenario Assumptions

Wind Energy Sector in Ontario Installed Capacity Forecast Scenario Assumptions			
Assumption	**High Market Forecast**	**Expected Market Forecast**	**Low Market Forecast**
Political Support	High	Steady	Low
Transmission Capacity	Aggressive Additions	Steady Additions	Minor Additions
Project Delays*	Few	Some	Significant
Project Cancellations	Few	Some	Significant

**These delays include the February, 2011 offer from the OPA for a 1-year extension on commercial operation date (COD) for FIT contract holders.*

Source: ClearSky Advisors 2011

Factors that were considered to contribute positively or negatively to the assumptions listed above include:

- Environmental benefits;
- Environmental concerns;
- Increased awareness of the cost of traditional energy sources;
- Perceived causes of the increase in the cost of electricity to ratepayers;
- Community support;
- Community opposition; and
- Contracting and permitting processes.

1. Expected Market Forecast – The Expected Scenario reflects a situation where government policy supports the targets laid out in the LTEP. The Expected Scenario is mostly based on information garnered from the interviews with developers of wind generation projects in the province as well as related research and analysis of the targets set out in the LTEP in conjunction with planned transmission expansions and upgrades.
2. High Market Forecast – The High Scenario is based upon expedited transmission expansions and increases in either a) the target itself, or b) the relative proportion of wind included in the LTEP target of 10,700 MW of renewable energy generation to be installed in Ontario by 2018.
3. Low Market Forecast –The Low Scenario is predominantly based upon assumptions around delays to the current transmission expansion plans, coupled with a loss of political will to continue with the growth of the wind energy generation sector in Ontario.

Table 3.6: Installed Wind Capacity to be Built in Ontario, 2011-2018

Annual Installed Wind Capacity in Ontario (MW)										
	2011	2012	2013	2014	2015	2016	2017	2018	Installed Capacity From 2011-2018	Total Installed Capacity by 2018
Expected Scenario	516	438	472	985	803	923	771	766	5,673	7,101
High Scenario	653	456	660	1,111	976	1,015	1,059	1,010	6,939	8,366
Low Scenario	386	384	283	516	248	311	152	-	2,280	3,708

Source: ClearSky Advisors 2011

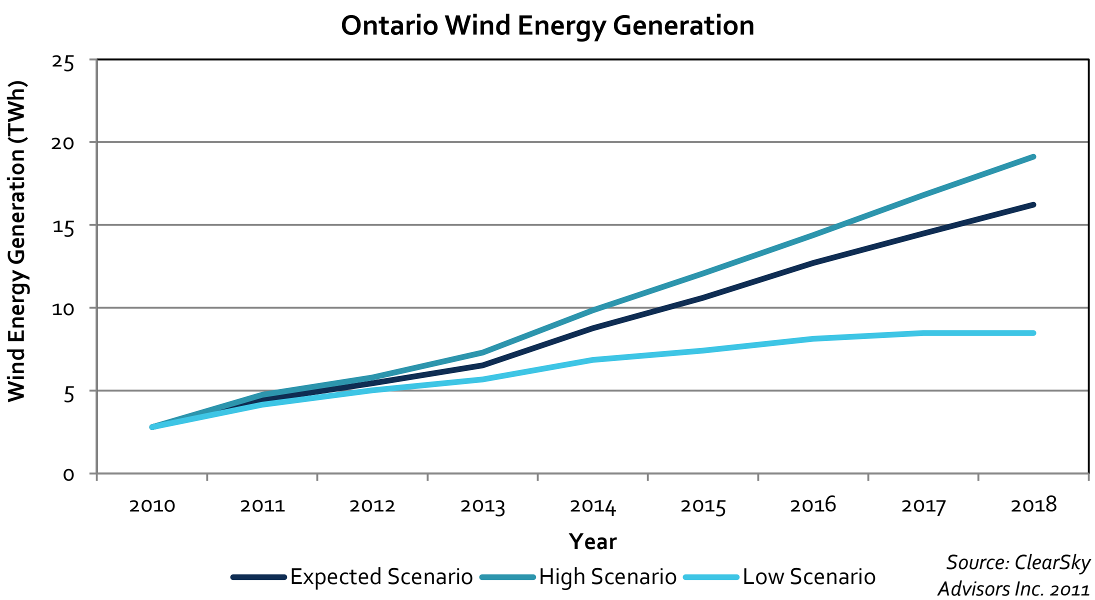


Figure 3.3: Ontario Wind Energy Generation (in TWh)

It is important to note that the Expected Case and High Case only slightly differ between the present and 2014. This reflects the assumption that wind energy capacity is currently being added to the grid essentially as fast as the grid can allow for. It also reflects the fact that wind energy takes approximately 3 to 4 years to develop from inception to connection. The remaining time is spent on activities such as development, contracting, permitting, etc.

As was outlined above, we considered many factors in developing our three market scenarios. However, as a result of the interviews we conducted it was apparent that political support and the availability of transmission were the two factors that had the biggest impact on the wind energy sector in Ontario.

3.4.1 High Scenario Overview:

Assumptions used in the creation of the high scenario include:

- Strong political support for continued procurement of wind energy generation capacity.
- Aggressive transmission additions will facilitate an increase in project awards and installations.
- Potential interruptions to original project schedules:
  - Permitting – few;
  - Construction – few (chiefly due to winter weather);
  - OPA's 1 year extension on COD – some; and
  - Project cancellations – few.

3.4.1.1 Installation Rate in Ontario

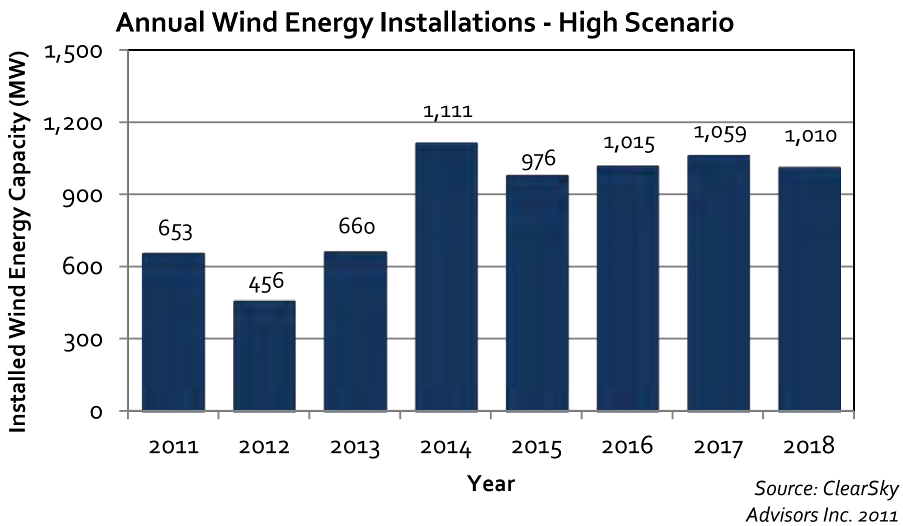


Figure 3.4: Annual Wind Energy Installations in Ontario (in MW), High Scenario (2011-2018)

- Total 2011-2018 installations: 6,939 MW - total cumulative installations by 2018: 8,366 MW.
- Average annual installations: 867 MW - ranging from 456 MW (2012) to 1,111 MW (2014).

3.4.1.2 Trends

- Annual installations will peak in 2014 and maintain a high level through 2018 due to:
  1. The Bruce to Milton transmission expansion project
  2. East-West tie transmission upgrades
  3. Substantial transmission upgrades in south-western Ontario (2017)
- Market supply capacity for wind turbine installations of 1,100 - 1,200 MW per year:
  - The market may experience potential domestic content supply constraints in 2014-2018 as there will be a near doubling of market volume from 2013 to 2014 and 5 consecutive years approaching market capacity.
  - Most parts of the value and supply chains can stretch beyond 1,200 MW per year, but depending on future market conditions, the supply of domestic-content compliant steel and the availability of skilled labour (especially for electrical and tower erection) could be constraining factors that could cause delays and/or price increases.

3.4.2 Expected Scenario Overview:

Assumptions used in the creation of the expected scenario include:

- Steady political support for continued procurement of wind energy generation capacity.
- Several transmission additions and upgrades that will facilitate the growth of the market in line with the LTEP.
- Potential interruptions to original project schedules:
  - Permitting – some;
  - Construction – few (chiefly due to winter weather);
  - OPA's 1 year extension on COD – some; and
  - Project cancellations – some.

3.4.2.1 Installation Rate in Ontario

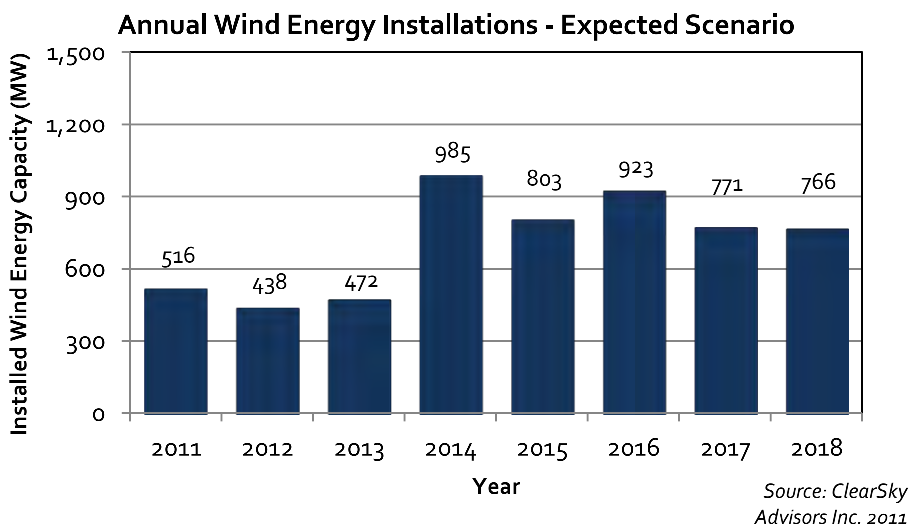


Figure 3.5: Annual Wind Energy Installations in Ontario (in MW), Expected Scenario (2011-2018)

- Total 2011-2018 installations: 5,673 MW - total cumulative installations by 2018: 7,101 MW.
- Average annual installations: 709 MW - ranging from 438 MW (2012) to 985 MW (2014).

3.4.2.2 Trends

- Annual market volume will peak in 2014 and maintain a high volume until 2018 due to:
  1. The Bruce to Milton transmission expansion project
  2. East-West tie transmission upgrades
  3. Substantial transmission upgrades in south-western Ontario
- Market supply capacity for wind turbine installations of 900 - 1,000 MW per year:
  - The market may potentially experience domestic content supply constraints in 2014-2016 as there will be 3 years in a row of installation volume at nearly market capacity.
  - Most parts of the value and supply chains can stretch beyond 1,000 MW per year, but depending on future market conditions, the supply of domestic-content compliant towers could be constraining factors that could cause delays and/or price increases.

3.4.3 Low Scenario Overview:

Assumptions used in the creation of the low scenario include:

- Low political support for continued procurement of wind energy generation capacity:
  - Potential changes to the domestic content rules.
- Minor transmission additions to facilitate additional project awards and installations (by 2018).
- Potential interruptions to original project schedules:
  - Permitting – significant;
  - Construction – few (chiefly due to winter weather);
  - OPA's 1 year extension on COD – significant; and
  - Project cancellations – significant.

3.4.3.1 Installation Rate in Ontario

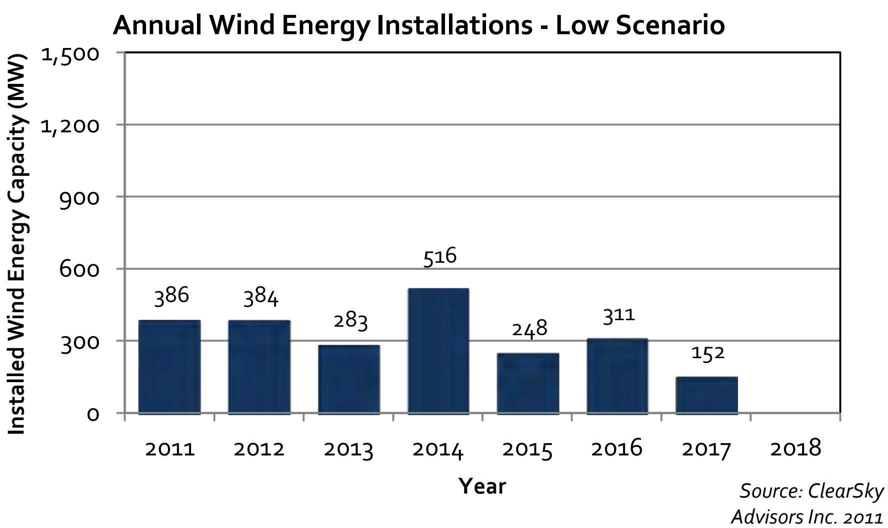


Figure 3.6: Annual Wind Energy Installations in Ontario (in MW), Low Scenario (2011-2018)

- Total 2011-2018 installations: 2,280 MW - total cumulative installations by 2018: 3,708 MW.
- Average annual installations: 285 MW - ranging from 0 MW (2018) to 516 MW (2014).

3.4.3.2 Trends

- Annual installations will peak in 2014 due to:
  1. The Bruce to Milton transmission expansion project
- Market supply capacity for wind turbine installations of 600 - 700 MW per year:
  - It is unlikely that the market will experience any domestic content supply constraints from 2011-2018.
  - Most parts of the value and supply chains have significant flexibility in terms of scaling production and service up and down. Further, additional supply in the Ontario marketplace could be used to serve other North American markets fairly easily due to the strong transportation infrastructure in Ontario. As such, though the market capacity will be far greater than demand in most years, it is unlikely that there will be a surplus of equipment and/or production capacity that could cause decreases in price.

4 Economic Impacts

4.1 Overview of Economic Impacts

Investment in the wind energy sector impacts a number of stakeholder groups within the province of Ontario in a variety of ways, including stimulation of local spending, generation of tax revenue, lease payments, job creation, and the development of local expertise and innovation[7]. Based on market activities corresponding with the "expected" scenario laid out in the previous section, the key economic indicators are:

- The wind energy sector will result in 80,328 person years of employment (PYE) from 2011-2018.
- Total private sector investment for wind turbine installations will be more than $16.4billion, of which greater than $8.5billion will be spent locally in Ontario from 2011-2018, shown in Figure 4.1.
- Total private sector benefits paid in Ontario, demonstrated in Table 4.7, as a result of installations in 2011-2018 will surpass $1.1billion (based on and paid over 20-year contracts from the installation date), including:
    - $1.03billion in lease payments to landowners; and
    - $147million in taxation payments to municipalities.

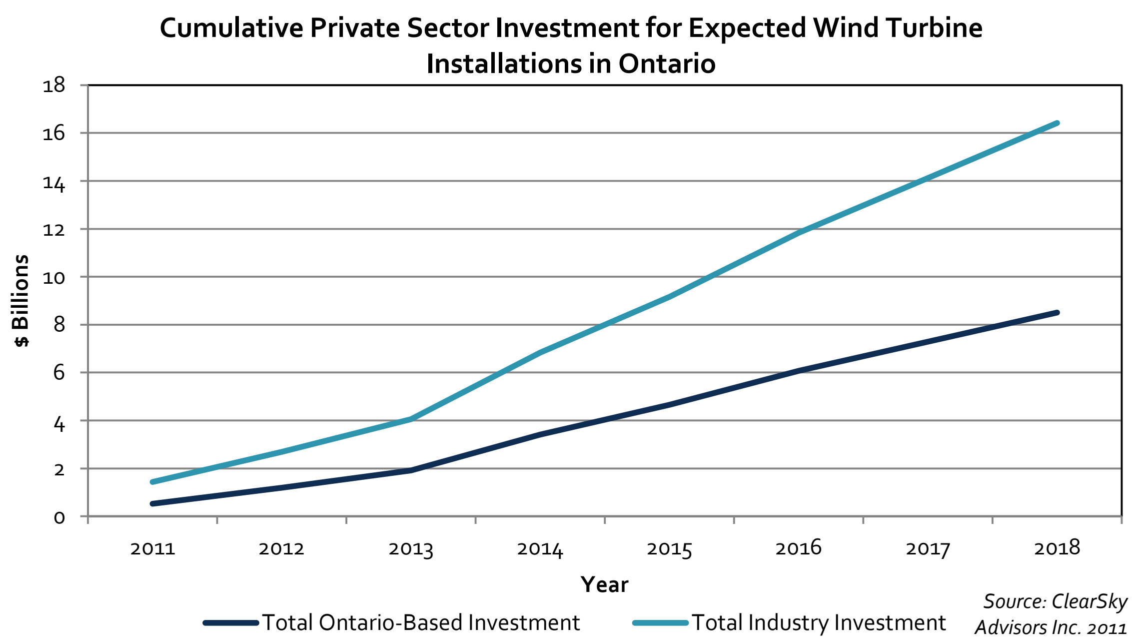


Figure 4.1: Cumulative Private Sector Investment for Wind Turbine Installations in Ontario, Expected Scenario 2011-2018

[7] The analysis in this report does not include the economic or labour impacts associated with the decommissioning, re-powering, and/or refurbishment of wind turbines at the end of their service life. It is likely that a combination of all three options will be employed for wind turbines in Ontario, but at this point in time it is unclear what percentage of turbines will subjected to each end of service life option.

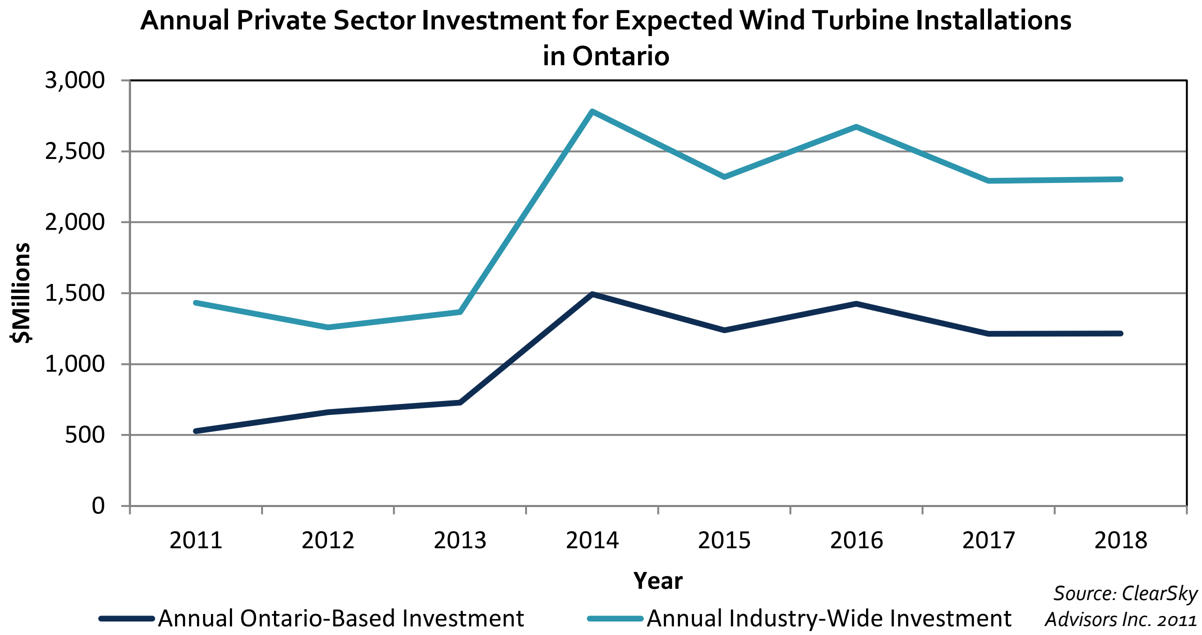


Figure 4.2: Annual Private Sector Investment for Wind Turbine Installations in Ontario, Expected Scenario 2011-2018

4.2 Job Creation

When compared to existing traditional energy sources in Ontario, the wind energy sector creates more employment opportunities per unit of energy produced and does so at a lower cost per job. This fact, as demonstrated in the following figures, helps to explain why the province of Ontario and other governments from around the world are including wind energy as a growing part of their energy mix.

In general, when considering jobs created by the wind energy sector, it is useful to make a distinction between pre-connection and post-connection jobs. Post-connection jobs are typically ongoing and include operation and maintenance (O&M) while pre-connection jobs are more variable in nature and include project development, onsite labour, manufacturing, wholesale, and distribution. For the purposes of our study, we have termed pre-connection jobs as "Construction Phase" and have assumed that the pre-connection jobs would be one-time[8]. In order to be sustained on an ongoing basis, these jobs would need to be maintained with export projects and/or additional local market awards.

In order to compare ongoing jobs with one-time jobs, we use a measure called person-years of employment (PYE). As the name suggests, PYE represent one year of employment for one individual (i.e. 40 hours per week for 52 weeks). To illustrate, since Ontario FIT contracts last for 20 years, we equate one O&M job associated with a FIT contract to 20 PYE.

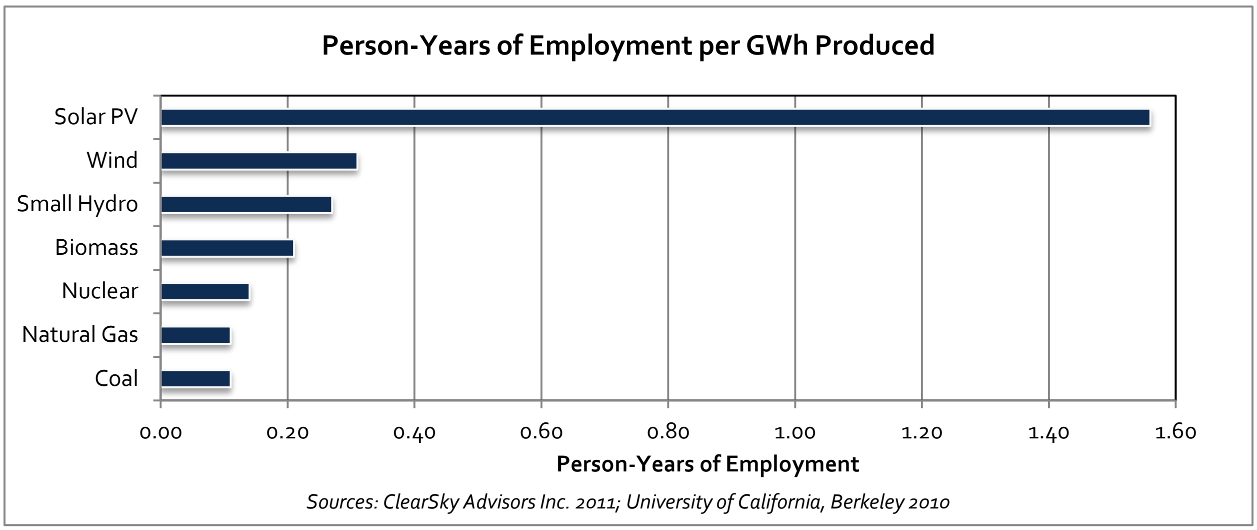


Figure 4.3: Person Years of Employment per GWh of Generated Energy by Various Technologies Employed in Ontario.

To compare job creation (in terms of PYE) by various generation technologies, it is most useful to measure the number of PYE created per unit of energy produced (GWh in this case). Figure 4.3 demonstrates PYE per GWh by different technologies used in Ontario for energy generation. Results from a 2010 study published in Energy Policy by Wei et al. that synthesized data across 15 job studies

[8] Re-powering construction phase employment was not taken into consideration as it will appear much later than the scope covered in this report. A continuous wind market will create these jobs and allow for a number of construction phase jobs to be self-sustaining.

were coupled with Ontario-specific conditions (such as wind regime, solar insolation, and FIT contract data) to inform the model used in Figure 4.3[9].

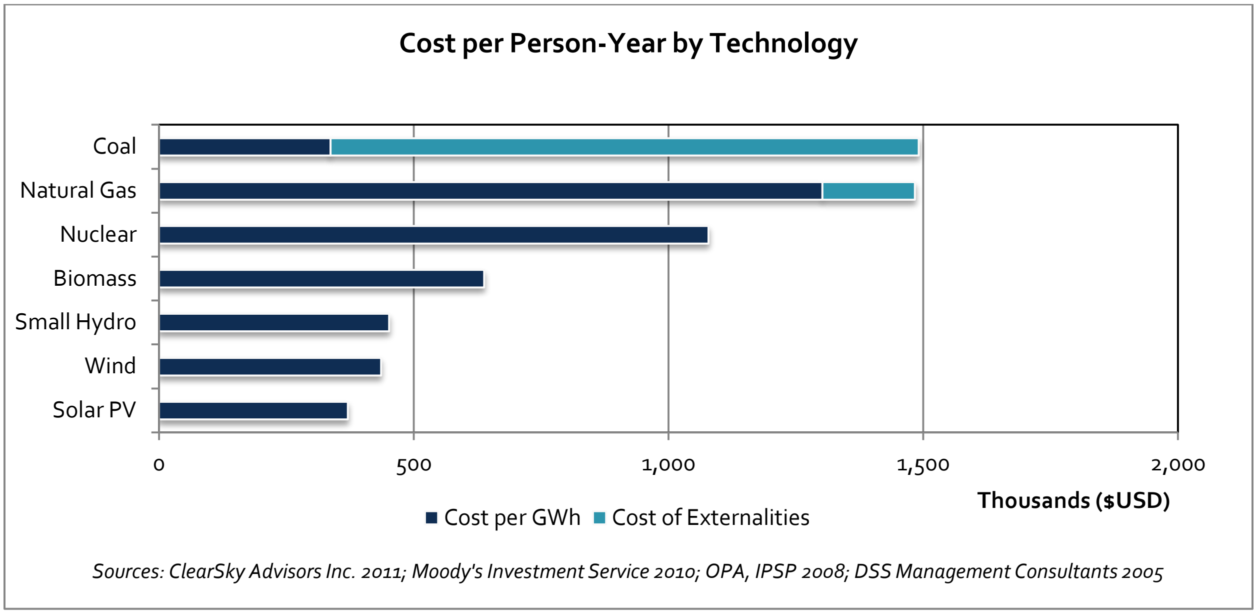


Figure 4.4: Cost per Person Year of Employment by Various Energy Generating Technologies Used in Ontario

The cost of job creation can be calculated by comparing PYE per unit of energy with the cost per unit of energy. Our cost calculations have come from current Feed-In Tariff rates, Moody's Investment Service (for nuclear data)[10], and the OPA's integrated power system plan (IPSP) evidence[11]. In order to reflect a more complete and accurate cost to Ontarians, our assumptions for the cost of fossil fuels incorporates conservative estimates (2¢/kWh for natural gas and 12.7¢/kWh for coal)[12] published by the Ontario Ministry of Energy of the cost of health and environmental externalities caused by these types of power generation[13].

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[9] Wei, M., Patadia, S., Kammen, D. 2010. Putting renewables and energy efficiency to work: How many jobs can the clean energy industry generate in the US? Energy Policy. 38: 919-931.

[10] Weis, T., Stensil, S.-P., & Stewart, K. (August, 2010). Renewable is Doable. http://pubs.pembina.org/reports/ontario-green-energy-report-august-web.pdf

[11] Ontario Power Authority. (2007). Methodology and Assumptions for the Cost to Consumer Model. http://www.powerauthority.on.ca/ipsp/Storage/53/4886_G-2-1_Att_1_corrected_071019.pdf; and Ontario Power Authority. (2008). Integrated Power System Plan for the Period 2008-2027. http://www.powerauthority.on.ca/integrated-power-system-plan/g-plan-outcomes
For natural gas pricing the OPA considered several scenarios that fall within a spot-price range from $4.00 to $12.00; as present day prices are close to the low end of that range, we used the OPA's low price case in our cost calculations. Ontario Power Authority. (2008). Integrated Power System Plan for the Period 2008-2027. http://www.powerauthority.on.ca/integrated-power-system-plan/g-plan-outcomes.

[12] DSS Management Consultants Inc., RWDI Air Inc. (2005). Cost Benefit Analysis: Replacing Ontario's Coal Fired Electricity Generation. Toronto, ON: Ontario Ministry of Energy.

[13] Externalities of 18¢/kWh due to coal were reported in a Harvard study. (Reuters. (2011). Coal's hidden costs top $345 billion in U.S.-study.)

4.2.1.1 Total Jobs Created Annually and Total for 2011-2018

Figure 4.5 demonstrates annual job creation in Ontario by the wind energy industry. The number of PYE presented includes both one-time and ongoing jobs. All PYE from permanent jobs are attributed to the year in which the project was installed[14].

The cumulative expected PYE created by the wind energy sector in Ontario from 2011-2018 is shown in Table 4.1. It should be noted that the jobs reported here are solely a result of the LTEP.

- From 2011-2018, 80,328 PYE will be created in Ontario due to the wind energy sector.
- On an annual basis, the number of jobs created varies from a low of 5,708 PYE in 2011 to 14,249 in 2014.

Note: The O&M job numbers listed for each year in Figure 4.5, are created as a result of the projects built that year, but are actually carried out over the 20 year period a project is expected to be in operation. Figure 4.8 illustrates that fact in more detail.

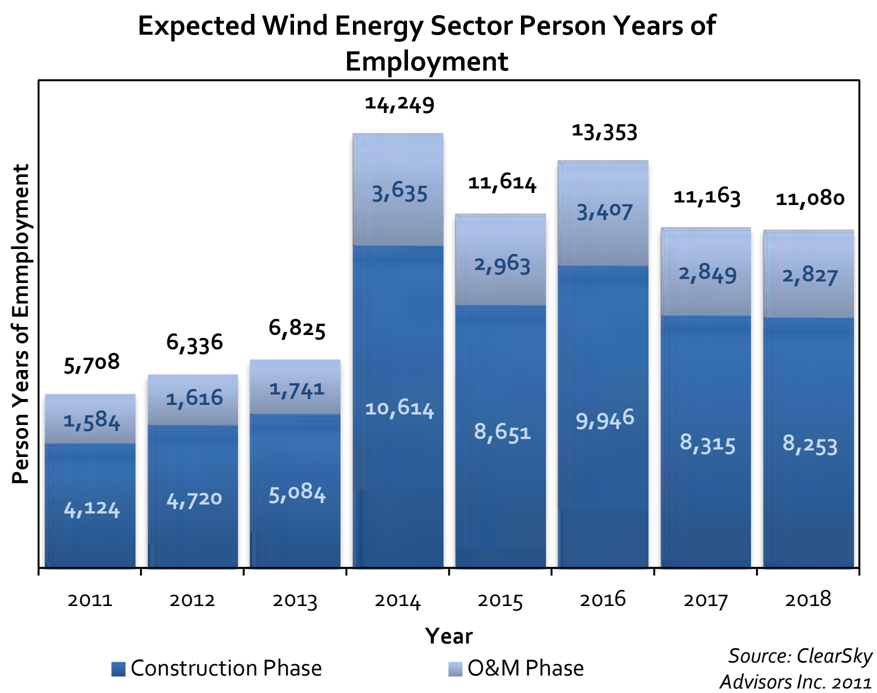

Figure 4.5: Person Years of Employment Created by the Wind Energy Sector in Ontario, Expected Scenario 2011-2018

4.2.1.2 Jobs Creation by Type in Ontario for 2011-2018

Figure 4.6 demonstrates the relative proportion of employment by different types of jobs in Ontario from 2011-2018, due to the wind energy sector.

- 54% of PYE created in Ontario due to the wind energy sector will occur in the construction phase due to labour and manufacturing employment.

[14]Developmental PYE are included in the construction phase as service jobs. As the employment calculations are for only connected projects, any development work in the prospecting phase, as well as any other development, manufacturing, and/or construction work for incomplete projects are not accounted for in our scenarios.

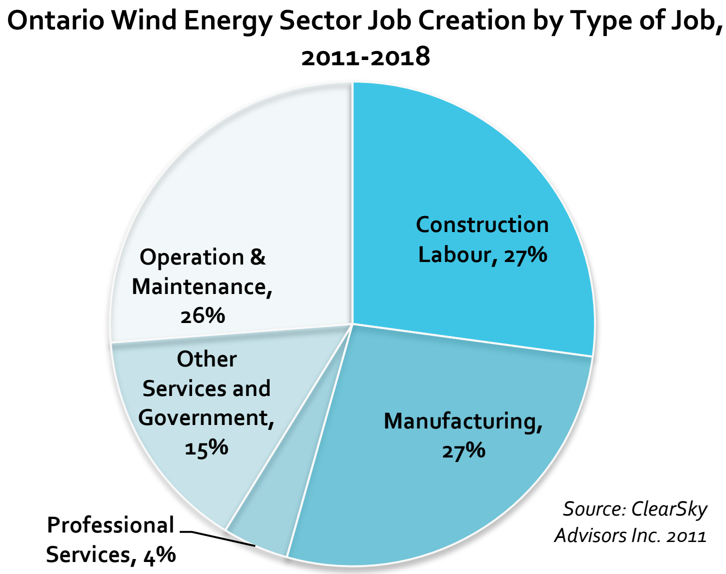

Figure 4.6: Total Ontario Wind Energy Sector Job Creation by Type of Job, Expected Scenario 2011-2018

PYE can be classified into three categories: direct, indirect, and induced.

- Direct PYE are jobs that are created to immediately serve the actual supply chain, such as wind turbine manufacturing and construction.
- Indirect[15] PYE are jobs that have been created to facilitate the creation and maintenance of the supply chain, such as the construction and manufacture of facilities and equipment used in the wind energy generation supply chain.
- Finally, induced PYE are jobs that are created elsewhere in the economy as a result of spending from both direct and indirect workers and firms[16]. Induced PYE were not included in this study so as to be conservative with PYE estimates as well as due to their ambiguous nature. Induced jobs are real, but quantifying them is difficult, so we have focused our analysis on direct and indirect jobs.

Expected PYE creation due to Ontario's Wind Energy Sector from 2011-2018, demonstrated in Table 4.1, will be almost equally split between direct and indirect employment:

- 38,135 direct PYE; and
- 42,193 indirect PYE will be generated in Ontario due to the wind energy sector.

[15] Note: The model assumes (based on inputs and multipliers from Statistics Canada) that a certain percentage of indirect jobs would need to exist in the province to serve the wind energy sector. These jobs are counted in the year in which the installations are complete and not necessarily in the year that they occur.
[16] Estimates of Job Creation from the American Recovery and Reinvestment Act of 2009. http://www.whitehouse.gov/assets/documents/Job-Years_Revised5-8.pdf

Table 4.1: Job Creation (PYE) in the Ontario Wind Energy Sector, 2011-2018

Wind Energy Sector Job Creation (PYE) in Ontario, 2011-2018										
		2011	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**Total**
Expected Scenario	*Direct*	2,651	3,013	3,246	6,776	5,523	6,349	5,308	5,269	38,135
	Indirect	3,057	3,323	3,579	7,473	6,091	7,003	5,855	5,811	42,193
	Total	5,708	6,336	6,825	14,249	11,614	13,353	11,163	11,080	80,328
High Scenario	*Direct*	3,349	3,138	4,540	7,643	6,714	6,985	7,285	6,947	46,602
	Indirect	3,863	3,461	5,007	8,430	7,405	7,704	8,035	7,663	51,567
	Total	7,212	6,598	9,548	16,073	14,120	14,689	15,319	14,610	98,169
Low Scenario	*Direct*	1,979	2,642	1,950	3,549	1,710	2,138	1,069	-	15,037
	Indirect	2,282	2,914	2,150	3,914	1,885	2,359	1,155	-	16,658
	Total	4,262	5,557	4,100	7,462	3,595	4,497	2,223	-	31,695

Source: ClearSky Advisors 2011

Note: In Table 4.1 all jobs created by an installation in a given year are tied back to that year regardless of when the job actually occurs. See Figure 4.7 for an alternative view of the same data.

Table 4.2: Net Job Creation (PYE) Difference Between Market Scenarios (Relative to the Expected Scenario), 2011-2018

Net Difference in Job Creation (PYE) in Ontario Relative to the Expected Scenario, 2011-2018									
	2011	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**Total**
Expected Scenario	5,708	6,336	6,825	14,249	11,614	13,353	11,163	11,080	80,328
High Scenario	1,504	262	2,723	1,824	2,506	1,336	4,156	3,530	17,841
Low Scenario	(1,446)	(780)	(2,725)	(6,787)	(8,020)	(8,856)	(8,940)	(11,080)	(48,633)

Source: ClearSky Advisors 2011

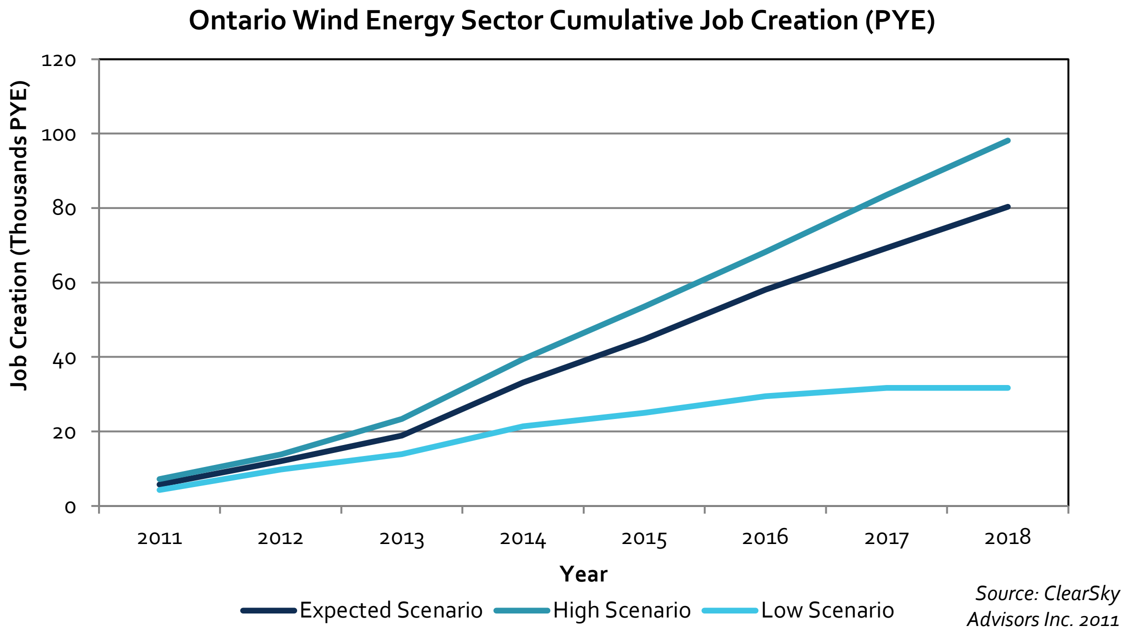

Figure 4.7: Ontario Wind Energy Sector Cumulative Job Creation (in PYE), 2011-2018

Alternatively expected job creation by year and by job type from 2009 to 2038[17] as a result of the wind energy sector in Ontario is shown in Figure 4.8, assuming that:

- Each project is awarded at the beginning of the 1st year;
- Services (developmental and other) take place in years 1 and 2;
- Sufficient lead-time is provided to allow for manufacturing to mainly take place in the 1st and 2nd years;
- Construction is not performed over the winter and is a 2 year process;
  - Foundation and infrastructure work is completed in year 2
  - Turbine erection is completed in year 3
- Each project will be connected and generating at the end of year 3;
- O&M work will begin at the beginning of the 4th year and last for 20 years; and
- Tax payments and lease payments to landowners will begin in year 4 and last for 20 years.

Note: These figures are ONLY for the projects forecast for installation in 2011 through 2018. The actual number of jobs is likely to be higher because no jobs are included for export, pre-contract development, or any ongoing installations after 2018. Furthermore, we have only considered direct and indirect jobs and not induced jobs. Therefore, these numbers are conservative for all years. The drop-off in employment after 2017 would only occur if exports and continued project awards beyond 2018 did not materialize.

[17] For the purposes of this model direct and indirect employment were assumed to occur at the same time. As such, there is no differentiation between these two employment categories in this measure of employment.