How Does EV Adoption Affect Air Quality for Low-Income and Minority Households?

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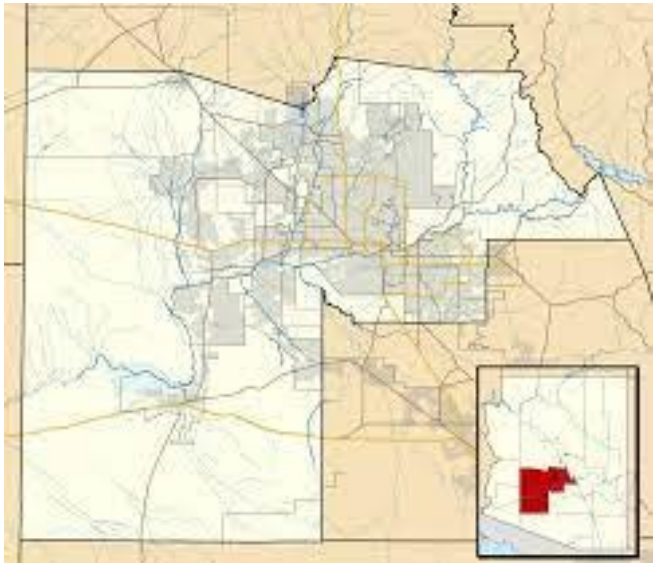
Motivation

- Electric vehicles shift criteria air pollutant emissions from mobile sources along the highways to point source electricity generators.

- In aggregate, this is expected to be positive as along as the power is not coal-based but powerplants can lead to more concentrated distribution of those fewer emissions.

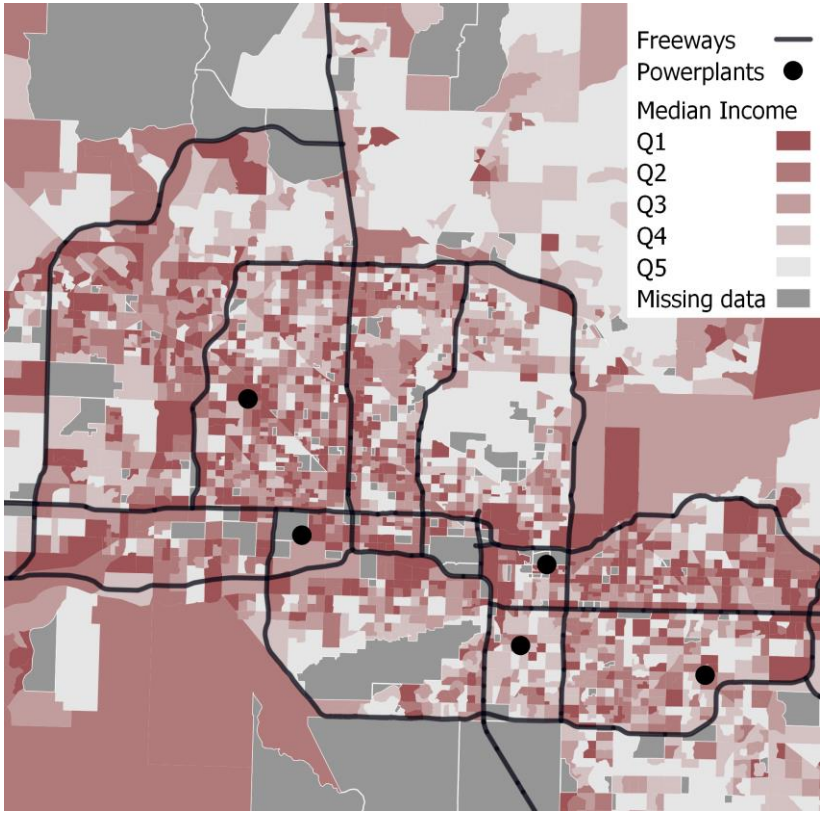
Maricopa County, Arizona



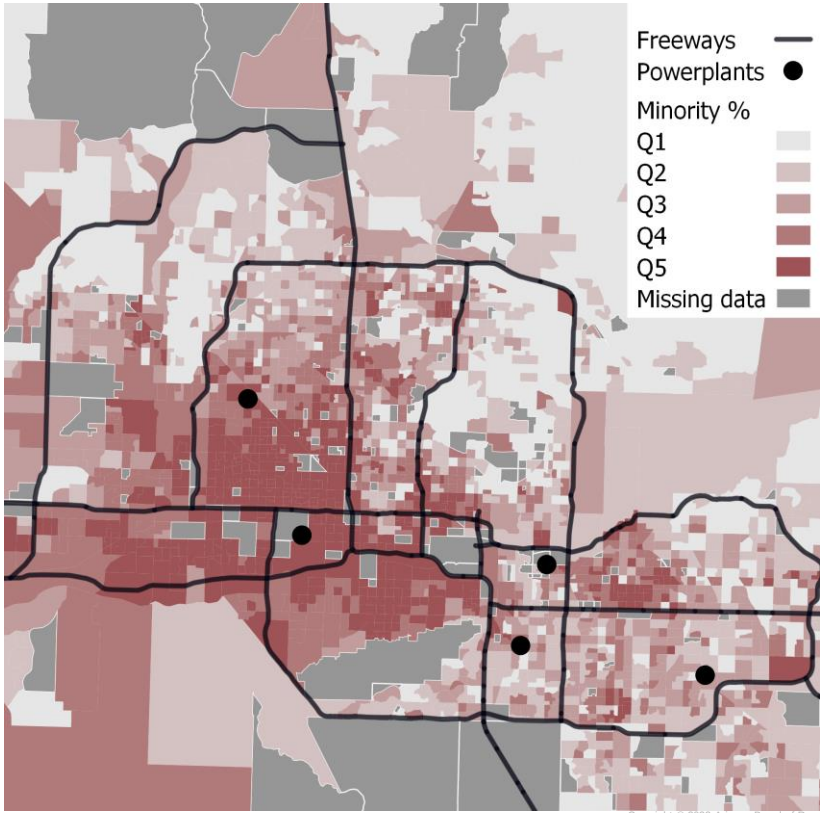
- Fast growing, highly car dependent region
- Phoenix metro area is the 5th worse in the nation for ozone pollution and 13th worse for $PM_{2.5}$ pollution.
- On-road **mobile sources** are responsible for **43% of NOx** (18,604 tons/year) and **17% of $PM_{2.5}$** emissions (3,313 tons/year) in Maricopa County in 2020.
- Power generation is responsible for less than **9% of NOx** and **3.3% of $PM_{2.5}$** emissions.

Disadvantaged communities and pollution sources

Income



Minority percent



Methods

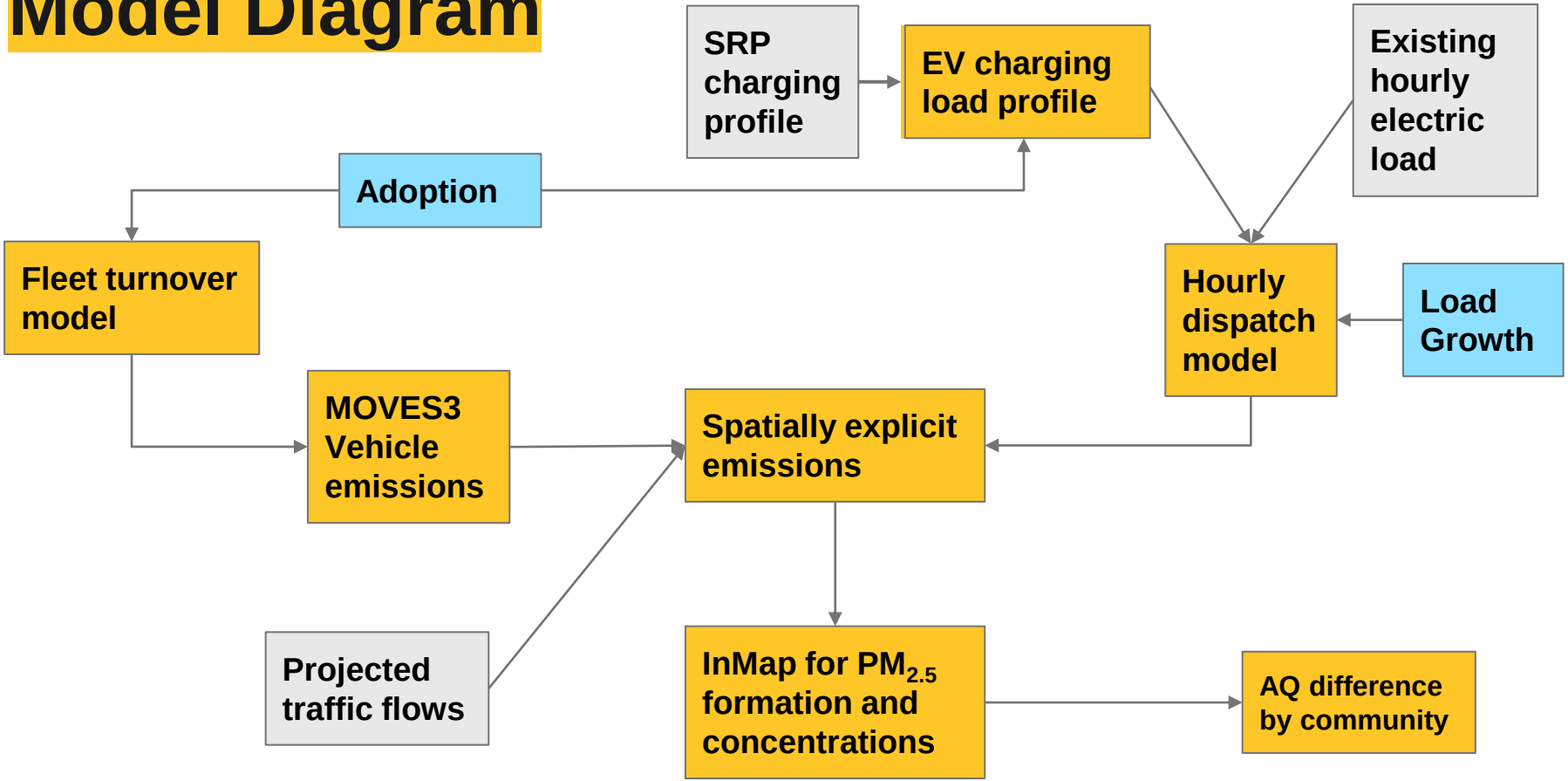
Scenarios of light-duty vehicle (LDV) electrification

Model spatial emissions from transportation and electricity

Reduced form air pollution model for PM2.5

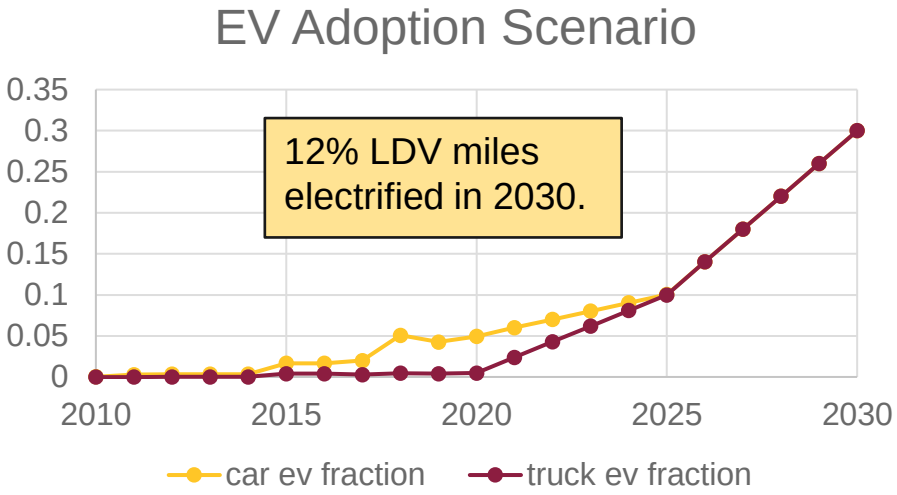
Compare incidence of pollution concentrations by census block groups

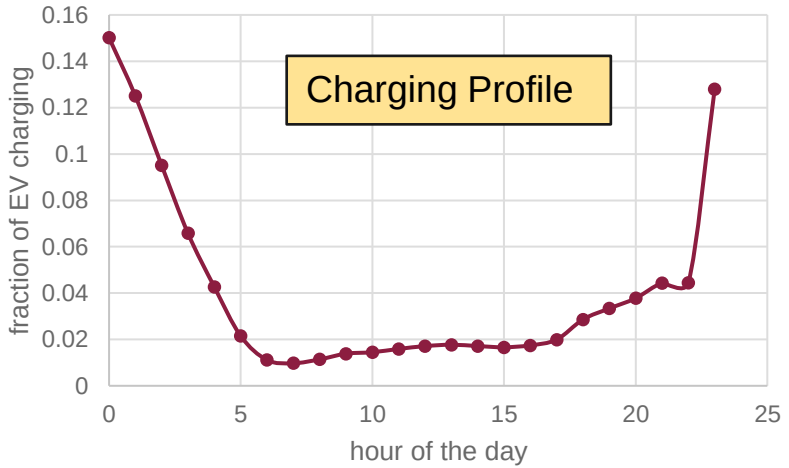
Model Diagram



Scenarios

- Baseline represents 2019-2021 average
- No EV adoption case
- EV adoption case – 30% of new vehicle sales in 2030, evenly distributed spatially
- Electricity includes existing and planned power plants



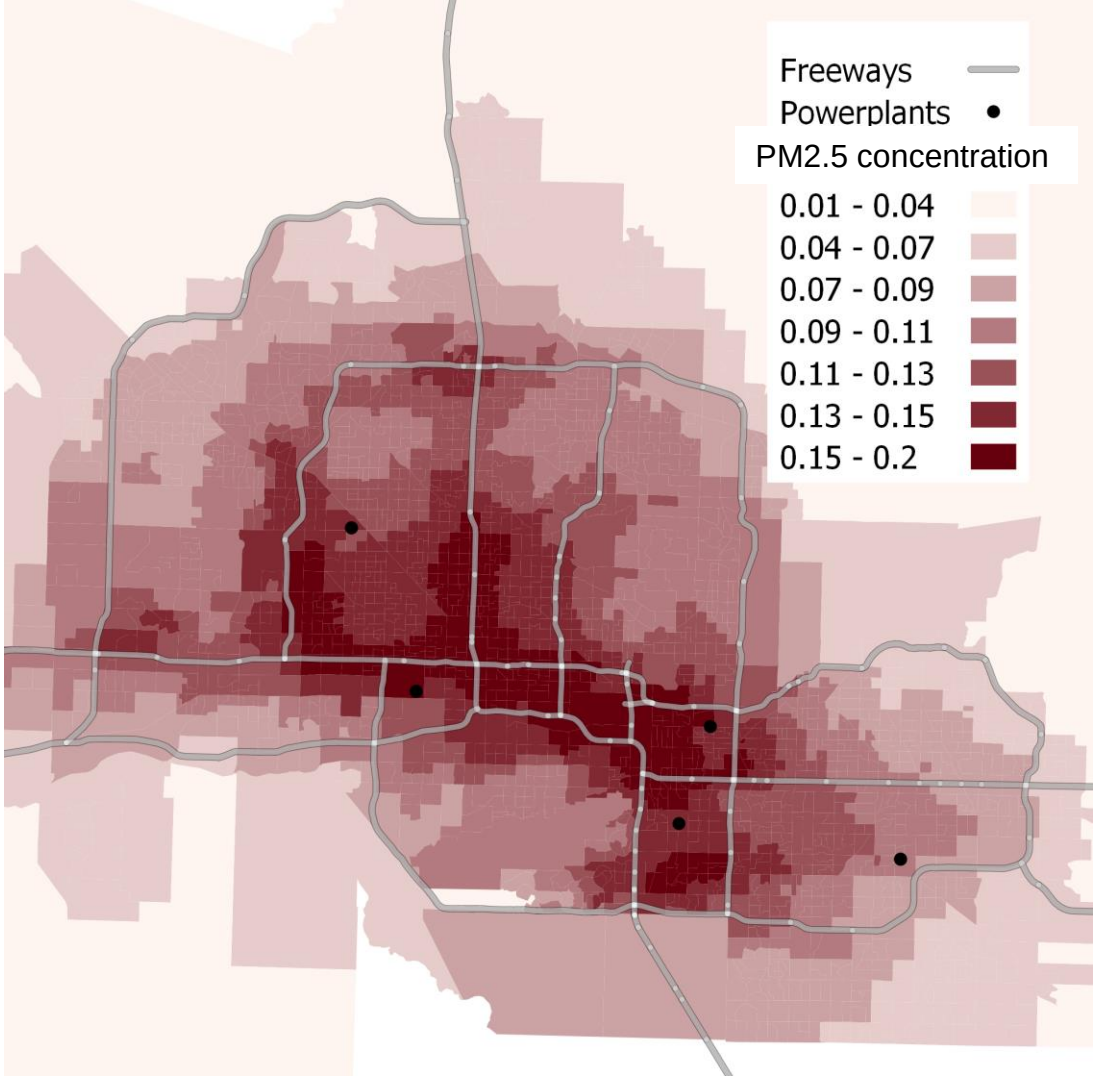


Results

- Baseline
- Changes 2021 – 2030
- Impact of EV adoption

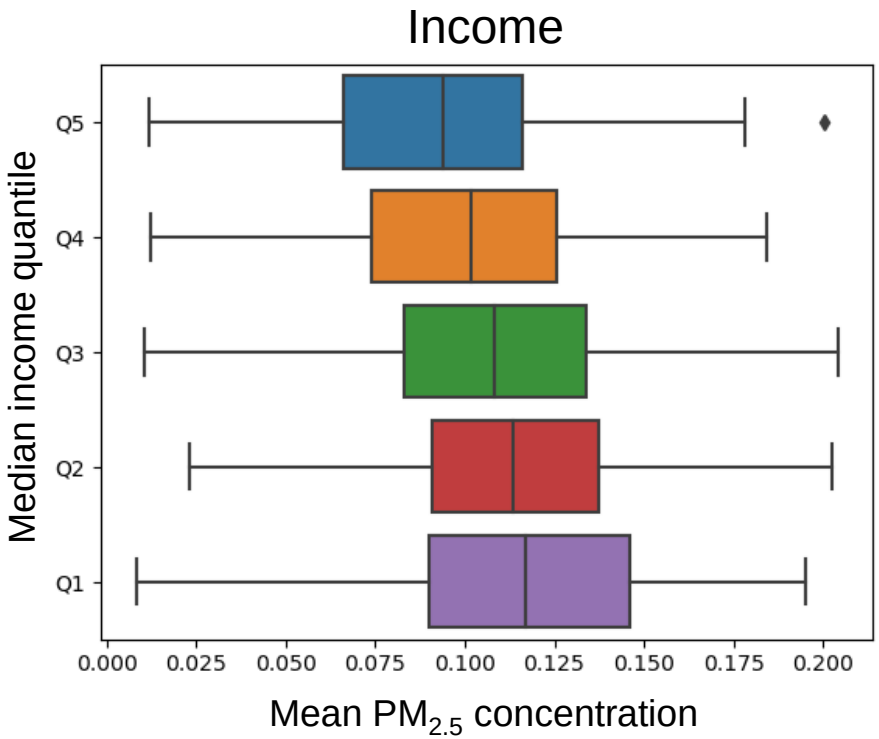
Baseline $PM_{2.5}$ concentrations

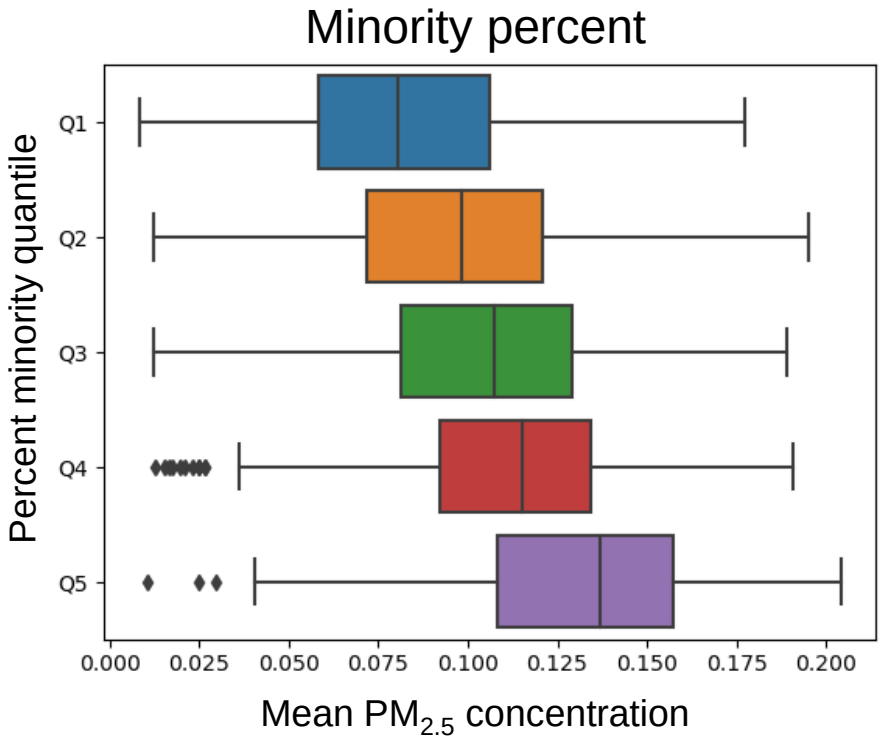
Air pollution is worst along high traffic volume roads and at freeway junctions.



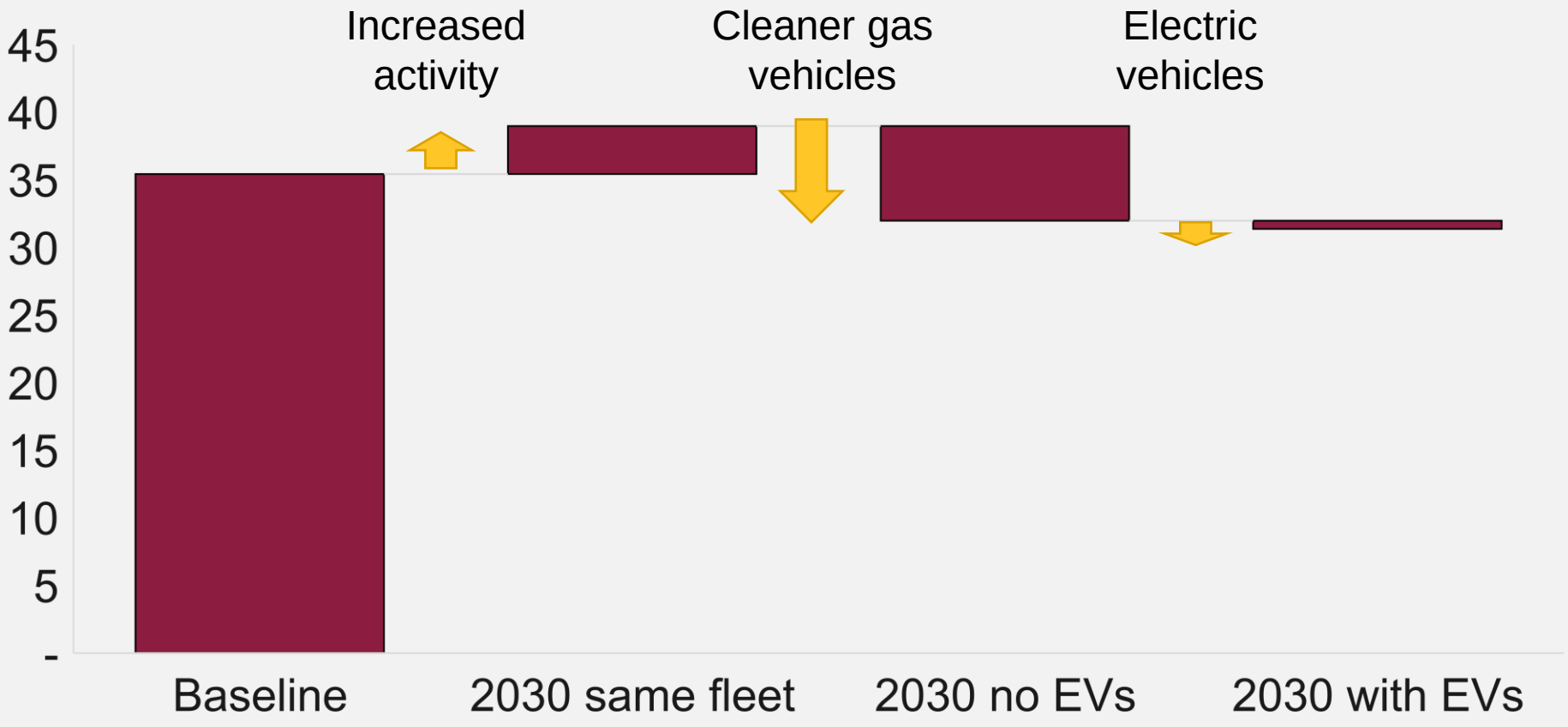
Baseline $PM_{2.5}$ concentrations

Higher pollution concentrations in lower income and minority block groups

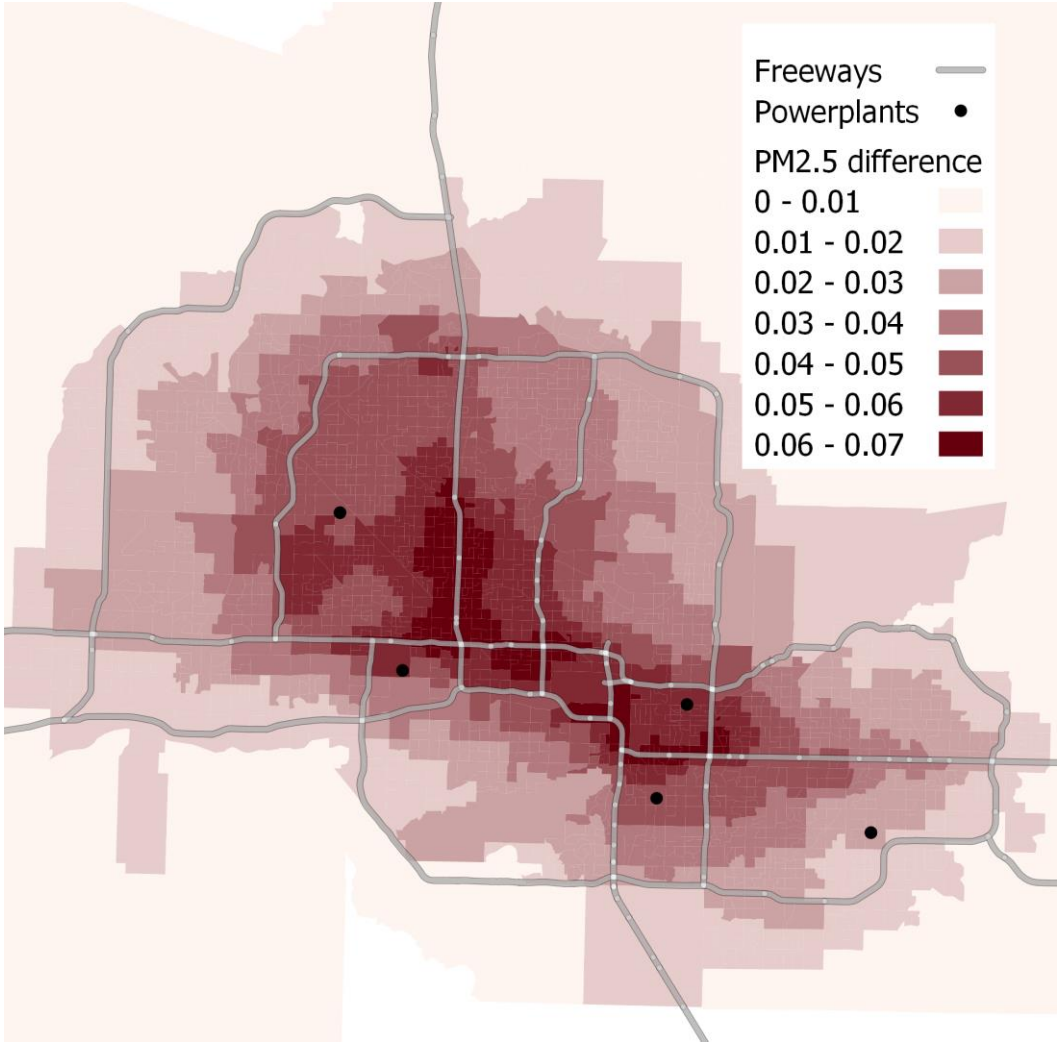




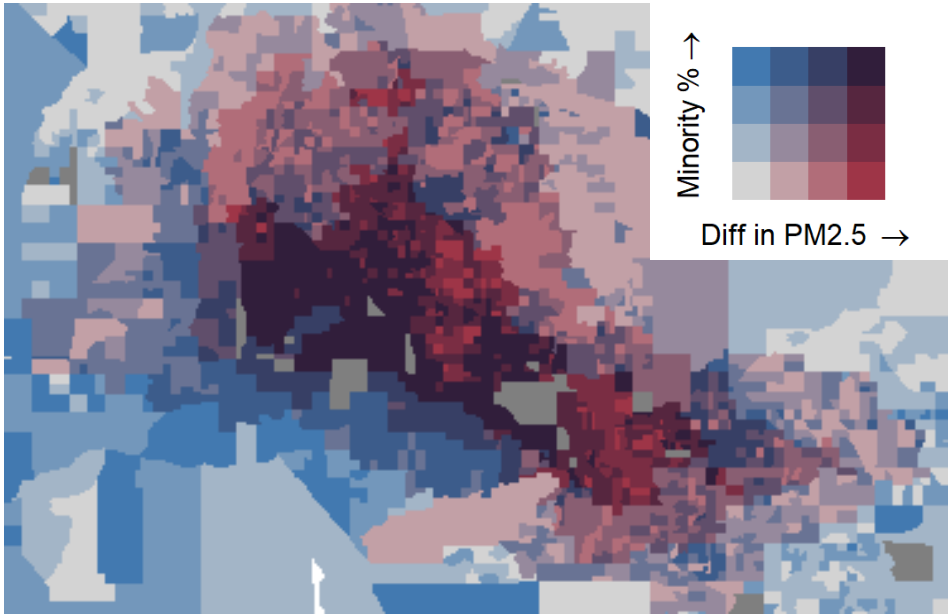
NO_x emissions change 2021 to 2030

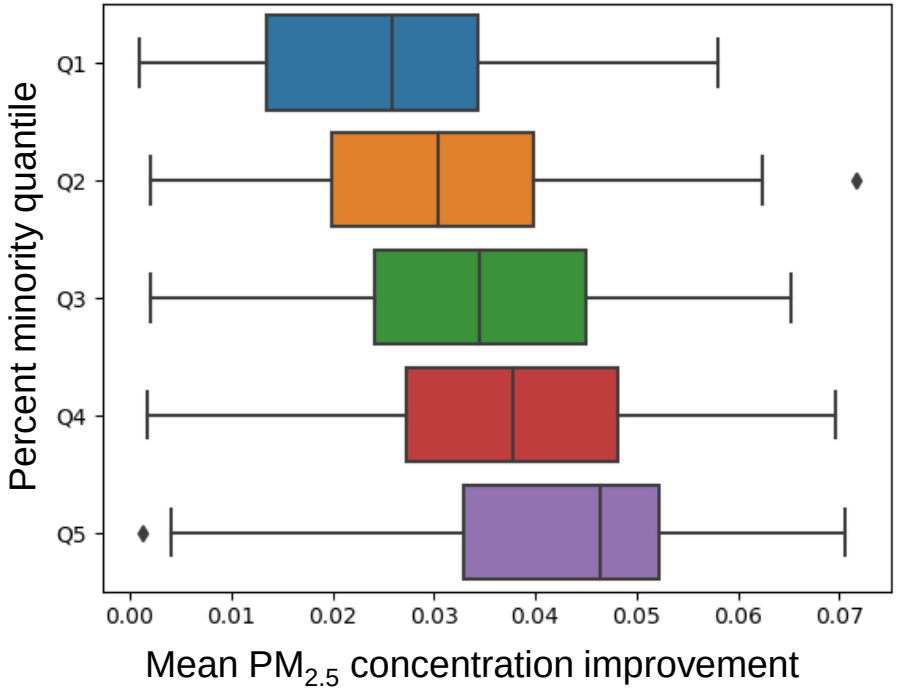


Change in PM2.5 concentration due to electric vehicles in 2030

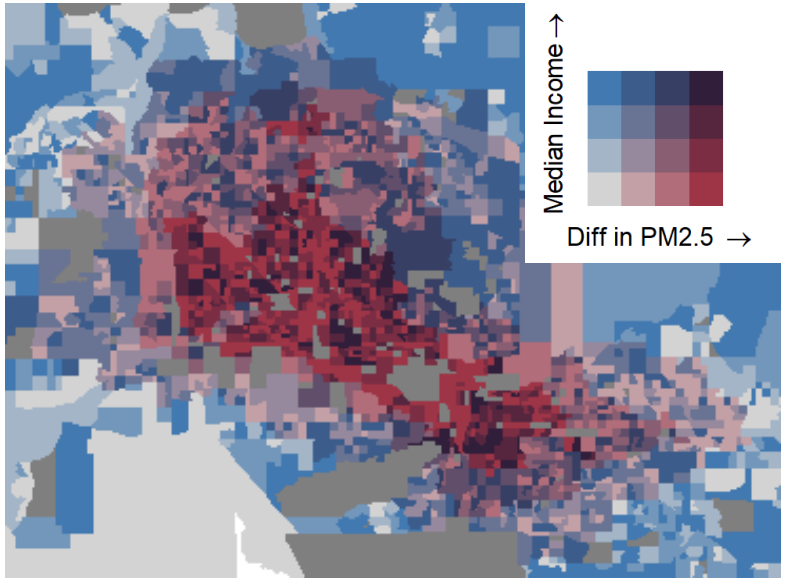


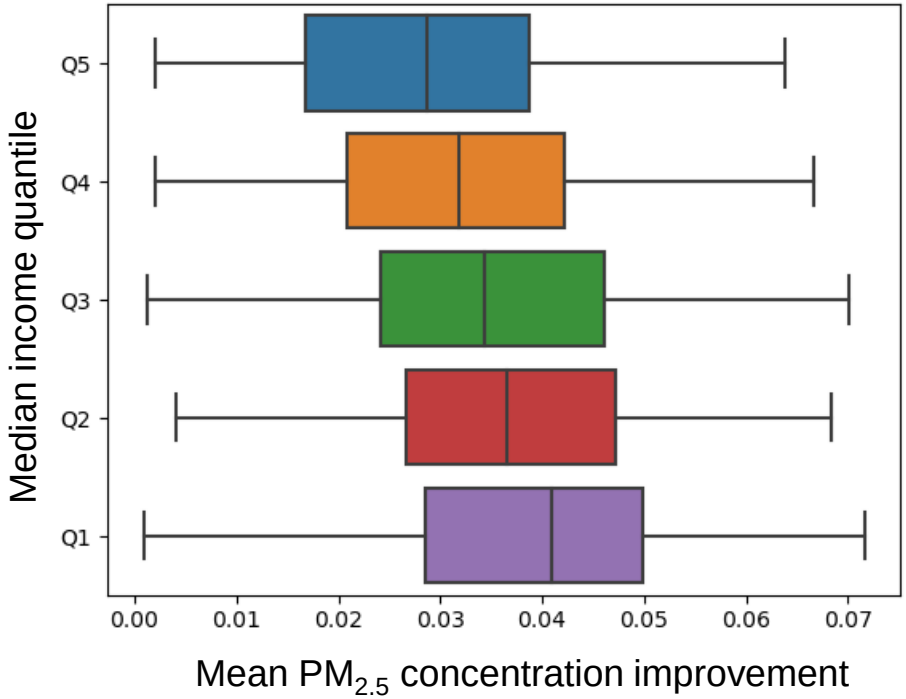
Benefit of electrification distributed by minority fraction in 2030





Benefit of electrification distributed by median income in 2030





Thoughts and discussion

- In Phoenix, increased emissions from generation are offset by reductions from vehicles even at the local scale.
- LDV electrification at expected rates provide small air pollution benefits across the board.
- Disadvantaged communities see higher absolute reductions in pollution.
- Biggest impact on pollution over time is from cleaner ICE vehicles

Questions? Please feel free to contact us!

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Baseline: Electricity generation

We obtained the total monthly pollution generation from power plants in Maricopa County for an average year.

Data details:

1. Power plant location: CEMS
2. Power plant generation: EIA (monthly), eGRID (annual), CEMS heat input (hourly)
3. Emission factors:eGRID, CEMS

We obtained two buffers surrounding facilities:

1. 1 Km buffer
2. 5 Km buffer

Defined affected census block groups and obtained pollution exposure by average weighted distance exposure.