



Predicting Opposition to Windfarms Using Census Data

Sarah Mills & Jane Wentrack

University of Michigan, Ford School of Public Policy

Photo by Heritage Sustainable Energy



Photo by Curt Nikisch



Scott Miller / CTV London

Goal

- Can you predict where wind development will be contentious using publicly accessible datasets (U.S. Census, etc.)?
- Reduce wind development costs
- Minimize community conflict to save communities' some heartburn

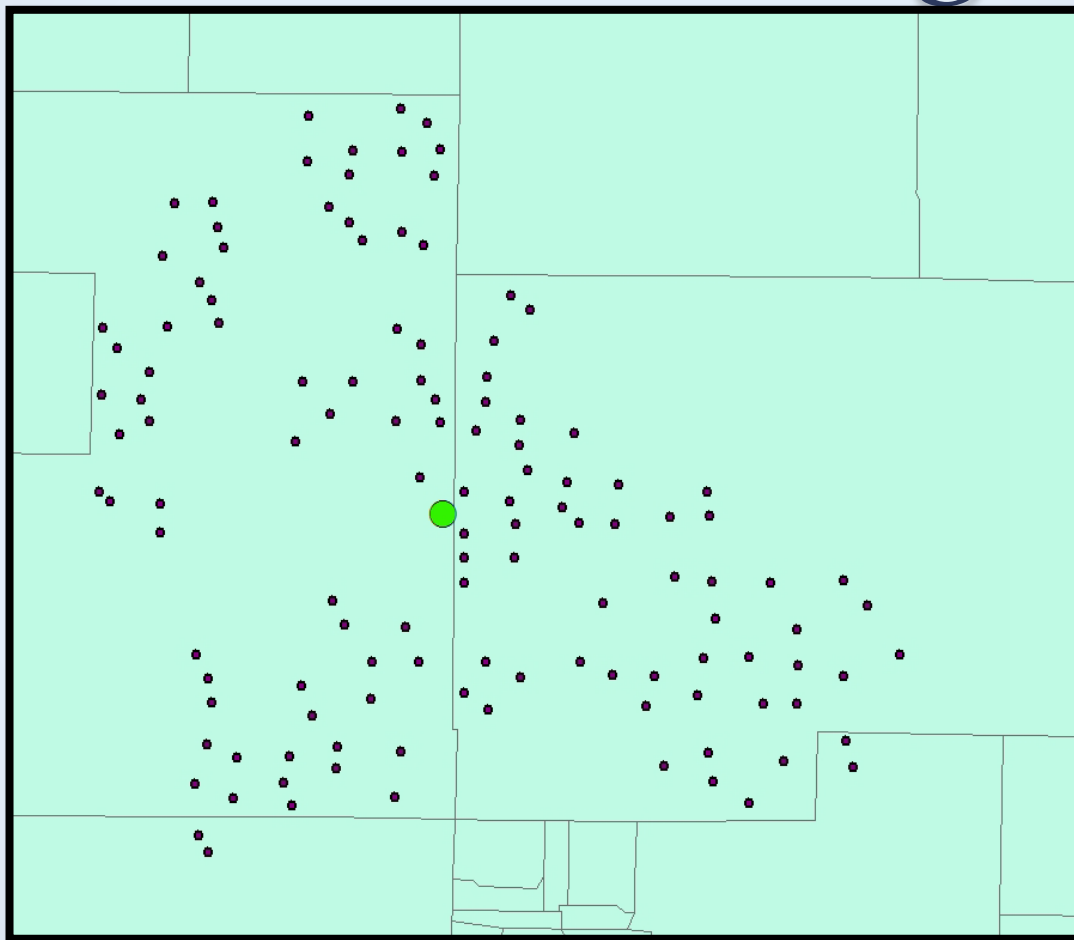
Literature Review

- **Farmers** support wind development for economic reasons (Holstead et al 2016, Slattery et al 2012, Brannstrom et al 2011)
- **Residential property characteristics** affect contention (i.e. worries over home value impacts) (Walker et al 2014, Fast et al 2015)
- Local opposition mobilizes **online** (Reusswig et al 2016, Walker et al 2018)
- Socioeconomic and other **demographic factors** may influence wind siting (Quick et al 2016)
- Land use characteristics that result in **place attachment** within a community can create contention (Phadke 2011, Larson et al, Devine-Wright 2017)

Research Design

- 29 independent variables from:
 - USDA Census of Agriculture (county)
 - USDA Economic Research Service (county)
 - U.S. Census American Community Surveys (block group)
 - Guardian Presidential Election Data (county)
 - Zillow Research Data (zip code)
- Unit of Analysis: Existing windfarms in 4 Great Lakes States
 - IL, IN, MI, MN

Research Design

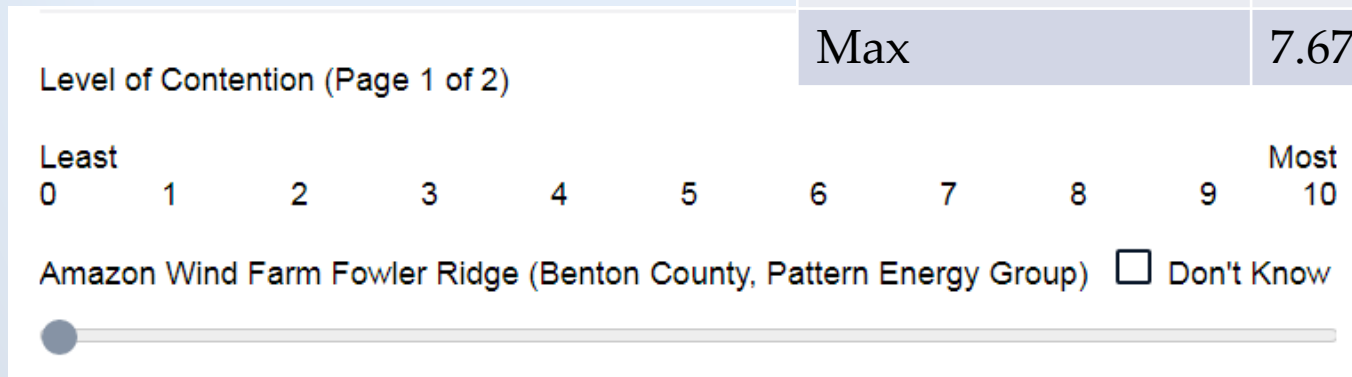


Mean center in ArcGIS used to determine spatial center of wind project

Research Design

- Dependent variable: “Crowd-sourced” survey of wind development experts
- 46 respondents - 41% response rate
- 69 windfarms

Level of contention: Survey results	
Mean	2.78
Min	0.8
Max	7.67



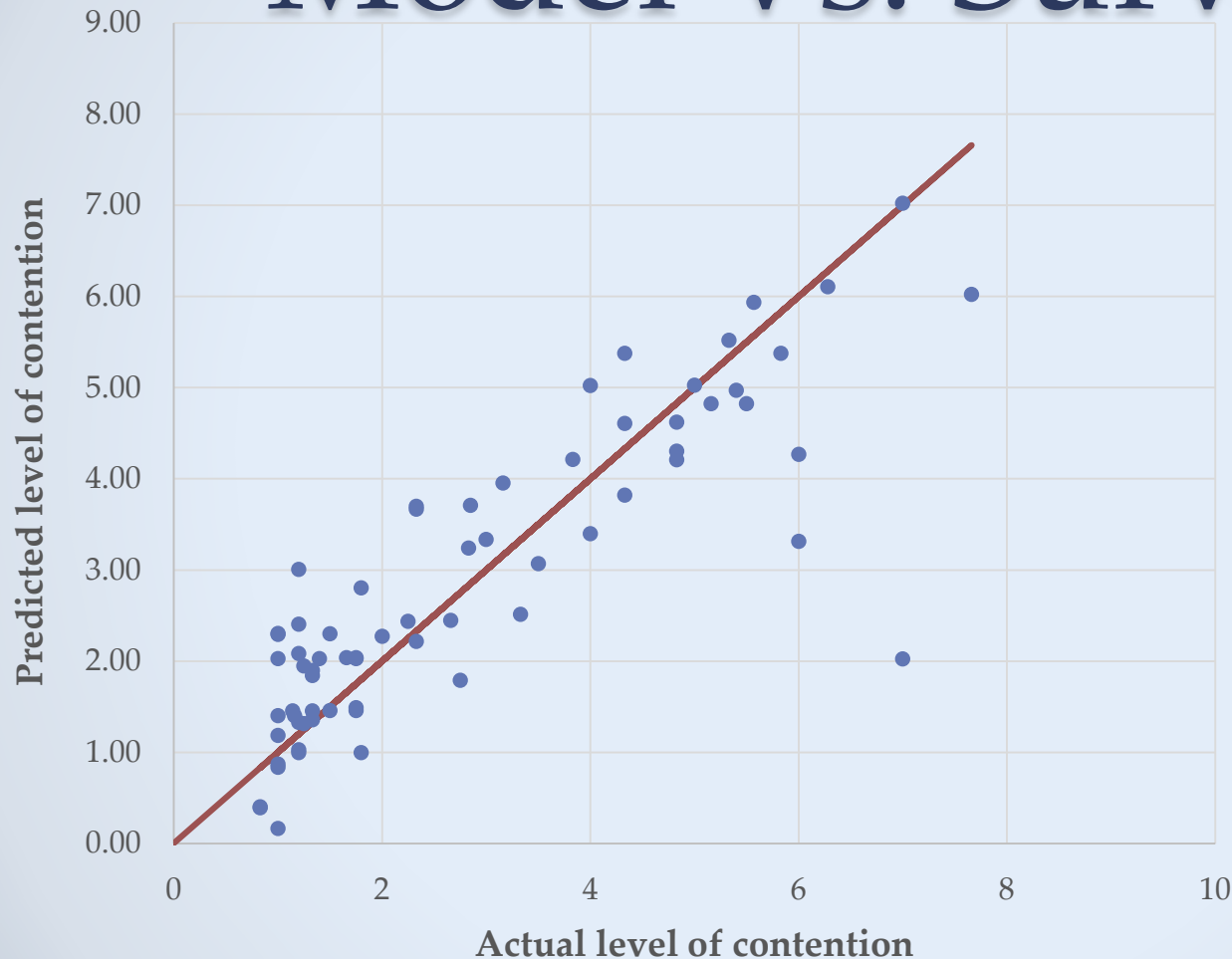
Results

- Eliminated 4 variables due to problems with multicollinearity
 - Agriculture Characteristics (4/12)
- Removed 9 more with limited impact on R^2 value; improved VIFs
 - 2012/2016 Presidential vote share
 - Median income
 - Median home value
 - Owner-occupied housing units
- $R^2 = .734$ (Adj. $R^2 = .631$)

Results

Category	Factor	Coefficient	P value
Agricultural Characteristics	% loss in # of farms: 2007-2012	-0.222	.103
	% change in acreage of farmland	-0.328	.024
	% principal operators not residing on farm operated	-0.196	<.001
	% operators with primary occupation as farming	-0.064	.002
	(Natural log of) Average farm income	1.053	.161
	% pop. in farming/fishing/forestry occupations	0.102	.022
	(Natural log of) Number of farms	0.830	.157
	% pop. that worked at home	-0.129	.014
	Farms per population	0.058	.315
Residential property characteristics	% housing units moved into before 1980	-0.040	.210
	% pop. with commute 40 minutes and up	0.043	.051
Internet Access	% farms with internet access	-0.113	.058
Demographics	% pop. with a bachelor's degree or higher	0.079	<.001
Land use characteristics	Rural-urban commuting area (RUCA)	0.110	.210
	Natural amenity rank	0.582	.051
	Recreation dependent counties	5.937	<.001

Results: Model Vs. Survey



Equation able to predict contention within 1 point 81% of the time

Within 1.5 points 93% of the time

Discussion

- Outliers the result of:
 - wind developer activities?
 - other factors not captured & not easily measured?
 - Local government leadership's attitudes
 - "Instigators" or "champions"
- Would model improve with detail about ag/tourism at local level?

Limitations and future research

- Poor response rate limits observations in IL
 - Explains significant state-level fixed effect?
- Findings reflect constructed projects only, not proposed ones
 - But work underway with large wind developer
- GIS analysis: how to represent the full spatial scale of wind turbines

Conclusions

- Many predictors of contention were related to agricultural intensity
- Wind significantly more contentious in recreation-dependent counties (measure of place attachment)
- Suggests that why people live in that place matters to receptivity to wind
- Likely not substitute for on-the-ground engagement

Questions / Feedback Most Welcome!

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Sarah Mills

sbmills@umich.edu

www.closup.umich.edu/wind

29 Independent Variables

Variable category	Independent Variables	
Agricultural Characteristics	% loss in # of farms: 2007-2012	% change in acres of farmland
	% principal operators not residing on farm operated	% operators with primary occupation as farming
	(Natural log of) Average farm income	(Natural log of) Number of farms
	Farms per population	% pop. employed in farming, fishing or forestry
	% pop. that worked at home	Size of farm
	% pop. working off farm	% of farms as a % of total land area
Demographic Information	% pop. that voted for Romney	% pop. with a bachelor's degree or higher
	% male population	(Natural log of) Median income
Land use Characteristics	Rural-urban commuting area (RUCA)	Population density
	Natural amenity rank	% change in total population
	Recreation-dependent counties	Land surface code
Residential Property Characteristics	% of homes vacant	(Natural log of) Average home value
	% housing units moved into before 1980	% owner-occupied housing units
	% households with retirement income	% pop. with commute 40 minutes and up
Internet Connectivity	% farms with internet access	