Economic Impacts of Renewable Energy in Indiana

Dagney Faulk, Ph.D.

Paul Niekamp, Ph.D.

Ball State University

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INDIANA RENEWABLE ENERGY

Siting through Technical Engagement and Planning (R-STEP™)

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OVERVIEW

- Research questions
- Locations of large wind and solar projects
- Data used in analysis
- Methods of analysis
- Results
- Conclusions
- Questions and comments



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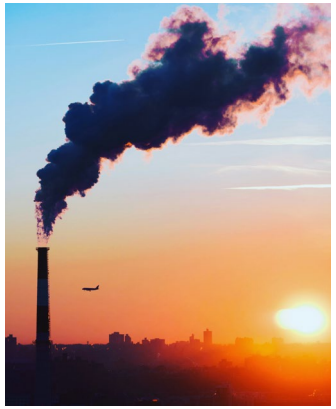
TWO INDIANA-FOCUSED STUDIES

- Impact of…
- Utility scale wind projects on residential property values
  - Indiana MLS data, properties within 5 miles of a turbine
- Utility scale solar projects on residential property values
  - Indiana MLS data, properties within 4 miles of a solar project

WHY WOULD LARGE WIND AND SOLAR PROJECTS AFFECT PROPERTY VALUES? EXTERNALITIES

- An externality is an economic side effect of an activity that helps or hurts a third party who did not choose to take part in the activity, an unintended consequence.
- May negatively or positively impact the third party.

- An **amenity/disamenity** is a property characteristic/feature that **increases/decreases** property value.



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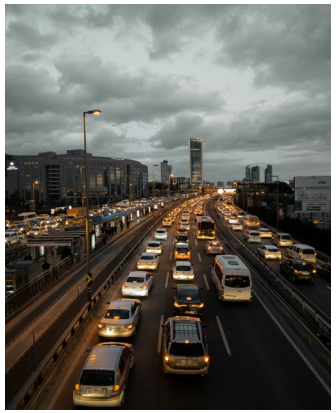

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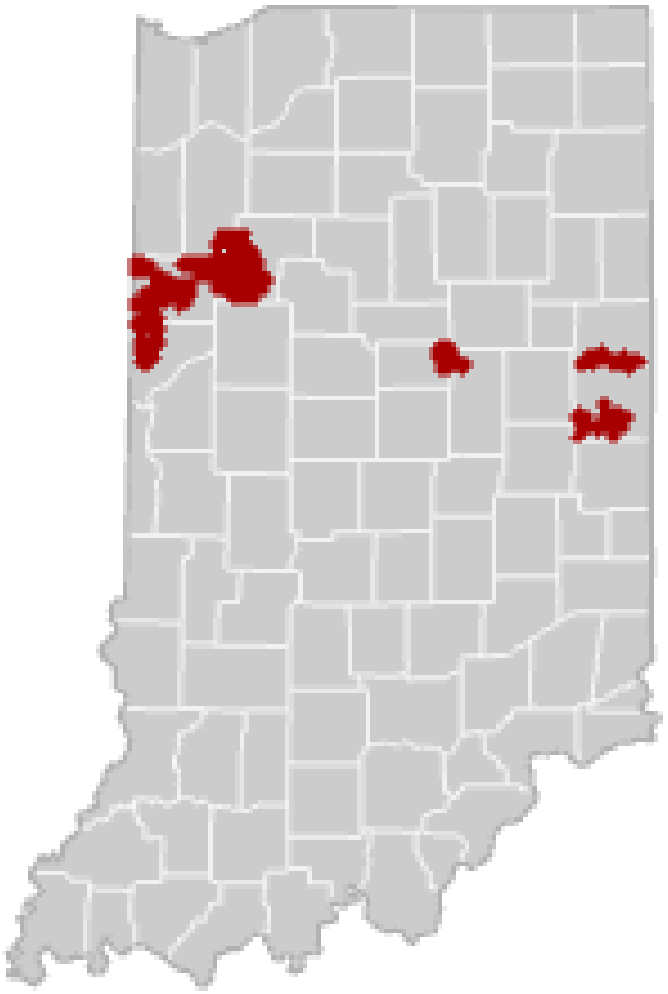
LOCATIONS OF UTILITY-SCALE WIND PROJECTS

Wind Projects



Class 3 Wind Speeds at 50 Meters Elevation



Note. Class 3 wind power areas have wind speeds between 14.3 and 15.7 miles per hour at 50 meters elevation.

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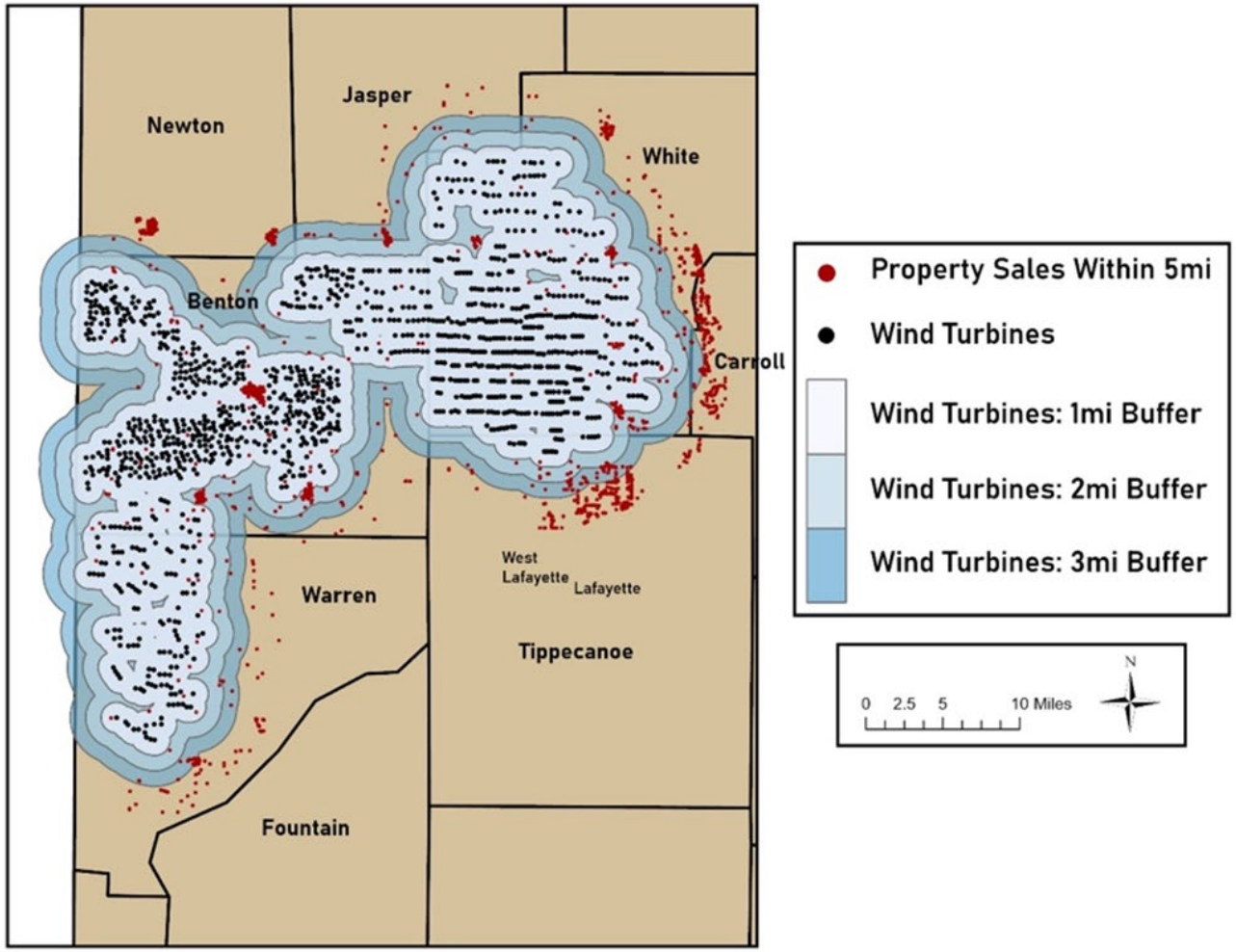
DATA: WIND

- Residential Property sales: ≈ 1.05 million Indiana MLS transactions from the Indiana Association of Realtors (IAR)
  - One record per sale with price, date, bedrooms, square feet, acreage, basement, age, school district, latitude/longitude
- Wind turbines: = 1,684 turbines operational between 2008 and 2023 georeferenced in the U.S. Wind Turbine Database (USWTDB)
  - Three regions (East Central, Northwest, and North Central)
  - 23 projects in 7 counties
- Use straight line distance from property to nearest turbine operational when house sold.
- Analyze transactions within five miles of nearest turbine
  - East Central, 2005-2024, (n=1,668), first turbine operational in 2014
  - Northwest, 2004-2024, (n=2,886), first turbine operational in 2008
  - North Central, 2004-2024, (n=1,432), first turbine operational in 2012

WIND TURBINES AND PROPERTY TRANSACTIONS
(DATA USED IN BSU CBER STUDY)
NORTHWEST REGION



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NORTHWEST REGION, DESCRIPTIVE STATISTICS

Total (2004-2024)	Mean	Std Dev	Min	Median	Max
Real Sale Price ($)	230,804	147,866	21,238	196,000	923,919
# of Bedrooms	3.2	0.8	1.0	3.0	6.0
# of Bathrooms	2.2	0.9	1.0	2.0	6.0
Living Area (sq. ft)	1,830	690	465	1,731	5,481
Lot Acreage	1.4	2.9	0.1	0.4	60.0
Age	47.3	24.9	1.0	50.0	100.0
Basement Dummy	0.4	0.5	0.0	0.0	1.0
Distance to Nearest Turbine (ft)	17,157	8,138	1,113	20,310	26,398
Post Project Completion Dummy	0.62	0.49	0.00	1.00	1.00
<1 Mile Dummy	0.16	0.36	0.00	0.00	1.00
[1, 2) Mile Dummy	0.11	0.32	0.00	0.00	1.00
[2, 3) Mile Dummy	0.07	0.26	0.00	0.00	1.00

Number of observations = 2,886; Pre-treatment obs. = 1,096; Post-treatment obs. = 1,790

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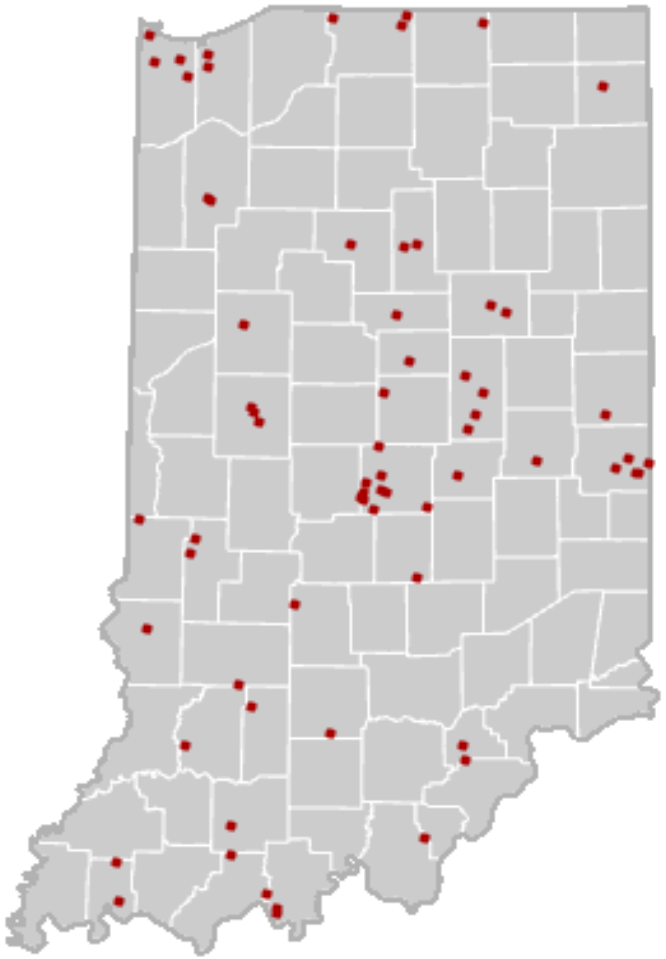
LOCATIONS OF UTILITY-SCALE SOLAR PROJECTS



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DATA: SOLAR

- Residential Property sales: ≈ 1.05 million Indiana MLS transactions from the Indiana Association of Realtors (IAR)
  - One record per sale with price, date, bedrooms, square feet, acreage, basement, age, school district, latitude/longitude
- Solar projects: 91 LSPVP projects (over 1 MW AC) that began operating in Indiana between 2011 and 2023 from the major projects list of the Solar Energy Industries Association (SEIA)
- Measure straight-line distance from properties to LSPVPs
- Analysis samples:
  - 4,821 sales within 0.5 miles of a current or future LSPVP
  - $\approx 227{,}000$ sales within 4 miles of one of the solar projects, sold within 7 years before and 5 years after the project began operating.

DATA: SOLAR (CONTINUED)

Descriptive Statistics of Properties by Distance Bin from LSPVP in Stacked DiD Analysis

Variable	< 0.5 mi	0.5-1 mi	1-2 mi	2-4 mi
N	3,232 (1.4%)	12,614 (5.6%)	57,860 (25.5%)	153,131 (67.5%)
Sale Price (1000s)	123.38 (67.53)	120.12 (76.60)	124.09 (80.33)	154.02 (105.94)
# of Bedrooms	2.96 (0.69)	2.99 (0.71)	3.07 (0.70)	3.18 (0.73)
# of Bathrooms	1.93 (0.79)	1.93 (0.81)	2.02 (0.83)	2.24 (0.89)
Square Feet	1,627.28 (631.74)	1,667.62 (682.62)	1,711.83 (721.66)	1,899.38 (852.51)
Lot Acreage	0.47 (2.12)	0.38 (1.28)	0.35 (1.06)	0.43 (1.35)
Age	52.09 (25.69)	55.41 (24.37)	52.32 (23.94)	46.34 (24.06)
Basement (1 = Yes)	0.34 (0.47)	0.37 (0.48)	0.33 (0.47)	0.36 (0.48)

MEASURING PROPERTY VALUE IMPACTS OF EXTERNALITIES:

COMMON METHODS OF ANALYSIS



- **Paired Sales Analysis** – Direct comparison of sale prices of similar properties that are adjacent and farther away from amenities or (dis)amenities.
- **Hedonic Analysis** – Econometric (regression) model separating the price of a house into the value of each characteristic (e.g., number of bedrooms, square footage, basement, and certain location characteristics including amenity or disamenity).
- **Hedonic Difference-in-Differences Analysis** – An econometric approach using the base hedonic approach, but with treatment (test) group (or multiple spatial treatment groups) and control groups before and after a certain event (siting of a solar or wind facility).
- **Event Studies** – Examines change in house price over time controlling for house characteristics and distance from disamenity.

WIND: METHODS OF ANALYSIS

(1) Standard (North Central) or staggered (North West and East Central) Difference in Differences models

$$\ln(P_{icst}) = \beta_0 + \beta_1 X_i + \beta_2 D_i + \beta_3 Post_t + \beta_4 D_i * Post_t + \gamma_c + \delta_s + \varphi_t + \varepsilon_{icst} \quad (1)$$

(2) Model that includes turbine density (number of turbines a specific radius of the property the year it is sold)

$$\ln(P_{icst}) = \beta_0 + \beta_1 X_i + \beta_2 Post_t + \beta_4 Dens_i^b * Post_t + \gamma_c + \delta_s + \varphi_t + \varepsilon_{icst}$$

(3) Event Study – we use similar approach to examine average home prices in periods before and after the operation of the nearest turbine relative to a reference period (year before turbine operational.

SOLAR: METHOD OF ANALYSIS (1)

$$\ln(P_{ismt}) = \beta_0 + \beta_1 T_{ismt} + X_i\alpha + \gamma_s + \delta_m + \phi_t + \varepsilon_{ismt}$$

- Observations: properties < 0.5 miles from an existing or future LSPVP site.
- Sales price P_{ismt} for residential property sale ***i*** in school district ***s*** transacted in month ***m*** of year ***t***.
  - T_{ismt} is a treatment indicator denoting whether a property sale occurred after the estimated construction start date of an LSPVP
  - γ_s denote school district fixed effects, δ_m are month fixed effects, and ϕ_t are year fixed effects
  - X_i denotes a vector of house characteristics
- This model compares changes in prices for properties after construction begins on a nearby LSPVP to changes in prices for properties whose nearby projects have not yet started, while simultaneously accounting for time-invariant property and location characteristics and common time shocks.

SOLAR: METHOD OF ANALYSIS (2)

$$\ln(P_{icdjqt}) = \beta T_{idt} + X_i\alpha + \delta_{dc} + \lambda_{tc} + \rho_{qc} + \phi_j + \epsilon_{icdjqt}$$

- Sale price ***P*** for property sale ***i*** in project cohort ***c*** within distance bin ***d*** and school district ***j***, transacting in quarter ***q*** of year ***t***.
  - T_{idt} is a vector of distance bin indicators for properties located [0, 0.5], [0.5, 1], and [1, 2] miles from an LSPVP, in which each indicator equals one if the property transacted after the estimated construction start date of the nearest LSPVP.
    - Control group: properties located [2,4] miles from an LSPVP
  - X_i denotes a vector of house characteristics; λ_{tc} denotes sale year-by-project cohort fixed effects; ρ_{qc} denotes sale quarter-by-project cohort fixed effects. Stack-interacted fixed effects ensure treatment effects are identified from within-project cohort variation in sale prices across distance bins. ϕ_j denotes school district fixed effects
- This model compares changes in prices for homes near a solar project after construction begins to changes in prices over the time for homes 2-4 miles from that same project. Each solar project's more distant houses serve as the comparison group for its closest ones.

UTILITY SCALE WIND PROJECTS AND PROPERTY VALUES: FINDINGS (WIND 1)

Does Proximity to a Wind Turbine Negatively Affect House Values?

The results of the hedonic models reveal no statistically significant negative effects of large wind projects on home prices in Indiana.

Region	East Central	Northwest
Dist to Turbine: < 1 mi	**-0.115 [0.098]**	**0.075 [0.047]**
Dist to Turbine: 1-2 mi	**-0.068 [0.083]**	**0.041 [0.048]**
Dist to Turbine: 2-3 mi	**-0.017 [0.067]**	**0.181***[0.066]**
Adj. R^2	0.5911	0.7179
Number of Observations	1,668	2,886
House characteristics	Yes	Yes
County, School Distr and Year FE	Yes	Yes

Region	North Central
NA	**NA**
Dist to Turbine: <2 mi	**0.058 [0.069]**
Dist to Turbine: 2-3 mi	**0.071 [0.079]**
Adj. R^2	0.5299
Number of Observations	1,432
House characteristics	Yes
County, School Distr and Year FE	Yes

*** indicates 0.01 level of significance

UTILITY SCALE WIND PROJECTS AND PROPERTY VALUES: FINDINGS (WIND 2)

Does Wind Turbine Density Affect House Values?

In the East Central and Northwest regions, the number of wind turbines in close proximity does not appear to affect the sale price of a home. In the North Central region, the number of turbines within 2 and 3 miles of a home does affect sale price, but we believe this result may be a false positive.

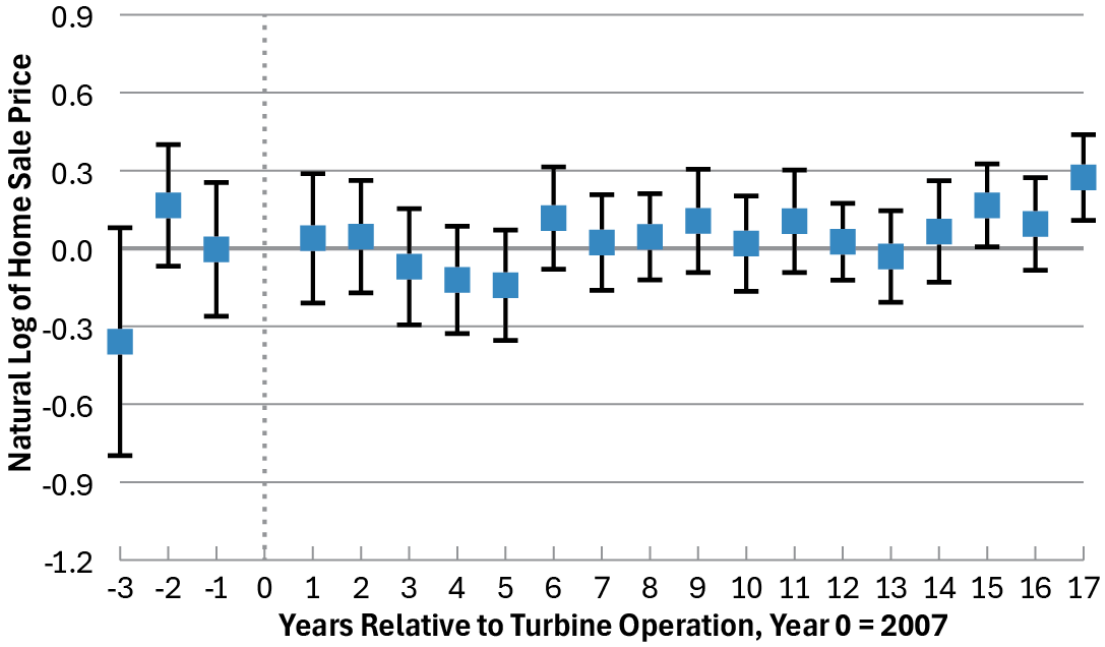
	East Central Coeff. [Std. Error]	Northwest Coeff. [Std. Error]	North Central Coeff. [Std. Error]
Turbines within 0.50 Mi	**NA**	**-0.057 [0.042]**	**NA**
Turbines within 0.75 Mi	**-0.052 [0.066]**	**0.021 [0.023]**	**0.031 [0.067]**
Turbines within 1 Mi	**0.016 [0.055]**	**0.0003 [0.016]**	**-0.012 [0.039]**
Turbines within 2 Mi	**0.007 [0.019]**	**0.007 [0.005]**	**0.033*** [0.009]**
Turbines within 3 Mi	**-0.004 [0.008]**	**-0.001 [0.002]**	**-0.014***[0.003]**
Adj. R^2	0.589	0.716	0.533
Number of Observations	1,664	2,886	1,432
House characteristics, County, School Distr and Year FE	Yes	Yes	Yes

UTILITY SCALE WIND PROJECTS AND PROPERTY VALUES: FINDINGS (WIND 3)

Does the Impact of Wind Turbines on House Values Vary Over Time?

Event studies provide no evidence that wind projects negatively affect the sale prices of homes over time.

Event Study: Home Prices within 1 Mile of Nearest Wind Turbine, Northwest Region, 2004-2024



First turbine operation in 2008.

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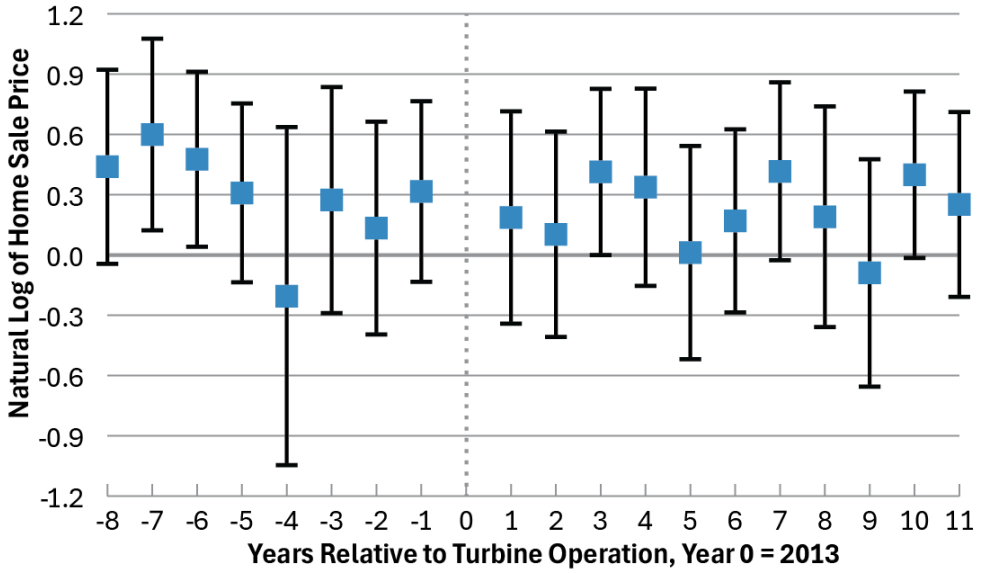
EVENT STUDIES FOR EAST CENTRAL AND NORTH CENTRAL REGIONS

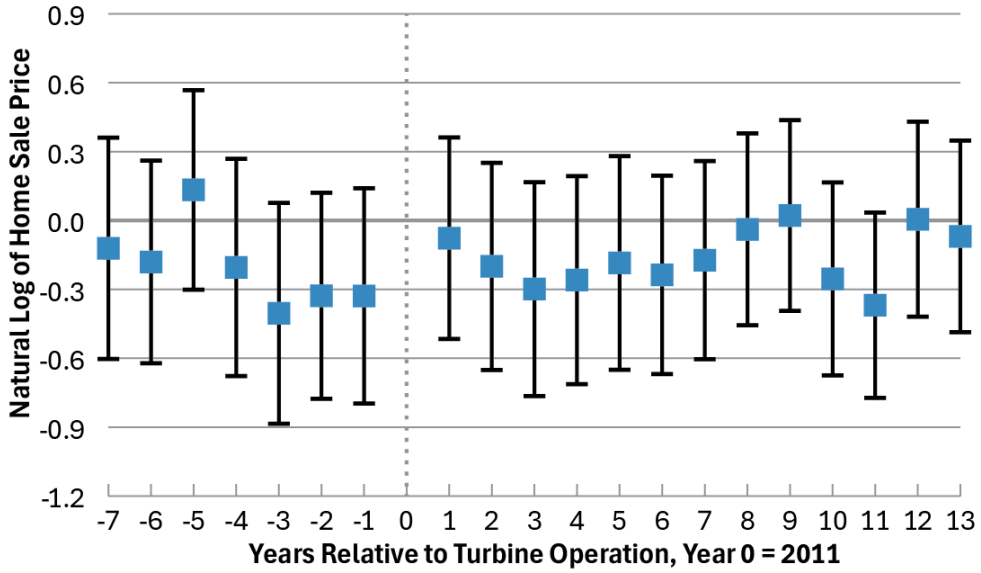
East Central Region

2005-2024, First turbine operational in 2014



North Central Region

2004-2024, First turbine operational in 2012



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UTILITY SCALE SOLAR PROJECTS AND PROPERTY VALUES: FINDINGS (SOLAR 1)

Does Proximity to a Large Solar Project Negatively Affect House Values?

The results of the hedonic models reveal no statistically significant negative effects of large solar projects on home prices in Indiana.

Table 4. Stacked DiD: Effect of LSPVP Construction and Proximity on Home Prices

Column	1	2	3	4	5
Variable	Stacked	Stacked	Stacked	Stacked	TWFE
Dist to LSPVP: < 0.5 mi	**-0.005 (0.027)**	**-0.004 (0.028)**	**-0.005 (0.023)**	**0.001 (0.023)**	**0.009 (0.034)**
Dist to LSPVP: 0.5-1 mi	0.009 (0.020)	0.008 (0.019)	0.009 (0.015)	0.009 (0.019)	0.024 (0.025)
Dist to LSPVP: 1-2 mi	-0.012 (0.013)	-0.011 (0.013)	-0.012 (0.009)	-0.006 (0.011)	0.017 (0.016)
Adj. R^2	0.745	0.748	0.745	0.788	0.716
F-statistic	146.33	138.82	168.67	343.63	107.82
N	226,751	225,610	226,751	226,785	226,783
House Characteristics	Yes	Yes	Yes	Yes	Yes
Distance-bin x Project Cohort FE	Yes	Yes	Yes	Yes	No
Sale Year x Project Cohort FE	Yes	No	Yes	Yes	No
Sale Quarter x Project Cohort FE	Yes	No	Yes	Yes	No
Sale Month x Project Cohort FE	No	Yes	No	No	No
School District FE	Yes	Yes	Yes	No	Yes
Census Tract FE	No	No	No	Yes	No
Cluster Level	Project Cohort	Project Cohort	School District	Project Cohort	School District

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UTILITY SCALE SOLAR PROJECTS AND PROPERTY VALUES: FINDINGS (SOLAR 2)

Does the Impact Large Solar Projects on House Values Vary Over Time?

Event studies provide no evidence that solar projects negatively affect the sale prices of homes over time.

Figure 6. Event Study: Effect of Solar Project Completion on Home Prices

Note: See *Appendix Table A6* for corresponding data.

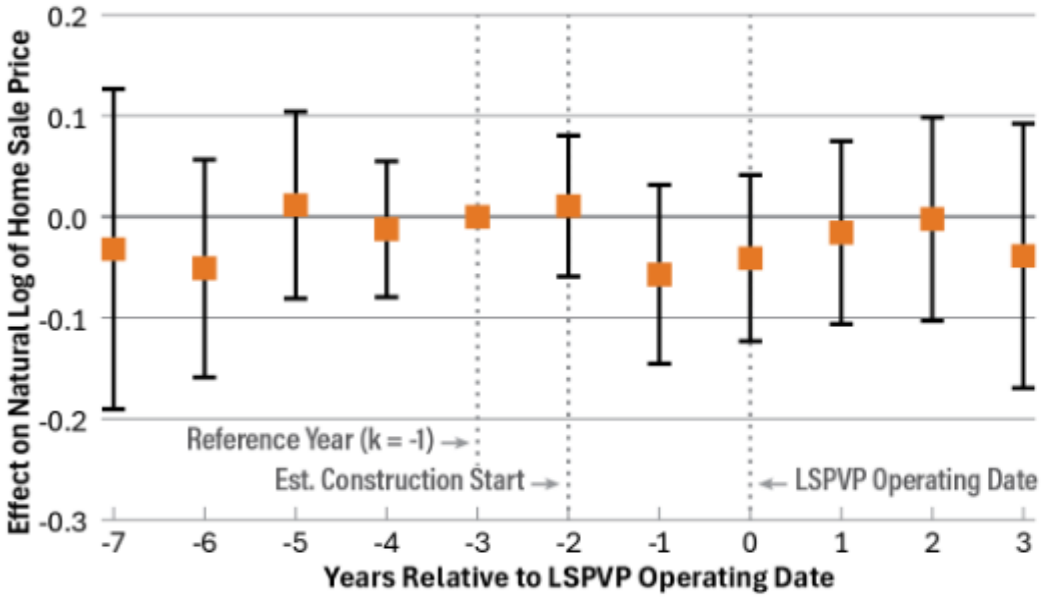
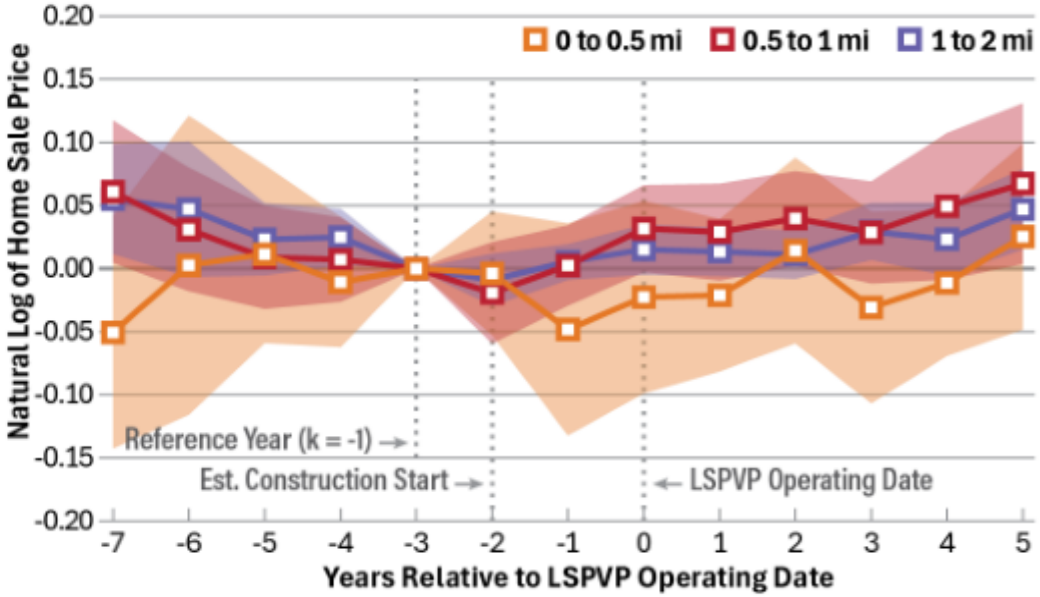


Figure 7. Stacked DiD: Effect of Solar Project Completion on Home Prices

Note: See *Appendix Table A7* for corresponding data.



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UTILITY SCALE SOLAR PROJECTS AND PROPERTY VALUES: FINDINGS (SOLAR 3)

Does Solar Project Capacity Affect House Values?

Homes within 0.5 miles of smaller solar projects sell for 5.7% more than similar homes that are 2 to 4 miles away, while homes near larger solar projects sell for 6.2% less than similar homes 2 to 4 miles away.

Do Solar Projects Have a Different Effect on House Values in Rural or Urban Areas?

The results for Indiana show no statistically significant difference in the sale price of homes near solar projects in rural or urban areas.

Do Solar Projects Located on or near Brownfields Have a Different Effect on House Values?

We find no evidence that solar projects located near brownfields have an effect on the average sale price of nearby residential properties in Indiana.

UTILITY SCALE SOLAR PROJECTS AND PROPERTY VALUES: FINDINGS (SOLAR 4)

Does the Type of Power Provider Affect House Values?

We find that home sales near investor-owned utilities experienced price increases after the solar project became operational, relative to homes 2 to 4 miles away.

CONCLUSIONS

- The results of the hedonic models and event studies reveal **no statistically significant negative effects** of large wind or solar projects on home prices in Indiana.
- The exception is homes located near large solar projects (>3MW), but this result is not definitive.
- There is no difference in sale price for urban and rural areas or solar projects near brownfields.
- Sale price is higher for homes near solar projects owned by investor-owned utilities.

REASONS THERE ARE NO NEGATIVE EFFECTS

- Our results are consistent with Hu et al. (2025), who find that negative effects of LSPVPs on property values are driven almost entirely by the US Northeast and that results are statistically insignificant with positive point estimates in the US Midwest.
  - Other state-specific estimates: Elmallah et al. (2023) find negative effects in North Carolina and New Jersey, but positive, statistically insignificant estimates for California and Connecticut.

- Potential reasons Indiana results are null
  - Local housing markets, siting conditions, landscape counterfactuals.
  - Indiana's solar-adjacent residential property sales are largely urban (90%)
    - Negative effects in Elmallah et al. (2023) and Gaur et al. (2023) in rural/greenfield
  - Tax Capitalization Effects

REFERENCES

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Faulk, D., Niekamp, P., Hicks, M.J. 2026. Indiana Renewables and the Residential Real Estate Market. Ball State University, Center for Business and Economic Research. (Brief that summarizes the two technical studies)

THANK YOU!



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