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Behind Environmental Injustice: Disparate Siting and Post-Siting Migration of Fossil Fuel Power Plants

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Abstract

Environmental injustice can be explained by two mechanisms: the disproportionate siting of polluting industries in low-income and minority communities, and demographic changes following the establishment of toxic sites. This paper investigates fossil fuel power plant siting decisions and the subsequent demographic changes in the context of environmental injustice. Using census tract level data from the United States between 2010 and 2019, we find that fossil fuel power plants are more likely to be located in areas with higher minority populations, and leads to more than 2.5 percentage points increase in the local minority share.

Key words: Environmental Justice, Fossil Fuel Power Plant, Siting, Migration

* All remaining errors and omissions are our own.

1 Introduction

As the global energy landscape undergoes a profound transition toward decarbonization, the socio-technical impacts of existing and new energy infrastructure remain a critical concern for sustainable development. Socioeconomic disparities in exposure to environmental externalities from energy production continue to be a persistent and significant challenge in the United States (Colmer et al., 2020). Decades of empirical research have documented that minority and low-income communities bear a disproportionate share of pollution burdens, particularly from fossil fuel power facilities, one of the major point sources that significantly degrade local environmental quality (Bullard, 1983; Banzhaf et al., 2019b; Colmer et al., 2020). This pattern of environmental injustice has endured since the 1980s, persisting despite evolving regulatory frameworks and intensified government efforts to mitigate racial and spatial inequalities in environmental outcomes (Bullard, 1993). These disparities are not only morally and ethically troubling but also associated with serious health and economic consequences for the affected populations.

In the context of power plant life-cycle management and urban energy planning, understanding the mechanisms behind this inequity is essential for designing effective and equitable policy interventions. As conceptualized by Banzhaf et al. (2019b), two primary channels drive environmental injustice: disparate siting and post-siting migration. Disparate siting refers to the tendency for polluting facilities to be located in minority and disadvantaged communities, often due to lower land acquisition costs, proximity to infrastructure, weaker political resistance, or historical patterns of segregation (Been, 1994; Hamilton, 1995; Banzhaf et al., 2019a). Conversely, post-siting migration captures the demographic sorting that occurs after a facility becomes operational: White or high-income households often possess the mobility to relocate away from the disamenity, while minority or lower-income households may remain or move in due to shifting housing market dynamics and job opportunities (Stretesky and Hogan, 1998; Crowder and Downey, 2010).

While these mechanisms are conceptually well-established, there is a notable scarcity of empirical work that quantifies both channels within a unified, high-resolution framework (Pastor et al., 2001). Previous studies have frequently relied on coarse county-level data or historical datasets that may not reflect contemporary energy market dynamics (Clay et al., 2026). This paper addresses this gap by providing new census-tract-level evidence on both mechanisms by examining the siting of fossil fuel power plants in the United States from 2010 to 2019. This period is especially relevant, as it follows major environmental justice initiatives and coincides with continued debates over energy transition and the unequal distribution of its burdens.

Our empirical analysis yields several key findings. First, we find that new fossil fuel power plants are significantly more likely to be sited in census tracts with higher minority population shares, even after controlling for a wide range of socioeconomic, geographic, and infrastructure characteristics. This confirms that disparate siting remains a contemporary issue, not merely a historical artifact. Second, we estimate the effects of power plant siting on local demographics. On

average, the local minority share increases about 2.5 percentage points after a plant is sited, driven by a 16-17% increase in minority population and a 9-14% decline in White population. These patterns suggest that demographic sorting plays a significant role in amplifying racial disparities in pollution exposure. To the best of our knowledge, this is the first study to provide combined evidence of both siting and post-siting migration mechanisms in the U.S. energy sector using recent data and census tract level geographic resolution. By quantifying how firms' location decisions and individuals' migration responses jointly shape environmental inequity, our findings illustrate that plant siting is not an isolated event influencing environmental justice, but the initiator of a long-term socio-environmental trajectory.

The remainder of the paper is structured as follows. Section 2 provides a conceptual framework and reviews related literature. Section 3 details the empirical strategies. Section 4 describes the data sources and presents summary statistics. Section 5 presents the main results. Section 6 discusses policy implications. Section 7 concludes.

2 Conceptual Perspective and Literature

2.1 Siting: Polluting Plants Location Selection

The selection of polluting industrial plant sites, including fossil fuel power plants, is primarily determined by the operating costs, including production costs, transportation costs, and abatement costs (Wolverton, 2009). Specifically, production cost depends on factors such as land rents, labor costs, and the cost of raw or intermediate materials; transportation costs are associated with the distance required to deliver products to targeted markets; and abatement costs depend on local government regulation stringency as well as public pressure (Lyon and Maxwell, 1999, Bi and Khanna, 2012, Zhang and Khanna, 2024). Operating costs are strongly correlated with the socioeconomic characteristics of local communities: disadvantaged communities are more likely to be areas with lower costs of land, labor, and materials (Been, 1994, Hamilton, 1995, Banzhaf et al., 2019b). In addition, disadvantaged communities tend to have less public pressure to reduce pollution because local residents typically have a lower willingness to pay for environmental amenities, inadequate information about pollution damage, and limited capacity for collective action and Coasian bargaining against polluting industries (Depro et al., 2015; Hamilton, 1995; Shapiro, 2005; Banzhaf et al., 2019a). Therefore, polluting facilities are more likely to site in disadvantaged communities, leading to higher pollution exposure for local underrepresented residents.

There is a large literature examining the disparities in the siting of polluting facilities, consistently documenting that they tend to be located in communities with higher shares of disadvantaged residents. Early work by Bullard (1983) highlighted that solid waste sites in Houston were disproportionately sited in African American neighborhoods, laying the foundation for the concept of environmental racism. Subsequent studies extended this insight across regions and facility types.

For example, Saha and Mohai (2005) analyzed hazardous waste facilities in Michigan and found persistent racial and socioeconomic disparities in siting decisions between 1950 and 1990. More recently, McCoy (2017) provided evidence that coal-fired power plants were more likely to be sited in minority communities, reaffirming the continuation of these patterns into the modern energy sector.

2.2 Sorting: Post-siting Residential Migration

Environmental emissions from polluting facilities degrade local environmental quality, which in turn influences residential mobility and community demographics. Households' decisions to stay or relocate in response to changes in environmental quality depend on not only individual preferences but also socioeconomic constraints such as income, job opportunities, and housing costs. Disadvantaged households may face greater constraint when considering moving away from pollution sources, a phenomenon sometimes described as being "stuck with the nuisance". In some cases they may even "move toward the nuisance", drawn by lower housing costs since proximity to pollution may reduce property values and rents, or by employment opportunities tied to polluting industries.

A growing body of literature models these dynamics through residential location sorting frameworks. For example, Bayer et al. (2009) and Klaiber and Phaneuf (2010) show that environmental quality is a key factor in household location decisions, and that individuals sort themselves into neighborhoods based on both preferences and constraints. Depro et al. (2015) find a racial gap in the willingness to pay (WTP) for clean air, with White households having higher WTP to avoid polluted areas, contributing to increasing racial disparities in environmental exposure. Relatedly, Melstrom and Mohammadi (2022) show that minority residents are more likely to leave areas where environmental quality improves, potentially due to the associated increases in housing prices or neighborhood gentrification.

Despite strong theoretical support for post-siting demographic changes, empirical evidence remains mixed. Some studies, such as Pastor et al. (2001) and Hunter et al. (2001), do not find significant changes in local minority share following the siting of polluting facilities. Other research, such as Stretesky and Hogan (1998) and Crowder and Downey (2010), provide evidence that White households are more likely to move away from areas near polluting facilities, whereas minority households are less mobile or more likely to remain. These mixed findings suggest that the demographic effects of pollution siting may be context-dependent and vary across time periods, facility types, and geographic scales. Our study contributes to this literature by providing recent, census tract-level evidence on post-siting migration patterns in the context of fossil fuel power plant sitings across the U.S. from 2010 to 2019.

2.3 Comprehensive Analysis on Both Siting and Sorting

There is limited empirical work that jointly analyzes both disparate siting and post-siting demographic changes as mechanisms driving environmental injustice. Mohai et al. (2009) and Banzhaf et al. (2019b) provide theoretical frameworks and qualitative reviews of these two channels, emphasizing their interplay in producing unequal pollution exposure. However, few studies quantify both mechanisms in a unified empirical framework. Pastor et al. (2001) investigated siting and migration around toxic storage facilities in Los Angeles County. While their analysis raised important questions, it found no significant post-siting demographic shifts. Clay et al. (2026) studied the long-run impacts of fossil fuel power plant siting using county-level data from 1900 to 2020. While they focus on historical siting patterns and observe demographic shifts over several decades, they find little evidence of disparate siting by race.

To our knowledge, this is the first study to provide a comprehensive empirical analysis of both disparate siting and post-siting migration in the contemporary fossil fuel power generation industry, offering insight into how both channels interactively contribute to racial disparities in environmental exposure and demonstrating that these dynamics reinforce socioeconomic segregation at the census-tract level. Our findings complement and diverge from Clay et al. (2026) as our analysis targets a more recent period (2010–2019) at finer spatial resolution (census tracts), allowing us to identify both statistically significant racial disparities in siting decisions and immediate demographic changes following plant openings. A key advantage of focusing on a more recent decade rather than the long historical horizon studied in Clay et al. (2026) is that demographic changes over such long periods may partially reflect broader macroeconomic and social transformations, such as the Great Migration and the industrialization of northern U.S. cities that are potentially correlated with power plant siting, rather than direct responses to localized environmental changes; for example, observed increases in the Black population following plant siting in some counties may have been driven by the growth of regional employment opportunities or large-scale domestic migration trends during the early and mid-20th century, introducing potential confounding factors that complicate the interpretation. By focusing on the post-2010 period, our analysis is less susceptible to such large-scale migration events and also benefits from increasing social awareness of environmental amenities and environmental justice, enabling us to better isolate the effects of local environmental conditions on demographic shifts. Our results therefore provide cleaner evidence that fossil fuel power plant siting plays an important role in shaping local racial composition through post-siting migration. Taken together, our study and Clay et al. (2026) highlight the importance of examining both long-run historical processes and contemporary dynamics to fully understand the persistence of environmental injustice.

3 Empirical Method

3.1 Siting

To examine power plants' location decisions, we estimate the following logistic regression model:

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

where $y_{it} = 1$ if a new fossil fuel-fired power plant is sited in census tract i in year t and $y_{it} = 0$ otherwise. M_{it} is the minority share, X_{it} is a vector of control variables, and ε_{it} is the error term. According to the literature, locations chosen for new fossil fuel power plant siting are primarily associated with local socioeconomic characteristics, including population density, income per capita, education level, median housing values, and weather, in addition to newly retired electricity capacity and current electricity capacity. We construct corresponding variables from data and include them in the covariate set X_{it} to isolate the influence of minority share on siting decisions β.

3.2 Sorting

To estimate the impact of new fossil fuel power plants on local racial composition, we exploit temporal variation in plant establishment and local demographics. Specifically, we compare changes in demographics between two groups of census tracts: those that experienced at least one new fossil fuel plant opening during the study period (2010–2019), and comparable census tracts with no new plant openings during the same period. We begin with a baseline longitudinal regression model with fixed effects:

$$q_{it} = \delta D_{it} + \gamma X_{it} + \zeta \, Group_i + \, Year_t + \varepsilon_{it} \tag{2}$$

where q_{it} is the demographic characteristics of census tract i in year t. Here we use three different outcome variables to measure demographics to cross-validate the robustness of our results: minority population, White population, and minority share. D_{it} is the treatment dummy. X_{it} includes a set of covariates similar to siting regression equation 1. $Group_i$ is a dummy variable capturing cross-sectional difference between the two groups of census tracts, with $Group_i = 1$ if census tract i has at least one new fossil fuel power plant established during 2010–2019 and $Group_i = 0$ otherwise. $Year_t$ denotes the time fixed effects, and ε_{it} is the residual. The parameter of interest in the model (2) is δ that captures the before-after siting differences in the demographic characteristics between census tracts with and without new siting of fossil fuel power plants.

To explore the more detailed time dynamic of post-siting demographic changes, we consider the following extended model:

$$q_{it} = \sum_{\tau=-9}^{-2} \eta_\tau \mathbf{I}[t - t_i^s = \tau] + \sum_{\tau=0}^{9} \eta_\tau \mathbf{I}[t - t_i^s = \tau] + \gamma X_{it} + \zeta \, Group_i + \, Year_t + \varepsilon_{it} \tag{3}$$

where t_i^s is the year in which a new plant is sited in census tract i. For census tracts that do not have a plant during the sample period, we set $t_i^s = \infty$. τ is the difference in years between year t and the siting year t_i^s. $\mathbf{I}[t - t_i^s = \tau]$ is the indicator function, which equals 1 if the condition in the bracket is satisfied and 0 otherwise. η_τ capture the conditional changes in demographic composition τ years before or after a siting, relative to tracts without any siting and after partialling out covariates and fixed effects. The full sequence of η_τ traces out the dynamic pre- and post-siting trends. We set years when $t_i^s = -1$ as the reference time to normalize the cross-sectional difference between census tracts, so η_{-1} is omitted from the regression.

4 Data

We construct a census tract level dataset covering all fossil fuel power plants in the contiguous U.S. from 2010 to 2019. Compiled from multiple data sources, the dataset includes annual information on census tract socioeconomic characteristics, weather, and the total capacity of new, existing, and retired fossil fuel power plants.

4.1 Data Sources

We obtain fossil fuel power plant data from the Electric Generator Inventory by the U.S. Energy Information Administration (EIA). The data is collected from EIA-860 form, a survey form including generator-level information for new, existing, and retired generators with 1 megawatt or greater of combined nameplate capacity. The dataset includes power plant locations, energy sources, electricity generation capacities, operation start years, and retirement years. We aggregate the generator-level data to the plant level and select fossil fuel power plants based on whether their energy sources are coal, petroleum, or natural gas. According to the data, a total of 3,898 fossil fuel power plants ever operated in the contiguous U.S., among which 1,479 plants were retired by 2019, and 818 are newly established between 2010 and 2019. Figure 1 plots the locations of these newly established fossil fuel power plants, which are mostly located around major metropolitan areas in California, Texas, and the Northeastern region.

We obtain the annual socioeconomic data from American Community Survey at the census tract level, including per capita income, high school graduate rate, population, and racial composition. We also use census tract geographical data from the U.S. Census Bureau to calculate population density. The socioeconomic data covers 71,958 census tracts across 3,108 counties in the contiguous U.S. (lower 48 states and Washington D.C.).

Since weather is closely related to energy consumption and may affect power plant siting, we collect annual temperature data from Parameter–elevation Regressions on Independent Slopes Model (PRISM), a spatial climate database (http://prism.oregonstate.edu). PRISM data are available at a 4 km^2 spatial resolution, which can be aggregated to various geographical units.

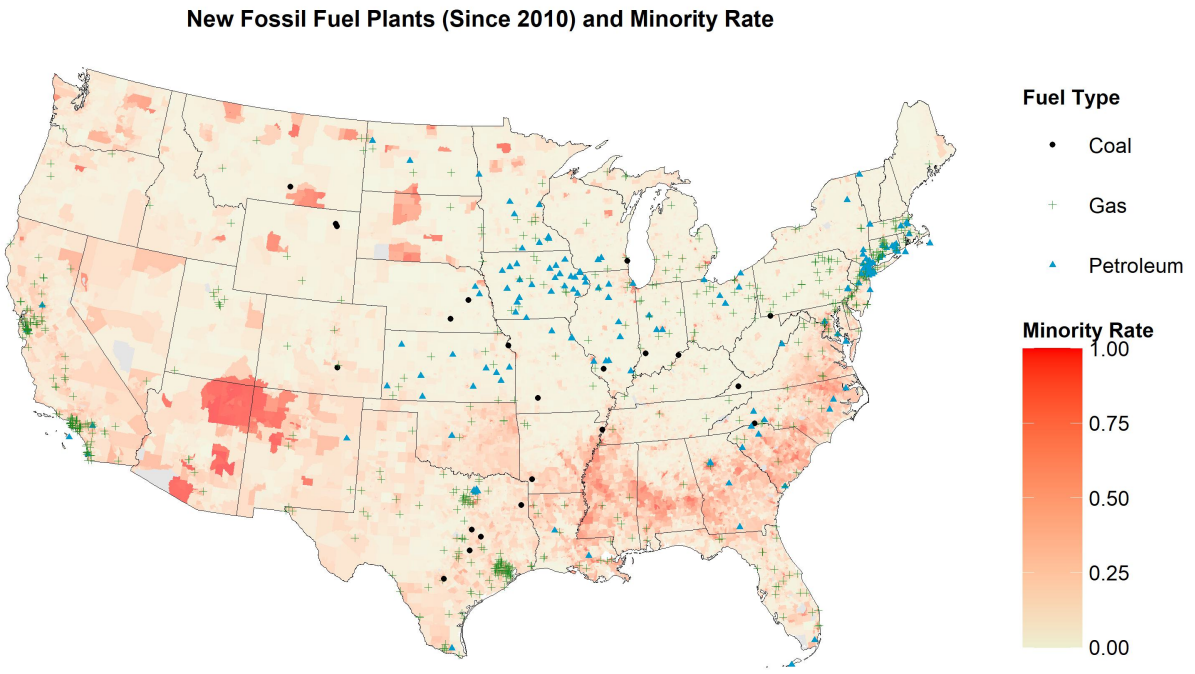


Figure 1: Fossil Fuel Power Plant Siting Locations, 2010–2019

Note: This map shows the locations of new fossil fuel power plants (coal, gas, and petroleum) built from 2010 to 2019, overlaid on census tracts shaded by minority population share from 2010. Coal plants are shown as black dots, gas plants as green crosses, and petroleum plants as blue triangles. Darker red areas indicate higher minority share.

Following Zhang et al. (2023), we aggregate the grid-level temperature data to the census tract level using a weighted average, where the weight is determined by the overlapping area between census tracts and grids.

4.2 Matched Sample

For the sorting analysis, we construct a matched sample using propensity score matching (PSM) (Rosenbaum and Rubin, 1983) to ensure that census tracts with and without new fossil fuel power plants are comparable and do not systematically differ in ways related to their demographic trends over time. Specifically, we estimate each census tract's propensity score (the predicted likelihood of a new fossil fuel power plant being sited) at yearly basis, using the logistic regression in equation (1) from the siting analysis. For each census tract that received a new fossil fuel power plant in a given year, we match it to the ten tracts without any new plant whose propensity scores in the same year are closest to that of the sited census tract.

As an alternative matching strategy, we construct a different matched sample focused on census tracts within the same geographic areas. Specifically, we retain the original set of sited census tracts but redefine the comparison group to include census tracts located in the same county as each sited tract. This is a reasonable matched sample because census tracts within the same county are likely to share similar demographic, economic, and social characteristics that are key determinants of local racial composition. This approach reduces confounding and improves the comparability of sited and unsited tracts with respect to the outcome variable.

4.3 Descriptive Statistics

Unmatched Sample The unmatched full sample is used in the siting analysis. Table 1 summarizes key variables for all census tracts, as well as for those with and without new siting of fossil fuel power plants between 2010 and 2019. It shows that new fossil fuel power plants are more likely to be located in census tracts with relatively higher minority populations, lower population density, lower educational attainment, lower housing values, and lower temperatures. Additionally, new fossil fuel power plants tend to be sited in areas that already have large fossil fuel power plants. Notably, new fossil fuel power plants are also more likely to be sited in census tracts with relatively higher income per capita, which is probably because of the positive association between local energy consumption (which influences new plant siting probability) and economic development (which is associated with higher income).

Figure 2a plots the annual trend in racial composition. In general, there is an increase in the minority share across all census tracts. However, as shown in Figure 2b, the minority share is relatively higher in census tracts with new siting of fossil fuel power plants, and their increase in minority share is also relatively faster.

Matched Sample The matched samples are used in the sorting analysis to ensure a balanced comparison between census tracts with and without new fossil fuel power plant sitings. Table 2 summarizes the characteristics of the two matched samples. After matching, census tracts with and without new siting of fossil fuel power plants exhibit similar socioeconomic profiles across both the propensity score and within-county matching strategies, indicating improved comparability between groups. Differences in minority population share remain small, consistent with evidence of racial disparities in siting even after accounting for observable covariates. These balanced samples provide a stronger basis for the subsequent regression analyses examining siting determinants.

The geographical distribution of the two matched samples are plotted in Appendix Figures A2 and A3, respectively. The two figures share the same group of census tracts with new fossil fuel power plants (in teal), which appear somewhat clustered in the Southwest, Midwest, and along the East Coast. Figure A2 shows the spatial distribution of the propensity score matched sample, where matched census tracts without new siting (in red) are dispersed relatively more widely.

Table 1: Summary Statistics before Matching

Variable	Full Sample	New Siting Census Tracts	Other Census Tracts
Minority Rate	0.2675	0.2759	0.2674
	(0.2525)	(0.2305)	(0.2526)
Current Elec. Cap. (MW)	12.3333	224.1702	11.2470
	(134.4152)	(535.6579)	(128.2881)
Newly Retired Elec. Cap. (MW)	0.1367	2.5661	0.1243
	(11.4675)	(51.8936)	(10.8785)
Population Density (1,000 per KM^2)	2.0416	1.2635	2.0456
	(4.5591)	(3.1010)	(4.5650)
Income per Capita ($1,000)	29.4086	30.4661	29.4032
	(0.1132)	(0.1104)	(0.1132)
High School Grad. Rate	0.8579	0.8557	0.8579
	(0.1132)	(0.1104)	(0.1132)
Median Housing Value ($10,000)	23.6149	23.5990	26.7850
	(20.0420)	(20.0300)	(22.0774)
Min. Temperature (℃)	8.7882	8.3762	8.7903
	(4.6670)	(4.6681)	(4.4194)
Max. Temperature (℃)	19.9026	19.4814	19.9048
	(4.8878)	(4.5309)	(4.8895)
Number of Census Tracts	72,040	367	71,673
Number of Observations	719,349	3,670	715,679

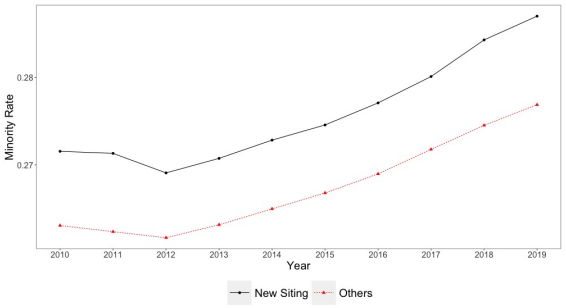
Note: Column "New Siting Census Tracts" reports the statistics of all census tracts with newly established fossil fuel power plants between 2010 and 2019, regardless of participating year. Column "Other Census Tracts" reports the statistics of all census tracts that do not have newly established fossil fuel power plants between 2010 and 2019. Current and newly Retired Capacities are only fossil fuel power plants. *p<0.1; **p<0.05; ***p<0.01.

Figure A3 shows the within-county matched sample, which improves geographic comparability and absorbs unobserved county-level factors (e.g., energy policy, zoning laws, or political environment). Together, these two matched samples allow us to test the robustness of our findings to different identification strategies.

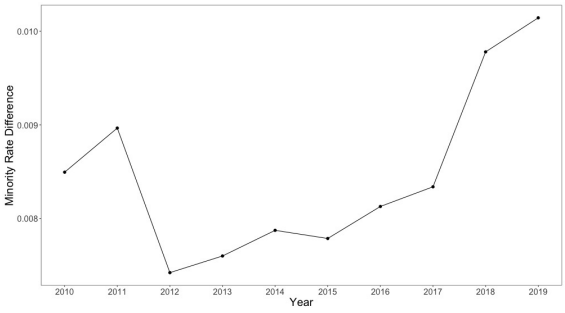
5 Results

5.1 Siting

Formal regression results from five model specifications based on logistic regression equation 1 but with different control variables and fixed effects are reported in Table 3. The coefficient on the census tract's minority share is positive and statistically significant across all model specifications. This implies that even after controlling for factors like income, education, and existing power infrastructure, tracts with higher minority shares were more likely to be chosen for new fossil fuel power plants, minority residents continue to bear a disproportionate burden of exposure to new



(a) Separate Trends of Census Tract Minority Shares with/without New Siting, Respectively



(b) Difference between Census Tracts with/without New Siting

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

pollution sources. Besides race, other factors emerge as significant predictors of siting: new plants are more likely to be located in areas with an existing cluster of power generation (i.e. greater current capacity or recently retired capacity) and in areas with lower population density and cooler climate. The relationships with income and education are less precisely estimated, but generally align with expectations that firms prefer sites with potentially less community pushback, which often correlate with lower-income, lower-education areas. Interestingly, median housing value is positively associated with siting probability, which may be driven by the confounding correlation between housing values and unobserved factors such as economic activity and infrastructure.

These findings take on particular salience in the context of contemporary energy transition policies. As shown in Appendix Figure A1, the post-2010 period witnessed a structural shift in the U.S. power sector, characterized by accelerated coal retirements and a major expansion of natural gas facilities. Our empirical results reveal that this modern expansion of cleaner burning infrastructure still followed legacy siting pathways, systematically gravitating toward areas with higher baseline minority representation. Taken together, these findings underscore the role of firm siting decisions in creating environmental injustice: polluting facilities continue to be preferentially sited in minority neighborhoods.

5.2 Sorting Effects

Table 4 reports baseline estimates of regression equation 2 for the PSM and within-county matched samples, with the White population, minority population, and minority share as outcomes. New sitings of fossil fuel power plants are associated with a decline in the local White population and a corresponding rise in the minority population. The coefficient on the new-siting indicator is -0.0919 (s.e. 0.0547, $p < 0.10$) in the PSM sample and -0.1366 (s.e. 0.0603, $p < 0.05$) in the county-matched sample, implying a 9–14% reduction in the local White population after the siting of a fossil fuel power plant. The estimates for the minority population are positive and of comparable magnitude,

Table 2: Summary Statistics

	Propensity Score Matched Sample		County Matched Sample	
	New Siting Census Tracts	**Other Census Tracts**	**New Siting Census Tracts**	**Other Census Tracts**
Minority Population	1451.386	1250.236	1415.106	1552.805
	(1898.779)	(1267.190)	(1864.353)	(1424.530)
White Population	3597.174	3137.432	3449.329	2864.081
	(1959.218)	(1901.373)	(2015.982)	(1888.231)
Minority Rate	0.269	0.288	0.276	0.362
	(0.229)	(0.256)	(0.231)	(0.273)
Income Per Capita	30.550	31.588	30.449	32.145
	(15.733)	(16.385)	(17.351)	(19.032)
High School Grad. Rate	0.856	0.860	0.855	0.841
	(0.107)	(0.114)	(0.112)	(0.134)
Median Housing Value ($10,000)	26.782	30.268	26.784	34.836
	(22.015)	(25.855)	(22.074)	(26.560)
Current Elec. Cap. (MW)	232.526	118.867	236.588	6.587
	(545.491)	(484.198)	(564.961)	(94.189)
Newly Retired Elec. Cap. (MW)	2.669	1.043	2.703	0.082
	(53.055)	(39.683)	(52.601)	(7.864)
Population Density (1,000 per KM^2)	1.210	1.482	1.240	4.277
	(3.122)	(2.844)	(3.077)	(7.384)
Max. Temperature (℃)	19.482	19.508	19.515	19.852
	(4.584)	(4.489)	(4.513)	(4.400)
Min. Temperature (℃)	8.309	8.401	8.451	9.241
	(4.471)	(4.233)	(4.421)	(3.756)
Number of Census Tracts	3,338		22,235	
Number of Observations	33,375		222,860	

Notes: Standard deviations are reported in parentheses.

at 0.1663 (s.e. 0.0883, $p < 0.10$) in the PSM sample and 0.1580 (s.e. 0.0853, $p < 0.10$) in the county-matched sample, implying an increase of roughly 16-17% in the local minority population after a new plant is sited. Combining these two changes, the minority share rises by 2.11 percentage points in the PSM sample (s.e. 0.0155, not statistically significant) and by 2.65 percentage points in the county-matched sample (s.e. 0.0158, $p < 0.10$). The two matching strategies, one designed to balance on observable socioeconomic and infrastructure covariates, and the other designed to absorb unobserved county-level factors such as zoning policy and labor-market conditions, yield estimates that are statistically indistinguishable, suggesting that the result is not an artifact of either matching choice. However, the county-matched estimate, which leverages within-county variation across neighboring tracts, is somewhat larger in magnitude and more precisely estimated with higher statistical power and significance, consistent with the idea that comparing census tracts within the same labor and housing market sharpens the sorting signal. These baseline results are tested for robustness by estimating alternative regression models with different fixed effects; results are reported in Appendix Tables A1–A3. The results are generally consistent in sign and similar in magnitude, though with somewhat smaller coefficients and lower statistical significance as more fixed effects are added, suggesting that the fixed effects absorb some of the identifying variation while leaving the core findings robust.

Figure 3 plots the conditional annual trends in the same three racial composition outcomes before and after a new siting using both matched samples, estimated from equation 3. The top panel shows a clear decline in the White population in census tracts where new plants are sited.

Table 3: New Fossil Fuel Power Plant Siting

	Dependent variable:				
	New Fossil Fuel Power Plant Siting Dummy				
	(1)	(2)	(3)	(4)	(5)
Minority Ratio	0.3507*	0.6968***	0.8463***	0.8961***	0.8864***
	(0.1946)	(0.2049)	(0.2364)	(0.2679)	(0.2691)
Current Elec. Cap. (MW)	0.0014***	0.0014***	0.0015***	0.0016***	0.0016***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Newly Retired Elec. Cap. (MW)	0.0021***	0.0021***	0.0021***	0.0021***	0.0020***
	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)
Population Density (per KM^2)		−0.0001***	−0.0002***	−0.0003***	−0.0002***
		(0.00003)	(0.00003)	(0.00004)	(0.00004)
Income per Capita ($1,000)			−0.0117**	−0.0079	−0.0082
			(0.0059)	(0.0069)	(0.0070)
High School Grad. Rate			−0.6724	0.1933	0.2331
			(0.6453)	(0.6522)	(0.6559)
Median Housing Value ($10,000)			0.0219***	0.0052	0.0046
			(0.0031)	(0.0045)	(0.0045)
Max. Temperature (℃)			−0.0386	−0.1336***	−0.1359***
			(0.0279)	(0.0367)	(0.0372)
Min. Temperature (℃)			−0.0091	0.0932**	0.0813**
			(0.0295)	(0.0382)	(0.0385)
Constant	−7.7259***	−7.6668***	−6.4299***		
	(0.0774)	(0.0786)	(0.6751)		
State FE	N	N	N	Y	Y
Year FE	N	N	N	N	Y
Observations	719,349	719,297	708,082	708,082	708,082
Log Likelihood	−3,198.8008	−3,188.2782	−3,020.9643	−2,873.7231	−2,862.3509
Akaike Inf. Crit.	6,405.6016	6,386.5563	6,061.9287	5,863.4462	5,858.7017

Note: Current electricity capacity and newly retired electricity capacity are only for fossil fuel power plants. Newly retired electricity capacity is for all fossil fuel power plants that retired within the year. *p<0.1; **p<0.05; ***p<0.01

The downward pattern begins even before the siting year ($\tau = 0$), with coefficients estimated positive and stable from 9 to 4 years before siting and statistically significant for 5 and 6 years before siting. Based on the pattern, decline of white population seems to begin from 4 years before siting, suggesting that White households respond to early signals such as permitting, public announcements, or visible construction, and relocate in anticipation of the siting. By contrast, the middle panel shows that the minority population begins rising only at the year of siting: the coefficient turns positive at $\tau = 0$ and grows steadily over the post-siting period, reaching roughly 0.30 log points (approximately 35%) by $\tau = 9$. The bottom panel plots the minority share, which is similar to the trajectory of minority population: it drifts upward after siting by roughly 2–4 percentage points. Among all figures, the estimated pattern is strikingly similar across the PSM and within-county samples, indicating that the post-siting divergence is robust to alternative

comparison groups.

The spatial dispersion of our matching frameworks (Appendix Figures A2 and A3) offers distinct operational insights for land-use planners. While the macro-level matching captures generalized socioeconomic commonalities across regions, the within-county analysis restricts comparisons to localized real estate markets and shared institutional zoning constraints. The higher magnitude of demographic sorting observed within the county cohort (-0.1366 for White decline) suggests that environmental sorting operates at a hyper-local spatial scale, where households selectively adjust their locations across neighborhood boundaries within the same administrative jurisdiction.

Taken together, the static and dynamic estimates above point to consistent household location sorting results around fossil fuel power plant sitings: White households appear to relocate in anticipation of a plant's arrival, while minority in-migration after siting occurs and accumulates over the following decade. Similar patterns are documented in the residential-sorting literature: White households, who on average have higher willingness to pay for environmental quality and greater residential mobility (Depro et al., 2015), tend to relocate away from tracts that receive new pollution sources. The two responses are economically meaningful and are stable across both matching strategies, suggesting that the post-siting shift in racial composition reflects demographic change rather than an artifact of design choices or residual confounding.

Table 4: Sorting Effects

	Propensity Score Matched Sample			Matched by County		
Dependent Variables:	White	Minority	Minority Ratio	White	Minority	Minority Ratio
New Site	-0.0919*	0.1663*	0.0211	-0.1366**	0.1580*	0.0265*
	(0.0547)	(0.0883)	(0.0155)	(0.0603)	(0.0853)	(0.0158)
Income per Capita ($1,000)	0.0111***	-0.0244***	-0.0059***	0.0163***	-0.0189***	-0.0061***
	(0.0022)	(0.0030)	(0.0007)	(0.0023)	(0.0028)	(0.0006)
High School Grad. Rate	1.441***	-0.9326***	-0.4217***	0.5303	-0.7726**	-0.2486**
	(0.3264)	(0.3459)	(0.0942)	(0.3291)	(0.3654)	(0.0980)
Median Housing Value ($10,000)	-0.0036**	0.0156***	0.0030***	-0.0024	0.0084***	0.0020***
	(0.0016)	(0.0026)	(0.0006)	(0.0019)	(0.0024)	(0.0006)
Current Elec. Cap. (1,000 MW)	0.0895***	-0.2048***	-0.0405***	0.1885***	-0.1676**	-0.0596***
	(0.0293)	(0.0437)	(0.0076)	(0.0550)	(0.0675)	(0.0137)
Newly Retired Elec. Cap. (1,000 MW)	-0.2184	-0.2265	-0.0132	0.0185	-0.1363	-0.0449
	(0.2286)	(0.1560)	(0.0390)	(0.2829)	(0.2254)	(0.0565)
Population Density (1,000 per Squared KM)	-0.0236**	0.0788***	0.0149***	-0.0061	0.0348***	0.0066***
	(0.0115)	(0.0215)	(0.0047)	(0.0071)	(0.0046)	(0.0017)
Max. Temperature (C)	0.0748***	0.0498***	-0.0087**	0.1258***	0.0392***	-0.0163***
	(0.0161)	(0.0154)	(0.0038)	(0.0272)	(0.0143)	(0.0051)
Min. Temperature (C)	-0.0679***	0.0496***	0.0189***	-0.1185***	0.0344**	0.0246***
	(0.0162)	(0.0154)	(0.0041)	(0.0261)	(0.0156)	(0.0051)
Group Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	33,266	33,266	33,266	216,069	216,069	216,069
R^2	0.1215	0.2871	0.2967	0.1436	0.2578	0.2901
Within R^2	0.1167	0.2855	0.2961	0.1418	0.2551	0.2886

White and minority population are measured in logarithms; minority ratio is measured in levels. Clustered (County FIPS) standard errors in parentheses. Signif. Codes: *** p<0.01, ** p<0.05, * p<0.1.

6 Discussion

6.1 Anticipation Effects

A natural question regarding our baseline finding is why White out-migration begins before the year of siting while minority in-migration only starts after the plant is sited. One explanation is that different demographic groups respond at different points in the lifecycle of siting a new power plant. This is consistent with evidence that large energy infrastructure projects in the U.S. typically require multiple years for permitting and construction. For example, the Brookings "Eight facts about permitting and the clean energy transition" report finds that many energy generation projects historically took several years from first permitting milestone to completion (Bauer et al., 2024). Media and policy sources also estimate that a new gas power plant may take up to 4-5 years from proposal to full operation under current regulatory, supply chain, and construction conditions (Climate Reality Project, 2025). Furthermore, studies of environmental hazards (e.g., around Superfund sites) show that socio-demographic changes often begin well before full operation or remediation, hinting that households anticipate environmental disamenities (Cameron and McConnaha, 2005).

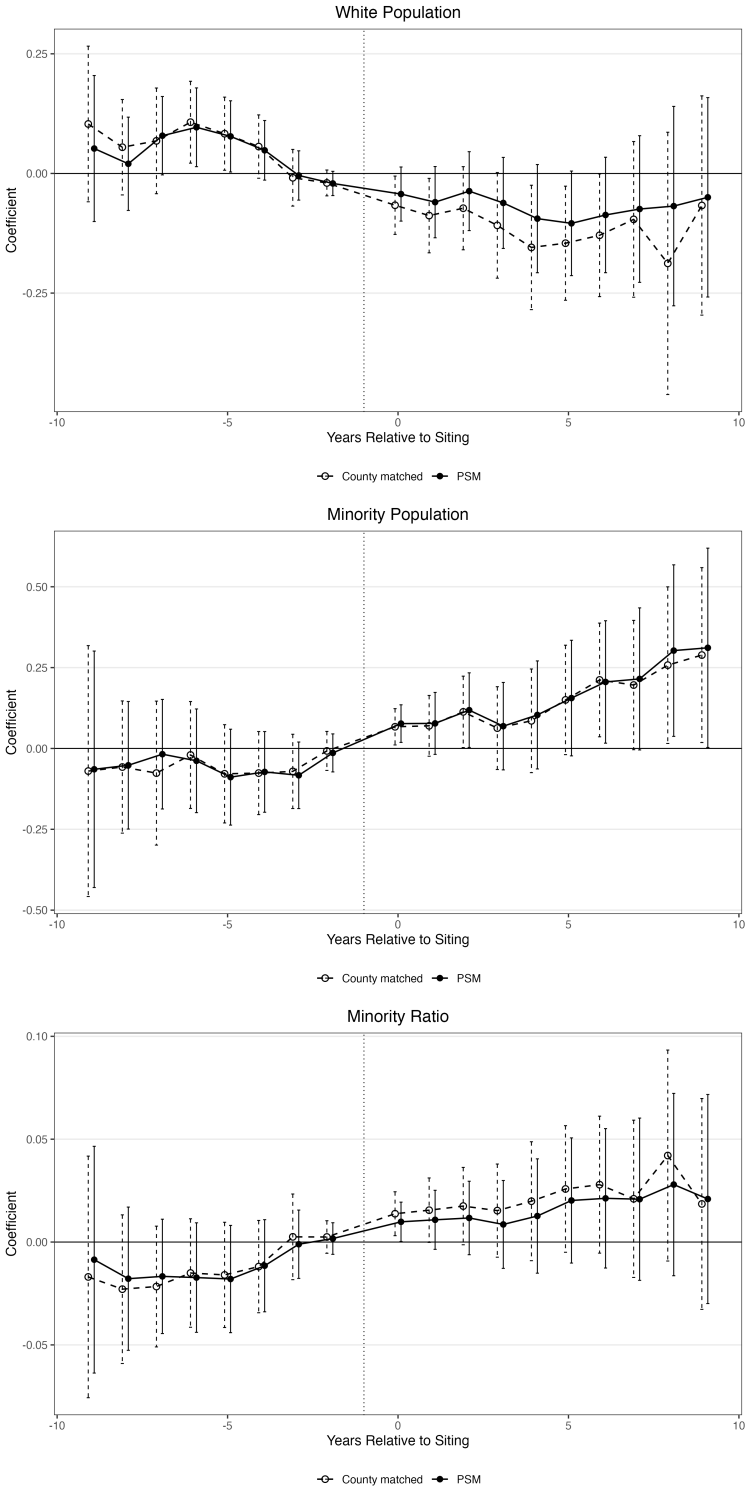
To account for potential anticipation effects and early responses in White out-migration, we shift the reference year to four years prior to the siting year. Regression results are reported in Table 5 and Figure 4. The coefficients of new siting on the White population outcome, reported in the first and fourth columns of Table 5, yield larger and more precisely estimated declines (-0.1122 in PSM, $p < 0.05$; -0.1495 in county-matched, $p < 0.01$). The corresponding dynamic trajectory estimates plotted in the upper panel of Figure 4 exhibit a flat trend in the years preceding the shifted reference year and an immediate decline thereafter, even including three pre-siting years. This pattern suggests that White out-migration begins approximately three years prior to the siting year, when prospective neighborhood disamenities associated with power plants become public information but the plant is not yet sited and operational. In contrast, the coefficients of new siting on the minority population outcome, reported in the second and fifth columns of Table 5, shrink slightly (0.1185 in PSM, 0.1217 in county-matched) and lose statistical significance. The corresponding dynamic trajectory estimates plotted in the middle panel of Figure 4 display a flat trend in the immediate post-period relative to the new reference year, followed by a more gradual ramp-up. This pattern is consistent with the absence of anticipatory in-migration among minority households during the permitting and construction phases of power plants. For the minority share outcome, shifting the reference year yields increases of 2.48 percentage points in the PSM sample and 3.01 percentage points in the county-matched sample ($p < 0.10$). The estimated dynamic trajectory of minority share in the lower panel of Figure 4 becomes noticeably steeper, changing from near zero in the years before the shifted reference year to roughly 4 percentage points above the control trajectory by year 13. The early rise in the years immediately following the shifted

reference year is primarily driven by the anticipatory out-migration of White households. Across all three outcomes, the estimates from the two matched data tell a broadly consistent story: census tracts that receive a new fossil fuel plant subsequently exhibit White population decline, faster minority population growth, and a modestly rising minority share relative to comparable control census tracts.

The corresponding robustness tests are reported in Appendix Tables A4–A6, where we again estimate alternative regression models with different fixed effects. The results are in general consistent across model specifications, especially for White population.

6.2 Interpretation and Caveats

To properly interpret our findings, three points are worth emphasizing. First, the migration pattern, which leads to a rising minority share in census tracts that host new fossil fuel power plants, is consistent across matching strategies and model specifications, and it aligns with the residential-sorting theory and empirical evidence documented in the literature (Depro et al., 2015; Crowder and Downey, 2010). Second, the absolute magnitudes of these demographic changes are sizable but should be interpreted with caution: the siting effects on White and minority populations are estimated with limited precision in the baseline specification, with many estimates showing statistical significance only at the 10% level. However, the dynamic estimates reveal persistent and more statistically significant effects over years, particularly in the PSM sample. Third, because the siting of fossil fuel power plants is not random, our analysis cannot fully rule out unobserved local factors that jointly influence siting decisions and demographic change, which could cause census tracts with and without new sitings imperfectly comparable. Nevertheless, the dynamic estimates exhibit fairly stable pre-siting demographic trends, suggesting that our matching strategies successfully select highly comparable census tracts. We therefore interpret our estimates as robust associations between new siting and local racial composition rather than causal effects on migration.



Note: Group and year fixed effects. Standard errors are clustered at the county level. Confidence intervals are plotted at 95% level.

Figure 3: Event Study Estimates of Differences in White, Minority, and Minority Ratio

Table 5: Sorting Effects

Effects Started from 4 Years Prior Siting

	Propensity Score Matched Sample			Matched by County		
Dependent Variables:	White	Minority	Minority Ratio	White	Minority	Minority Ratio
New Site (-4)	-0.1122**	0.1185	0.0248	-0.1495***	0.1217	0.0301*
	(0.0491)	(0.0927)	(0.0162)	(0.0534)	(0.0950)	(0.0161)
Income per Capita ($1,000)	0.0111***	-0.0244***	-0.0059***	0.0163***	-0.0189***	-0.0061***
	(0.0022)	(0.0030)	(0.0007)	(0.0023)	(0.0028)	(0.0006)
High School Grad. Rate	1.440***	-0.9333***	-0.4217***	0.5303	-0.7727**	-0.2486**
	(0.3267)	(0.3463)	(0.0942)	(0.3291)	(0.3654)	(0.0980)
Median Housing Value ($10,000)	-0.0036**	0.0156***	0.0030***	-0.0024	0.0084***	0.0020***
	(0.0016)	(0.0026)	(0.0006)	(0.0019)	(0.0024)	(0.0006)
Current Elec. Cap. (1,000 MW)	0.0883***	-0.2019***	-0.0402***	0.1829***	-0.1598**	-0.0585***
	(0.0292)	(0.0437)	(0.0076)	(0.0545)	(0.0677)	(0.0136)
Newly Retired Elec. Cap. (1,000 MW)	-0.2201	-0.2218	-0.0128	0.0111	-0.1248	-0.0436
	(0.2284)	(0.1567)	(0.0390)	(0.2830)	(0.2269)	(0.0566)
Population Density (1,000 per Squared KM)	-0.0237**	0.0789***	0.0149***	-0.0062	0.0348***	0.0066***
	(0.0115)	(0.0215)	(0.0047)	(0.0071)	(0.0046)	(0.0017)
Max. Temperature (C)	0.0748***	0.0499***	-0.0087**	0.1258***	0.0392***	-0.0163***
	(0.0161)	(0.0154)	(0.0038)	(0.0272)	(0.0143)	(0.0051)
Min. Temperature (C)	-0.0678***	0.0494***	0.0189***	-0.1185***	0.0343**	0.0246***
	(0.0162)	(0.0154)	(0.0041)	(0.0261)	(0.0156)	(0.0051)
Group Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	33,266	33,266	33,266	216,069	216,069	216,069
R^2	0.1214	0.2868	0.2966	0.1436	0.2577	0.2901
Within R^2	0.1166	0.2853	0.2960	0.1418	0.2551	0.2886

White and minority population are measured in logarithms; minority ratio is measured in levels. Clustered (County FIPS) standard errors in parentheses. Signif. Codes: *** p<0.01, ** p<0.05, * p<0.1.

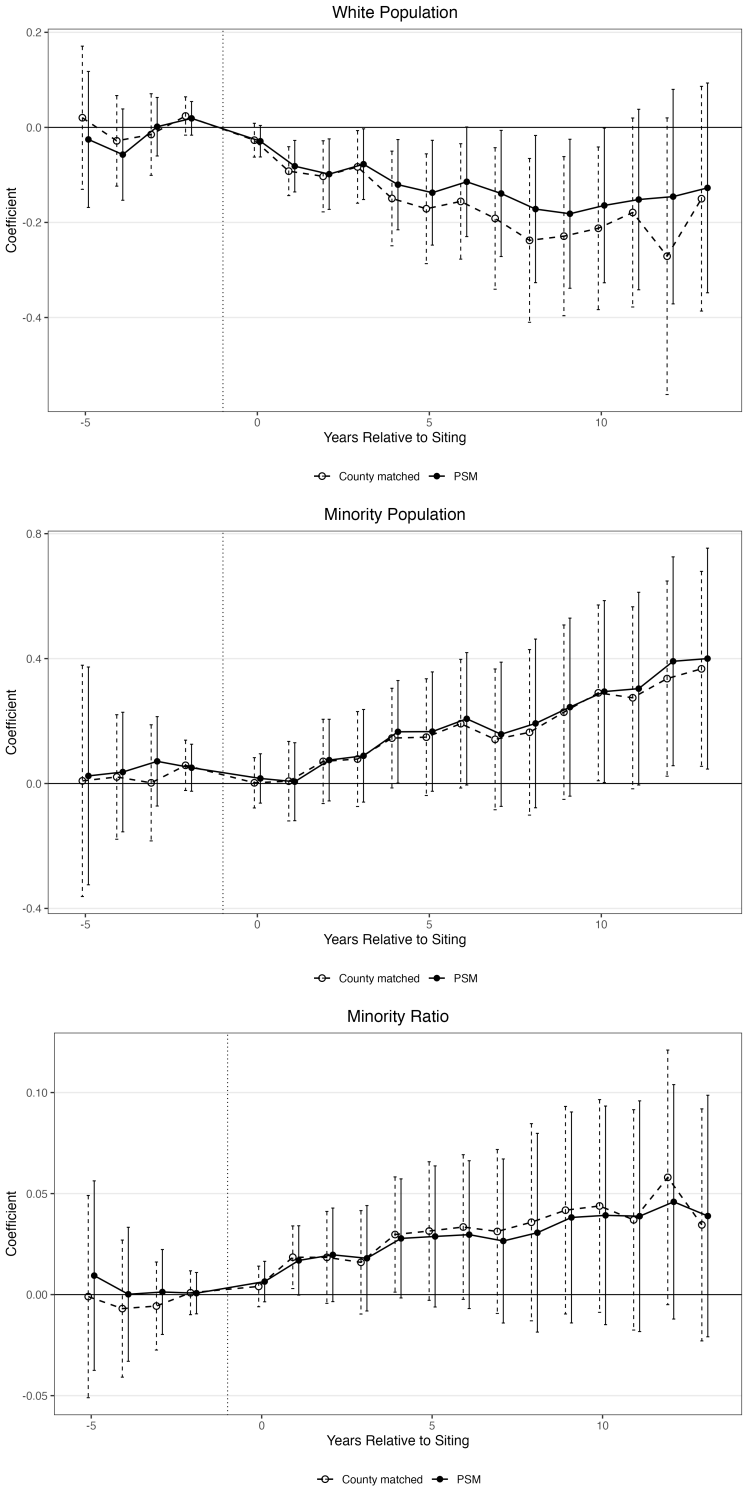
7 Conclusion

Understanding the mechanisms behind environmental injustice is essential for designing effective and equitable environmental policies. In this paper, we disentangle the sources of racial disparities in exposure to fossil fuel power plants into two distinct but interacting channels: (1) the disparate siting of polluting facilities by firms, and (2) post-siting migration patterns by individuals. Using high-resolution data that combines fossil fuel plant locations, census tract demographics, and weather conditions, we provide the first tract-level analysis of both mechanisms in the context of the U.S. power generation sector during 2010–2019.

We find clear evidence of disparate siting: fossil fuel power plants are significantly more likely to be located in census tracts with higher shares of minority residents, even after controlling for socioeconomic and geographic characteristics. This siting pattern reinforces concerns that marginalized communities continue to bear a disproportionate share of environmental burdens. Moreover, our regression analyses reveal strong post-siting demographic shifts. Within a few years after a new plant is sited, the minority population increases by 16-17%, while the White population decreases by 9-14%, resulting in about 2.5 percentage point increase in the minority share of the local population. These findings indicate that racial disparities in environmental exposure are not only the result of where polluting facilities are located, but also of who chooses (or is able) to live near them afterward. Such demographic sorting may stem from differences in income, housing market responses, occupational opportunities, or preferences for environmental quality.

Importantly, our analysis shows that environmental injustice is both a siting and a sorting problem. While siting reflects firm strategies that can be regulated through environmental justice review processes, migration reflects individual behavior that is more difficult to directly regulate. Policies targeting only firm siting decisions may thus be insufficient to mitigate long-term racial disparities in pollution exposure. To reduce these disparities, policy solutions should take a dual approach. First, strengthen environmental siting regulations that explicitly consider demographic distribution. Second, address housing affordability, school access, and employment opportunities in communities with high environmental quality to prevent segregation. Integrating environmental justice goals into zoning, housing, and public health policies may be essential to disrupt the reinforcing cycle of pollution and inequality.

Finally, this paper opens the door for future research to explore the heterogeneity in post-siting migration mechanisms, for example, examining how the magnitude of sorting varies by plant type, local housing market conditions, or baseline community characteristics. Longitudinal household-level data could further uncover whether sorting is driven by changes in household decisions or by cohort replacement, a process whereby existing residents gradually age out or relocate for unrelated reasons, and vacancies are subsequently filled by in-movers of different demographic backgrounds. Understanding these dynamics will be crucial for designing policies ensuring that environmental benefits and burdens are equitably shared, both now and in the decades to come.



Note: Group and year fixed effects. New Siting - 4; Standard errors are clustered at the county level. Confidence intervals are plotted at 95% level.

Figure 4: Event Study Estimates of Differences in White, Minority, and Minority Ratio Effects Started 4 Years Prior to Siting

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- sitingprojectAppendix.zip