Wind Farm Announcements and Rural Home Prices: Maxwell Ranch and Rural Northern Colorado

Article *in* Journal of Sustainable Real Estate · January 2010
DOI: 10.1080/10835547.2010.12091798

2 authors:

Steven Laposa
Laposa Realty Advisors LLC
17 PUBLICATIONS **194** CITATIONS
SEE PROFILE

Andrew G Mueller
University of Denver
13 PUBLICATIONS **129** CITATIONS
SEE PROFILE

Journal of Sustainable Real Estate

ISSN: 1949-8276 (Print) 1949-8284 (Online) Journal homepage: https://www.tandfonline.com/loi/rsre20

Wind Farm Announcements and Rural Home Prices: Maxwell Ranch and Rural Northern Colorado

Steven Laposa & Andrew Mueller

To cite this article: Steven Laposa & Andrew Mueller (2010) Wind Farm Announcements and Rural Home Prices: Maxwell Ranch and Rural Northern Colorado, Journal of Sustainable Real Estate, 2:1, 383-402, DOI: 10.1080/10835547.2010.12091798

To link to this article: https://doi.org/10.1080/10835547.2010.12091798

Wind Farm Announcements and Rural Home Prices: Maxwell Ranch and Rural Northern Colorado

Authors Steven P. Laposa and Andrew Mueller

Abstract This study examines the announcement affect of a proposed wind farm development on an 11,000-acre ranch in Northern Colorado on surrounding rural housing prices. This study analyzes 2,910 single-family home transactions in two rural census tracts adjacent to the proposed wind farm prior to, and after the wind farm announcement. The results account for the timing of the announcement in March 2007, which coincided with the beginning of national and regional housing price declines, and still shows insignificant and minimal impacts to surrounding home values and sales, adjusted for the economic recession, after the announcement.

In March 2007, Colorado State University (CSU) announced a proposed wind farm development on an 11,000-acre ranch known as Maxwell Ranch in Northern Colorado. Although the proposal eventually collapsed with the original wind farm developer, at the time of the announcement local homeowners publicly expressed concerned about the impact of the wind farm on rural home prices[1] located adjacent to Maxwell Ranch.

CSU acquired the Maxwell Ranch property, located in Larimer County in Northern Colorado, in the 1970s and subsequently used the property for agricultural research. CSU's strategy to cultivate a 'green university' encouraged the Colorado State University Research Foundation (CSURF) to investigate its diverse portfolio of land and ranch holdings as possible alternative energy locations, suitable for education and research. Maxwell Ranch is located in a rural, semi-mountainous corridor estimated to have 'excellent' wind farm capacity based on numerous studies including the U.S. Department of Energy's National Renewal Energy Laboratory. The original wind farm developer of the CSU Green Power Project at Maxwell Ranch received regulation approvals to move forward with the project on October 20, 2008 by the Larimer County Commissioners. By November 2009, the project was in an undetermined state due to lease defaults by the wind farm developer. In June 2010, CSU reached an agreement with a new wind farm developer and the project is currently proceeding through the development process.

General studies on wind farms and home prices build on the literature based on home valuation impacts due to externalities like high voltage transmission lines and underground storage tanks, which illustrates a broader view of sustainability and real estate by addressing the externality effects of the growing alternative

energy sector. Although there is a growing body of research on green building in the residential sector (Laquatra, Pillai, Singh, and Syral, 2008; Williams, 2008; Gottfried and Malik, 2009; Dator, 2010; Soratana and Marriott, 2010), this article builds specifically on the literature addressing wind farms and home values, with a focus on the announcement impact on a semi-mountainous rural location.

The emergence of government policies attempting to influence the innovation and economic development in areas such as the clean energy sector in an economy has direct and indirect relationships with the real estate sector. Clean energy clusters, wind farm developments, geothermal installations, new transmission lines, and extensive solar installations directly and indirectly alter the spatial economy by changing economic and business agglomerations with new firms, suppliers, and land use demand. Furthermore, there is the possibility of positive and negative spillover effects due to changes in the externalities of locations surrounding such developments. The development, construction, and operation of such alternative energy projects challenges existing land use codes, homeowner association regulations, zoning restrictions, and consumer acceptance of sustainable developments.

As various alternative energy development projects are announced, local and regional stakeholders react with a range of emotions and opinions from strong support to typical not-in-my-backyard (NIMBYism) sentiments and opposition. Prior to the recent approval of an offshore wind farm near Cape Cod, Massachusetts, local residents and national anti-wind farm coalitions frequently protested their resistance to the offshore development based on a variety of environmental impacts and property valuation concerns.

Installation of industrial projects is typically accompanied by some negative externalities to the surrounding community. In the case of Maxwell Ranch and wind farms in general, these externalities include visual impacts on scenery, increased noise resulting from the operation of wind turbines, and disturbance of previously natural environments during construction and installation of wind turbines and transmission lines.

This study specifically develops a hedonic price model using sales of existing single-family homes located in close proximity to Maxwell Ranch and compares these sales to other sales occurring over the same time period in Larimer County within the same census tract, and the census track adjacent to the west. The hedonic pricing model tests if the mere announcement of the proposed wind farm installation on Maxwell Ranch had a significant effect on home prices near Maxwell Ranch subsequent to March 2007.

Literature Review

Growing acceptance and public sentiment toward renewable energy indicate that development of wind farms in the United States is likely to continue. Annual wind capacity in the U.S. grew by 46% in 2007, adding 5,329 MW of generation capacity and $9 billion of investment (Wiser and Bolinger, 2008). Two distinct

approaches to determining the market and social consequences of new wind projects have developed: post-development hedonic pricing models of real estate values and consumer sentiment surveys.

Sterzinger, Beck, and Kostiuk (2003) conduct an analysis of wind farms in nine site locations across the country and find that in all but two of the locations, the property values of residential real estate increased at a faster rate for properties located within the view shed of wind farm projects. Their approach incorporates sales in each view-shed area (defined as a five-mile radius) of existing wind farm projects and comparing the median house price against a township or city with comparable geographic and demographic characteristics. Due to apparent deficiency, the data is limited to sales price and sale date for each property. Their model suffers from missing variable bias, as it does not control for typical housing characteristics that affect price, but does provide evidence that view sheds disturbed by wind farms may not impact home prices.

Other literature uses survey methods to determine public perception of wind farm developments in existing communities. Warren and McFadyen (2009) survey residents with and without experience living near wind farm projects and find that people with experience of wind farms are more likely to favor their expansion. Ouderkirk and Pedden (2004) perform a survey of local impacts of wind farm development in Sherman County, Oregon and find that substantial tax revenues, additional income to landowners on which turbines are located, and stimulated local employment generated through development, construction, and operations had a positive effect on regional businesses. Groothuis, Groothuis, and Whitehead (2008) perform a logit model test of a sample population in Wautaga County, North Carolina and determine that a payment to households can induce a willingness to accept wind farm development in a mountainous region where wind farm visibility is high for residential and recreational users. A summary of several studies finds that on an abstract level, about 80% of the population supports wind power in the surveys studied (Damborg and Krohn, 1998).

Many of the conclusions drawn from the various survey studies imply that collaboration between developers and local governments with the local communities in the development stage of wind energy facilities can generate valuable community benefits and energy commodities with minimal impact on the region (Woods, 2003; BBC, 2005; Toke, 2005; Devine-Wright, 2005; Warren and McFadyen, 2009). The survey literature suggests that good planning and collaboration with all stakeholders involved in the development of wind energy in local communities plays a large role in the public acceptance of wind farm projects. By involving regional stakeholders in the design and placement of wind turbines and addressing public concerns from the beginning, much of the negative impacts associated with wind farm projects can be mitigated and offset by positive economic benefits, an increased sense of involvement of community members, and actual community ownership of the wind farm projects.

Hoen, Wiser, Cappers, Thayer, and Sethi (2009) recently analyzed 7,459 home sales within 10 miles of 24 wind energy facilities. They do not find a widespread and statistically significant negative impact on home values across the wind energy

locations, although they recognize the probability of individual homes negatively impacted. The authors' offer an extensive literature review on wind farms and residential impacts and include several models that address announcement and post-construction impacts to home values. The study, however, does not directly address rural locations as the average lot sizes by distance ranges are generally less than five acres.[2]

Hoen (2006) used a hedonic pricing model on homes surrounding a wind farm project in Madison County, New York and found no statistically significant difference in sale prices for houses that were sold within the view shed of an existing wind farm. Several hedonic pricing models are compared, and the conclusion from each model is similar, including testing for properties located within a view shed defined as a one or five-mile radius around the existing wind farm. Hoen's model included actual on-site inspections of each home's view of the existing wind farm project and a score associated with the amount and level of visible turbines from each residential property. The model also controlled for generated income from the projects payments in lieu of taxes and found that this variable was also not significantly different from other counties that did not receive payments from the wind project.

Dent and Sims (2008) study of visual impacts of wind farms in the United Kingdom found that distance from the nearest turbine is not a significant factor in house price, while a view of the countryside significantly increases price. The authors caution that although no causal link between proximity to wind turbines and housing price was found, the vista enjoyed by the property occupier had some intrinsic value and therefore further research in developing a methodology that captures the value of scenic vistas for property owners needed to be developed. The authors performed a hedonic pricing model of housing prices near a wind farm in the U.K., and found that screened and side views had a positive impact on housing prices, while a rear-facing view of the wind farm had a significantly negative impact on housing sale price.

The general conclusions of the studies referenced above are contrary to common perceptions of the visual impacts of wind turbines on residential property values. While negative impacts of other large-scale utility projects such as high voltage transmission lines have found negative impacts on property values (Colwell, 1990; Delaney and Timmons, 1992), these effects may be due to characteristics that are different from those of wind turbines. The findings of previous studies suggest that wind farms may escape the negative impact on housing prices that are found with high voltage transmission lines based on current research. Part of the answer may lie in a different public perception of wind turbines, and their association with renewable and ''environmental'' goals, which possibly induce higher public acceptance.

Methods and Data

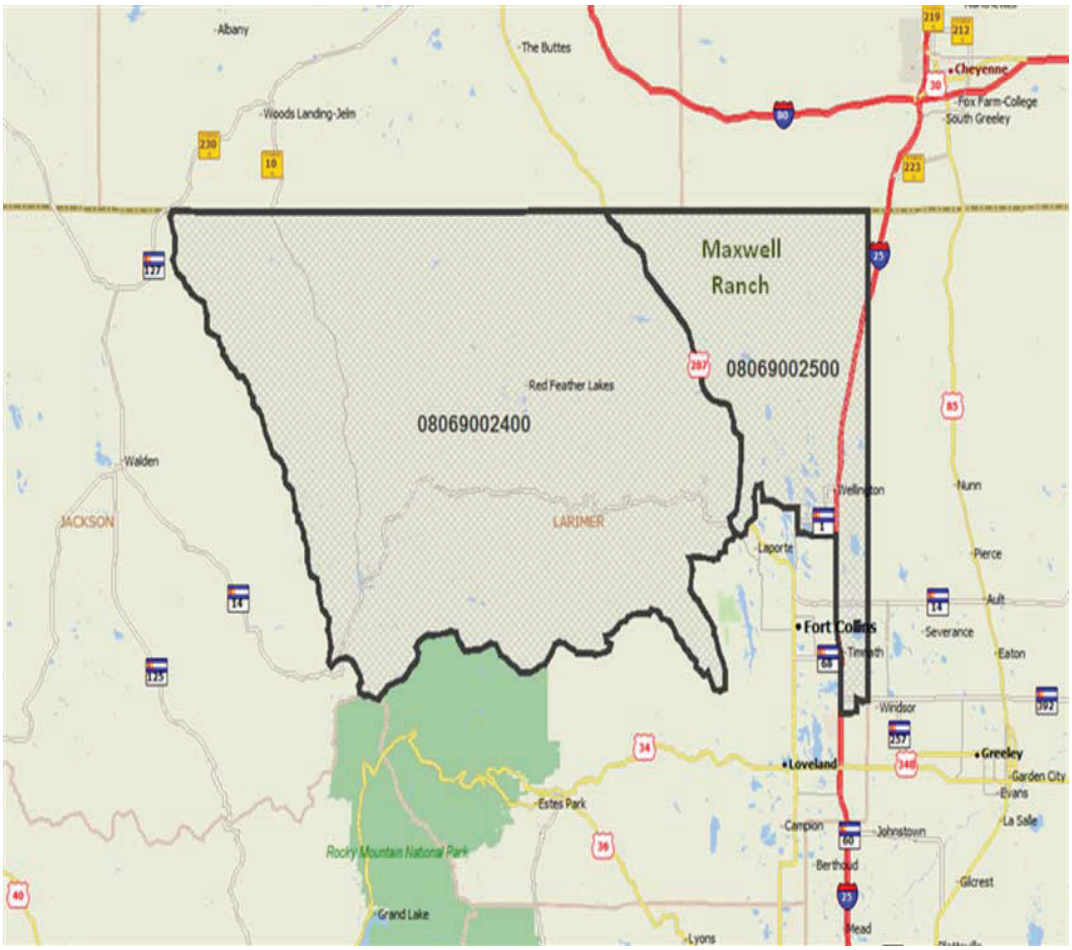
Residential sales transaction data was collected from Colorado State University's Everitt Real Estate Center's database of previous home sales and currently listed

properties in northern Colorado. The dataset is based on the regional provider for the National Association of Realtors' Multiple Listing Service (MLS) and includes attached and detached residential sales dating from 1997 that has been scrubbed, geocoded for location verification, and cross-checked with county assessor data.

Residential house sales transactions were grouped into: (1) properties located in the local homeowners' associations adjacent to Maxwell Ranch, (2) properties located in the census tract that includes Maxwell Ranch but not in the adjacent local homeowners' associations, and (3) properties located in the census tract west of Maxwell Ranch's census tract. Exhibit 1 shows the two census tract boundaries that include all three group (census tract 08069002500 includes Maxwell Ranch and 08069002400 includes the Red Feather Lakes area).

The rural nature of the residential developments surrounding Maxwell Ranch and topography of the surrounding developments, based on several site visitations,

Exhibit 1 | Maxwell Ranch Census Tract Map



Sources: ESRI and U.S. Census Bureau.

indicate that the majority of properties in developments not sharing or abutting Maxwell Ranch will have little or no view of the proposed wind turbines, while some of the homes in adjacent developments are also shielded from view of the projected wind turbine operation areas. Exhibit 2 confirms the rural nature of Maxwell Ranch and Red Feathers Lake census tracts by highlighting the low population densities per square mile in both census tracts. Population growth in the area exploded from 1990 to 2000, growing at a compound annual growth rate (CAGR) close to 6%, fueling rising housing demand. Over the last decade, population growth has moderated and is forecast to slow even further through 2014. Maxwell Ranch and Red Feather Lakes also include a sizeable amount of second home and retirement home households.

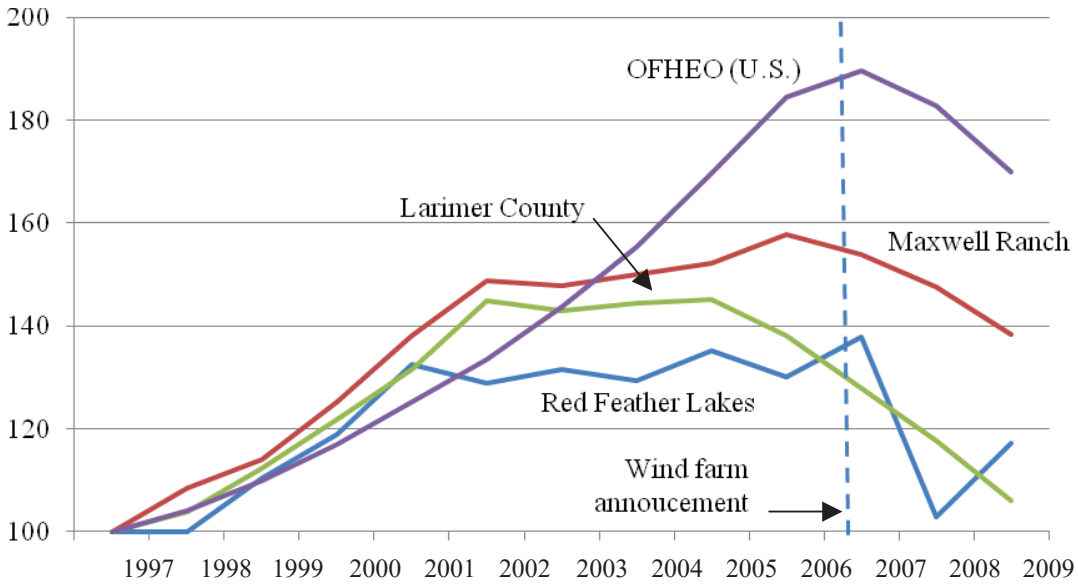
Home prices in the Maxwell Ranch and Red Feather Lakes census tracts followed the Larimer County index from 1997 to 2001, as seen in Exhibit 3. As home prices moderated in Larimer County in the years following the 2001 recession, home prices in the Maxwell Ranch census track continued to increase through 2006 before declining through 2009. Conversely, home prices in the Red Feather Lakes census tract abruptly fell, coinciding with national and regional house price

Exhibit 2 | Census Tract Demographics

	Red Feather Lakes	Maxwell Ranch
Demographic Variable	08069002400	08069002500
Population 1990	2,189	6,013
Population 2000	3,860	10,754
Population 2009	4,775	15,736
Population 2014	5,252	18,181
CAGR 1990 to 2000	5.84%	5.99%
CAGR 2000 to 2009	2.39%	4.32%
CAGR 2009 to 2014		2.93%
Area in square miles	1,344.84	410.74
Population density 2009 per square mile	3.55	38.31
Households 1990	927	2,203
Households 2000	1,686	3,917
Households 2009	2,156	5,800
Households 2014	2,395	6,721
CAGR 1990 to 2000	6.16%	5.92%
CAGR 2000 to 2009	2.77%	4.46%
CAGR 2009 to 2014	2.13%	2.99%
Population per household 2009	2.21	2.71
Median household income 2009	$61,130	$70,713
Median value home 2009	$248,839	$257,448

Note: The sources are ESRI, Business Analyst, and authors.

Exhibit 3 | U.S. vs. Northern Colorado Home Price Indices, 1997 to 2009[5]



Source: Everitt Real Estate Center (CSU), base year 1997 = 100.

declines. The final database of all individual home sales transaction used in the hedonic models are represented in the two distinct census tract home price indices in Exhibit 3.

The relevant issue regarding the Maxwell Ranch wind farm announcement is separating the effects of the announcement with the contagion consequences of national and regional home price devaluations. Exhibit 3 includes the national OFHEO[3] home price index, which illustrates the proximity of the wind farm announcement to the beginning of the national decline in home prices. Did home prices near Maxwell Ranch decline solely due to national and regional housing declines, or are they due to the wind farm announcement? The solution to isolating the national contagion from the wind farm announcement is addressed in the Results section.

The initial data set included 5,621 property sales in the two census tracts between January 1, 2000 and December 31, 2008. Of these sales, 144 were dropped because the subject property was an attached residential building rather than single-family dwelling. Another 2,110 sales were dropped for critical missing variables in the data, and an additional 97 observations were dropped for sales where the property did not have at least one bedroom, one bathroom, or were at least 600 square feet to eliminate properties that were either land only or land with a non-residential property built on it. The truncated and final sample contained 2,910 observations. Summary statistics are listed in Exhibit 4.

The majority (83%) of residential sales from January 2000 to December 2008 were prior to the announcement of the Maxwell Ranch wind farm, consistent with

Exhibit 4 | General Descriptives

	N	Min.	Max.	Mean	Std. Dev.
Log of sold price	2,910	10.60	14.88	12.45	0.52
Log of sq ft	2,910	6.40	8.94	7.41	0.41
# bedrooms	2,910	1.00	7.00	3.11	0.94
# of baths	2,910	1.00	7.00	2.44	1.05
# of garage spaces	2,910	0.00	10.00	1.86	1.25
# of acres	2,910	0.05	160.00	7.06	13.81
Days on market	2,910	1.00	1,160	149.00	135.68
Sold price ($)	2,910	40,000	2,900,000	294,499.53	189,434.07
List price ($)	2,910	42,900	3,300,000	303,305.02	199,996.70
Year built	2,910	1875	2008	1988.81	19.48
Age	2,910	1.00	134.00	20.19	19.48
Square footage	2,910	600	7,607	1,797.22	779.82
# full baths	2,910	0	8	1.67	0.798
# half baths	2,910	0	8	0.35	0.543
# 3/4 baths	2,910	0	4	0.41	0.597
Price per square foot	2,910	25.27	855.82	163.37	59.88
Valid *N* (listwise)	2,910				

Note: The sources are Everitt Real Estate Center (CSU) and authors.

the amount of time prior to the wind farm announcement. Over half (62%) of all sales involved homes in the Maxwell Ranch census tract, with 17% of all sales transactions occurring in the Maxwell Ranch census tract after the announcement. Only 36 sale transactions occurred in the adjacent Maxwell Ranch homeowners' associations' boundaries—29 sales prior to the announcement and seven sales after the announcement (Exhibit 5). Acreage for all 36 sale transactions ranged from 35 to 40 acres, confirming the rural nature of the location, with selling prices of $213,000 to $675,000, and house sizes from 1,040 square feet to 4,926 square feet.

The sales transactions were concentrated in the larger cities of Northern Colorado, but did include several in small rural towns such as Livermore and Red Feather Lakes, which provide a sufficient non-Maxwell Ranch sample for comparative purposes. The Red Feather Lakes census tract effectively acts as an out-of-sample subset to test for national housing crisis effects after the wind farm announcement.

Exhibit 6 compares correlations between the natural log of sold price by time periods (prior to and after announcement) and by census tracks (Maxwell Ranch and Red Feather Lake) to the natural log of square footage, # of acres, and days on market. The objective of the correlation matrix is to examine initial differences

Exhibit 5 | Descriptive by Locations

	Maxwell Ranch Census Track			Maxwell Ranch HOAs Locations		
Announcement	0 = No	1 = Yes	Subtotal	0 = No	1 = Yes	Subtotal
Before	1,106	1,288	2,394	2,365	29	2,394
After	—	516	516	509	7	517
Totals	1,106	1,804	2,910	2,874	36	2,910

Note: The sources are the Everitt Real Estate Center (CSU) and authors.

Exhibit 6 | Correlation Matrix by Announcement Periods by Census Tracts

	Log sold price vs.		
Census Tracks	Log of sq. ft.	# acres	Days on market
Sold Prior to Announcement			
Red Feather Lake (n = 880)	.695	.487	.029
	.000	.000	.382
Maxwell Ranch (n = 1,288)	.794	.249	.245
	.000	.000	.000
Sold after Announcement			
Red Feather Lake (n = 226)	.616	.446	−.038
	.000	.000	.569
Maxwell Ranch (n = 516)	.803	.116	.216
	.000	.008	.000

between the dependent variable (natural log of sold price) to several primary independent variables for the two census tracts and the pre- and post-announcement time periods. Correlations are significant at the 1% level for Maxwell Ranch for both time periods, whereas the correlations between natural log of sold price and days on market for the Red Feather Lake census track are insignificant in both time periods.

Our proposed hedonic price models follow common methodologies found in Sirmans, Macpherson, and Zietz (2005) and Hoen, Wiser, Cappers, Thayer, and Sethi (2009) in order to account for the announcement and spatial characteristics of the three location groups. Unlike prior wind farm studies, however, this study investigates the impact of an announcement of future wind farm development plans rather than the effect of existing wind farm externalities. Previous studies have found little to no evidence of an impact from existing wind farms on residential property values. This study attempts to determine whether just the threat of wind farm development within close proximity to residential properties

in a rural area may have an effect on residential property values. Unlike other wind farm studies, we did not use distance as an independent variable due to: (1) the exact location of the wind turbines is not finalized, and (2) the rolling hills and mountainous qualities of the surrounding land area bordering Maxwell Ranch that impact potential visibility of wind turbines regardless of distance.

Five models are proposed, beginning with a general model without the announcement dummy variable (Equation 1), and progressing to additional models that cumulatively add the announcement dummy (Equation 2), the Maxwell Ranch census tract dummy (Equation 3), the Maxwell Ranch dummy that includes all home sales located in one of the six adjacent homeowner associations (Equation 4), and finally a basic model with an interactive variable accounting for the wind farm announcement and properties located within the six Maxwell Ranch HOAs (Equation 5).

General model without announcement:

$$\begin{aligned} \text{Ln}(soldprice) = {} & \alpha + \beta_0(lnsqft) + \beta_1(bdrm) + \beta_2(garspaces) \\ & + \beta_3(acres) + \beta_4(dom) + \beta_5(fullbath) \\ & + \beta_6(halfbath) + \beta_7(threeqtrbath) \\ & + \beta_8(age) + \varepsilon. \end{aligned} \tag{1}$$

General model with announcement:

$$\begin{aligned} \text{Ln}(soldprice) = {} & \alpha + \beta_0(lnsqft) + \beta_1(bdrm) + \beta_2(garspaces) \\ & + \beta_3(acres) + \beta_4(dom) + \beta_5(fullbath) \\ & + \beta_6(halfbath) + \beta_7(threeqtrbath) + \beta_8(age) \\ & + \beta_9(announce) + \varepsilon. \end{aligned} \tag{2}$$

General model, announcement and census tract:

$$\begin{aligned} \text{Ln}(soldprice) = {} & \alpha + \beta_0(lnsqft) + \beta_1(bdrm) + \beta_2(garspaces) \\ & + \beta_3(acres) + \beta_4(dom) + \beta_5(fullbath) \\ & + \beta_6(halfbath) + \beta_7(threeqtrbath) + \beta_8(age) \\ & + \beta_9(announce) + \beta_{10}(census) + \varepsilon. \end{aligned} \tag{3}$$

General model, announcement, census tract, and Maxwell Ranch HOAs:

$$\begin{aligned}\text{Ln}(soldprice) = {} & \alpha + \beta_0(lnsqft) + \beta_1(bdrm) + \beta_2(garspaces) \\ & + \beta_3(acres) + \beta_4(dom) + \beta_5(fullbath) \\ & + \beta_6(halfbath) + \beta_7(threeqtrbath) + \beta_8(age) \\ & + \beta_9(announce) + \beta_{10}(census) \\ & + \beta_{11}(mwrhoa) + \varepsilon. \end{aligned} \quad (4)$$

Basic model, announcement × Maxwell Ranch HOAs:

$$\begin{aligned}\text{Ln}(soldprice) = {} & \alpha + \beta_0(lnsqft) + \beta_1(acres) + \beta_2(dom) \\ & + \beta_3(age) + \beta_4(mwrann) + \varepsilon. \end{aligned} \quad (5)$$

Where:

lnsqft = Log square foot of single-family home;
bdrm = # of bedrooms;
garspaces = # of garage spaces;
acres = # of acres;
dom = Days on market;
fullbath = # of full baths;
halfbath = # of half baths;
threeqtrbath = # of three-quarter baths;
age = Age of property structure in years;
announce = Sold after March 2007 = 1, else 0;
census = Property in census track 08069002500 = 1, else 0;
mwrhoa = Property in Maxwell Ranch HOAs = 1, else 0; and
mwrann = Announcement x Maxwell Ranch HOAs interactive variable.

There are three hypotheses based on the five equations. The first hypothesis states that the announcement of the Maxwell Ranch wind farm did not have a significant price impact on homes located in the two census tracks (Equation 2). The second hypothesis states that the announcement of the Maxwell Ranch wind farm did not have a significant price impact on homes in the Maxwell Ranch census tract (Equation 3), and the third hypothesis states that the announcement of the Maxwell Ranch wind farm did not have a significant price impact on properties located in the adjacent Maxwell Ranch six homeowner associations (Equations 4 and 5).

Exhibit 7 illustrates the sale price per square foot history for the 2,910 sample, with the vertical line indicating the date of the announcement of the wind farm.

Exhibit 7 | Sales Transactions vs. Price Index

The graph shows that the Maxwell Ranch properties (black diamond symbols) lie around the average price and price per square foot of the overall sample time period and do not contain any outliers. Some of the non-Maxwell Ranch HOA outliers may be due to the inclusion of a large amount of land with a single-family home. To reduce the effect of the outlying significantly high prices in terms of sold price and price per square foot, transformations of these variables to natural logarithms result in a more stochastic distribution of these indicators, as shown in Exhibit 8. Both exhibits include the Maxwell Ranch census tract price index on the right scale confirming the potential effect of regional prices peaking prior to the announcement of the Maxwell Ranch wind farm and declining after the announcement similar to national and regional home price indices.

Results

Results of the five proposed models are listed in Exhibit 9. The general model without the announcement dummy variable (Equation 1) shows a relatively high explanatory power of 0.689, with all coefficients significant at the 5% level with the exception of # bedrooms and age of the property. Adding the announcement dummy variable to the general model (Equation 2), shows similar results as the

Exhibit 8 | Natural Log of Sold Price

previous model and a coefficient of −0.022 for the announcement variable, although insignificant at the 5% level but showing partial support for the spurious impact of the national and regional housing price declines.

The coefficient for the announcement variable effectively remains the same in the additional models (Equations 3, 4, and 5), with significance levels slightly increasing from 0.086 to 0.095. The Maxwell Ranch census tract dummy variable is insignificant (Equation 3), as well as the Maxwell Ranch HOA variable (Equation 4). The new interactive variable consisting of the wind farm announcement dummy multiplied by Maxwell Ranch HOA location dummy results in ''1'' for only properties sold after the announcement and located in the adjacent Maxwell Ranch HOAs. The coefficient of the interactive variable is −0.070 with a significance level of 0.448, indicating insignificant impact of the wind farm announcement.

Based on the results in Exhibit 9, we conclude that:

1. **Hypothesis One**: The Maxwell Ranch wind farm announcement did not have a significant impact on property values in the Maxwell Ranch and Red Feather Lakes census tracts.

Exhibit 9 | Summary Results

Variable	Equation 1	Equation 2	Equation 3	Equation 4	Equation 5
Constant	7.408 (0.000)	7.423 (0.000)	7.426 (0.000)	7.426 (0.000)	5.520 (0.000)
Log of sq. ft.	0.618 (0.000)	0.617 (0.000)	0.616 (0.000)	0.616 (0.000)	0.931 (0.000)
# bedrooms	−0.010 (0.210)	−0.010 (0.219)	−0.008 (0.316)	−0.009 (0.301)	
# of garage spaces	0.070 (0.000)	0.071 (0.000)	0.072 (0.000)	0.072 (0.000)	
# of acres	0.008 (0.000)	0.008 (0.000)	0.008 (0.000)	0.008 (0.000)	0.007 (0.000)
Days on market	$7.886E^{-5}$ (0.049)	$7.813E^{-5}$ (0.051)	$7.349E^{-5}$ (0.071)	$7.405E^{-5}$ (0.068)	$5.285E^{-5}$ (0.225)
# full baths	0.115 (0.000)	0.116 (0.000)	0.116 (0.000)	0.116 (0.000)	
# half baths	0.100 (0.000)	0.101 (0.000)	0.101 (0.000)	0.101 (0.000)	
# 3/4 baths	0.157 (0.000)	0.157 (0.000)	0.156 (0.000)	0.156 (0.000)	
Years	$5.158E^{-5}$ (0.868)	$-3.581E^{-6}$ (0.991)	$5.883E^{-6}$ (0.985)	$-5.065E^{-6}$ (0.987)	−0.001 (0.000)
Announcement dummy		−0.022 (0.086)	−0.021 (0.092)	−0.021 (0.095)	
Maxwell Ranch census tract dummy			−0.009 (0.490)	−0.009 (0.509)	
Maxwell Ranch HOA dummy				−0.034 (0.503)	
Maxwell Ranch HOA × announcement					−0.070 (0.448)
Adj. R^2	0.689	0.689	0.689	0.689	0.630
F	716.29 (0.000)	645.39 (0.000)	586.65 (0.000)	537.70 (0.000)	990.596 (0.000)

Note: Significance levels are in parentheses.

2. **Hypothesis Two**: The Maxwell Ranch wind farm announcement did not have a significant impact on property values specifically in the Maxwell Ranch census tract.
3. **Hypothesis Three**: The Maxwell Ranch wind farm announcement did not have a significant impact on the property values located in the local homeowner associations adjacent to the proposed wind farm development.

Exhibit 10 | ANOVA Results of Log of Sold Price by Announcement

Maxwell Ranch Census Tract Dummy		Sum of Squares	df	Mean Square	*F*	Sig.
Red Feather Lakes census track	Between Groups	.206	1	.206	.922	.337
	Within Groups	246.904	1104	.224		
	Total	247.110	1105			
Maxwell Ranch census track	Between Groups	.074	1	.074	.277	.599
	Within Groups	478.497	1802	.266		
	Total	478.571	1803			

Note: The table gives the results of an ANOVA test for the natural log of the sold price by census tract by announcement period.

In addition to testing for the wind farm announcement affect on home prices in the adjacent Maxwell Ranch homeowners' associations or the Maxwell Ranch census track, it is necessary to test for spurious impacts of a national housing crisis on home sale transactions in the area. If the presence of a national housing crisis is present, then it is reasonable to expect significant differences in home values (e.g., decline in home values after the wind farm announcement in March 2007 that coincides with the beginning of the national housing crisis). Thus, the hypothesis is that there is a significant difference of means for a variable such as the natural log of sold price pre- and post-announcement for either the Maxwell Ranch or Red Feather Lakes census tracts. Exhibit 10 shows the results of an ANOVA test for the natural log of the sold price by census tract by announcement period. The results show that there is insufficient evidence to state that the means are different from each other for either the Maxwell Ranch or Red Feather Lakes census tracts pre- and post-announcement. Therefore, the presence of the national housing crisis contagion is insignificant during the time period.

Conclusion

This study is one of the first to investigate wind farm announcements on rural residential properties, developing five alternative models to test for significant impacts at a regional (two census tracts), local (Maxwell Ranch census tract), and adjacent properties (Maxwell Ranch HOAs) levels. The rolling terrain near the proposed wind farm at Maxwell Ranch challenges typical spatial-based models that use latitude and longitude coordinates of individual properties and calculate distances to wind turbine locations to estimate visual impacts.[4]

The Maxwell Ranch wind farm announcement is significant at the 10% level for the entire sample. Yet, this level of significance is attributable more to the beginning of the national housing crisis rather than the wind farm announcement. The entire sample of 2,910 sales transactions includes properties located in the Red Feather Lakes census tract that contains home sales located 10 to over 50 miles from the Maxwell Ranch. There are, however, no significant property value

impacts for homes located in the Maxwell Ranch census tract or the adjacent Maxwell Ranch homeowner association properties. As previously stated, the announcement variable is a time event variable that splits the sample into home sales before and after March 1, 2007. The wind farm announcement coincides with the rupture of the national, regional, and local housing bubbles and therefore any significance is most likely spurious with the general decline in housing values.

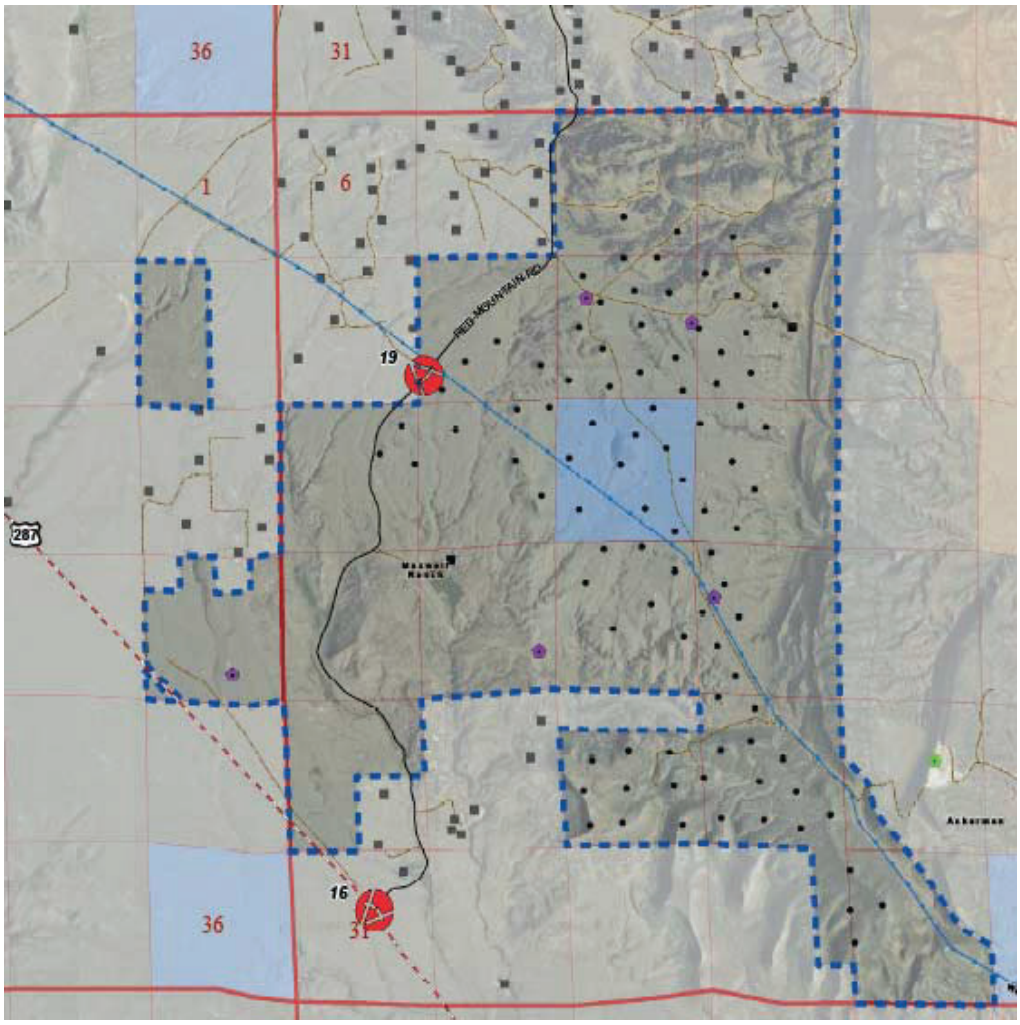
Our conclusion is that prices in Larimer County and the sample census tracts, as measured by the home price indices in Exhibit 3, started to decline sometime around the start of 2007, and the cause of the decline may be linked to the announcement of the wind farm, but may also be linked to the general decline in housing prices nationally. The fact that the Maxwell Ranch announcement variable is insignificant indicates that the properties most likely to actually see or be affected by the wind farm, did not experience an impact from the announcement significantly different from other properties in the region that are least likely to experience any impact from the announcement. Thus, we can reasonably conclude that the announcement variable is acting as a proxy for the start of the downturn in overall market conditions rather than a negative impact caused by perceived externalities arising from the Maxwell Ranch wind farm project announcement.

There are several limitations to this study. First, the contagion effect of the national and regional housing crisis clouds the results, although the models included several spatial dummy variables to isolate impacts of the wind farm announcement. The use of home sales in the Red Feather Lakes census tract essentially acts as a control subset of the overall 2,910 home sale transactions. Second, the rural nature and diminished residential inventory turnover in the adjacent Maxwell Ranch HOAs resulted in a small sample of sold properties out of the 2,910 total population of sold properties. Third, our focus on the announcement effect rationally does not include an actual construction or operation period of the wind farm and thus any positive or negative wind farm impacts are beyond the scope of this study.

As part of this study, we interviewed several residential real estate brokers that had active listings close to Maxwell Ranch to gain a subjective assessment of the impact that the announcement of the proposed wind farm has had on local residential values, and the general conditions of the market surrounding Maxwell Ranch. We identified 13 residential real estate brokers with active listings as of June 2009 and contacted them for interviews (Exhibit 12). Of the thirteen contacted, we were able to reach ten. The brokers were asked questions about the state of the rural real estate market in Northern Colorado and if they had heard of the proposed wind farm project, and if the project had had any impact on their listed properties.

During our interviews with the brokers, several indicated that they had not heard of the proposed project. Several others had heard of the project but admitted they had very little knowledge of any details and a few other brokers indicated that they had knowledge of the proposal. Of those who had knowledge of the proposed wind farm, only one indicated it had impacted a listing, with a buyer backing out of a signed contract after the announcement of the wind farm project. Another

Exhibit 11 | Maxwell Ranch Preliminary Wind Turbine Locations and Adjacent Home Locations



Source: Colorado State University Research Foundation. Note: Circles indicate wind turbines, squares indicate existing residential structures.

broker indicated that his sellers viewed the project favorably, and that any increase in jobs in the area would only help real estate prices.

Most of the brokers thought that the wind farm would have a negative impact on residential real estate values, but said it was hard to tell if the current lack of showings in the area was caused by the general downturn in the real estate market or by the announcement of the wind farm. A small sample of the brokers also stated that they thought only a few properties would have their view affected because the primary orientation of views for properties in the area is westward. Overall, the general impression is that some of the brokers thought that the real estate might be impacted negatively in the area, but could not be sure that this was the case.

Exhibit 12 | Entrance to Maxwell Ranch

Source: Authors (July 1, 2009).

There are numerous areas for further research as alternative energy projects are announced, constructed, and operated in the future. Returning to the housing market in the Maxwell Ranch census tract once the wind farm is operating and the housing crisis dissipates may result in different findings as demand for housing could increase due to changes in job-related growth associated with the wind farm. Additional time series of home sale transactions in geographies adjacent to wind farms will likely support or challenge existing research such as Hoen, Wiser, Cappers, Thayer, and Sethi (2009). The development of alternative energy projects such as wind farms, whether urban, semi-rural, or rural-based, impacts land uses, spatial agglomerations, and local externalities. Developments supporting clean and alternative energy sectors will change the urban and rural landscape and thus offer new research opportunities to explain positive and negative valuation impacts, as well as intended and unintended consequences.

Endnotes

[1] See "Maxwell Ranch neighbors oppose CSU wind project" http://www.wind-watch.org/news/2009/10/09/maxwell-ranch-neighbors-oppose-csu-wind-project/ [May 12, 2010].

[2] Homes adjacent to Maxwell Ranch are generally 35 acres.

[3] See http://www.fhfa.gov under the Home Price Index pull-down menu for complete series.

[4] The authors completed two field trips in 2009 to Maxwell Ranch visually inspecting adjacent home sites. The project's engineering firm provided a preliminary plan of wind turbine locations and nearby existing residential properties (see http://www.green.colostate.edu/pdfs-gpp/visual-resources.pdf for further information [May 15, 2010]).

[5] The Everitt Real Estate Center at Colorado State University produces quarterly repeat sales indices for Northern Colorado at the county, city, and census tract levels.

References

BBC. *Wind Power Facility Siting Case Studies: Community Response*. BBC Research & Consulting. 2005. Retrieved April 7, 2009, from http://www.nationalwind.org/publications/siting/Wind_Power_Facility_Siting_Case_Studies.pdf.

Colwell, P.F. Power Lines and Land Value. *Journal of Real Estate Research*, 1990, 5:1, 117–27.

Damborg, S. and S. Krohn. Public Attitudes Towards Wind Power. Danish Wind Turbine Manufacturers Association, 1998.

Dator, M. Green Building Regulations: Extending Mandates to the Residential Sector. *Boston College Environmental Affairs Law Review*, 2010, 37:2, 393–424.

Delaney, C.J. and D. Timmons. High Voltage Power Lines: Do They Affect Residential Property Value? *Journal of Real Estate Research*, 1992, 7:3, 315–30.

Dent, P. and S. Sims. Wind Farms and House Prices in the United Kingdom. RICS ROOTS Rural Research Conference. Trinity College, Oxford England: RICS, 2008.

Devine-Wright, P. Beyond NIMBYism: Towards an Integrated Framework for Understanding Public Perceptions of Wind Energy. *Wind Energy*, 2005, 8:2, 125–39.

Gottfried, D. and H. Malik. Perspectives on Green Building. *Renewable Energy Focus*, 2009, 10:6, 38–41.

Groothuis, P.A., J.D. Groothuis, and J.C. Whitehead. Green vs. Green: Measuring the Compensation Required to Site Electrical Generation Windmills in a Viewshed. *Energy Policy*, 2008, 36(4), 1545–50.

Hoen, B. Impacts of Windmill Visibility on Properties Values in Madison County, New York. Thesis, Bard College, 2006.

Hoen, B., R. Wiser, P. Cappers, M. Thayer, and G. Sethi. The Impact of Wind Power Project on Residential Property Values in the United States: A Multi-Site Hedonic Analysis. Ernest Orland Lawrence Berkeley National Laboratory, 2009.

Laquatra, J., G. Pillai, A. Singh, and M.G. Syal. Green and Healthy Housing. *Journal of Architectural Engineering*, 2008, 14:4, 94–7.

Ouderkirk, B. and M. Pedden. Windfall from the Wind Farm Sherman County, Oregon. Renewable Northwest Project, 2004.

Sirmans, G.S., D.A. Macpherson, and E.N. Zietz. The Composition of Hedonic Pricing Models. *Journal of Real Estate Literature*, 2005, 13:1, 3–43.

Soratana, K. and J. Marriott. Increasing Innovation in Home Energy Efficiency: Monte Carlo Simulation of Potential Improvements. *Energy & Buildings*, 2010, 42:6, 828–33.

Sterzinger, G., F. Beck, and D. Kostiuk. *The Effect of Wind Development on Local Property Values*. Renewable Energy Policy Project, 2003.

Toke, D. Explaining Wind Power Planning Outcomes: Some Findings from a Study in England and Wales. *Energy Policy*, 2005, 33:12, 1527–39.

Warren, C.R. and M. McFadyen. Does Community Ownership Affect Public Attitudes to Wind Energy? A Case Study from South-west Scotland. *Land Use Policy*, 2009, 27:2, 204–13.

Williams, J. Green Houses for the Growth Region. *Journal of Environmental Planning & Management*, 2008, 51:1, 107–40.

Wiser, R. and M. Bolinger. *Annual Report on US Wind Power Installation, Cost, and Performance Trends: 2007 (Revised)*. DOE/GO-102008-2590. National Renewable Energy Laboratory (NREL), Golden, CO, 2008.

Woods, M. Conflicting Environmental Visions of the Rural: Windfarm Development in mid Wales. *Sociologia Ruralis*, 2003, 43:3, 271–88.

This research was partially underwritten by Colorado State University Research Foundation. The views expressed are the authors and do not necessarily reflect the views of Colorado State University or Colorado State University Research Foundation.

Steven P. Laposa, Colorado State University, Fort Collins, CO 80523-1272 or steve.laposa@colostate.edu.

Andrew Mueller, Colorado State University, Fort Collins, CO 80523-1272 or Andrew.Mueller@lamar.colostate.edu.