

# **PREDICTING OPPOSITION TO WINDFARMS USING CENSUS DATA**

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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.)?
- Minimize community conflict to save communities' some heartburn (Colvin et al 2019)

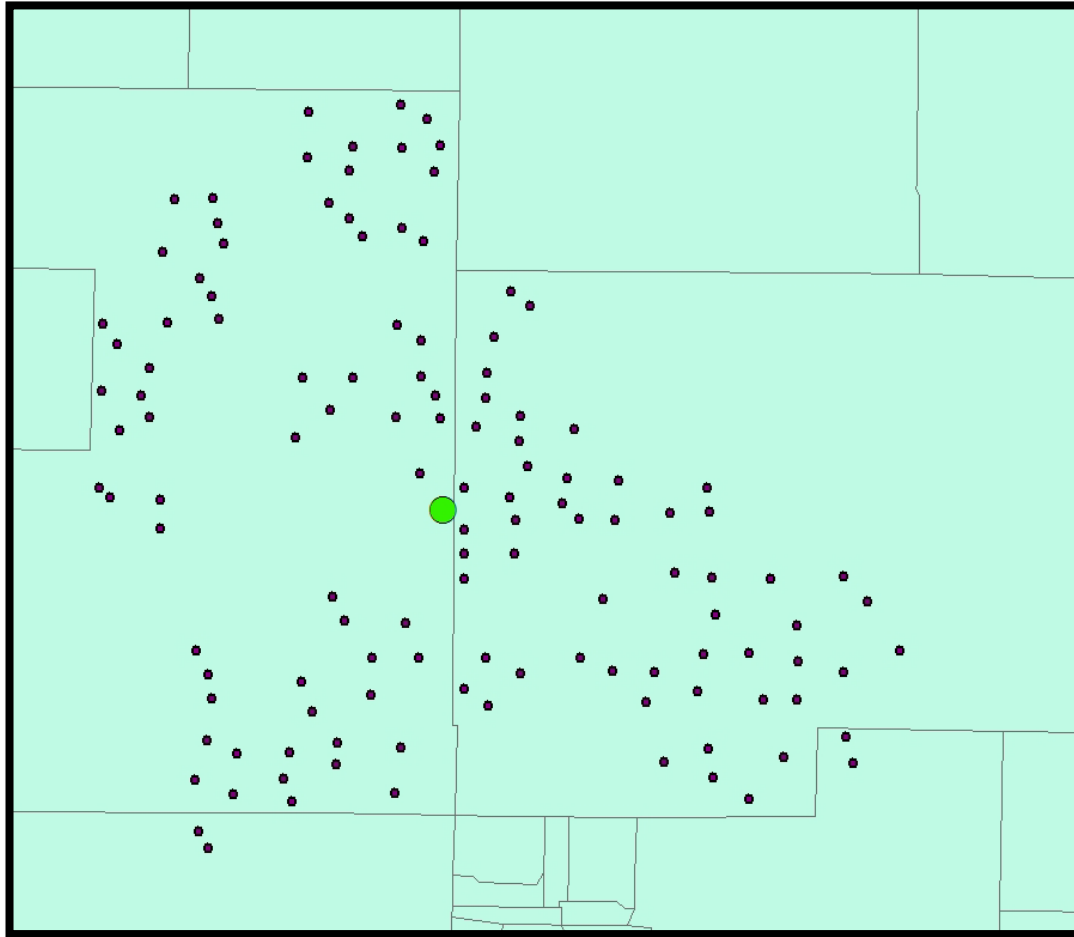
# From the literature

- **Farmers** support wind development for economic reasons (Holstead et al 2016, Slattery et al 2012, Brannstrom et al 2011)
- **Residential property characteristics** arise in siting (i.e. worries over home value impacts) (Walker et al 2014, Fast et al 2015)
- **Socioeconomic and political factors** may influence attitudes toward local wind energy (Quick et al 2016; Walker et al 2018)
- Increased protest in **amenity landscapes** (Phadke 2011, Larson et al, Devine-Wright 2017)

# Research Design

- 15 independent variables from:
  - USDA Census of Agriculture (county)
  - USDA Economic Research Service (county)
  - U.S. Census American Community Surveys (block group)
  - Townhall Presidential Election Data (county)
  - [Previous iterations included home values]
- 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	2.88
Min	0.83
Max	7.67

Level of Contention (Page 1 of 2)

Least 1 2 3 4 5 6 7 8 9 10 Most

Amazon Wind Farm Fowler Ridge (Benton County, Pattern Energy Group)  Don't Know



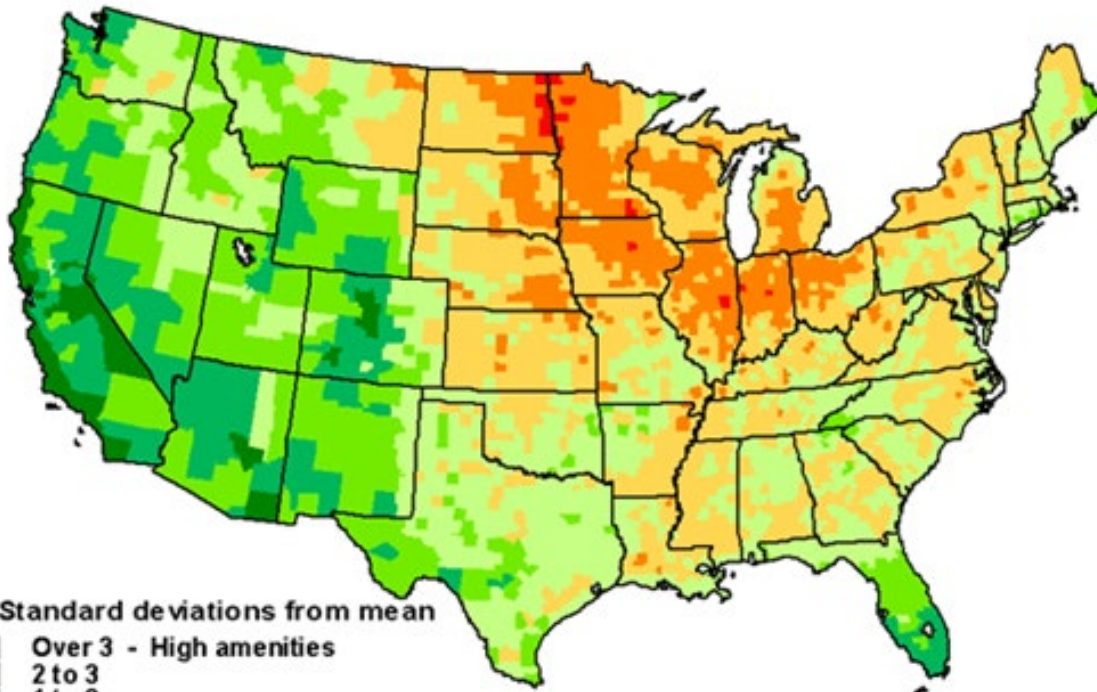
# Correlations

Category	Factor	As factor ↑, Contention...
Agricultural characteristics	<b>Principal operators not residing on farm operated (%)</b>	↓
	Population employed in farming, fishing or forestry (%)	↑
	<b>Size of farm</b>	↓
	<b>Population that worked at home (%)</b>	↓
	<b>Farm-dependent counties</b>	↓
	<b>Land in farms (%)</b>	↓
Demographic information	Population that voted for Trump (%)	↓
	<b>Population with a bachelor's degree or higher (%)</b>	↓
	<b>Median income (natural log)</b>	↓
Residential property characteristics	<b>Housing units moved into before 1980 (%)</b>	↑
	<b>Households with retirement income (%)</b>	↑
	Commute 40 minutes and up (%)	↓
Land characteristics	Population density	↑
	<b>Natural amenity rank</b>	↑
	Recreation-dependent counties	↑

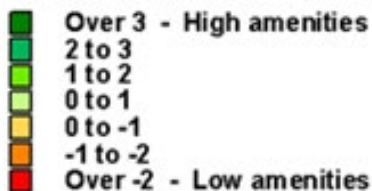


# What is the Natural Amenities Scale?

Natural amenities scale



Standard deviations from mean



Source: USDA, Economic Research Service.

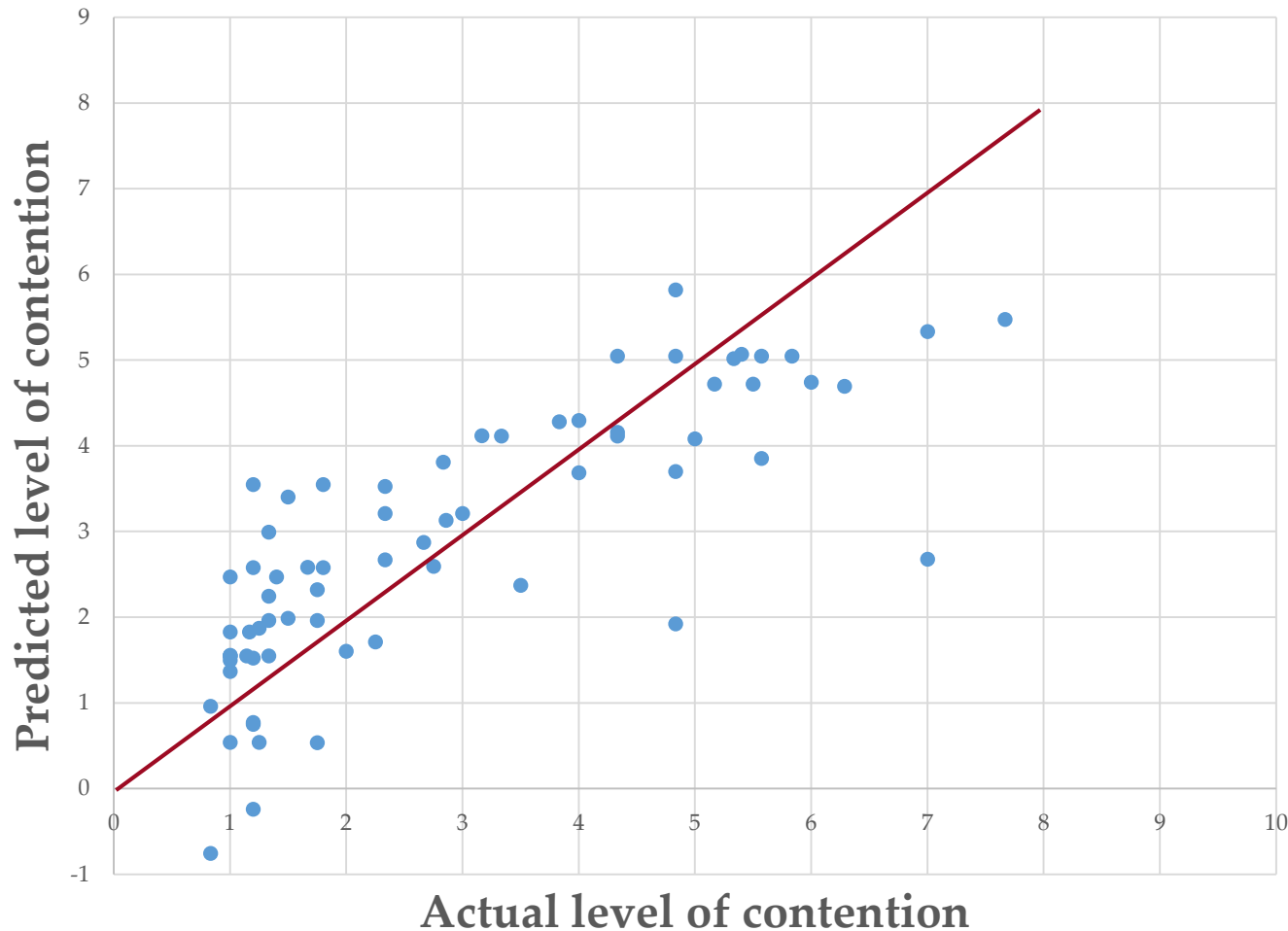
- Climate
- Topography
- Water area

<https://www.ers.usda.gov/data-products/natural-amenities-scale/>

# Regression Results

Category	Factor	Coeff.	P
Agricultural characteristics	Principal operators not residing on farm operated (%)	-0.147	<b>0.002</b>
	Size of farm	0.005	0.101
	Population that worked at home (%)	-0.070	<b>0.056</b>
Demographic information	Population that voted for Trump (%)	-0.066	<b>0.021</b>
	Population with a bachelor's degree or higher (%)	-0.049	0.156
Residential property	Households with retirement income (%)	0.035	0.145
Land characteristics	Natural amenity rank	1.539	<b>0.000</b>
States	Illinois	2.093	<b>0.001</b>
	Indiana	0.784	0.248
	Michigan	0.597	0.341
	Minnesota	0	
<b>R Squared</b>		<b>0.642</b>	

# Results: Model Vs. Survey



Equation able to predict contention within 1 point 71% of the time

Within 1.5 points 84% 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”
- Student ground-truthing in Michigan this summer with projects under development  
(presenting at EPRC)

# Limitations & Future Research

- Geographical scope
  - Repeat this nationwide?
- Findings reflect constructed projects only, not proposed ones
- GIS
  - Something fancier beyond mean center?
  - Ag, amenity measures on at county level

# Conclusions

- Ag, landscape characteristics linked to wind contention in Great Lakes region
- Suggests that why people live in that place matters to receptivity to wind; can pick this up with publicly available data

# Thank you & questions

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# Correlations

Category	Factor	Pearson's Coefficient	Significance
Agricultural characteristics	Principal operators not residing on farm operated (%)	<b>-.298</b>	<b>0.013*</b>
	Population employed in farming, fishing or forestry (%)	0.021	0.863
	Size of farm	<b>-.441</b>	<b>0.000***</b>
	Population that worked at home (%)	<b>-.421</b>	<b>0.000***</b>
	Farm-dependent counties	<b>-.415</b>	<b>0.000***</b>
	Land in farms (%)	<b>-.328</b>	<b>0.006**</b>
Demographic information	Population that voted for Trump (%)	-.113	0.354
	Population with a bachelor's degree or higher (%)	<b>-.337</b>	<b>0.005**</b>
	Median income (natural log)	<b>-.322</b>	<b>0.007**</b>
Land use characteristics	Population density	0.016	0.895
	Natural amenity rank	<b>0.459</b>	<b>0.000***</b>
	Recreation-dependent counties	0.118	0.336
Residential property characteristics	Housing units moved into before 1980 (%)	<b>0.293</b>	<b>0.014*</b>
	Households with retirement income (%)	<b>0.406</b>	<b>0.001***</b>
	Commute 40 minutes and up (%)	-0.018	0.883



# Results: Full Model

Category	Factor	Coefficient	P value
Agricultural characteristics	<b>Principal operators not residing on farm operated (%)**</b>	<b>-0.158</b>	<b>0.002</b>
	Population employed in farming, fishing or forestry (%)	-0.003	0.948
	Size of farm	0.005	0.178
	<b>Population that worked at home (%)*</b>	<b>-0.097</b>	<b>0.024</b>
	Farm-dependent counties	0.474	0.427
	Land in farms (%)	0.002	0.907
Demographic information	<b>Population that voted for Trump (%)+</b>	<b>-0.068</b>	<b>0.051</b>
	Population with a bachelor's degree or higher (%)	-0.061	0.151
	Median income (natural log)	1.532	0.350
Land use characteristics	Population density	0.000	0.896
	<b>Natural amenity rank**</b>	<b>1.501</b>	<b>0.004</b>
	Recreation-dependent counties	0.653	0.602
Residential property characteristics	Housing units moved into before 1980 (%)	0.028	0.421
	Households with retirement income (%)	0.043	0.146
	Commute 40 minutes and up (%)	-0.025	0.315
R Squared		<b>0.667</b>	
Adjusted R Squared		<b>0.561</b>	

P-value: \*\*\*p<0.001, \*\*p<0.01, \*p<0.05, + p<0.1

# Regression Results

- Strongest Ag characteristics
  - % operators not on farm (1pt ↓: 7%)
  - % work at home (1pt ↓: 14%)
- Demographics
  - % Trump voters (1pt ↓: 15%)
- Land Use Characteristics
  - Natural amenity rank (1.5 pt ↑ : 1pt)