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Pervasive racial and ethnic disparities in the U.S. petrochemical workforce

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ABSTRACT

The burden of petrochemical pollution on communities of Color is well established, but the corresponding distribution of economic benefits is unclear. We evaluated employment equity in chemical manufacturing (NAICS 325) and petroleum/coal products manufacturing (NAICS 324) among U.S. states and core-based statistical areas (CBSAs) relative to racial education gaps, using data from the Equal Employment Opportunity Commission and Census Bureau. As a case study, we also examined local-level employment disparities and industrial tax incentives in Louisiana. People of Color were consistently *underrepresented* among the *highest*-paying jobs and *overrepresented* among the *lowest*-paying jobs in both subsectors. Disparities persisted on a local scale, including in Louisiana parishes providing large tax subsidies for job creation. For both subsectors, the strongest predictor of disparities in better-paying jobs was population diversity. Education gaps were not significantly correlated with observed disparities in either subsector. Collectively, our findings reveal systemic inequality in the United States' petrochemical workforce. The observed disparities appear to reflect institutional racism and are not solely due to the racial education gap, as some have suggested. Regulators should consider that current approaches to industrial permitting, which typically ignore the distribution of economic benefits, are likely to perpetuate this pattern of racial injustice.

1. Introduction

Job creation is often cited by U.S. environmental regulators and pro-industry advocates as justification for the construction or expansion of petrochemical manufacturing facilities (e.g., DeBerry, 2021; Muller, 2023a), but it is not clear if these jobs are equitably distributed among racial or ethnic groups. Further, potential differences in petrochemical employment equity have not been explored at the state or metropolitan level. By contrast, a large body of research indicates that petrochemical manufacturing disproportionately and systemically harms low-income communities and Black, Hispanic, and Indigenous people in the U.S. (reviewed in Donaghy et al., 2023). These communities have been described as "sacrifice zones," where industrial pollution and the associated health impacts are concentrated, often as a product of systemic racism (Donaghy et al., 2023; Maraniss and Weisskopf, 1988; Mohai and Saha, 2015; Smyth and McCormick, 2023).

Disparities in petrochemical pollution are part of a larger pattern of environmental injustice that has been widely recognized for decades. People of Color in the U.S. are disproportionately exposed to common pollutants (Bell and Ebisu, 2012; Collins et al., 2022; Collins and Grineski, 2022; Colmer et al., 2020; Dressel et al., 2022; Kravitz-Wirtz et al., 2016; Lane et al., 2022; Liu et al., 2021; Tessum et al., 2021) as well as toxic chemicals (Ash and Boyce, 2018; Bullard et al., 2007; Donley et al., 2022; Hurbain et al., 2024; Zwickl et al., 2014). Race is a strong independent predictor of pollution disparities even with extensive controls for economic resources (Clark et al., 2017; Liu et al., 2021; Mikati et al., 2018; Mohai et al., 2009; Paolella et al., 2018) and despite overall air quality improvements (Colmer et al., 2020; Jbaily et al., 2022; Kravitz-Wirtz et al., 2016). Pollution disparities are not proportional to consumption patterns (Tessum et al., 2019) and may contribute to over half of the racial disparity in mortality rate between Black and non-Hispanic White Americans (Geldsetzer et al., 2024). This extensive body of research has helped inform policies to reduce environmental inequities, including New Jersey's landmark 2020 cumulative-burden law (N.J. Stat. § 13:1D-160) requiring state regulators to deny permits for harmful projects in overburdened communities (Sheats, 2018). Similarly, knowledge about the racial distribution of petrochemical jobs, including factors associated with potential disparities, may inform efforts to

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promote economic equity in industrialized communities.

States have broad discretion over environmental permitting, including whether to consider the racial distribution of economic benefits from polluting facilities (see 40C.F.R. 70 and 40C.F.R. 122), and relevant state laws vary widely. For example, the Massachusetts Environmental Policy Act (1972) requires a detailed assessment that considers specified Environmental Justice Principles, including "the equitable distribution of energy and environmental benefits and environmental burdens" (301C.M.R. § 11.02). By contrast, the South Dakota Environmental Policy Act (1974) does not require any consideration of environmental justice, nor any evaluation of how the project's costs or benefits would be distributed (S.D.C.L. §34 A-9-7). In states without relevant statutes, court rulings (i.e. case law) may require a cost-benefit analysis in environmental permitting decisions, but these rulings are generally unspecific about methodology (e.g., Save Ourselves, Inc., *1984*).

Extensive research has documented that Black Americans are underrepresented in many job sectors (e.g., Becker, 1957; Bergmann, 1974; Chung-Bridges et al., 2008; Darity and Mason, 1998; Meyer, 2014; Murray, 2003). Yet, there is limited research focused on employment equity in industrial manufacturing. A 1975 report commissioned by the U.S. Department of Labor found that industry avoided hiring Black workers for a number of reasons related to systemic racism (e.g., "blacks tend to join unions more readily than whites"; Till et al., 1975). Early studies of industrial development found that local residents received a small proportion of jobs at newly-constructed facilities (reviewed in Nolan and Heffernan, 1974; see also Gray, 1969; Little and Lovejoy, 1979), which is consistent with modern-day allegations that impacted communities do not receive a fair share of economic benefits from petrochemical development, including jobs and local tax revenue (DeBerry, 2021). The only quantitative, nationwide study of industrial employment disparities appears to be an analysis of 2010 Equal Employment Opportunity Commission (EEOC) data, which found that Blacks and Hispanics were underrepresented among the top 1000 polluting industrial facilities in the U.S., especially in high-paying jobs (Ash and Boyce, 2018). Yet there are more than 4000 petrochemical manufacturing facilities nationwide (NAICS 324 or 325), and employment equity in this subsector remains unexplored. Further, there is a lack of research about the potential predictors of industrial employment disparities. For decades, access to education has been cited as an explanation for industrial employment disparities (Gray, 1969; Howie et al., 1983; Nolan and Heffernan, 1974; Shattuck and Nunoo, 2020; Till et al., 1975), but without empirical support. This explanation warrants further scrutiny, especially considering that education disparities explain less than half of the wage gap between Black and White workers from all sectors (Wilson and Darity Jr., 2022).

To increase knowledge about petrochemical employment equity, our study examined the racial composition of the chemical manufacturing (NAICS 325) and petroleum and coal products manufacturing (NAICS 324; excludes extraction) workforce among U.S. states and core-based statistical areas (CBSA) by wage strata. We focus on chemical manufacturing because it is responsible for more air pollution in the United States than any other industry sector, based on toxicity-weighted emissions in EPA's Risk-Screening Environmental Indicators (RSEI) database (U.S. EPA, 2023). We include petroleum and coal products manufacturing because the fossil fuel industry is known to disproportionately pollute communities of Color (reviewed in Donaghy et al., 2023), and because the vast majority of chemicals, including most pharmaceuticals, are manufactured from oil and gas feedstocks (Hess et al., 2011; The Royal Society, 2024; Wollensack et al., 2022). Using publicly available data from the U.S. Equal Employment Opportunity Commission (EEOC), we quantified racial disparities in employment for these two sectors relative to each area's working-age civilian population. We then examined the extent to which these employment disparities were associated with four area-specific factors: population diversity, racial education gap, industry premium (i.e., relative wage), and job prevalence. Finally, we evaluated local patterns of job disparities and tax incentives in Louisiana as a case study. We focused on this state because it stood out in our main analysis, but also due to its relatively large number of petrochemical jobs, extreme racial inequities, and internationally-recognized environmental justice issues (Achiume et al., 2021).

2. Materials and methods

2.1. Data sources

We used the most recent state-level and CBSA-level datasets available at the time of our analysis. We obtained employee race data and job numbers for NAICS 325 and NAICS 324 industries from the 2022 EEO-1 Public Use File published by the U.S. EEOC. This dataset represents private employers with 100 or more employees, as well as certain federal contractors with 50 or more employees (U.S. Equal Employment Opportunity Commission, 2023). The NAICS 325 subsector encompasses a broad set of industrial processes, including the manufacturing of basic chemicals, plastics, synthetic rubber, paints, adhesives, cleaning products, pharmaceuticals, explosives, pesticides, and fertilizers (NAICS Association, 2023a). The NAICS 324 subsector consists mostly of petroleum refineries and asphalt product manufacturers (NAICS Association, 2023b). We refer to these two sectors collectively as "petrochemical," because both sectors rely heavily on oil and gas feedstocks (Hess et al., 2011; The Royal Society, 2024; Wollensack et al., 2022). We used the prior data year (2021) to calculate NAICS 324 disparities for Louisiana, because it was far more complete compared to 2022 data (missing only 0.1 % versus 27.6 % of race data for higher-paying jobs) and excluding Louisiana would have limited our analysis, given that this state has the second-highest number of NAICS 324 employees. We are confident that this substitution did not affect the outcome of our analyses because we originally conducted our entire analysis with 2021 data, and findings were consistent with those presented here.

We obtained all wage data from the May 2022 National Industry-Specific Occupational Employment and Wage Statistics (OEWS) published by the Bureau of Labor Statistics. We used 5-year estimates of racial demographics (C23002) and educational attainment (C15002) from the U.S. Census Bureau's 2022 American Community Survey (ACS). We obtained industrial tax exemption and job creation data for 2010 through 2022 from Louisiana Economic Development's Industrial Tax Exemption Projects Report. This report includes all manufacturing facilities in Louisiana with contracts through the state's Industrial Tax Exemption Program (ITEP). The ITEP dataset contains the *estimated* number of new jobs associated with each tax-exempt project but does not include net change in jobs or actual (i.e. confirmed) job numbers. A small proportion of contracts in our dataset ($n = 204$ of 4595) were listed with estimated new jobs as "NA," which we considered to be zero.

2.2. Classification of jobs into wage categories

The EEO-1 dataset provides occupation but not wage data. Therefore, we used OEWS median hourly wage data to classify EEO-1 occupations into four wage categories: highest-paying, higher-paying, lower-paying, and lowest-paying (Table S1). The highest and lowest categories were subsets of the higher and lower categories, respectively. Because EEO-1 and OEWS do not use the same classification scheme, we assigned multiple OEWS occupations to certain EEO-1 job categories. For example, we considered the EEO-1 "Professionals" category to include OEWS occupations related to business, finance, computers, mathematics, architecture, engineering, and science. Because of the differences between EEO-1 and OEWS job classifications, and because of wage differences between the petroleum versus chemical industry, there was some overlap in wages among the categories (Table S1). The range of median hourly wages were $35 to $78 for the highest-paying jobs, $18 to $78 for higher-paying jobs, $15 to $37 for lower-paying jobs, and $15 to $24 for the lowest-paying jobs (Table S1).

2.3. Disparities in petrochemical manufacturing jobs (NAICS 325 and 324)

We analyzed employment data for non-Hispanic White workers (hereafter referred to as "White"), because this group had the highest job numbers overall and therefore the fewest suppressed values in the EEO-1 dataset. Thus, we report disparities in terms of people of Color (including Hispanics). We recognize that this approach may obscure important differences among racial and ethnic groups. However, aggregating these groups allowed us to have a far more complete dataset.

Within each subsector (NAICS 325 and 324), we calculated racial disparities by wage category for each state and CBSA with available EEO-1 data. We calculated disparities as the share of subsector jobs minus the corresponding share of the working-age (18 to 64) civilian population. (Because the datasets did not report population of Color, we calculated the relevant values as 100 % minus the share of non-Hispanic Whites.) We considered absolute disparity values lower than 5 percentage points to be non-substantive. To ensure data quality, we omitted disparity values that were calculated from incomplete EEO-1 data (i.e. race data missing for ≥15 % of jobs in the combination of geography, subsector, and wage group). In the rare instance that employee numbers were unavailable for Whites, but were available for other races, we inferred the number of White employees based on other races and the corresponding total. Given space constraints, we report only a subset of CBSA results (i.e. CBSAs within states that had extreme disparities), with the full dataset provided as supplemental materials.

2.4. Potential predictors of petrochemical employment disparities

We evaluated four area-specific variables as potential predictors of racial disparities in petrochemical employment at the state or CBSA level: diversity of the working-age (16 to 64) civilian population (i.e. percent people of Color), education gaps, job prevalence, and industry premium. We calculated each area's education gap as the proportion of Whites with the relevant education minus the corresponding proportion of people of Color. We defined relevant education as holding at least a high school diploma or at least a bachelor's degree for lowest/lower-paying versus highest/higher-paying jobs, respectively. We calculated job prevalence as the number of relevant jobs per 10,000 working-age (16 to 64) civilians. Finally, we calculated industry premium as each state's median wage for the subsector (i.e. NAICS 325 or 324), divided by its overall median wage. Because subsector wages were not available for CBSAs, we assigned industry premium values based on the state where most of the CBSA population was located.

Using separate multivariate linear regression models, we evaluated predictors of employment disparities for all combinations of subsector (i.e. NAICS 325 or 324), wage category (i.e. highest, higher, lower, or lowest), and geographic level (i.e. state or CBSA). Predictor variables were scaled and centered prior to analysis. We used a Bonferroni correction to control the family-wise error rate across wage categories (i.e. $\alpha = 0.0125$), as well as quantile-quantile plots to confirm that model residuals were approximately normally distributed. We tested for spatial autocorrelation in the final models using Moran's I (Hartig, 2021). We found evidence of spatial autocorrelation ($P < 0.001$) only in the CBSA-level chemical manufacturing (NAICS 325) dataset for all wage categories except lowest-paying jobs. We considered using spatial lag models to analyze these datasets; however, significant autocorrelation remained after accounting for the lag ($P \leq 0.003$). Additionally, many CBSAs ($n =$ 49 out of 290) lacked any neighbor, resulting in lag values of zero for ~17 % of the dataset. As an alternative approach, we included State as a dummy variable in CBSA models for NAICS 325, resulting in no significant spatial autocorrelation ($P \geq 0.10$).

2.5. Employment disparities within Louisiana

We quantified parish-level employment disparities for Louisiana using the approach described above, except that we used EEO-1 data for the entire manufacturing sector (NAICS 32) because subsector data (NAICS 325 or 324) were mostly unavailable at this geographic scale. The majority (59 %) of manufacturing in Louisiana consists of chemical (325) and petroleum and coal products (324), but the sector also includes wood products (321), paper (322), printing (323), plastics and rubber (326), and nonmetallic minerals (327) (U.S. Bureau of Labor Statistics, 2022).

3. Results

3.1. Summary statistics and quality assurance

Summary statistics are provided in Tables S2 & S3. Missing data (i.e. jobs reported without racial breakdown) represented <5 % of jobs in most states (Tables S4 & S5) and core-based statistical areas (CBSAs; Tables S6 & S7). However, there were some instances where the proportion of missing data was sufficiently high (>15 %) to warrant exclusion from our analysis. Excluded data represented ≤5 % of jobs for any combination of geography (i.e. state or CBSA), subsector, and wage group, except for higher-paying NAICS 324 jobs at the CBSA level (8.4 % of data excluded) and the lowest-paying NAICS 324 jobs at the state and CBSA levels (13.3 % and 17.6 % of jobs excluded, respectively; Tables S4–S7). Final sample sizes are provided in tables and figures.

3.2. Geographic patterns of chemical manufacturing (NAICS 325) employment disparities by wage group

Chemical manufacturers reported EEO-1 data in all 50 states and in 290 CBSAs (Fig. 1; Tables 1, S4, & S6). Most (80 %) of the *highest*-paying jobs in this subsector were concentrated in 15 states (in decreasing order: NJ, CA, PA, TX, MA, IL, NY, NC, IN, OH, MI, MD, MN, MO, and LA). People of Color were *underrepresented* in these jobs among 30 states and 150 CBSAs, which accounted for most of this subsector (i.e. 72 % or 77 % of highest-paying NAICS 325 jobs among all states or CBSAs, respectively; Fig. 1, Tables S4 & S6). Among the 15 key states, the most extreme disparities occurred in Louisiana and Texas, and these inequities persisted on a local scale (i.e. among CBSAs; Table 1). The opposite disparity (i.e. Whites underrepresented among *highest*-paying NAICS 325 jobs) occurred in only two states (Maine and Oregon), which represented less than 1 % (0.47 %) of jobs in this category. Results were similar when we used a broader definition of desirable jobs (i.e. "*higher*-paying;" Fig. 1, Tables 1, S4, & S6).

For less desirable NAICS 325 jobs, findings were somewhat influenced by wage classification, with people of Color being almost universally *overrepresented* in the *lowest*-paying jobs, but with a less extreme pattern for *lower*-paying jobs (which included clerical and operative workers in addition to laborer and service workers; Fig. 1, Table 1). For the *lowest*-paying jobs, people of Color were *overrepresented* in at least 32 states and 126 CBSAs, representing nearly all of the subsector (i.e. 95 % or 91 % of these jobs among all states and CBSAs, respectively; Tables S4, & S6). The analogous values for *lower*-paying jobs were 31 states and 161 CBSAs, which represented somewhat less of the subsector (75 % or 78.6 %, respectively; Tables S4 & S6). The opposite disparity (i.e. Whites overrepresented in less desirable jobs) occurred in relatively few states, which collectively represented less than 1 % (0.60 %) of the *lowest*-paying and 3.9 % of the *lower*-paying NAICS 325 jobs nationwide (Fig. 1; Tables S4 & S6).

3.3. Geographic patterns of petroleum and coal products manufacturing (NAICS 324) employment disparities by wage group

Manufacturers of petroleum and coal products reported EEO-1 data

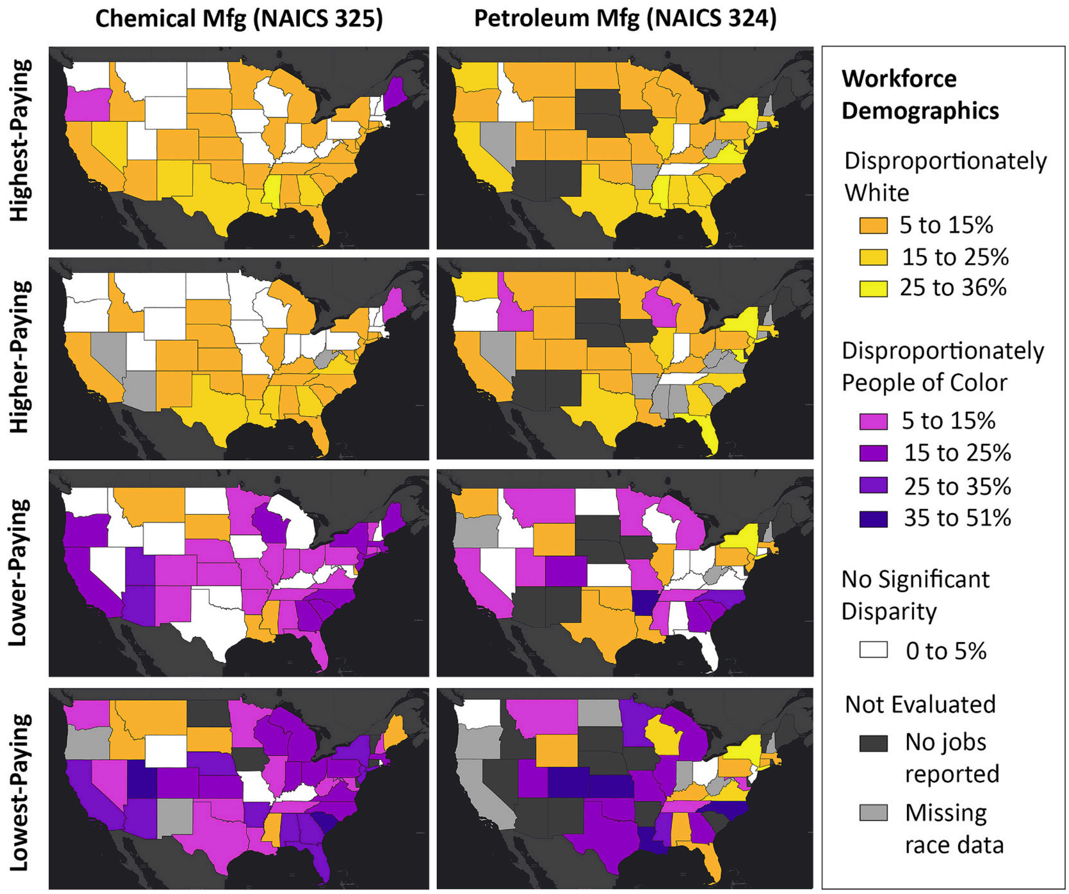

Fig. 1. Racial disparities in petrochemical manufacturing (mfg) jobs by subsector and wage category from EEOC 2022 data. Disparities were calculated as the racial group's workforce share minus population share and are expressed as nominal percentage points (see Methods). Job numbers vary widely by state and are provided with disparity values in Tables S4 & S5. Overall, the top-employing states were CA, LA, IL, NJ, NY, OH, PA, and TX.

Table 1
States with Most Extreme Disparities in Chemical Manufacturing Jobs (NAICS 325), and Corresponding Core-Based Statistical Areas[1].

State or CBSA	Number of NAICS 325 Jobs	Working-Age Population of Color (%)	NAICS 325 Workers of Color (%)			
			Highest Paid	Higher Paid	Lower Paid	Lowest Paid
Texas (TX)	**79,155**	**59.7**	**37.9**	**39.4**	**57.4**	**74.2**
Houston, TX	41,453	66.0	39.0	40.2	54.2	79.6
Dallas-Fort Worth, TX	12,740	55.8	37.6	41.4	71.2	80.0
Beaumont-Port Arthur, TX	5557	44.2	23.9	22.6	28.4	39.5
Louisiana (LA)	**24,757**	**41.0**	**18.5**	**21.2**	**32.6**	**55.2**
Baton Rouge, LA	11,412	43.1	22.3	23.9	32.6	63.1
Lake Charles, LA	5714	31.5	15.7	15.3	25.2	38.1
New Orleans, LA	4446	48.0	23.4	24.2	36.5	63.2
Georgia (GA)	**22,468**	**49.7**	**30.9**	**30.9**	**65.1**	**75.5**
Atlanta, GA	12,674	55.4	34.3	33.0	72.5	80.3
Augusta, GA	2025	48.0	34.0	29.8	54.4	91.8
South Carolina (SC)	**22,333**	**36.8**	**23.7**	**26.5**	**61.4**	**84.4**
Charlotte-Concord, NC-SC	9476	41.0	26.9	27.3	61.5	57.5
Columbia, SC	5895	45.2	27.0	38.1	77.1	87.4
Greenville, SC	5511	28.9	29.2	27.9	59.5	72.2
Tennessee (TN)	**20,672**	**27.5**	**15.6**	**13.6**	**35.9**	**41.6**
Memphis, TN	3740	57.5	32.8	32.3	75.9	80.6
Nashville, TN	2293	29.2	19.8	21.5	47.1	52.0
Chattanooga, TN	2045	22.7	15.0	18.2	34.2	31.6

[1] Ranking based on disparities in *highest*-paying chemical manufacturing (NAICS 325) jobs; excludes states with <2 % (<19,707) of total US NAICS 325 jobs and CBSAs with relatively few NAICS 325 jobs.

in 39 states and 83 CBSAs (excludes extraction operations; Fig. 1, Tables 2, S5, & S7). Most (76 %) of the *highest*-paying jobs in this subsector were concentrated in nine states (in decreasing order: TX, LA, CA, NJ, PA, OK, IL, OH, and KY). People of Color were almost universally *underrepresented* in these jobs, including in at least 30 states and 45 CBSAs (excluding areas with missing data), which represented nearly all of the subsector (94 % of nationwide jobs in this category for either geographic unit; Fig. 1, Tables S5 & S7). Among the nine key states, the

Table 2
States with Most Extreme Disparities in Petroleum and Coal Products Manufacturing Jobs (NAICS 324), and Corresponding Core-Based Statistical Areas[1].

State or CBSA	Number of NAICS 324 Jobs	Working-Age Population of Color (%)	NAICS 324 Workers of Color (%)			
			Highest Paid	Higher Paid	Lower Paid	Lowest Paid
Texas (TX)	**29,719**	**59.7**	**36.7**	**38.3**	**54.4**	**78.2**
Houston, TX	13,943	66.0	38.0	39.1	52.4	58.6
Beaumont, TX	3935	44.2	22.4	27.8	38.2	No jobs
Dallas-Ft. Worth, TX	2557	55.8	34.8	37.9	62.4	78.4
Louisiana (LA)	**8434**	**40.6**	**16.9**	NA	**26.8**	**91.2**
New Orleans, LA	4022	47.3	18.2	NA	24.4	No jobs
Illinois (IL)	**4904**	**39.7**	**15.9**	**21.5**	**32.1**	**55.9**
Chicago, IL	4311	47.5	24.5	25.3	43.2	NA
New Jersey (NJ)	**3867**	**47.7**	**28.0**	**25.9**	**35.9**	**47.1**
New York (NY)	**2538**	**45.7**	**9.9**	**13.5**	**13.2**	**12.6**
New York-Newark, NY-NJ	3639	56.0	29.2	27.2	40.0	47.1

[1] Ranking based on disparities in *highest*-paying petroleum and coal produce manufacturing (NAICS 324) jobs; excludes states with <2 % (<2284) of total US NAICS 324 jobs and CBSAs with relatively few NAICS 324 jobs. Louisiana state and CBSA values for this category are based on 2021 data (see Methods). NA: Missing a large proportion (>15 %) of race data.

most extreme disparities occurred in Illinois, Louisiana, and Texas, and these inequities persisted on a local scale (Table 2). Results were similar when we used a broader definition of desirable jobs (i.e. *higher*-paying): people of Color were underrepresented in the 24 states and 38 CBSAs that account for almost all of the subsector (94–95 % of nationwide jobs; Fig. 1, Tables 2, S5, & S7).

The pattern of disparities among the *lowest*-paying NAICS 324 jobs was mixed (Fig. 1, Tables S5 & S7). People of Color were *overrepresented* among these jobs in 15 states and 17 CBSAs (each accounting for 64 % of nationwide jobs in this category). But people of Color were *underrepresented* among these jobs in 10 states and 9 CBSAs (accounting for 30 % or 21 % of nationwide jobs, respectively). As with the chemical subsector, broadening the wage group to encompass *lower*-paying petroleum jobs attenuated the overrepresentation of people of Color. Specifically, people of Color were *overrepresented* in 13 states and 27 CBSAs (accounting for 32 % or 25 % of nationwide jobs, respectively) and *underrepresented* in 9 states and 21 CBSAs (each accounting for 39 % of nationwide jobs; Fig. 1, Tables S5 & S7).

3.4. Potential predictors of employment disparities in petrochemical manufacturing (NAICS 325 and 324)

Results were generally consistent between state-level and CBSA-level regression analyses; thus, we focus on CBSA-level findings (Table 3), given the larger sample sizes, and provide state-level regression results as supplemental material (Table S8.) For both subsectors (NAICS 325 and 324), population diversity was the strongest and most consistent predictor of disparities in highest/higher-paying jobs (Tables 3 & S8). Specifically, people of Color were more severely underrepresented in highest/higher-paying petrochemical jobs when they constituted a larger share of the working-age civilian population, regardless of subsector or geographic unit (i.e. state or CBSA; Tables 3 & S8). The only other consistent finding was that the racial education gap was not significantly associated with job disparities, regardless of subsector, wage group, or geographic unit (Tables 3 & S8). There were no consistent predictors of disparities in lowest/lower-paying jobs, and most of these models performed poorly, as evidenced by low R^2 values (Tables 3 & S8). A greater industry premium was associated with more extreme *overrepresentation* of people of Color among the lowest-paying petroleum jobs (NAICS 324) at the state level, but the opposite pattern was evident among lower-paying chemical jobs (NAICS 325) and neither effect was significant in the corresponding CBSA model (Tables 3 & S8). Relationships among predictors are illustrated in supplemental materials (Figs. S1 & S2).

3.5. Louisiana case study: local employment disparities and industrial tax incentives

Race data (EEO-1) for chemical manufacturing (NAICS 325) were available for all six Louisiana CBSAs, with most (87.1 %) of the jobs located in Baton Rouge, Lake Charles, or New Orleans metropolitan areas (Tables 1 & S6). Patterns of racial disparities in NAICS 325 employment for these three areas were consistent with the state overall: people of Color had about half their expected share of highest/higher-paying jobs and about three quarters their expected share of lower-paying jobs, but *more* than their expected share of the lowest-paying

Table 3
Coefficients (SE) from regression models of racial disparities in petrochemical employment among U.S. core-based statistical areas.

Model Component[1]	Chemical Manufacturing (NAICS 325)				Petroleum & Coal Products Manufacturing (NAICS 324)			
	Highest Paying	Higher Paying	Lower Paying	Lowest Paying	Highest Paying	Higher Paying	Lower Paying	Lowest Paying
N (# CBSAs)	229	210	253	166	58	53	72	34
Population Diversity	8.47	9.07	1.04	2.73	6.95	7.87	−2.49	−2.34
(% People of Color)	(0.91)***	(0.72)***	(1.36)	(2.17)	(1.58)***	(1.50)***	(2.01)	(4.09)
Racial Education Gap	−0.71	0.18	−2.00	0.43	3.43	1.37	−0.96	2.24
	(0.63)	(0.72)	(1.06)	(1.77)	(1.71)†	(1.81)	(2.01)	(3.59)
Industry Premium	6.28	3.46	−1.80	−2.59	−2.81	−1.36	−0.001 (1.89)	7.44
	(5.57)	(5.84)	(8.43)	(3.38)	(1.37)†	(1.37)		(3.66)
Job Prevalence	−0.67	0.07	0.23	2.14	1.77	0.74	−4.02	−1.30
	(0.48)	(0.52)	(0.83)	(1.01)†	(1.00)	(0.96)	(2.85)	(2.14)
Overall Adjusted R^2	0.51***	0.48***	0.18**	0.18*	0.43***	0.47***	0.024	0.070

[1] Predictor variables were scaled and centered prior to analysis. See Methods for descriptions of predictors. $^{\dagger}P \leq 0.05$, but above Bonferroni-corrected value of 0.0125. *$P < 0.0125$. **$P < 0.001$. ***$P < 0.0001$. For all models, a positive coefficient indicates that the disparity becomes more severe as the variable increases, i.e. that people of Color are more severely underrepresented in higher/highest-paying jobs, or more severely overrepresented in lower/lowest-paying jobs. All data were scaled and centered prior to analysis.

jobs (Tables 1 & S6). Petroleum and coal products manufacturing (NAICS 324) disparities were not calculated for any Louisiana CBSA except New Orleans (Table 2), given the large proportions ($\geq$45 %) of missing race data for highest- and higher-paying jobs (Table S7).

At the parish (i.e. county equivalent) level, subsector (i.e. NAICS 325 or 324) EEO-1 data were generally unavailable, while data for the overall manufacturing sector (i.e. NAICS 32) were available for 23 parishes (out of 64 total; Fig. 2, Table S9). Notably, EEO-1 data were not available for manufacturing in Calcasieu Parish, which encompasses the city of Lake Charles, more than 50 petrochemical facilities, and more manufacturing workers than most parishes in Louisiana (U.S. Bureau of Labor Statistics, 2024). For each wage group, various subsets of parishes were either missing race data for a large proportion ($\geq$15 %) of jobs, or had no jobs reported, resulting in differing sample sizes (n = 17–21 parishes per wage group; Fig. 2, Table S9). Most (74 %) of the *highest*-paying manufacturing jobs were concentrated in six parishes (in decreasing order): East Baton Rouge, Ascension, Iberville, St. Charles, Jefferson, and St. John the Baptist (Table S9). People of Color were *underrepresented* among the *highest*-paying manufacturing jobs in nearly all parishes with available data, representing almost the entire sector (i.e., 99.5 % of jobs in this wage group; Fig. 2, Table S9). The sole exception, Livingston Parish, was outside the petrochemical corridor (i.e., parishes along the lower Mississippi River) and had the smallest population of Color (13 %). When the wage category was broadened to include *higher*-paying jobs, these parish-level disparities persisted in most of the state, and throughout the petrochemical corridor (Fig. 2). By contrast, the pattern was mixed for *lower*-paying manufacturing jobs: People of Color remained *underrepresented* in most of the petrochemical corridor but were *overrepresented* for most of the parishes outside this region (Fig. 2, Table S9). With respect to the *lowest*-paying jobs, people of Color were *overrepresented* in nearly every parish with data available. The sole exception was St. John the Baptist, where people of Color represented 69 % of the population but held only 50 % of the *lowest*-paying manufacturing jobs (Table S9). St. John the Baptist also had the most extreme disparities for every wage group, with people of Color holding just 17 %, 22 %, and 29 % of the *highest-, higher-, and lower*-paying manufacturing jobs.

As observed for the state analysis, population diversity was a strong predictor of parish-level disparities in the *highest*- and *higher*-paying jobs. Specifically, people of Color were more severely underrepresented in these more desirable manufacturing jobs when they constituted a larger portion of the parish population ($r \geq 0.92$, $P < 0.0001$; Table S9). There was no significant correlation between the racial gap in college attainment and disparities in *highest*- or *higher*-paying jobs ($r = 0.15$ and 0.22, respectively, $P \geq 0.39$), or between the racial gap in high school attainment and disparities in *lower*- or *lowest*-paying jobs ($r = 0.13$ and

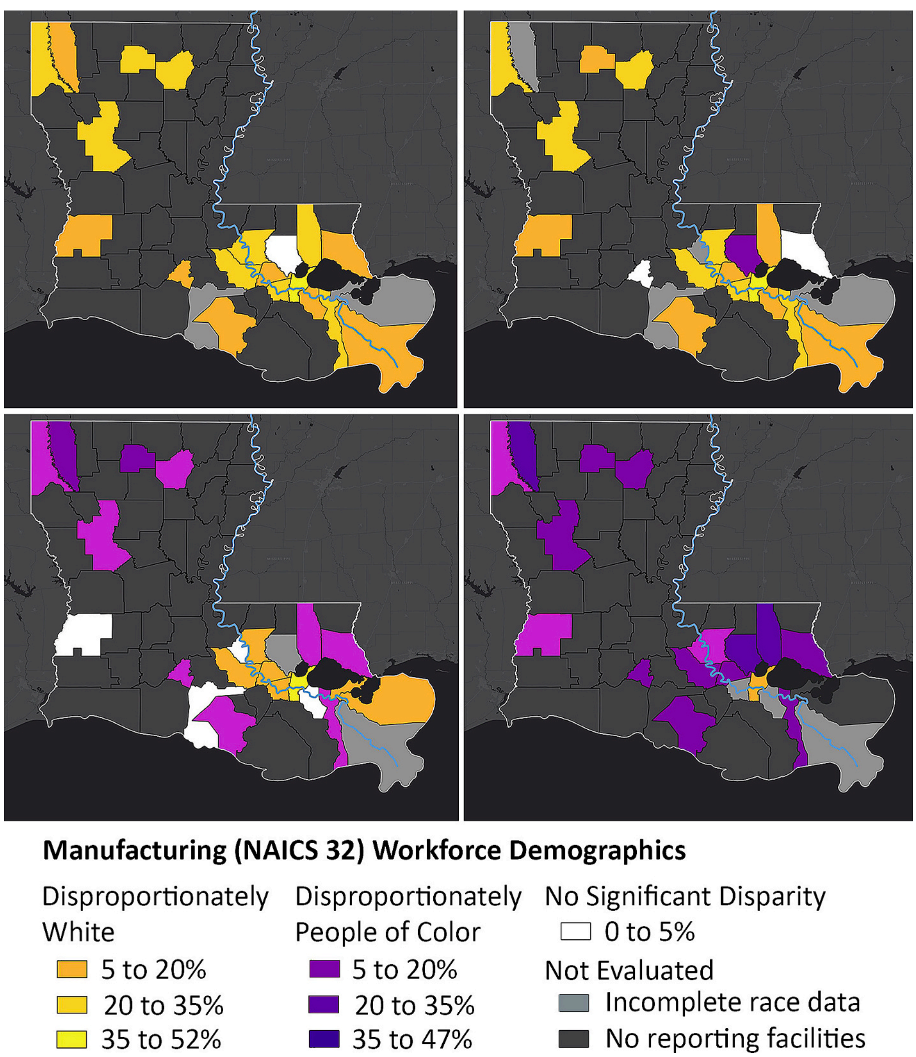

Fig. 2. Racial disparities in *highest*-paying (A), *higher*-paying (B), *lower*-paying (C), and *lowest*-paying (D) manufacturing jobs (NAICS 32), among Louisiana parishes with 2022 EEO-1 data available (n = 23). Disparities were calculated as the group's workforce share minus population share and are expressed as percentage points (see Methods).

0.22, respectively, $P \geq 0.41$) at the parish level. Notably, in addition to having the most extreme job disparities, St. John the Baptist Parish had the highest population of Color (69 %) and almost no racial gap in college education. In this parish, 15.9 % of people of Color held a Bachelor's degree or higher compared to 17.8 % of non-Hispanic Whites.

Estimated first-year values of *ad valorem* tax credits granted through Louisiana's Industrial Tax Exemption Program (ITEP) from 2010 to 2022 were available for 4965 individual contracts, representing 60 parishes. After excluding projects that were canceled, denied, withdrawn, missing key information, or listed in duplicate, 4595 contracts remained. Overall, chemical manufacturers (NAICS 325) represented one-third (32.8 %) of ITEP contracts but received a large majority of tax credits by value (82.6 %). Petroleum and coal products manufacturers (NAICS 324) represented 9.1 % of contracts and 7.0 % of tax credit value. The aggregated totals of tax credits and estimated new jobs varied widely by parish, both overall and for petrochemical subsectors (Table 4). St. John the Baptist Parish had the highest aggregated tax credit per petrochemical job, having provided nearly $1 million in first-year tax credits for each estimated new job (Table 4). This tradeoff was even more extreme for the petroleum subsector (NAICS 325) specifically, which received over $19 million in aggregated first-year tax credits for creating zero new jobs in St. John the Baptist Parish (Table 4). Cameron Parish had the highest *absolute cost*, with $1.1 billion in aggregated first-year tax credits from 2010 to 2022 (Table 4). Because nearly all ITEP contracts are 5 years in duration and eligible for an additional 5-year renewal, these values can be multiplied by 10 to provide some indication of total cost over the life of the exemption (not accounting for depreciation or millage rate changes). According to the ITEP dataset, the highest numbers of new manufacturing jobs were created in Calcasieu Parish (3970 estimated jobs), followed by Cameron Parish (1904 estimated jobs). Notably, the EEO-1 dataset contained no race data for either of these high-employing parishes.

4. Discussion

We found that people of Color in the U.S. are underrepresented in petrochemical manufacturing, with differences linked to industry subsector, geography, and relative wage (Figs. 1 & 2; Tables 1 & 2). There was no evidence that petrochemical employment disparities were correlated with racial gaps in educational attainment – a longstanding explanation offered by industry for which we find no empirical support (Tables 3 & S6) (Gray, 1969; Howie et al., 1983; Neuhauser, 2018; Nolan and Heffernan, 1974; Shattuck and Nunoo, 2020; Till et al., 1975). Rather, disparities were generally more severe in geographic areas that were more racially diverse (i.e. non-White; Tables 3 & S8). Additionally, people of Color were more consistently underrepresented in higher-paying (versus lower-paying) occupations and in the better-paying subsector (i.e. petroleum and coal products manufacturing; Fig. 1, Tables S4-S7). By contrast, People of Color were generally *over-represented* in the *lowest*-paying jobs, especially in the lower-paying subsector (i.e. chemical manufacturing; Fig. 1, Tables S4-S7). These patterns were consistent among three sets of geographic areas (i.e. U.S. states, U.S. core-based statistical areas, and Louisiana parishes), thereby increasing confidence in our findings. Our analysis reveals a systemic disparity in petrochemical employment that cannot be simply attributed to the racial gap in educational attainment, as some have alleged (Gray, 1969; Howie et al., 1983; Neuhauser, 2018; Nolan and Heffernan, 1974; Shattuck and Nunoo, 2020; Till et al., 1975). Rather, the pattern of disparities appears to reflect opportunities and incentives for discrimination, as indicated by the correlations with population diversity and differences between wage groups, respectively.

Our findings emphasize the need to consider the *distribution* of economic benefits from petrochemical operations in environmental decision-making. Existing economic impact assessments likely overestimate these benefits for minority communities. For example, the American Petroleum Institute predicted that over 700,000 new petrochemical jobs would become available for minorities from 2015 to 2035, solely based on the location of the job and the proportion of minorities in that area (American Petroleum Institute, 2016). Our analysis of EEOC data highlights the obvious flaw in this approach and indicates that White workers will receive a significant portion of those "job opportunities for minority workers" (American Petroleum Institute, 2016).

Table 4
First-year *ad valorem* tax credits and estimated new jobs, aggregated for the 20 Louisiana parishes with the largest petrochemical tax credits (NAICS 325 and 324 combined), relative to racial equity in manufacturing jobs.[1]

Parish	Racial Job Gap[2]	Estimated First-Year Tax Credit ($)[3]			Estimated New Jobs			Petrochem Credit ($) Per Job (325 & 324)
		All Mfg	Chemical (325)	Petroleum (324)	All Mfg	Chemical (325)	Petroleum (324)	
Cameron	?*	1,122,104,000	1,122,076,000	NA	1904	1904	NA	589,000
Calcasieu	?*	797,838,000	695,858,000	57,009,000	3970	1927	230	349,000
Ascension	All	196,510,000	194,460,000	271,000	1721	1535	0	127,000
Iberville	All	123,300,000	120,225,000	NA	1553	1438	NA	84,000
St. Charles	Higher-Paying	140,631,000	25,257,000	76,791,000	273	82	122	500,000
Plaquemines	Higher-Paying	85,731,000	84,004,000	456,000	527	312	0	271,000
East Baton Rouge	All	69,888,000	44,475,000	11,309,000	645	164	43	269,000
St. James	Higher-Paying	37,999,000	22,480,000	10,820,000	724	289	86	89,000
West Baton Rouge	Higher-Paying	33,090,000	25,045,000	6,204,000	356	123	53	178,000
Rapides	?	29,024,000	8,483,000	80,000	782	209	5	40,000
St. John the Baptist	All	22,740,000	2,054,000	19,282,000	23	23	0	928,000
Jefferson	Higher-Paying	19,598,000	2,187,000	79,000	1417	29	4	69,000
Caddo	Higher-Paying	17,744,000	2,275,000	2,270,000	996	256	15	17,000
St. Bernard	?*	10,688,000	NA	10,503,000	83	NA	81	130,000
St. Mary	Higher-Paying	9,679,000	2,718,000	NA	1476	53	NA	51,000
Lafourche	?	9,538,000	2,732,000	3,555,000	344	57	5	101,000
Red River	?	5,658,000	5,531,000	NA	150	60	NA	92,000
Lincoln	Higher-Paying	5,147,000	3,303,000	NA	74	10	NA	330,000
Richland	?	3,640,000	1,268,000	NA	383	12	NA	106,000
Bienville	?	1,967,000	1,271,000	NA	31	0	NA	∞

NA indicates no ITEP contracts. Infinity symbol (∞) denotes non-zero credit divided by zero jobs.
[1] Tax and job values from contracts granted (2010–2022) under Louisiana's Industrial Tax Exemption Program (ITEP) for manufacturing (mfg).
[2] Denotes parishes where people of Color are underrepresented among all manufacturing jobs or within a wage category. Question marks (?) indicate that race data are unavailable for manufacturing employees, but NAICS 325 race data exist at the CBSA level for parishes denoted with an asterisk (?*; Table 1).
[3] Values are rounded to the nearest thousand.

Implicit in a cost-benefit analysis is the assumption that costs and benefits affect the same population. Not only are the costs of petrochemical manufacturing disproportionately placed on communities of Color (reviewed in Donaghy et al., 2023), it is now evident that jobs, especially good jobs, disproportionately go to White workers. This "double disparity" means that a typical cost-benefit analysis for a proposed petrochemical facility would yield drastically different results depending on the focal population. These considerations are especially important in states with large numbers of petrochemical jobs and extreme employment disparities, such as Louisiana and Texas.

While Louisiana has a unique historical and cultural context, our case study has broader implications because it illustrates the multiple layers of racial inequities from petrochemical operations. These inequities were most starkly apparent in St. John the Baptist Parish, a majority-Black area that has received considerable attention for its legacy of slavery and for the ongoing impacts of heavy industry on human health and historic resources (Burnett and Peñaloza, 2021; Dermansky, 2020; Muller, 2023b; Nagra et al., 2021; Russell, 2019). Across all wage categories, St. John the Baptist had the most severe racial disparities in manufacturing jobs of any Louisiana parish (Fig. 2, Table S9), as well as the highest cost-per-job of petrochemical manufacturing industrial tax credits, at nearly $1 million per job (Table 4). The costs were even more extreme for the petroleum subsector (NAICS 324), which received $19 million in first-year tax credits for creating *zero* direct jobs (Table 4). Notably, these totals are derived from estimated first-year credits *only* and thus understate the full cost of Louisiana's Industrial Tax Exemption Program (ITEP), which typically allows each tax exemption to last 10 years. (The total costs, which are influenced by depreciation and millage rates, are not available as a public dataset.) Research has found that Louisiana's ITEP tax credits are not correlated to job growth or personal income growth (Messenger, 2024), yet represent a substantial portion of local tax revenue in many parishes (Waguespack et al., 2022). For example, in 2018 and 2019, the value of taxes exempted through ITEP exceeded the total taxes levied in St. John the Baptist Parish (Waguespack et al., 2022). This magnitude of incentives, combined with an extreme pollution burden, have led some to argue that Louisiana taxpayers "have indirectly subsidized the destruction of their own environment and health" (Messenger, 2024). Our study extends this argument to employment inequality, as these subsidies benefit industries that disproportionately hire Whites, at the expense of workers of Color across Louisiana (Fig. 2, Tables 1, 2, & 4). Given that many other states provide industrial tax exemptions, the subsidization of petrochemical employment disparities is a larger issue that warrants further examination.

With the largest population of Color (69 %) in Louisiana and almost no racial gap in education, St. John the Baptist Parish contradicts the industry's narrative that there are simply not enough people of Color with sufficient education (Gray, 1969; Howie et al., 1983; Neuhauser, 2018; Nolan and Heffernan, 1974; Shattuck and Nunoo, 2020; Till et al., 1975). This example is consistent with our broader finding that petrochemical employment disparities do not correlate with racial gaps in educational attainment at the state or CBSA level. Understanding the drivers of petrochemical job disparities is key to improving employment equity in this industry. Given the non-significant effect of racial education gap, our study suggests that investment in education/training is insufficient without attention to job *access*. This topic could be further explored by examining enrollment and job placement rates for industrial training programs among different racial groups. Yet, researchers should consider that enrollment is likely influenced by the perceived likelihood of job placement, which in turn may be influenced by systemic racism. Addressing systemic racism in the petrochemical workforce will require data-driven interventions by state and federal regulatory authorities. These interventions include consistent enforcement of Title VI under the U.S. Civil Rights Act of 1964, a goal that is complicated by a recent court decision that requires proof of *discriminatory intent* (versus disparate impact) under EPA Title VI regulations (State of Louisiana v. U.S. Environmental Protection Agency, *2024*).

As with any analysis, our study had limitations. Because we focused solely on employee numbers, we could not detect other forms of racial inequity. For example, previous studies of U.S. workers have documented racial inequities with respect to employment benefits (Kristal et al., 2018; Semyonov et al., 2011), workplace harassment (Okechukwu et al., 2014), job insecurity (Landsbergis et al., 2014), and workplace hazards (Frumkin et al., 1999; Leeth and Ruser, 2006). Additionally, we did not consider the racial demographics of construction workers that build new/expanding petrochemical facilities; however, research indicates that people of Color are underrepresented in the U.S. construction industry (reviewed in Isingizwe et al., 2023). Finally, we did not evaluate the racial demographics of contract workers. This topic is an important area for future research, especially given the potential differences in wages, benefits, job security, and workplace hazards between contract workers and full-time employees.

Our study provides unequivocal evidence that people of Color do not receive a fair share of U.S. petrochemical jobs, consistent with allegations made by community members. Environmental justice requires that decision-makers consider how the "pollution versus jobs" tradeoff differs among racial groups. While access to higher-paying jobs cannot truly compensate for health/environmental harms, our finding that these jobs mostly go to White workers emphasizes the unfairness of industrial operations that disproportionately harm Black, Hispanic, and Indigenous communities. Decision-makers should consider that taxpayers are heavily subsidizing these employment and pollution disparities, and that certain facilities receive enormous tax incentives despite creating few – or even zero – direct jobs. Future research should examine how access to jobs is allocated and whether racial disparities exist in job placement rates for industrial training programs. From a regulatory perspective, U.S. environmental regulators should use EEOC data to evaluate employment equity for petrochemical companies seeking permits to expand their operations. These same considerations apply to proposed chemical plants that would use fossil fuel feedstocks to produce "alternative" energy sources (e.g. "blue ammonia"), especially those in communities that are already burdened with industrial pollution. Our findings suggest that new tax incentives for low-carbon energy production (e.g., 26 U.S.C. § 45Q) may have the unintended consequence of perpetuating employment disparities alongside pollution exposures. Without efforts to address and disincentivize petrochemical employment disparities, these racial inequities will persist alongside the intractable disparities in industrial pollution exposure.

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CRediT authorship contribution statement

Kimberly Terrell: Writing – review & editing, Writing – original draft, Supervision, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Gianna St. Julien:** Writing – review & editing, Visualization, Investigation, Formal analysis, Data curation, Conceptualization. **Michael Ash:** Writing – review & editing, Methodology, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ecolecon.2025.108623.

Data availability

Data will be made available on request.

References

Achiume, E.T., Day, D., Reid, A., Balcerzak, M., Gumedze, S., Sunga III, R.A., Pesce, D., Deva, S., Karska, E., Muigai, G., Ramasastry, A., Boyd, D., Mofokeng, T., Orellana, M., 2021. USA: Environmental Racism in "Cancer Alley" Must End. Special Procedures of the Human Rights Council, United Nations, Geneva.

American Petroleum Institute, 2016. Minority and Female Employment: Regional Forecasts for the Oil and Natural Gas and Petrochemical Industries, 2015–2035.

Ash, M., Boyce, J.K., 2018. Racial disparities in pollution exposure and employment at US industrial facilities. PNAS 115, 10636–10641. https://doi.org/10.1073/pnas.1721640115.

Becker, G.S., 1957. The Economics of Discrimination. The University of Chicago Press, Chicago.

Bell, M.L., Ebisu, K., 2012. Environmental inequality in exposures to airborne particulate matter components in the United States. Environ. Health Perspect. 120, 1699–1704. https://doi.org/10.1289/ehp.1205201.

Bergmann, B.R., 1974. Occupational segregation, wages and profits when employers discriminate by race or sex. East. Econ. J. 1, 103–110.

Bullard, R., Mohai, P., Saha, R., Wright, B., 2007. Toxic Wastes and Race at Twenty 1987–2007. (A Report Prepared for the United Church of Christ Justice & Witness Ministries).

Burnett, J., Peñaloza, M., 2021. Descendants of Slaves Say this Proposed Grain Complex Will Destroy the Community. NPR.

Chung-Bridges, K., Muntaner, C., Fleming, L.E., Lee, D.J., Arheart, K.L., LeBlanc, W.G., Christ, S.L., McCollister, K.E., Caban, A.J., Davila, E.P., 2008. Occupational segregation as a determinant of US worker health. Am. J. Ind. Med. 51, 555–567. https://doi.org/10.1002/ajim.20599.

Clark, L.P., Millet, D.B., Marshall, J.D., 2017. Changes in transportation-related air pollution exposures by race-ethnicity and socioeconomic status: outdoor nitrogen dioxide in the United States in 2000 and 2010. Environ. Health Perspect. 125, 097012. https://doi.org/10.1289/EHP959.

Collins, T.W., Grineski, S.E., 2022. Racial/ethnic disparities in short-term PM2.5 air pollution exposures in the United States. Environ. Health Perspect. 130, 087701. https://doi.org/10.1289/EHP11479.

Collins, T.W., Grineski, S.E., Shaker, Y., Mullen, C.J., 2022. Communities of color are disproportionately exposed to long-term and short-term PM2.5 in metropolitan America. Environ. Res. 214, 114038. https://doi.org/10.1016/j.envres.2022.114038.

Colmer, J., Hardman, I., Shimshack, J., Voorheis, J., 2020. Disparities in PM2.5 air pollution in the United States. Science 369, 575–578. https://doi.org/10.1126/science.aaz9353.

Darity, W.A., Mason, P.L., 1998. Evidence on discrimination in employment: codes of color, codes of gender. J. Econ. Perspect. 12, 63–90. https://doi.org/10.1257/jep.12.2.63.

DeBerry, J., 2021. The tax breaks for jobs scheme isn't working out for Louisiana | Jarvis DeBerry. Louisiana Illuminator. https://lailluminator.com/2021/06/18/the-tax-breaks-for-jobs-scheme-isnt-working-out-for-louisiana-jarvis-deberry/.

Dermansky, J., 2020. Long Exposed to Polluted Air, Louisiana's Cancer Alley Residents Are Now in a COVID-19 Hotspot [WWW Document]. DeSmog. https://www.desmogblog.com/2020/04/13/polluted-air-louisiana-cancer-alley-st-john-baptist-parish-covid-19-hotspot. accessed 5.5.20.

Donaghy, T.Q., Healy, N., Jiang, C.Y., Battle, C.P., 2023. Fossil fuel racism in the United States: how phasing out coal, oil, and gas can protect communities. Energy Res. Soc. Sci. 100, 103104. https://doi.org/10.1016/j.erss.2023.103104.

Donley, N., Bullard, R.D., Economos, J., Figueroa, I., Lee, J., Liebman, A.K., Martinez, D. N., Shafiei, F., 2022. Pesticides and environmental injustice in the USA: root causes, current regulatory reinforcement and a path forward. BMC Public Health 22, 708. https://doi.org/10.1186/s12889-022-13057-4.

Dressel, I.M., Demetillo, M.A.G., Judd, L.M., Janz, S.J., Fields, K.P., Sun, K., Fiore, A.M., McDonald, B.C., Pusede, S.E., 2022. Daily satellite observations of nitrogen dioxide air pollution inequality in New York City, New York and Newark, New Jersey: evaluation and application. Environ. Sci. Technol. https://doi.org/10.1021/acs.est.2c02828.

Frumkin, H., Walker, E.D., Friedman-Jiménez, G., 1999. Minority workers and communities. Occup. Med. 14, 495–517.

Geldsetzer, P., Fridljand, D., Kiang, M.V., Bendavid, E., Heft-Neal, S., Burke, M., Thieme, A.H., Benmarhnia, T., 2024. Disparities in air pollution attributable mortality in the US population by race/ethnicity and sociodemographic factors. Nat. Med. 1–9. https://doi.org/10.1038/s41591-024-03117-0.

Gray, I., 1969. Employment effect of a new industry in a rural area. Mon. Labor Rev. 92, 26–30.

Hartig, F., 2021. DHARMa: Residual Diagnostics for Hierarchical (Multi-Level / Mixed) Regression Models. R package version 0.4.1.

Hess, J., Bednarz, D., Bae, J., Pierce, J., 2011. Petroleum and health care: evaluating and managing health care's vulnerability to petroleum supply shifts. Am. J. Public Health 101, 1568. https://doi.org/10.2105/AJPH.2011.300233.

Howie, M.R., Phillips, R.L., Wade, S.L., 1983. An analysis of the impact of industrial development in selected counties in South Carolina. J. Rural Sociol. Sci. 01, 5.

Hurbain, P., Strickland, M.J., Liu, Y., Li, D., 2024. Environmental inequality in estimated Cancer risk from airborne toxic exposure across United States communities from 2011 to 2019. Environ. Sci. Technol. 58, 19115–19127. https://doi.org/10.1021/acs.est.4c02526.

Isingizwe, J., Eiris, R., Gheisari, M., 2023. Racial disparities in the construction domain: a systematic literature review of the US educational and workforce domain. Sustainability 15, 5646. https://doi.org/10.3390/su15075646.

Jbaily, A., Zhou, X., Liu, J., Lee, T.-H., Kamareddine, L., Verguet, S., Dominici, F., 2022. Air pollution exposure disparities across US population and income groups. Nature 601, 228–233. https://doi.org/10.1038/s41586-021-04190-y.

Kravitz-Wirtz, N., Crowder, K., Hajat, A., Sass, V., 2016. The long-term dynamics of racial/ethical inequality in neighborhood air pollution exposure, 1990-2009. Du Bois Rev. 13, 237–259. https://doi.org/10.1017/S1742058X16000205.

Kristal, T., Cohen, Y., Navot, E., 2018. Benefit inequality among American workers by gender, race, and ethnicity, 1982–2015. Sociol. Sci. 5, 461–488. https://doi.org/10.15195/v5.a20.

Landsbergis, P.A., Grzywacz, J.G., LaMontagne, A.D., 2014. Work organization, job insecurity, and occupational health disparities. Am. J. Ind. Med. 57, 495–515. https://doi.org/10.1002/ajim.22126.

Lane, H.M., Morello-Frosch, R., Marshall, J.D., Apte, J.S., 2022. Historical redlining is associated with present-day air pollution disparities in U.S. cities. Environ. Sci. Technol. Lett. https://doi.org/10.1021/acs.estlett.1c01012.

Leeth, J.D., Ruser, J., 2006. Safety segregation: the importance of gender, race, and ethnicity on workplace risk. J. Econ. Inequal. 4, 123–152. https://doi.org/10.1007/s10888-005-9008-2.

Little, R.L., Lovejoy, S.B., 1979. Energy development and local employment. Soc. Sci. J. 16, 27–49.

Liu, J., Clark, L.P., Bechle, M.J., Hajat, A., Kim, S.-Y., Robinson, A.L., Sheppard, L., Szpiro, A.A., Marshall, J.D., 2021. Disparities in air pollution exposure in the United States by race/ethnicity and income, 1990–2010. Environ. Health Perspect. 129, 127005. https://doi.org/10.1289/EHP8584.

Maraniss, D., Weisskopf, M., 1988. The Faces of Pollution : As Cancer, Miscarriages Mount, Louisiana Wonders If It Is a "National Sacrifice Zone". Los Angeles Times.

Messenger, N., 2024. Giving Away the Future: How Louisiana's Industrial Tax Exemption Program (ITEP) Has Failed to Produce Prosperity. Ohio River Valley Institute.

Meyer, J.D., 2014. Race-based job discrimination, disparities in job control, and their joint effects on health. Am. J. Ind. Med. 57, 587–595. https://doi.org/10.1002/ajim.22255.

Mikati, I., Benson, A.F., Luben, T.J., Sacks, J.D., Richmond-Bryant, J., 2018. Disparities in distribution of particulate matter emission sources by race and poverty status. Am. J. Public Health 108, 480–485. https://doi.org/10.2105/AJPH.2017.304297.

Mohai, P., Saha, R., 2015. Which came first, people or pollution? Assessing the disparate siting and post-siting demographic change hypotheses of environmental injustice. Environ. Res. Lett. 10, 115008. https://doi.org/10.1088/1748-9326/10/11/115008.

Mohai, P., Lantz, P.M., Morenoff, J., House, J.S., Mero, R.P., 2009. Racial and socioeconomic disparities in residential proximity to polluting industrial facilities: evidence from the Americans' changing lives study. Am. J. Public Health 99, S649–S656. https://doi.org/10.2105/AJPH.2007.131383.

Muller, W., 2023a. A Company Promised 100 High-Paying Jobs in Jefferson Parish. Now it's Just 13 at Half the Pay. Louisiana Illuminator. https://lailluminator.com/2023/08/28/a-company-promised-100-high-paying-jobs-in-jefferson-parish-now-its-just-13-at-half-the-pay/.

Muller, W., 2023b. Proposed Grain Terminal Would Harm Historic Slave Sites in St. John Parish, Review Finds. Louisiana Illuminator.

Murray, L.R., 2003. Sick and tired of being sick and tired: scientific evidence, methods, and research implications for racial and ethnic disparities in occupational health. Am. J. Public Health 93, 221–226.

Nagra, R., Taylor, R., Hampton, M., Hilderbrand, L., 2021. "Waiting to die": toxic emissions and disease near the Denka performance elastomer neoprene Facility in Louisiana's cancer alley. Environ. Justice 14, 14–32. https://doi.org/10.1089/env.2020.0056.

NAICS Association, 2023a. NAICS Code Description: 325 - Chemical Manufacturing [WWW Document]. NAICS Association. https://www.naics.com/naics-code-description/?code=325. accessed 10.13.23.

NAICS Association, 2023b. NAICS Code Description: 324 - Petroleum and Coal Products Manufacturing [WWW Document]. NAICS Association. https://www.naics.com/naics-code-description/?code=324. accessed 10.13.23.

Neuhauser, A., 2018. Oil Boom a Bust for Blacks. U.S. News & World Report.

Nolan, M.F., Heffernan, W.D., 1974. The rural development act of 1972: a skeptical view. Rural. Sociol. 39, 536–545.

Okechukwu, C.A., Souza, K., Davis, K.D., de Castro, A.B., 2014. Discrimination, harassment, abuse, and bullying in the workplace: contribution of workplace

injustice to occupational health disparities. Am. J. Ind. Med. 57, 573–586. https://doi.org/10.1002/ajim.22221.
Paolella, D.A., Tessum, C.W., Adams, P.J., Apte, J.S., Chambliss, S., Hill, J., Muller, N.Z., Marshall, J.D., 2018. Effect of model spatial resolution on estimates of fine particulate matter exposure and exposure disparities in the United States. Environ. Sci. Technol. Lett. 5, 436–441. https://doi.org/10.1021/acs.estlett.8b00279.
Russell, G., 2019. Louisiana Officials Say They Will Conduct "Comprehensive Study" of Cancer Risks Near Denka Plant. NOLA.com.
Save Ourselves, Inc., 1984. The Louisiana Environmental Control Commission.
Semyonov, M., Lewin-Epstein, N., Bridges, W.P., 2011. Explaining racial disparities in access to employment benefits. Ethn. Racial Stud. 34, 2069–2095. https://doi.org/10.1080/01419871003687552.
Shattuck, T., Nunoo, N.A., 2020. The diversity imperative in oil and gas. J. Pet. Technol.
Sheats, N., 2018. From science to action: leveraging cumulative impacts analyses and tools for environmental justice and health equity. In: American Public Health Association's Annual Meeting & Expo.
Smyth, J., McCormick, M., 2023. 'Sacrifice Zone': Booming US LNG Sector Leaves Its Mark on the Gulf. Financial Times.
State of Louisiana v. U.S. Environmental Protection Agency, et al., 2024.
Tessum, C.W., Apte, J.S., Goodkind, A.L., Muller, N.Z., Mullins, K.A., Paolella, D.A., Polasky, S., Springer, N.P., Thakrar, S.K., Marshall, J.D., Hill, J.D., 2019. Inequity in consumption of goods and services adds to racial–ethnic disparities in air pollution exposure. PNAS 116, 6001–6006. https://doi.org/10.1073/pnas.1818859116.
Tessum, C.W., Paolella, D.A., Chambliss, S.E., Apte, J.S., Hill, J.D., Marshall, J.D., 2021. PM2.5 polluters disproportionately and systemically affect people of color in the United States. Sci. Adv. 7. https://doi.org/10.1126/sciadv.abf4491.
The Royal Society, 2024. Catalysing Change: Defossilising the Chemical Industry (Policy Briefing). The Royal Society.
Till, T., Thompson, A., Marshall, R., 1975. Stages of Industrial Development and Poverty Impact in Nonmetropolitan Labor Markets of the South.
U.S. Bureau of Labor Statistics, 2022. OEWS Research Estimates by State and Industry [WWW Document]. URL. https://www.bls.gov/oes/current/oes_research_estimates.htm.
U.S. Bureau of Labor Statistics, 2024. 2022 Quarterly Census of Employment and Wages.
U.S. EPA, 2023. Risk-Screening Environmental Indicators 2021 Data; Accessed via EasyRSEI Dashboard Version 2.3.12. [WWW document]. https://edap.epa.gov/public/extensions/EasyRSEI/EasyRSEI.html.
U.S. Equal Employment Opportunity Commission, 2023. EEO-1 Data Collection [WWW Document]. US EEOC. https://www.eeoc.gov/data/eeo-1-data-collection. accessed 4.17.23.
Waguespack, M., Summerville Jr., E.F., LeBlanc, K., Brown, G.V., Chapman, A., Seyler, E. P., 2022. Industrial Tax Exemption Program - Program Statistics and Fiscal Impact on Local Governments. Louisiana Legislative Auditor, Baton Rouge, LA.
Wilson, V., Darity Jr., W., 2022. Understanding Black-White Disparities in Labor Market Outcomes Requires Models that Account for Persistent Discrimination and Unequal Bargaining Power. Economic Policy Institute.
Wollensack, L., Budzinski, K., Backmann, J., 2022. Defossilization of pharmaceutical manufacturing. Curr. Opin. Green Sustain. Chem. 33, 100586. https://doi.org/10.1016/j.cogsc.2021.100586.
Zwickl, K., Ash, M., Boyce, J.K., 2014. Regional variation in environmental inequality: industrial air toxics exposure in U.S. cities. Ecol. Econ. 107, 494–509. https://doi.org/10.1016/j.ecolecon.2014.09.013.