Benefits and Disbenefits of Legacy Diesel Fleet Turnover for Historically Marginalized Communities

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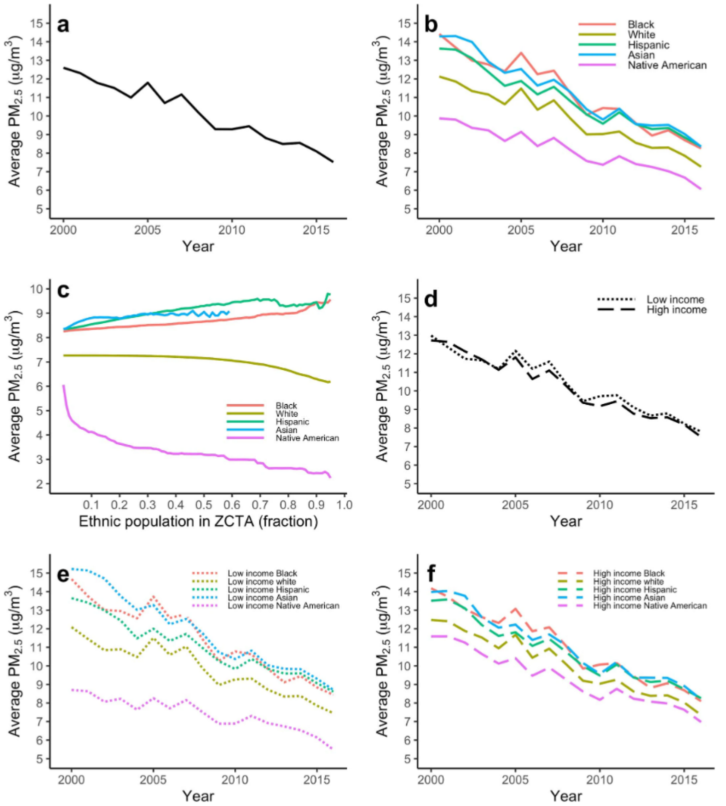
Disparities in Exposure to Traffic-Related Air Pollution

Extended Data Fig. 1: Summary $PM_{2.5}$ metrics across racial/ethnic and income groups.

From: Air pollution exposure disparities across US population and income groups



Source: (Jbaily et al., 2022)

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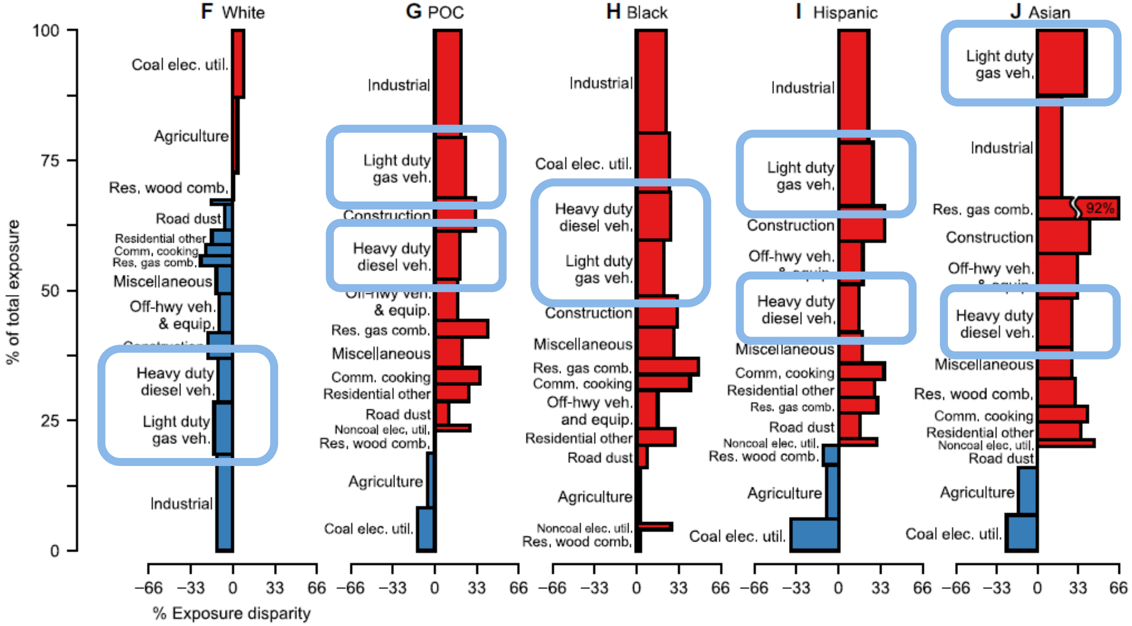

Fig. 1. Source contributions to racial-ethnic disparity in $PM_{2.5}$ exposure. (**A** to **E**) Individual source type ($n = 5434$ source types) contributions to exposure (*y* axis) and % exposure disparity (*x* axis, truncated at 200%, positive values are shaded red, negative values are shaded blue), with dashed lines denoting percent exposure caused by sources with positive exposure disparity. (**F** to **J**) Sources in (A) to (E) grouped into source sectors ($n = 14$ groups) and ranked vertically according to absolute exposure disparity, proportional to the area of each rectangle. As shown in (B), POC experience greater-than-average exposures from source types causing 75% of overall exposure. Source: data file S1, which also includes results for individual states and urban areas.

Source: (Tessum et al., 2021)

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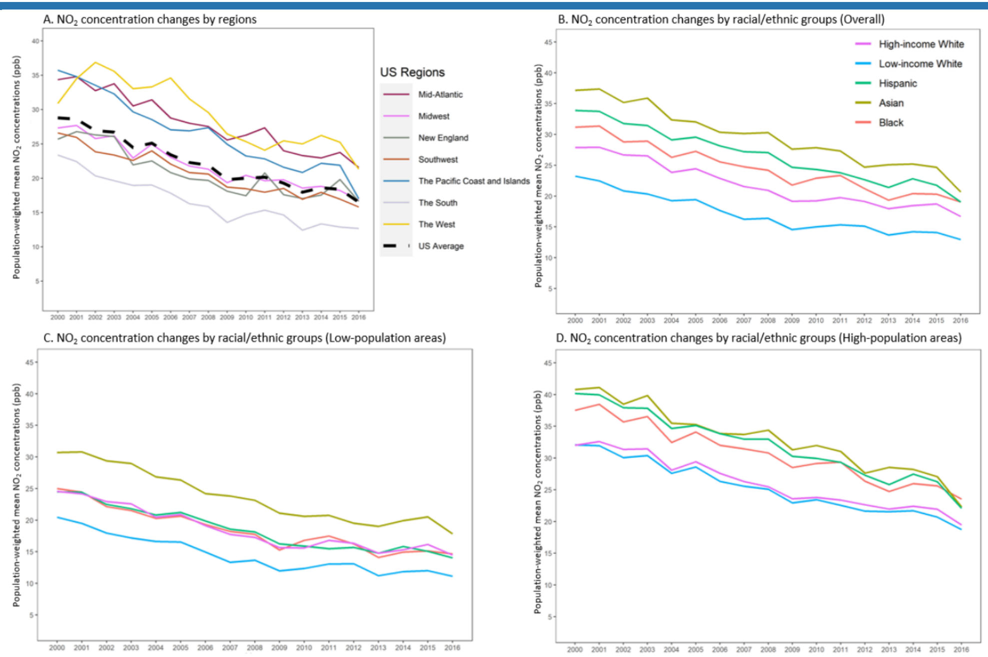

Figure S5. Time trends of NO_2 exposure level from 2000 to 2016 by regions or racial/ethnic groups (A: NO_2 concentration changes by regions; B: NO_2 concentration changes by racial/ethnic groups for all block groups across the U.S.; C: NO_2 concentration changes by racial/ethnic groups in low-population areas; D: NO_2 concentration changes by racial/ethnic groups in high-population areas)

Source: (Wang et al., 2023)

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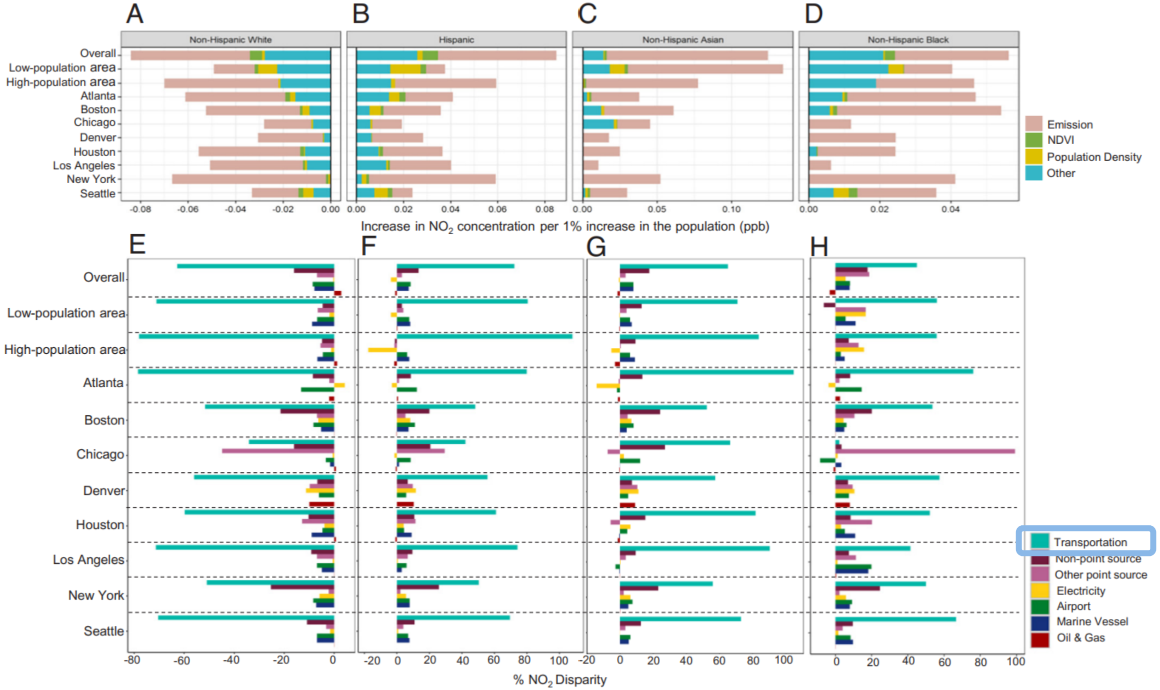

Fig. 3. Source contributions to racial/ethnic disparity in NO_2 exposure across the United States and MSAs (*A*–*H*). Sensitivity value of NO_2 exposure to the proportion of each racial/ethnic group across block groups (*A*–*D*). Breakdown of contributions from different emission sources to the emission-associated disparities for different racial/ethnic groups (*E*–*H*).

Source: (Wang et al., 2023)

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Disparities in Associated Health Risks

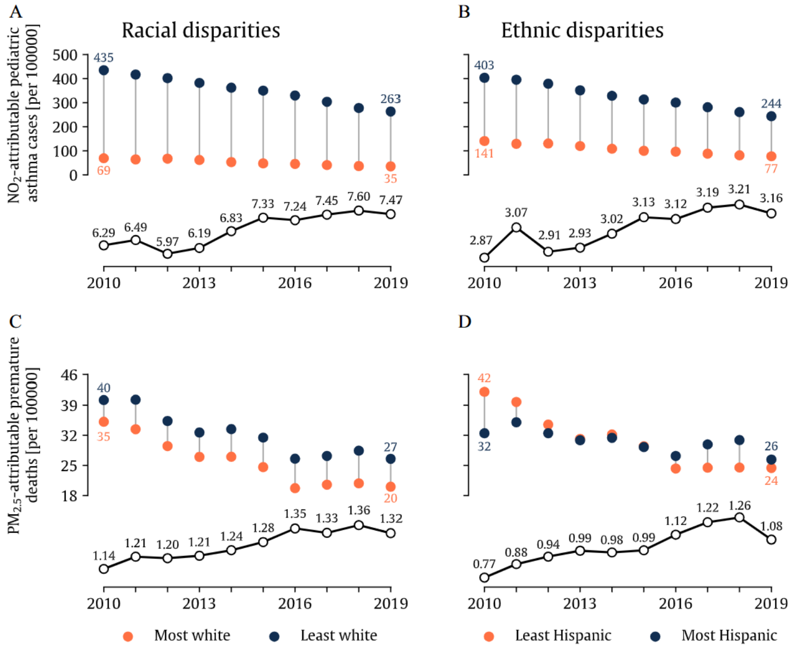
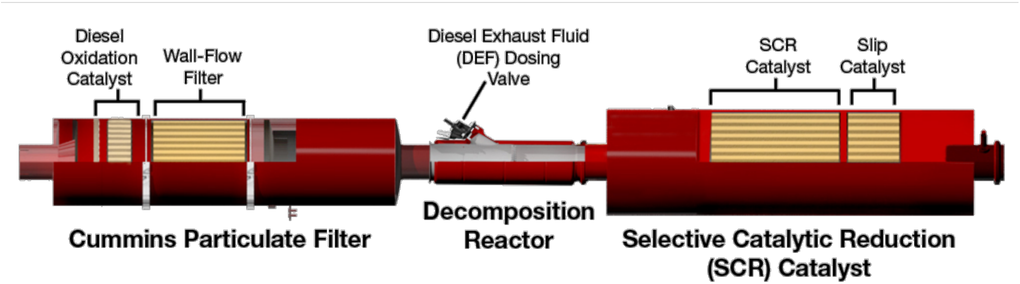


Figure 5. Trends in (A and B) NO_2-attributable pediatric asthma and (C and D) $PM_{2.5}$-attributable premature mortality rates for the most and least white and Hispanic tracts in the US. Black time series and corresponding text beneath each panel indicate the relative disparities, defined as the ratio of the rate for the bottom decile population subgroup (least white, most Hispanic) to the rate for top decile (most white, least Hispanic). A value of 1 for relative disparities implies that pollution-attributable burdens are equally shared across subgroups. For reference, rates for the first and last years of the analysis are indicated alongside the scatter points. Note: $PM_{2.5}$, fine particulate matter with aerodynamic diameter ≤ 2.5 µm.

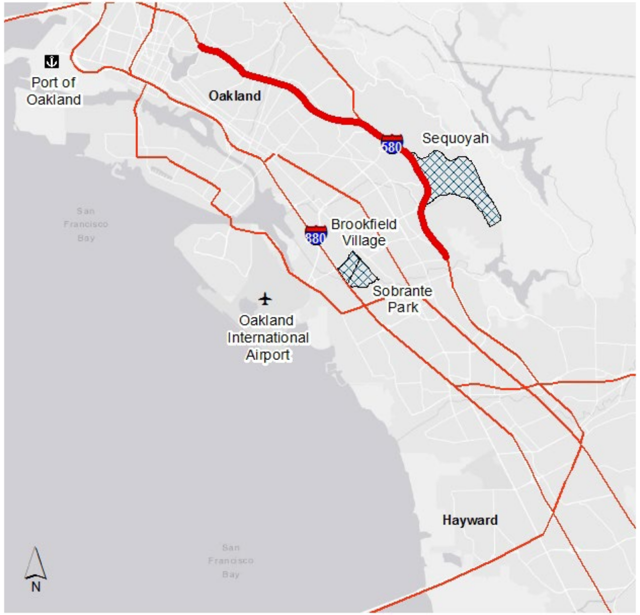
Source: (Kerr et al., 2024)

Effects of Accelerated Fleet Turnover in CA



- Exhaust after-treatment control technologies:
  - Diesel particle filters (DPFs) for PM control (2007+ MY)
  - Selective catalytic reduction (SCR) systems for NO_x control (2010+ MY)
- CA rules require all heavy-duty diesel engines have DPFs by 2018 and both DPFs + SCR by 2023

Study Area: East Oakland Freight Corridor



- I-880
  - Carries highest volumes of trucks in the region
- I-580
  - No trucks over 4.5 tons along segment indicated by **thick red line**
  - The *only* Interstate Freeway not open to trucks
- All truck traffic, including port- and airport-related freight movement must travel on I-880

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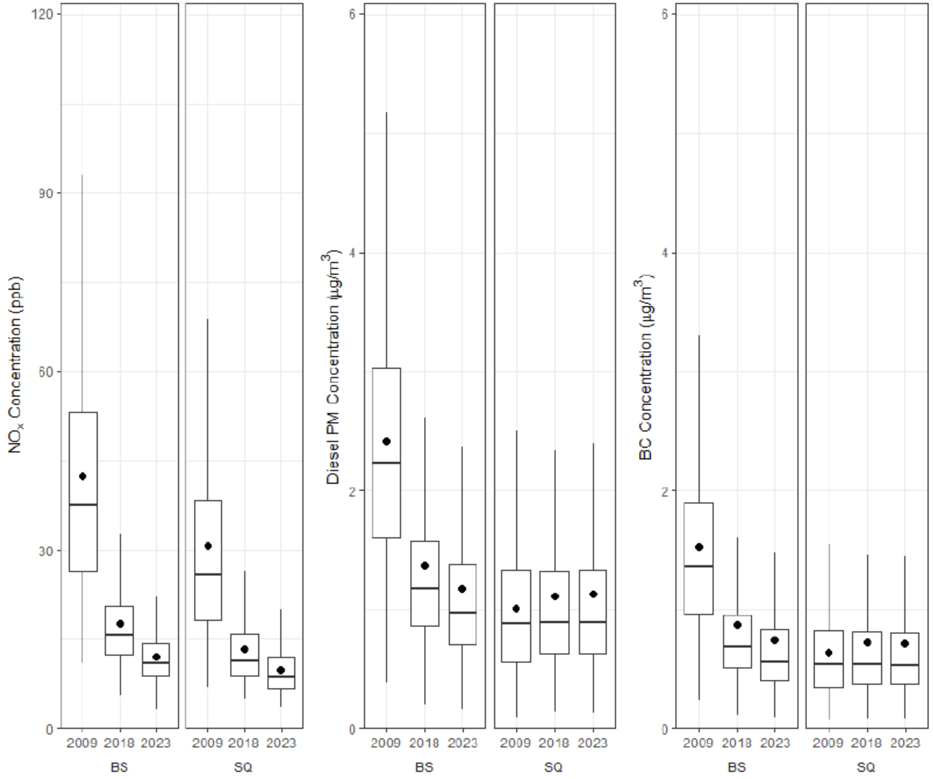
Reduction in Exposure Disparities



Source: (Patterson and Harley, 2021)

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Proliferation of Warehouses in Historically Marginalized Communities

Current work examines the relationship between warehouse growth and highway expansion, and its air quality implications (Lee and Patterson, under review)

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Conclusion

- Policies that accelerate legacy diesel fleet turnover are essential for achieving near-term reductions in disparities in exposure to traffic-related air pollution and its associated health risks
- Warehouse growth increases the urgency to replace legacy diesel fleets

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Thank You

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