


Behind Environmental Injustice: Disparate Siting Industries and Post-siting Demographic Transformation

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Motivation

- There are long-lasting and significant socioeconomic disparities in exposure to environmental pollution sources (Colmer et al., 2020; Bullard, 1983; Banzhaf et al., 2019).
- It is important to understand the mechanisms that cause environmental injustice.
- Two potential mechanisms: disparate siting (Bullard, 1983; Saha and Mohai, 2005; Wolverton, 2009; McCoy, 2017) and post-siting migration (Stretesky and Hogan, 1998; Melstrom and Mohammadi, 2022; Crowder and Downey, 2010).

This paper conducts a comprehensive analysis to show how disparate siting and post-siting migration together lead to environmental injustice problems.

Findings

This paper studies the relationship between the siting of fossil fuel power plants and local racial compositions in the U.S.

The paper finds:

- fossil fuel power plants are more likely to be sited in the census tracts with a higher minority ratio.
- After the siting, the local minority ratio increased by 2.1%, with a 9.2% decrease in the local white population and a 16.6% increase in the local minority population.

Data Description

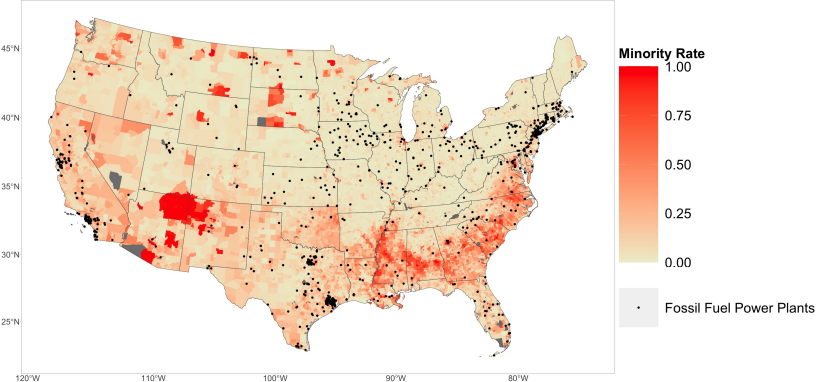
A census tract-by-year data set that covers all new fossil fuel power plants (sited between 2010 and 2019) in the contiguous U.S.

- Power Plant Data: Electric Generator Inventory (EIA-860 Form) data from U.S. Energy Information Administration (EIA).
- Socioeconomic Data: American Community Survey (ACS) 5-year estimates at census tract level.
- Weather Data: Parameter–elevation Regressions on Independent Slopes Model (PRISM, <http://prism.oregonstate.edu>)

The data covers 72,040 census tracts. There are 818 new fossil fuel power plants sited in 367 census tracts between 2010 and 2019.

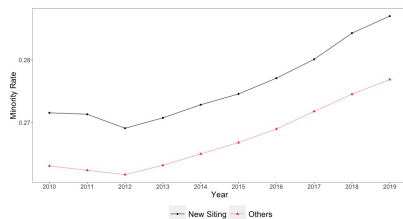
Data Description

Figure 1: Fossil Fuel Power Plants Siting Location, 2010 – 2019

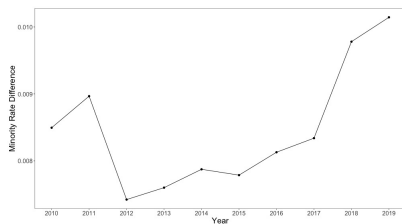


Data Description

Figure 2: Minority Rate Trend in Census Tracts with/without New Fossil Fuel Power Plants, 2010 – 2019



(a) Trends



(b) Differences

Hypotheses

- Fossil fuel power plants are more likely to be sited around minority communities
- Due to the opposite migration directions between white and minority households, local minority ratios increase after the siting of fossil fuel power plants.

Empirical Analysis: Disparate Siting

Logistic regression to analyze siting decision:

$$\text{Logit}(y_{it}) = \alpha + \beta M_{it} + \gamma X_{it} + \varepsilon_{it}, \quad (1)$$

- y_{it} : Binary siting outcome
- M_{it} : Minority ratio
- X_{it} : Covariates, industrial, socio-economic, and weather characteristics
- ε_{it} : Random error term

Empirical Analysis: Disparate Siting

Table 1: New Fossil Fuel Power Plant Siting

	<i>Dependent variable:</i>				
	New Fossil Fuel Power Plant Siting Dummy				
	(1)	(2)	(3)	(4)	(5)
Minority Ratio	0.3507* (0.1946)	0.6968*** (0.2049)	0.8463*** (0.2364)	0.8961*** (0.2679)	0.8864*** (0.2691)
Population Density (per KM^2)		-0.0001*** (0.00003)	-0.0002*** (0.00003)	-0.0003*** (0.00004)	-0.0002*** (0.00004)
Industrial Covariates	X	X	X	X	X
Socioecon. Covariates			X	X	X
Weather Covariates			X	X	X
State FE				X	X
Year FE					X
Observations	719,349	719,297	708,082	708,082	708,082

Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Empirical Analysis: Post-siting Migration

Event study regression to analyze post-siting migration:

$$q_{it} = \sum_{\tau=-9}^{-2} \eta_{\tau} \mathbf{I}[t - t_i^s = \tau] + \sum_{\tau=0}^9 \eta_{\tau} \mathbf{I}[t - t_i^s = \tau] + \gamma X_{it} + \mathbf{Group}_i + \mathbf{Year}_t + \varepsilon_{it} \quad (2)$$

- q_{it} : Minority ratio/white population/minority population
- t_i^s : Siting years of new fossil fuel power plants
- X_{it} : Covariates, industrial, socio-economic, and weather characteristics
- ε_{it} : Random error term

All census tracts are separated into two groups: with/without new siting.

Empirical Analysis: Post-siting Migration

Diff-in-diff regression to analyze post-siting migration:

$$q_{it} = \delta D_{it} + \gamma X_{it} + \mathit{Group}_i + \mathit{Year}_t + \varepsilon_{it} \quad (3)$$

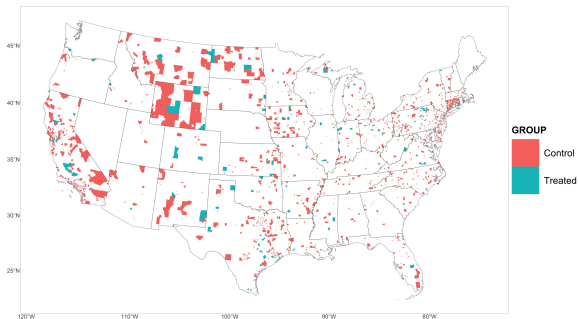
- q_{it} : Minority ratio/white population/minority population
- D_{it} : Siting treatment dummy
- X_{it} : Covariates, industrial, socio-economic, and weather characteristics
- ε_{it} : Random error term

All census tracts are separated into two groups: with/without new siting.

Empirical Analysis: Post-siting Migration

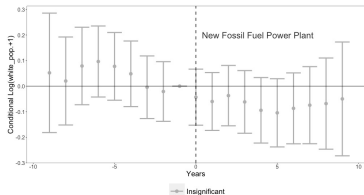
Sample selection: use propensity score matching to select the top 10 best control census tracts with replacement.

Figure 3: The Treated and Control Census Tracts in the Propensity Score Matched Sample

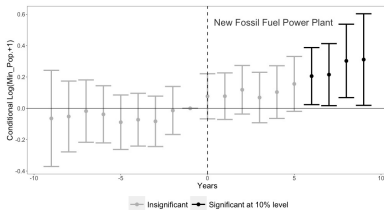


Empirical Analysis: Post-siting Migration

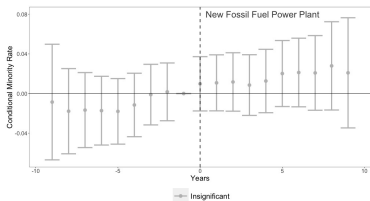
Figure 4: Post-Siting Demographic Changes, Population by Races



(a) White Population



(b) Minority Population



(c) Minority Rate

Empirical Analysis: Post-siting Migration

Table 2: The Impact of New Fossil Fuel Power Plant Siting on Local Racial Composition, a Difference-in-differences Analysis

	<i>Dependent variable:</i>		
	minority rate (%)	log(white_pop.+1)	log(min_pop.+1)
	(1)	(2)	(3)
New Siting (Treatment) Dummy	0.0211*** (0.0073)	-0.0919*** (0.0294)	0.1663*** (0.0386)
Industrial Covariates	X	X	X
Socioecon. Covariates	X	X	X
Weather Covariates	X	X	X
Group and Year FE	X	X	X
Observations	33,266	33,266	33,266
Adjusted R ²	0.2963	0.1210	0.2867

Note: *p<0.1; **p<0.05; ***p<0.01.

Empirical Analysis: Post-siting Migration

Robustness Check:

- Alternative geographical matching by county: quantitatively similar results
- Standard errors clustered at county level: more significant in event study, less significant in diff-in-diff.
- Staggered Treatment [Sun and Abraham \(2021\)](#)'s estimates: quantitatively similar results, more significant in event study, less significant in diff-in-diff.

Conclusion

- New fossil fuel power plants are more likely to be sited in census tracts with a higher minority ratio.
- New fossil fuel power plant siting increases local minority ratio increased by 2.1%, with a 9.2% out-migration of white populations and a 16.6% in-migration of minority populations.
- The paper provides empirical evidence that both disparate siting and post-siting migration exist and simultaneously cause environmental injustice across races.

Thank you!

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