How does U.S. pollution disparity respond to environmental policies?

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Across the U.S., pollution exposures have been shown to be systematically higher in places where disadvantaged communities reside.[1] What is less clear is which class of environmental policies would narrow these disparities. Pollution disparities depend on where polluting facilities are located, where disadvantaged households live, and the atmospheric transport patterns that disperse facility pollution onto households (Deschenes and Meng, 2018; Hernandez-Cortes and Meng, 2020). Failure to characterize these spatial relationships may lead to environmental policies with limited equity benefits. For example, targeting a polluting facility equally upwind of disadvantaged and other communities may not reduce pollution disparities as much as shutting down a facility that is more disproportionately upwind of disadvantaged communities.

In this study, we combine $PM_{2.5}$ emissions data from the near-universe of major U.S. polluting facilities with an atmospheric transport model to rank each facility's contribution to the U.S. $PM_{2.5}$ disparity. With that ranking in hand, we consider the pollution disparity consequences for the facility-level pollution reductions induced by various existing and proposed environmental policies. This will evaluate sector-specific policies, state-level policies, as well as both command-and-control and market-based approaches. We augment our analysis with facility-level data capturing pollution abatement costs to quantify any potential trade-offs between the efficiency in which pollution abatement is allocated across facilities and equity consequences in terms of changing pollution disparity.

To illustrate our approach, Figure 1 shows the disparities in pollution exposure for two oil refineries in Los Angeles. Notably, the PBF Energy, Torrance (panel a) and Phillips

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[1]Disparities across various pollutants in the U.S. have been documented through case (Bullard, 2000; Bowen, 2002; Ringquist, 2005; Mohai, Pellow and Roberts, 2009; Banzhaf, Ma and Timmins, 2019) and population-level (Colmer et al., 2020; Currie, Voorheis and Walker, 2020) studies.

66, Wilmington (panel b) refineries have similar output capacities and are located only 9 kilometers apart.[2] The intensity of red shading depicts intensity of total $PM_{2.5}$ concentrations across Census Tracts following a pulse of emissions from each refinery, as generated by an atmospheric transport model (Tessum, Hill and Marshall, 2017).[3] Census Tracts outlined in gray indicate those that are categorized as a "disadvantaged community" (DAC) under SB 535 by the State of California CalEPA (2018). More disadvantaged communities are downwind of the Torrance refinery. Specifically, 70% of resulting pollution concentration is borne by disadvantaged communities whereas that share is 60% for the Wilmington refinery. Thus, a policy reducing emissions from the Torrance refinery will narrow local pollution disparities more than a similar reduction from the Wilmington refinery, with likely little difference in the policy's compliance cost given the two refineries similar capacities and locations.

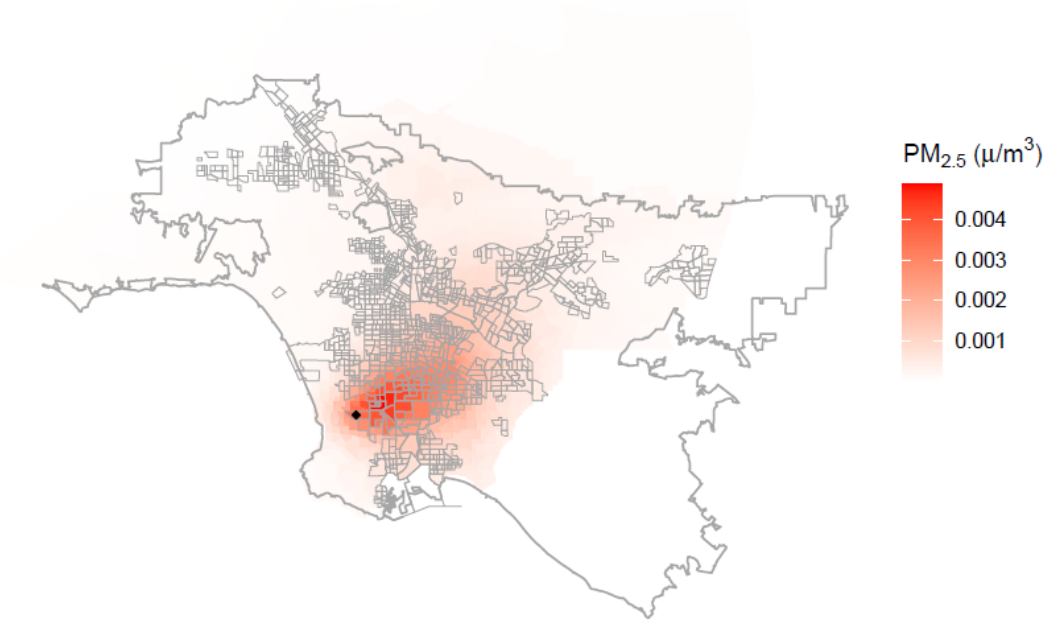
Our paper aims to replicate the information contained in Figure 1 for the near-universe of major polluting facilities across the U.S. This will enable us to systematically document the pollution disparity consequences of a variety of existing and proposed environmental policies and inform an analysis of the equity-efficiency trade-offs across these policies.

[2]Torrance refinery has a capacity of 160,000 barrels per day and Phillips 66 refinery has a capacity of 139,000 barrels per day.

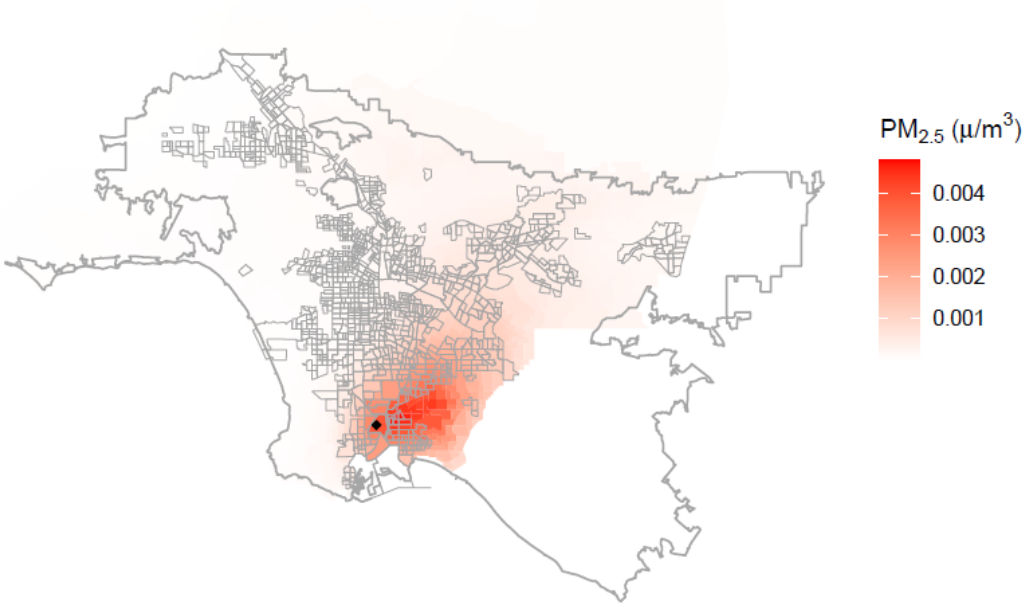
[3]Specifically, we simulate for each facility a 1-ton pulse of NO_x, SO_x, $PM_{2.5}$, PM_{10} and NH_3 and calculated the resulting total $PM_{2.5}$ concentration at the census tract level. InMap accounts for atmospheric chemical reactions such that the reported total $PM_{2.5}$ concentration accounts for primary $PM_{2.5}$ emissions and secondary $PM_{2.5}$ emissions from other pollutants.

Figure 1: Two refineries in Los Angeles

(a) PBF Energy, Torrance Refinery



(b) Phillips 66, Wilmington Refinery



NOTES: Panels illustrate the location of two refineries in Los Angeles metropolitan area (black points), the location of disadvantaged communities defined by SB 535 (gray polygons), and the $PM_{2.5}$ pollution levels (g/m^3) associated to a 1-ton increase in NO_x, SO_x, $PM_{2.5}$, PM_{10} and NH_3 using InMap pollution transport model. Panel (a) shows the pollution exposure from PBF Energy, Torrance Refinery and Panel (b) shows the pollution exposure from Phillips 66, Wilmington Refinery.

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