Energy Technologies Area Lawrence Berkeley National Laboratory

National Survey of Attitudes of Wind Power Project Neighbors

February 13th, 2017: Webinar 2 of 4

Planning Process Fairness and Attitudes

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Please Note:
- All participants will be muted during the webinar
- Please submit questions via the chat window
- This webinar will be recorded

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Outline Of The Presentation

Part I. National Survey Project Background

Part II. Survey Frame Overview

Part III. Planning Process Fairness and Attitudes

Part IV. Next Steps & Outreach

National Survey of Attitudes of Wind Power Project Neighbors: Project Overview

Project PI: Ben Hoen, Research Scientist, LBNL

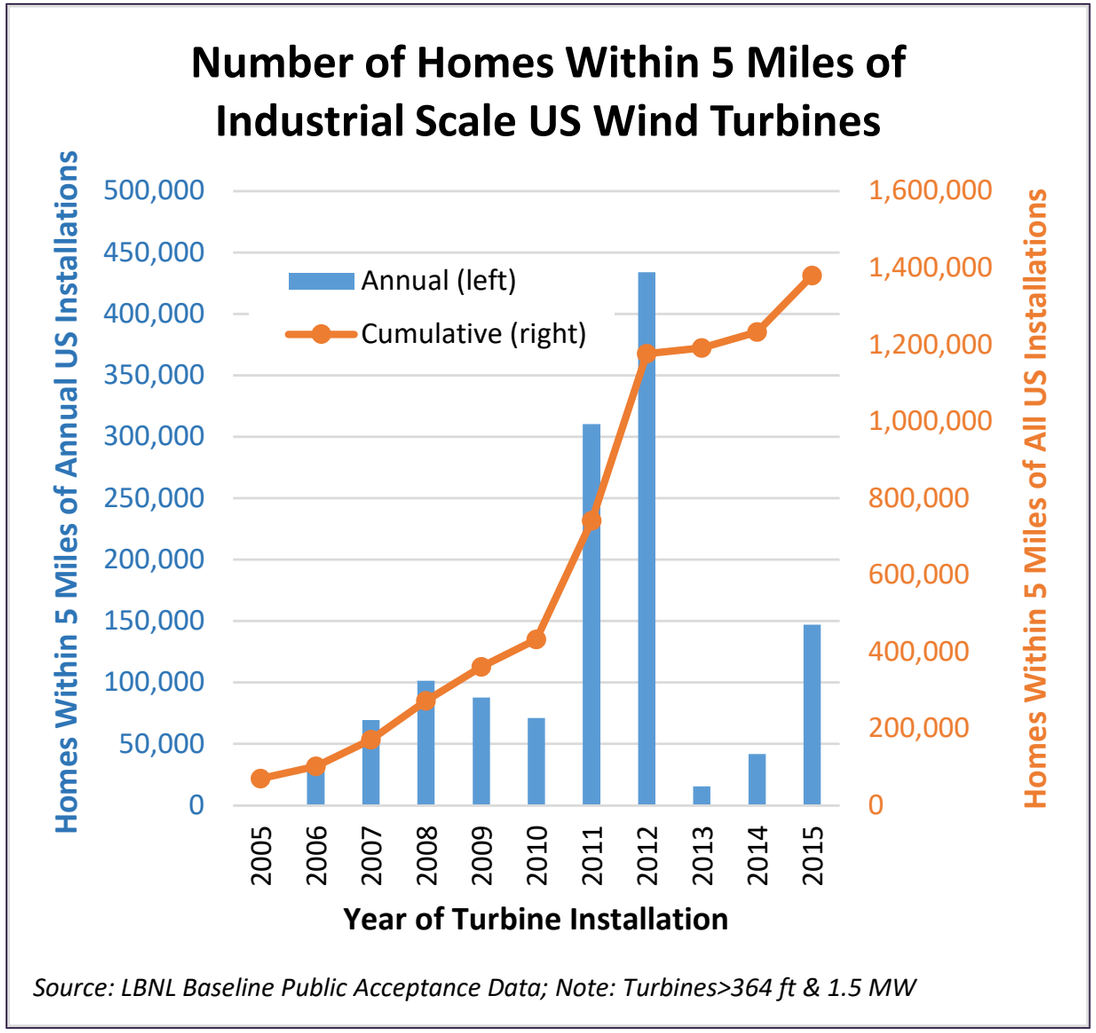
Collaborating Researchers:

- **LBNL:** Joe Rand, Ryan Wiser
- **University of Delaware:** Jeremy Firestone
- **Portland State University:** Debi Elliott
- **Martin Luther University:** Gundula Hübner, Johannes Pohl
- **NREL:** Eric Lantz
- **Resource Systems Group, Inc:** Ryan Haac, Ken Kaliski, Matt Landis

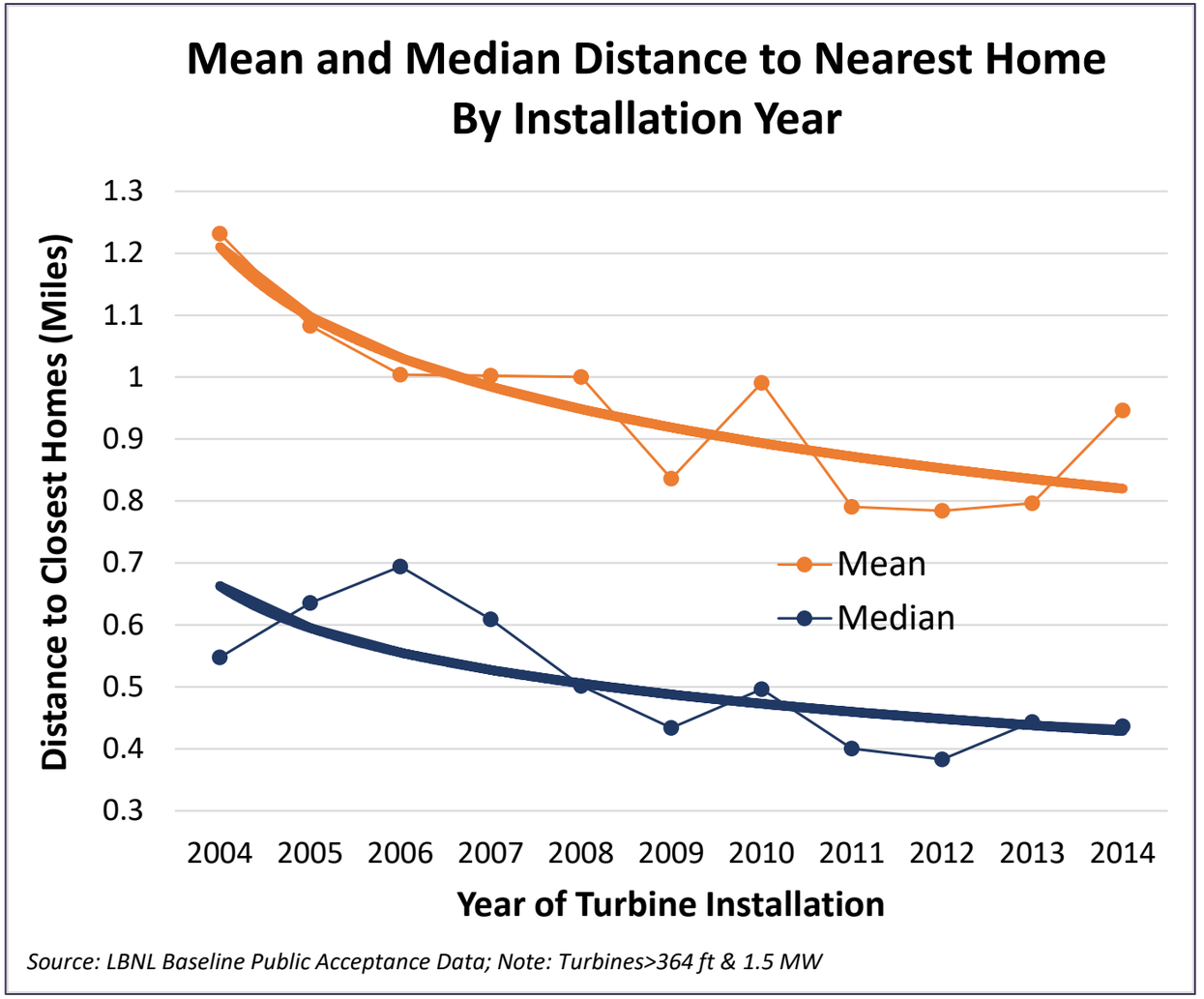
Project Years: FY2015-FY2018

DOE Program: Wind Energy Technologies Office

The Cumulative Number of Homes Near Turbines Is Increasing, While the Distance to the Nearest Homes Is Decreasing



Source: LBNL Baseline Public Acceptance Data; Note: Turbines>364 ft & 1.5 MW



Source: LBNL Baseline Public Acceptance Data; Note: Turbines>364 ft & 1.5 MW

National Survey of Attitudes of Wind Power Project Neighbors: Project Objectives

- Provide first-of-its kind **broad-based, representative** information on public acceptance issues surrounding wind facilities in the **United States**.
- Allow a **wide array of stakeholders to better understand** the attitudes & annoyances towards wind energy in local communities in the US and the main correlates to those perceptions.
- Allow **greater confidence in the likely effects** of proposed wind energy projects by increasing knowledge about existing projects.
- Potentially help **inform wind stakeholder & DOE R&D** priorities to increase benefits and reduce costs of the next-generation wind technologies and deployments.

Baseline Public Acceptance Analysis
Timeline

FY2015

FY2016

FY2017

FY2018

Literature Review: *"Thirty years of North American wind energy acceptance research: What have we learned?"*

Project Lead(s): Rand

Collaborating Researchers: Hoen

Purpose: (1) to summarize North American wind energy public acceptance literature with a focus on some of the key correlates; and (2) to identify research gaps that the current research might help address

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Review

Thirty years of North American wind energy acceptance research: What have we learned?

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ARTICLE INFO

Keywords:
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Social acceptance
Support and opposition
Attitudes

ABSTRACT

Thirty years of North American research on public acceptance of wind energy has produced important insights, yet knowledge gaps remain. This review synthesizes the literature, revealing the following lessons learned. (1) North American support for wind has been consistently high. (2) The NIMBY explanation for resistance to wind development is invalid. (3) Socioeconomic impacts of wind development are strongly tied to acceptance. (4) Sound and visual impacts of wind facilities are strongly tied to annoyance and opposition, and ignoring these concerns can exacerbate conflict. (5) Environmental concerns matter, though less than other factors, and these concerns can both help and hinder wind development. (6) Issues of fairness, participation, and trust during the development process influence acceptance. (7) Distance from turbines affects other explanatory variables, but alone its influence is unclear. (8) Viewing opposition as something to be overcome prevents meaningful understandings and implementation of best practices. (9) Implementation of research findings into practice has been limited. The paper also identifies areas for future research on wind acceptance. With continued research efforts and a commitment toward implementing research findings into developer and policymaker practice, conflict and perceived injustices around proposed and existing wind energy facilities might be significantly lessened.

1. Introduction

1.1. Background and motivation

Over the last 30 years, wind energy in North America has evolved from a fringe, isolated, experimental concept into a mainstream and viable source of electricity, meeting about 5% of U.S. electricity demand (6% in Canada) and representing the largest source of new electric capacity additions in many recent years [1,2]. Wind energy is widely seen as an abundant electricity source with the potential to provide a wide range of environmental and social benefits [3]. State/provincial-level mandates, federal incentives, declining wind energy costs, and relatively favorable economics have spurred the aggressive North American wind deployment of the past 10–15 years [2].

This rapid growth in wind energy deployment will likely continue. In the United States, for example, recent market analysis suggests that annual wind power capacity additions are expected to continue rapidly in the coming five years ([2], p. 1) driven by expected lower prices [4]. Meanwhile, the U.S. Department of Energy's recent *Wind Vision Report*, which outlines pathways for wind energy to provide up to 35% of the nation's electrical demand by 2050, suggests that the "low hanging fruit" wind sites (those that have good wind resources and are close to loads and transmission, yet far from communities) have largely been developed, implying that future wind development likely will happen increasingly near communities. As such, the report underlines the need for a better understanding of the drivers of wind facility acceptance among affected communities [5]. This recommendation echoes the calls of numerous social scientists, who have suggested that successful implementation of U.S. wind projects relies on a deeper understanding of local stakeholders (e.g., [6]).

Multiple facets of acceptance can impact the deployment of renewable energy projects. Wüstenhagen et al. [7] point to three dimensions: *Sociopolitical acceptance* (acceptance of policymakers and key stakeholders), *market acceptance* (acceptance of investors and consumers), and *community acceptance* (pertaining to procedural justice, distributional justice, and trust). However, as Sovacool ([8], p. 4511) points out, these social, technical, economic, and political dimensions of acceptance all influence each other in an integrated, "pernicious tangle." For example, community acceptance of wind energy can affect market acceptance and vice versa. Indeed, this has been the case when local opposition has delayed or derailed proposed wind projects [9–11]. For years, debates around wind energy acceptance in North America

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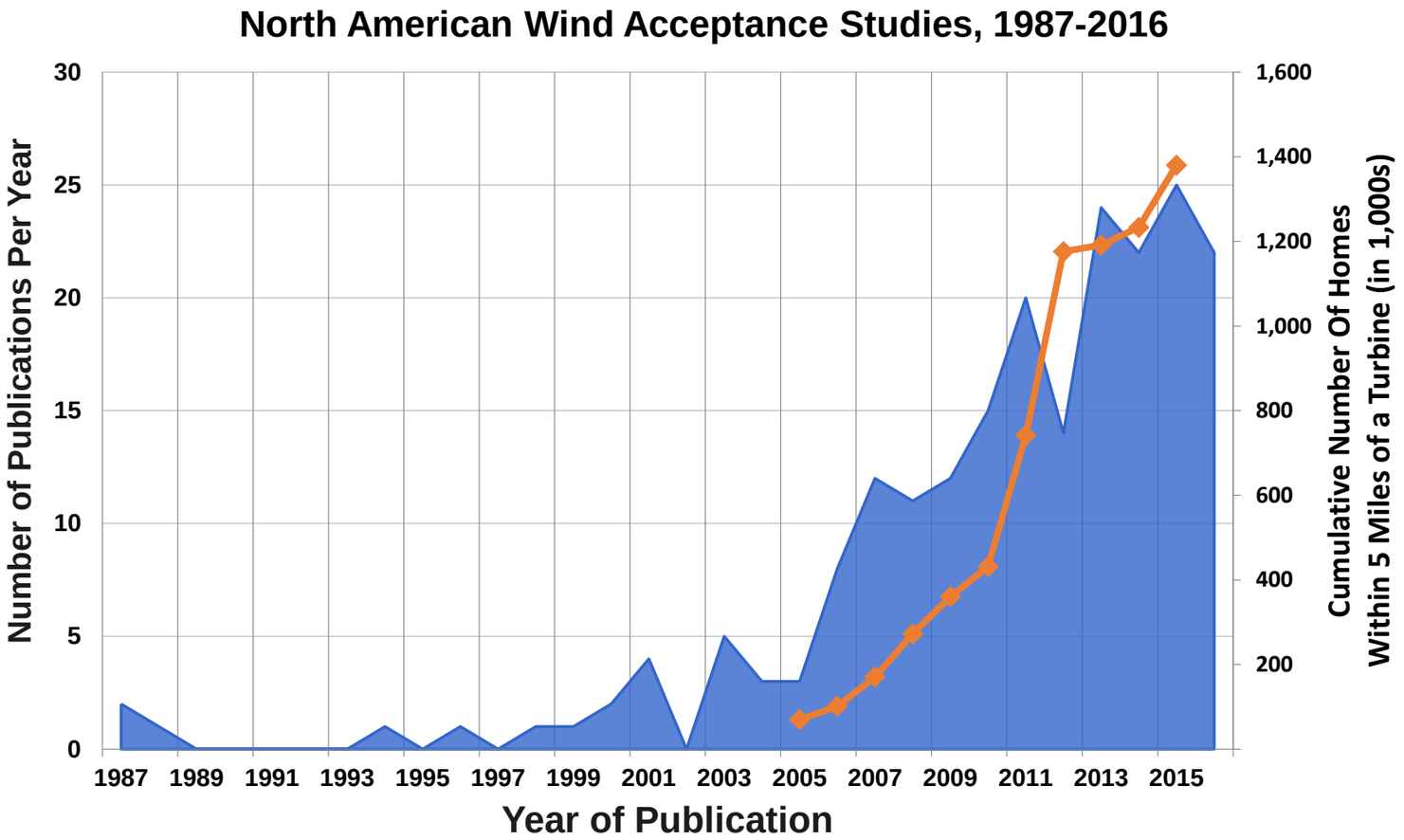
Literature Review: Overview

- Reviewed over 130 published reports and articles
- Focused primarily on North American literature
- Papers published from 1987 to 2016



Literature Review: Research Gaps

- A nationally representative sample of U.S. wind “neighbors”
- Larger sample of “very close” (< 1 mi) respondents
- Compare wind acceptance to other energy sources
- Distinguish those who moved-in *after* wind project construction from those living there *prior*
- Correlate attitudes / annoyance and modeled or measured sound
- Community preferences for the project development process
- Preferred compensation mechanisms (i.e., investment opportunity, reduced taxes, etc.)
- Public perceptions of property value impacts near wind projects
- Attitude changes over time around existing U.S. wind projects
- Implementation of strategies from previous wind acceptance research

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Multi-Model Survey Conducted in 2016

Sampling Steps

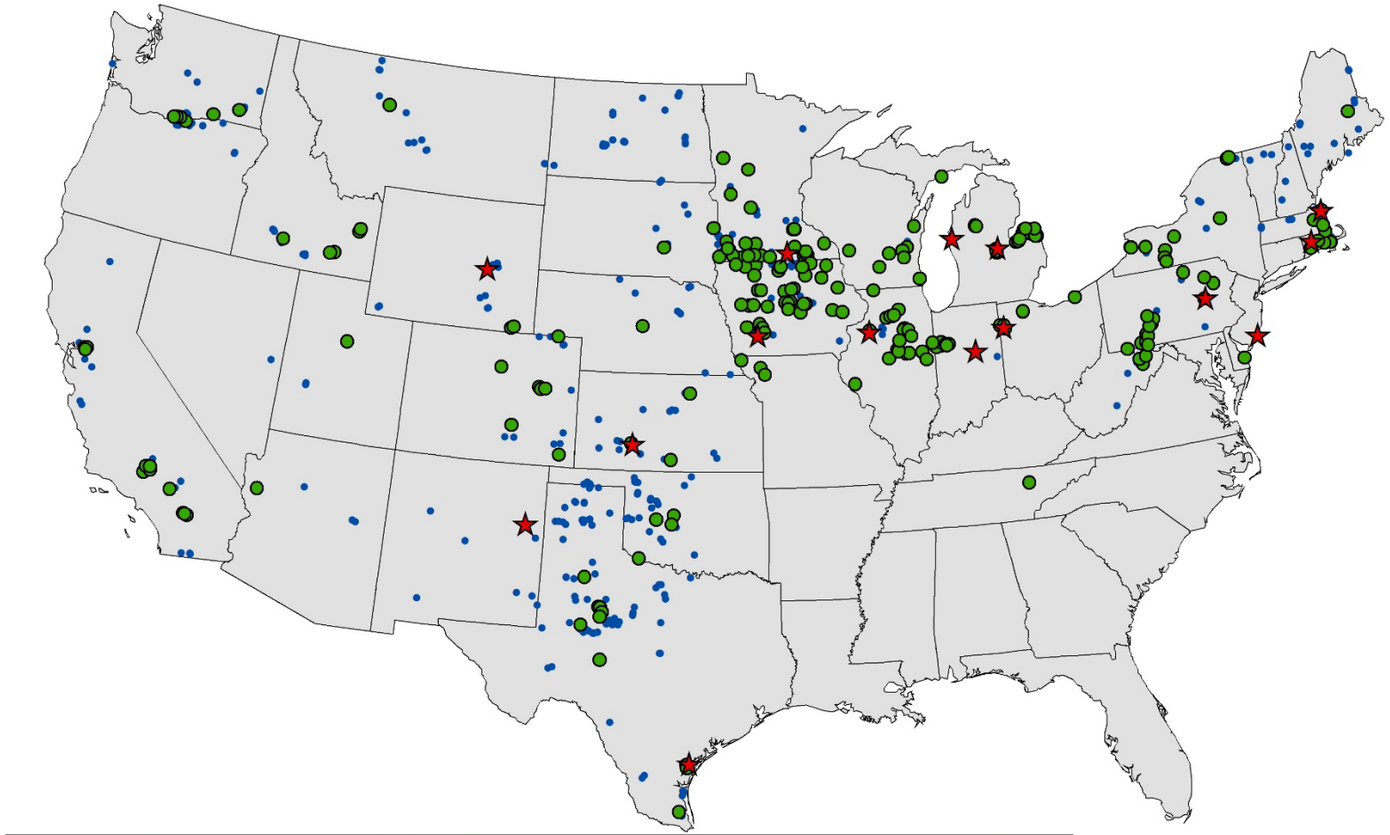
- Pilot phone survey (December 2015)
- Phone survey (March 2016)
- Internet & mail survey (June-July 2016)
- 1705 valid responses (22% overall response rate)

22-minute survey
~ 50 questions

Images: www.mmrstrategy.com

www.brookmark.com

Responses Collected Near 250 Wind Power Projects Across 24 States, From The Full Sample Of 604 Projects



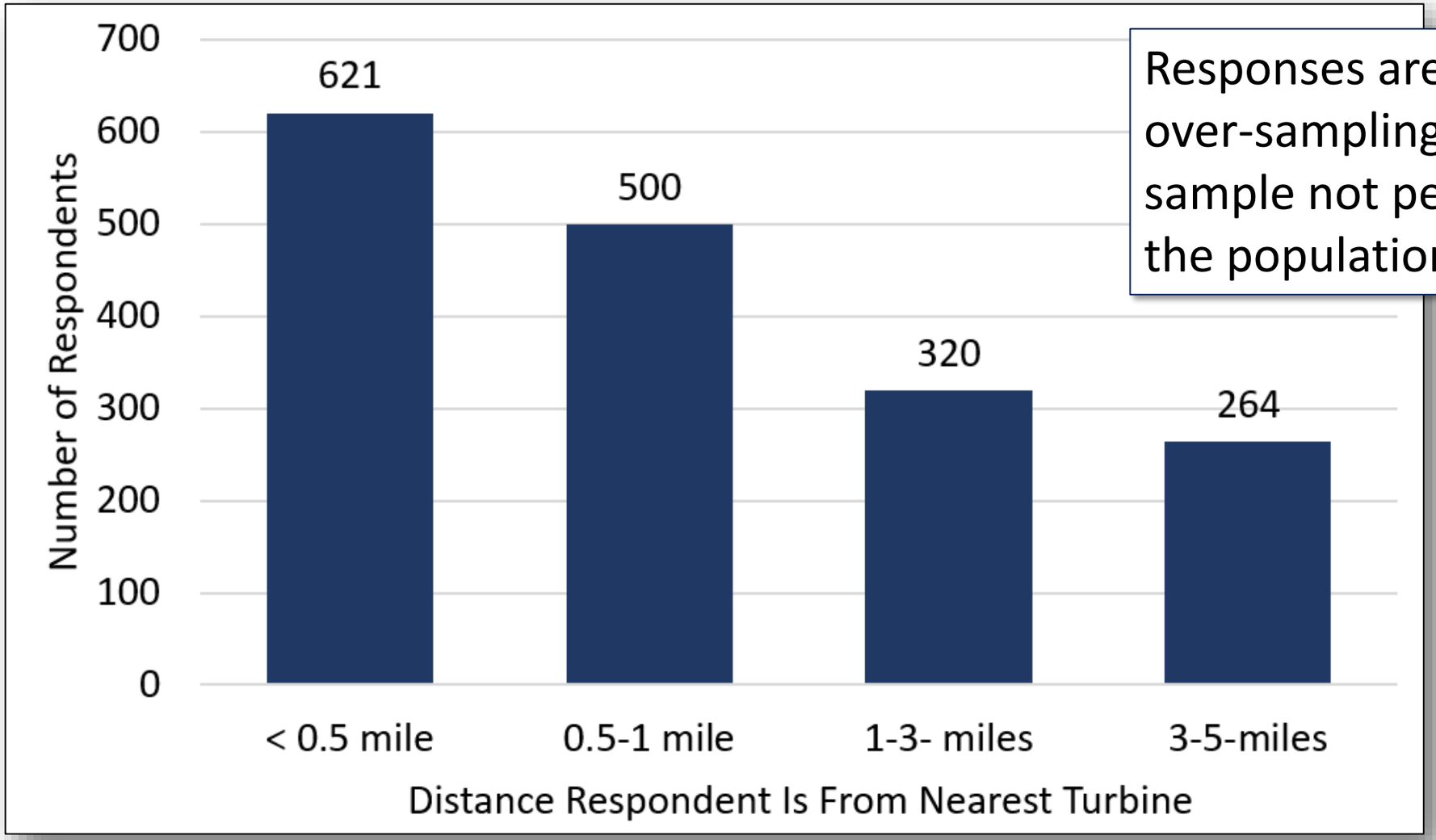
Random sample of residences within 5 miles of a modern wind turbine

- >= 364 feet tall
- >= 1.5 MW

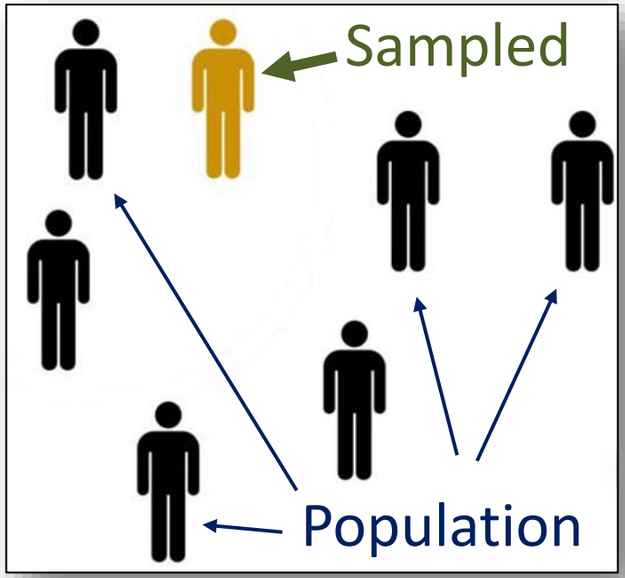
Oversampled

- close to (<1 mile) turbines
- large projects (>10 turbines)
- where sound was modeled

Final Responses By Sampling Cohort (*n* = 1705)



Responses are weighted to account for over-sampling and to adjust for a sample not perfectly representative of the population



National Survey of Attitudes of Wind Power Project Neighbors: Analysis Areas

Overall Analysis Areas

- Review of North American Wind Acceptance Literature
- Overall Analysis of Attitudes of 1,705 Wind Project Neighbors

Topic Specific Analysis Areas

- Planning Process Fairness and Attitudes
- Predicting Audibility of and Annoyance to Wind Project Sounds
- Strongly Annoyed Individuals and U.S./Europe Comparison

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Planning Process Fairness and Attitudes

Project Lead(s): Firestone

Collaborating Researchers: Hoen, Rand, Elliot, Hubner, & Pohls

Contributing Researchers: Wiser & Lantz

Purpose: To investigate various predictors of stated planning process fairness, and relative influences of planning process fairness on attitudes

Numbers of Respondents: 1261 (pre-construction only)

Primary Analysis Methodology: Summary Stats, T-Tests, Regression Analysis

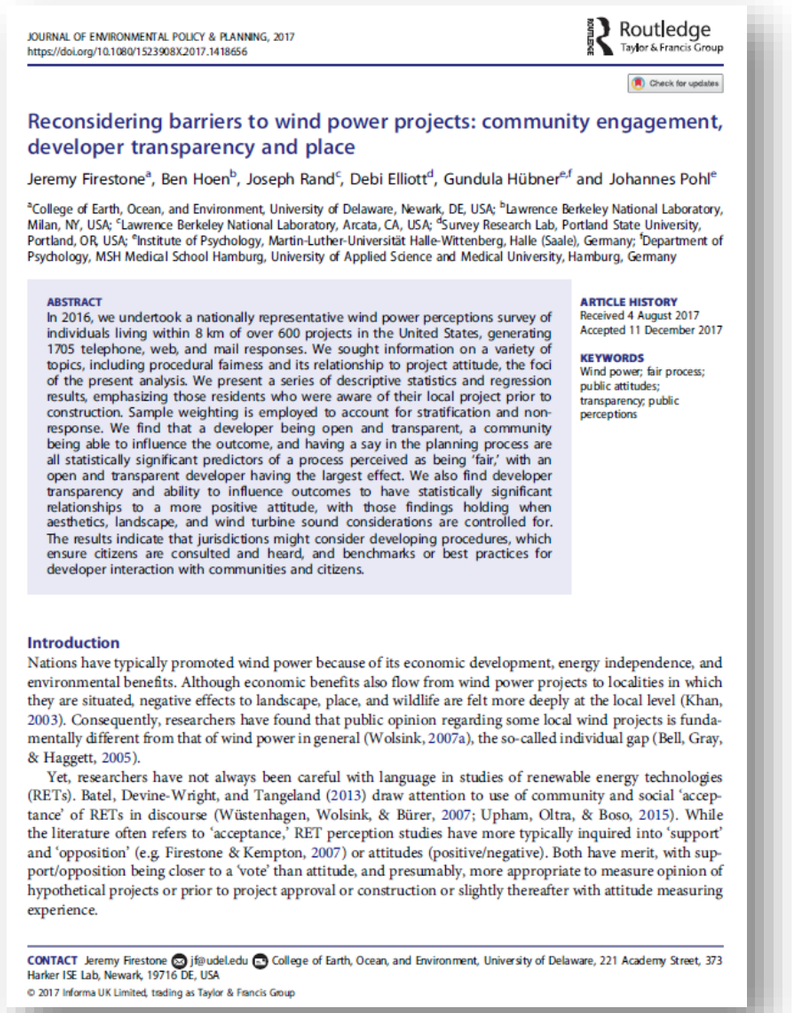
Planning Process Fairness and Attitudes

This paper has been published as:

"Reconsidering Barriers to Wind Power Projects: Community Engagement, Developer Transparency and Place"

Journal of Environmental Policy and Planning; December 21, 2017.

A pre-publication (and identical) version is available on the project website



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Reconsidering barriers to wind power projects: community engagement, developer transparency and place

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ABSTRACT

In 2016, we undertook a nationally representative wind power perceptions survey of individuals living within 8 km of over 600 projects in the United States, generating 1705 telephone, web, and mail responses. We sought information on a variety of topics, including procedural fairness and its relationship to project attitude, the foci of the present analysis. We present a series of descriptive statistics and regression results, emphasizing those residents who were aware of their local project prior to construction. Sample weighting is employed to account for stratification and non-response. We find that a developer being open and transparent, a community being able to influence the outcome, and having a say in the planning process are all statistically significant predictors of a process perceived as being 'fair,' with an open and transparent developer having the largest effect. We also find developer transparency and ability to influence outcomes to have statistically significant relationships to a more positive attitude, with those findings holding when aesthetics, landscape, and wind turbine sound considerations are controlled for. The results indicate that jurisdictions might consider developing procedures, which ensure citizens are consulted and heard, and benchmarks or best practices for developer interaction with communities and citizens.

ARTICLE HISTORY
Received 4 August 2017
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KEYWORDS
Wind power; fair process; public attitudes; transparency; public perceptions

Introduction

Nations have typically promoted wind power because of its economic development, energy independence, and environmental benefits. Although economic benefits also flow from wind power projects to localities in which they are situated, negative effects to landscape, place, and wildlife are felt more deeply at the local level (Khan, 2003). Consequently, researchers have found that public opinion regarding some local wind projects is fundamentally different from that of wind power in general (Wolsink, 2007a), the so-called individual gap (Bell, Gray, & Haggett, 2005).

Yet, researchers have not always been careful with language in studies of renewable energy technologies (RETs). Batel, Devine-Wright, and Tangeland (2013) draw attention to use of community and social 'acceptance' of RETs in discourse (Wüstenhagen, Wolsink, & Bürer, 2007; Upham, Oltra, & Boso, 2015). While the literature often refers to 'acceptance,' RET perception studies have more typically inquired into 'support' and 'opposition' (e.g. Firestone & Kempton, 2007) or attitudes (positive/negative). Both have merit, with support/opposition being closer to a 'vote' than attitude, and presumably, more appropriate to measure opinion of hypothetical projects or prior to project approval or construction or slightly thereafter with attitude measuring experience.

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Motivation

- For some, a fair process governing decision-making on a proposed wind power project may be as or more important than the substantive result and may lead to
  - More informed decision-making
  - Better results – Projects that meet the needs/desires of developers, society & the local community
  - More positive attitudes toward a project
- Process perceived as unfair may lead conditional supporters to turn into opponents

Research Questions

- **When** during the development cycle do projects become **known** to communities?
- **How** do individuals **participate** in planning processes?
- What role does the ***relationship of a wind project*** (e.g., distance to, size of) to a local citizen, general wind power attitudes, and demographic factors play in **fair process** perceptions?
- How are ***developer transparency*** and ***opportunities to participate*** related to perceptions of **fairness** and **attitudes** toward wind power projects?

Data

- Focus on survey answers to questions on process fairness and actions undertaken during the decision-making process and effect of process fairness on attitudes toward projects
- 1261 survey respondents moved in pre-construction, with a particular focus on those respondents who were aware of their local project pre-construction.
  - Important consideration given “Tiebout” sorting where individuals who move in after construction may be more supportive of local wind power and hold more positive perceptions related to consideration such as landscape and sound.
- Descriptive Statistics are weighted; Regression analysis is un-weighted

Approximately 70% Of Respondents Who Lived in Their Homes At The Time Of Construction Were Aware Of Their Local Project Prior To Its Construction

Project awareness among respondents who moved into their home prior to construction (n=1246)

When did you first become aware of the project?	%
Before first public announcement	22%
At time of first public announcement	35%
After first public announcement	14%
When construction began	22%
After operation commenced	8%
Don’t know	2%

Analysis Methodology

- Linear regression (Ordered logit models resulted in similar intuitions)
- Un-imputed and multiple imputed regression models (10 iterations) to account for possibility that opinions of individuals with missing data are correlated with dependent variables (e.g., those that do not report income)
- Dependent variables
  - Process Fairness
  - Attitude (toward nearby project)
    - Models with and without controlling for effects of visual and sound perceptions

Factors Informing Planning Process Fairness for Respondents Aware of Project Prior to Construction

	Individual had a say	Community Members had a say	Developer open/ transparent	Community influenced outcome
n	*904*	*908*	*907*	*907*
Strongly Disagree	33%	12%	7%	18%
Disagree	35%	16%	11%	18%
Neither Agree Nor Disagree or Don't Know	19%	38%	35%	41%
Agree	9%	28%	42%	19%
Strongly Agree	4%	6%	6%	5%

Majority Of Respondents Believe The Planning Process Was At Least Somewhat Fair

To what extent…	do you believe the planning process was fair?	did you feel annoyed by the planning process?
n	*915*	*917*
Don’t know	25%	8%
Not at all	11%	61%
Slightly	10%	9%
Somewhat	13%	8%
Moderately	26%	7%
Very	15%	7%

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Present Attitudes Are Similar To Attitudes Prior To Construction

	Attitude Prior to Construction	**Attitude at Present**	
	Aware Residents	Aware Residents	Other Pre-Construction Residents
n	*921*	*924*	*366*
Don't know	5%	3%	6%
Very negative	2%	7%	6%
Negative	6%	5%	6%
Neutral	41%	28%	43%
Positive	30%	40%	20%
Very positive	16%	18%	20%
Mean (SE)*	**3.56 (.08)**	**3.58 (.10)**	**3.50 (.13)**

** Excludes Don't know (standard error)*

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Approximately One In Five Undertook an Action With Most Of Those Having Attended A Meeting

Actions Taken by Respondents Aware of the Project Pre-Construction	
Took none of specified actions	79%
Took one or more specified actions	21%
Attended meeting	17%
Spoke at meeting	4%
Contributed to webpage	2%
Put up sign	2%
Letter to editor	1%
Don’t know	0.1%

***n*=909**

Although A Small Percentage Of Respondents Had A Negative Attitude Prior To Construction, They Took Many Actions

	Negative	Neutral	Positive
Respondent Attitude Prior To Construction (*n* = 897)	**8%**	**43%**	**47%**
Respondent Attitude Of Those That Took Action (*n* = 354)	**8%**	**31%**	**61%**

Action Type	Frequency	% of Action Type			Total
Attended meeting	67%	7%	37%	56%	**100%**
Spoke at meeting	14%	31%	34%	35%	**100%**
Contributed to webpage	10%	2%	2%	96%	**100%**
Put up sign	6%	10%	24%	66%	**100%**
Letter to editor	3%	44%	8%	48%	**100%**
Total (*n* = 531 actions)	**100%**				

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Regression Equations

1. Process Fairness = $Process\ Metrics_i + Relationship\ to\ wind\ turbine_j + General\ Attitudes_k + Demographics_l + e$

2. Attitude = $Process\ Metrics_m + Relationship\ to\ wind\ turbine_j + General\ Attitude_k + Demographics_l + e$

3. Attitude = $Process\ Metrics_m + Relationship\ to\ wind\ turbine_j + Landscape, Sound, Place, Attitude_n + Demographics_d + e$

Regression Variables:
Dependent & Independent: Process Metrics

Variable	Variable Description/Definition	Weighted Mean/ Proportion[b] (SE)
Dependent		
Overall process fairness	9 category composite of "planning process fairness" (not at all to very) (0-4) and "process annoyance" (very to not at all) (0-4) variables (0-8)	5.49(.28)
Present attitude toward project	5 category (very negative to very positive); don't know treated as missing (1-5)	3.58(.10)
Independent		
Process Metrics		
Community had say in planning process	5 category (strongly disagree to strongly agree); with middle category comprised of "neither agree nor disagree" and "don't know" (1-5)	3.01(.12)
I had say in planning process	(Same as above)	2.17(.11)
Developer open and transparent	(Same as above)	3.28(.10)
Community able to influence outcome	(Same as above)	2.75(.12)

[b]*proportion rather than mean*

Regression Variables: Independent Relationship to Wind Project/Stratification Variables

Variable	Variable Description/Definition	Weighted Mean/ Proportion[b] (SE)
Relationship to Wind Project/Stratification Variable		
Wind turbine on property	"1" if on respondent's property; "0" otherwise	0.012(.01)
Family received compensation	"1" if family received compensation; "0" otherwise	0.051(.01)
Year nearest turbine installed	Year installed (1997 treated as year 1)	2010 (.25 yrs)
Nearest turbine total height	Height to tip of a blade at its apex (meters)	126(1.0)
Installed capacity of nearby project	Project megawatts (MW)	39.1(3.0)
See turbine(s) from home/property	"1" if yes; "0" no	0.51(.049)
[a]Nearby project > 10 turbines	Large: greater than 10 turbines	0.34(.029)
[a]Case study project	"1" if case study project; "0" if "national" sample	0.12(.012)
[a]Dominant project	"1" if under-sampled given nearby population; "0" otherwise	0.19(.036)
[a]Live less than or equal to 0.5 mile from nearest turbine	"1" if in specified distance range to nearest turbine; "0" otherwise (omitted category)	[b]0.018(.001)
[a]Live 0.5 to 1 mile from nearest turbine	"1" if in specified distance range to nearest turbine; "0" otherwise	[b]0.048(.004)
[a]Live 1 to 3 miles from nearest turbine	"1" if in specified distance range to nearest turbine; "0" otherwise	[b]0.33(.037)
[a]Live 3 to 5 miles from nearest turbine	"1" if in specified distance range to nearest turbine; "0" otherwise	[b]0.60(.035)

[a]stratification variable; [b]proportion rather than mean

Regression Variables: Independent Demographic Variables

Variable	Variable Description/Definition	Weighted Mean/ Proportion[b] (SE)
Demographics		
Age	Age in years	55.6(1.5)
Age squared	Square of age	
Education level	Elementary/middle school; some high school; HS graduate or GED; some college; associate degree; bachelors; graduate/professional degree) (1-7)	Some college
Female	"1" if female; "0" male	0.55(.06)
Ln(income)	Natural log of median income of survey-selected census categories (7 categories: < $25,000 to > $250,000)	[c]$67847 ($4060)
Children	"1" if a child/children living in household; 0" otherwise	0.27(.05)
White	"1" if race is white; "0" otherwise	0.88(.04)
Homeowner	"1" if own home; "0" otherwise	0.93(.03)
Year moved in home	Year in home (1921 treated as year 1)	1992 (1.9 yrs)
Secondary residence	"1" if home a secondary residence; "0" otherwise (omitted category)	[b]0.063(.02)
Primary residence	"1" if home primary residence; "0" otherwise	[b]0.85(.03)
Residence status unknown	"1" if unknown; "0" otherwise	[b]0.086(.03)

[b]proportion rather than mean; [c]income rather than ln(income)

Regression Variables: Independent Landscape, Sound, Place/Attitude

Variable	Variable Description/Definition	Weighted Mean/ Proportion[b] (SE)
Landscape, Sound, Place/Attitude		
General attitude toward wind power	Prohibited; not sure; in appropriate circumstances; encouraged and promoted (1-4)	3.40 (.07)
Place attachment/identity	9 category composite of "Identity" and "Regret" (2-10)	7.99 (.17)
Community is part of "identity"	Strongly disagree to strongly agree (1-5)	3.99 (.10)
Would "regret' having to move	Strongly disagree to strongly agree (1-5)	4.00 (.11)
Annoyed by wind project sound	Not at all to very (0-4)	0.30 (.11)
Do not like wind project look and does not fit landscape	"1" if don't like look and does not fit, "0" otherwise (omitted category)	[b]0.12(.03)
Do not like wind project look, but fits landscape	"1" if don't like look, but fits; "0" otherwise	[b]0.042(.026)
Neutral or no opinion on wind project look	"1" if neutral or no opinion on look; "0" otherwise	[b]0.18(.04)
Like wind project look, but does not fit landscape	"1" if like look but does not fit; 0" otherwise	[b]0.34(.06)
Like wind project look & fits landscape well	"1" if like look and fits landscape; 0" otherwise	[b]0.32(.05)

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[b]proportion rather than mean

Regression Results: Developer Transparency More Important Than Fairness of the Public Process in Overall Fairness Perceptions

- Fairness Regression: Extent to which the planning process was fair? (not at all & very annoying to very fair) R^2=.61

What is statistically significant?

- **All four process metrics are, but *developer transparency***
  - **Coefficient on 5x larger** than individual or community having a say and 2-3x larger than community able to influence the outcome
  - In terms of **variance explained**, it explains 4x the sum of the other three metrics

Regression Results: Developer Transparency More Important Than Fairness of the Public Process in Overall Fairness Perceptions

- Fairness Regression: Extent to which the planning process was fair? (not at all & very annoying to very fair) R^2=.61

What else is statistically significant?

- Live further away
- Rent rather than own
- Positive general attitude toward wind power
- Wind turbine on property
  - But family otherwise receiving compensation is not

Regression Results: Developer Transparency and Being Able To Influence The Outcome (e.g., Turbine Location) Are Very Important Determinants of Attitude Formation

- Attitude Regression: Attitude toward project? (very negative to very positive)
  R^2=.76

What is statistically significant for a more positive attitude?

Overall fairness

Two process metrics

- Developer transparent
- Able to influence outcome

The **process metric** coefficients are **stable when the following variables are added**

- Turbine visibility
- Project appearance/aesthetics
- Landscape fit
- Sound annoyance

General attitude toward wind power

- But overall has less effect on attitude than combined effect of the process variables

Regression Results: Developer Transparency and Being Able To Influence The Outcome (e.g., Turbine Location) Are Very Important Determinants of Attitude Formation

- Attitude Regression: Attitude toward project? (very negative to very positive) R^2=.76

What else is statistically significant for a more positive attitude?

- Live 0-0.5 miles away (compared to 3-5 miles)
- Either family received compensation or wind turbine on property, depending on model
  - However, if, in the regression, we include an interactive term between compensation and turbine hosting, the linear combination of the three terms is large and significant
- Older projects

Conclusions:
Planning Process Fairness And Attitudes

- It is important to distinguish among residents who move in the vicinity of wind energy projects before and after construction when considering public perceptions

- **Perception of Process Fairness** is a key component in attitude formation
  - Developer transparency and openness is particularly important; it is more important than the extent of participation provided

- States and communities should consider developing procedures that ensure citizens are consulted and heard and establishing benchmarks or best practices for developer interaction with communities and citizens

Researcher Takeaways

- A question we are unable to answer with a dataset of built projects is: What are the perceptions of the public “approval” process and of developers at abandoned or failed projects? Research into this question would be valuable.

- In interpreting results, one needs to be careful to examine three things
  - What overall question is being asked (e.g., support or attitude or acceptance)?
  - For case studies, how was the case selected?
  - Did the researchers control for Tiebout sorting?
    - Becomes more important the more time has passed since construction commenced

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Upcoming Outreach & Next Steps

Upcoming Outreach

- Webinar Series:
  - **February 27, 2018:** Predicting Audibility Of and Annoyance To Wind Power Project Sounds Using Modeled Sound
  - **March 13, 2018:** Comparing Strongly Annoyed Individuals with Symptoms near U.S. Turbines to Those in Surveyed European Communities
- AWEA Siting Compliance Conference, Memphis (March 2018)

source: hingemarketing.com

Next Steps

- Submit additional journal papers (spring/summer 2018)
- Release the analysis data & survey instrument (fall 2018)

Questions?

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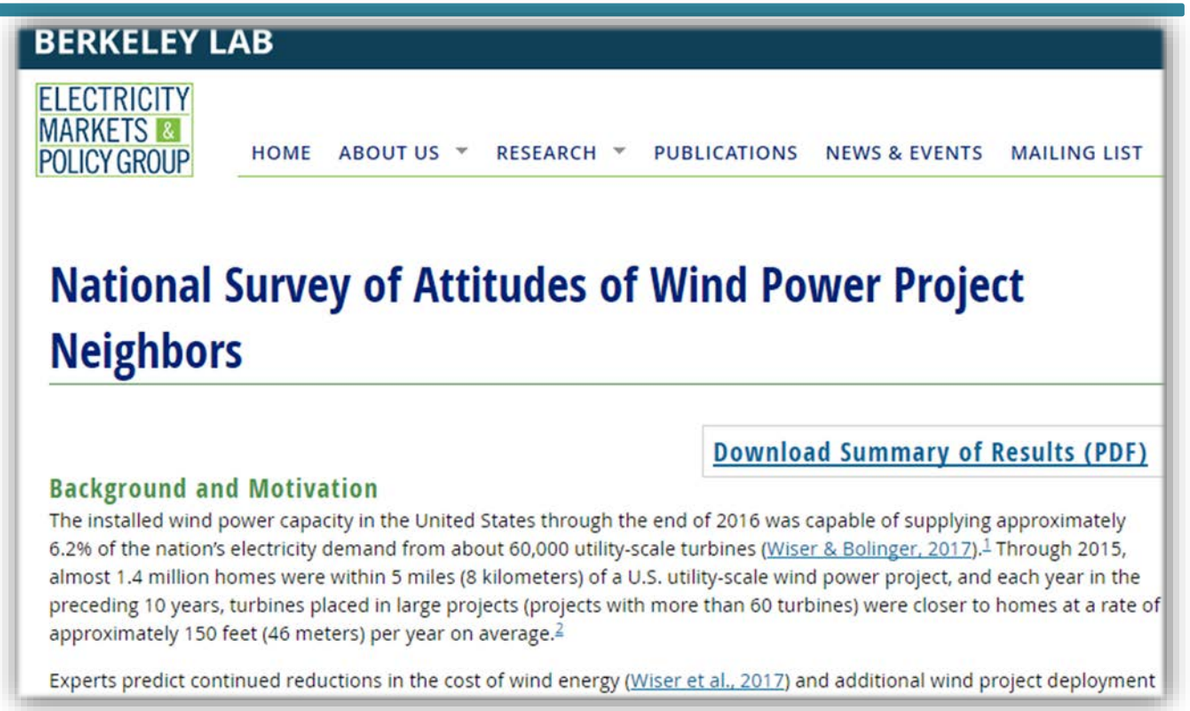
Visit the project webpage for more info and updates
https://emp.lbl.gov/projects/wind-neighbor-survey



If you wish to cite these results use the following:

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Supplemental Slides