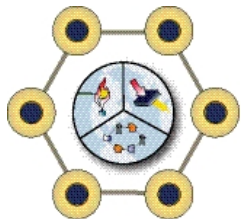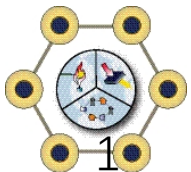# Air Quality and Public Health Benefits of California's 2022 Climate Change Scoping Plan

**ADVANCED POWER & ENERGY PROGRAM**
UNIVERSITY *of* CALIFORNIA · IRVINE

**August 17, 2021**
**Sacramento, CA**

# Air Quality and Public Health Benefits

- **Assess the air quality and public health benefits that result from the Scoping Plan Scenario(s) relative to a Reference Scenario**
  - Quantify health savings from improvements in outdoor air pollution
  - Identify scenarios that maximize air quality co-benefits
  - Provide insight into health savings within disadvantaged communities
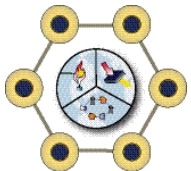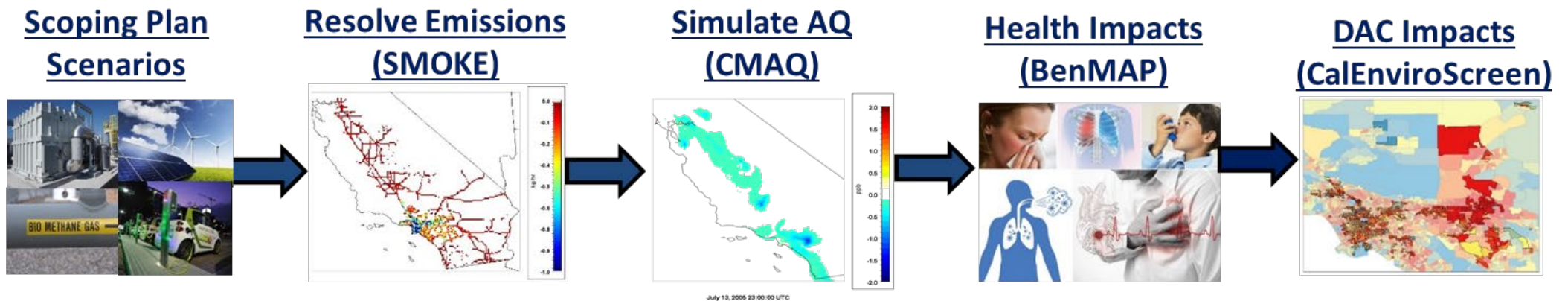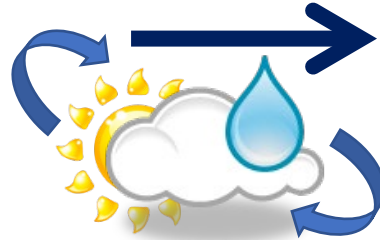
# Assessing Air Quality

**2.**

**Atmospheric Chemistry** $+$ **Transport** $=$ **Air Pollution**

$NOx + VOC + Sunlight \rightarrow Ozone$

$NO_x/SO_x/VOC \rightarrow PM_{2.5}$



$+$

$=$

**1.**

**Emissions**

$NO_x$     $SO_2$

$VOC$

$PM$     $CO$



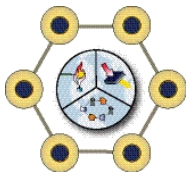Two kinds of pollutants in the atmosphere:
1.     **Primary (Emitted)**
2.     **Secondary (Formed)**

Secondary $PM_{2.5}$ is particularly important for health impacts

**Health Impacts**



**3.**

# 1. Emissions Modeling

- **Develop an emissions inventory for both the Reference and SP scenario(s) which include all emission sources in California**

  1. Map changes in end-use sectors from PATHWAYS to CARB emission inventory
     - Utilize energy consumption, fuel, and technology stock data to project total emissions
  2. Spatially and temporally assign emissions to locations of source activity
     - Sparse Matrix Operator Kernel Emissions (SMOKE) model used to input the locations of each emission source (e.g., refineries, roadways, industrial activity, buildings)
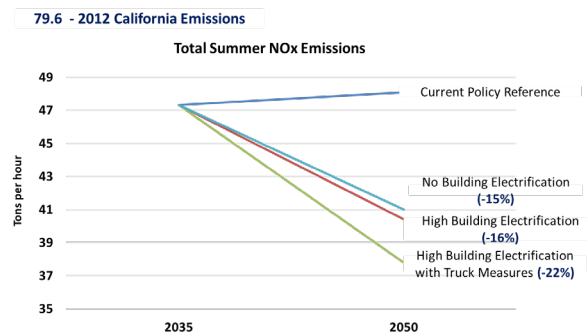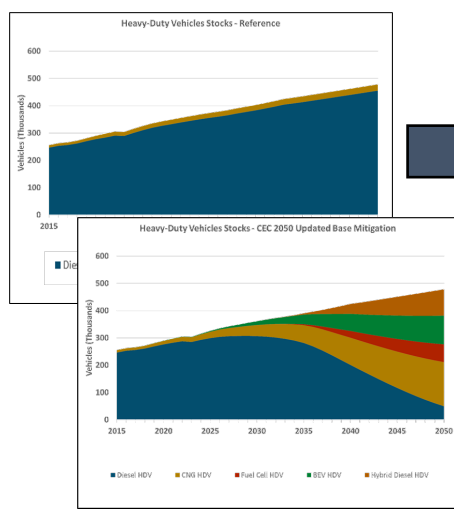


**\*Example Results Only\***
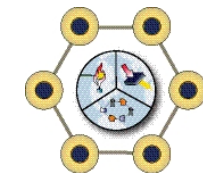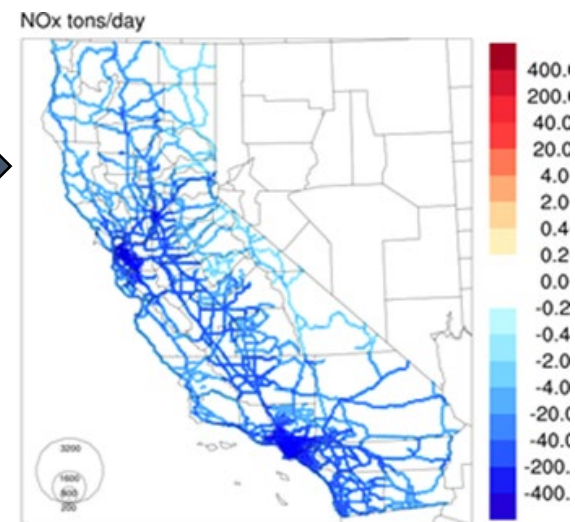
# 1. Emissions Modeling

- **Final emissions will combine information on the location, timing and totals of pollutant emissions with projections from PATHWAYS**
  - CARB emission inventory has highly detailed information for emission sources
  - PATHWAYS output is at the state level and will be used to estimate the future emissions

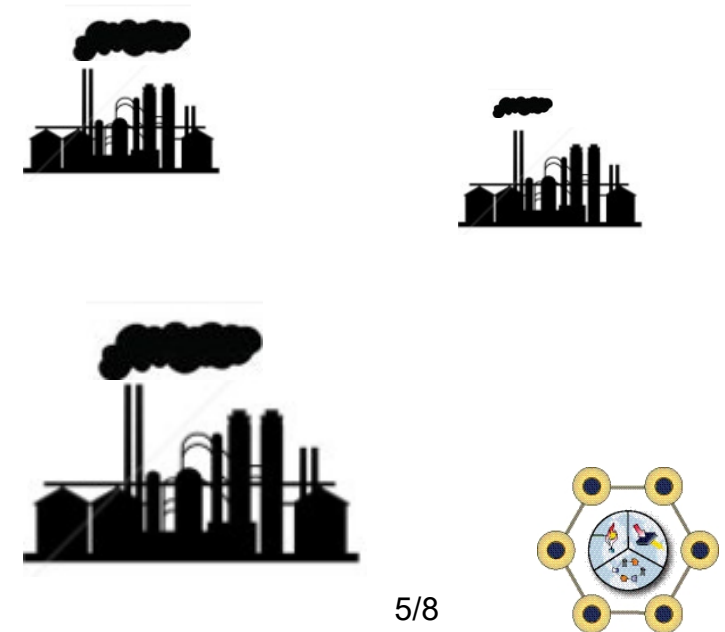**CARB inventory provides the location and current emissions for all refineries**
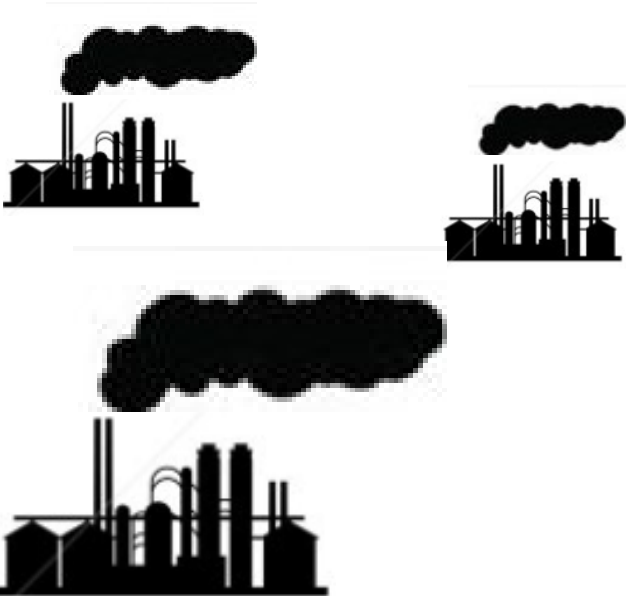
**PATHWAYS provides change in refinery energy consumption to a future year at the state level**
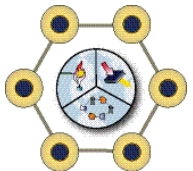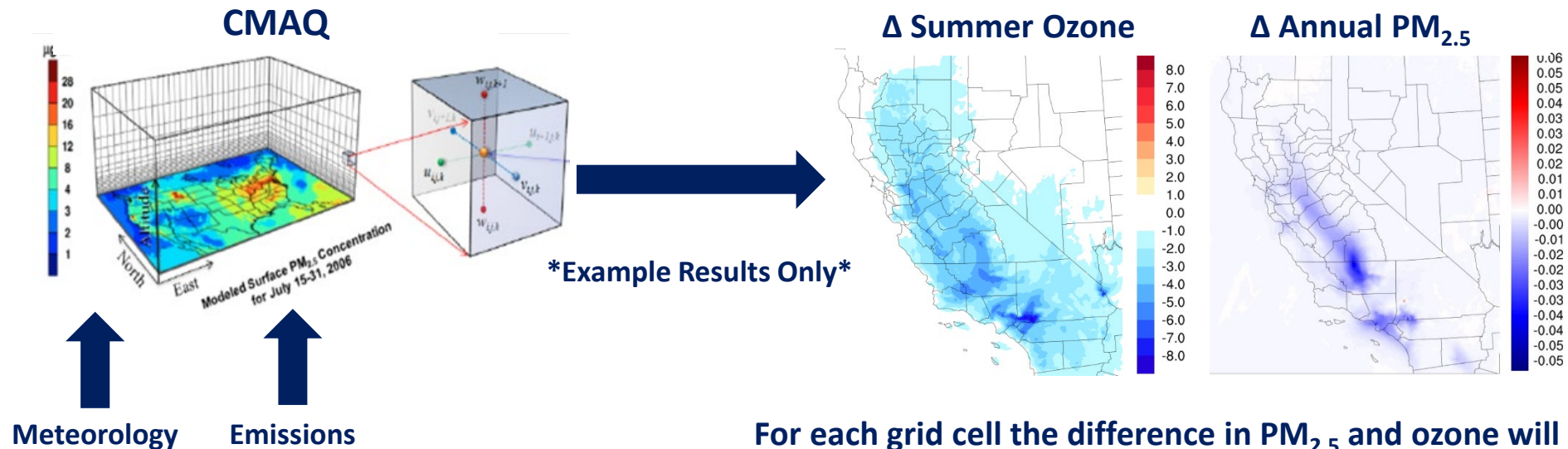
**E.g., 80% reduction in refinery emissions statewide**

**Future year emissions for refineries**

# 2. Air Quality Modeling

- **An advanced air quality model (CMAQ) will be used to translate changes in emissions into changes in air pollutant concentrations**
  - o Wide-spread use for regulatory and research purposes
  - o Simulate atmospheric chemistry and transport at 4 km x 4 km (2.5 mile) resolution
    - Allows for a comprehensive understanding of how air quality changes due to the emission reductions in the SP scenario by including both primary and secondary pollutants



**CMAQ**

*Example Results Only*

Meteorology     Emissions

**Δ Summer Ozone**          **Δ Annual PM$_{2.5}$**

**For each grid cell the difference in PM$_{2.5}$ and ozone will be calculated and used as input into the health impact assessment**
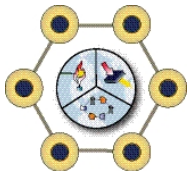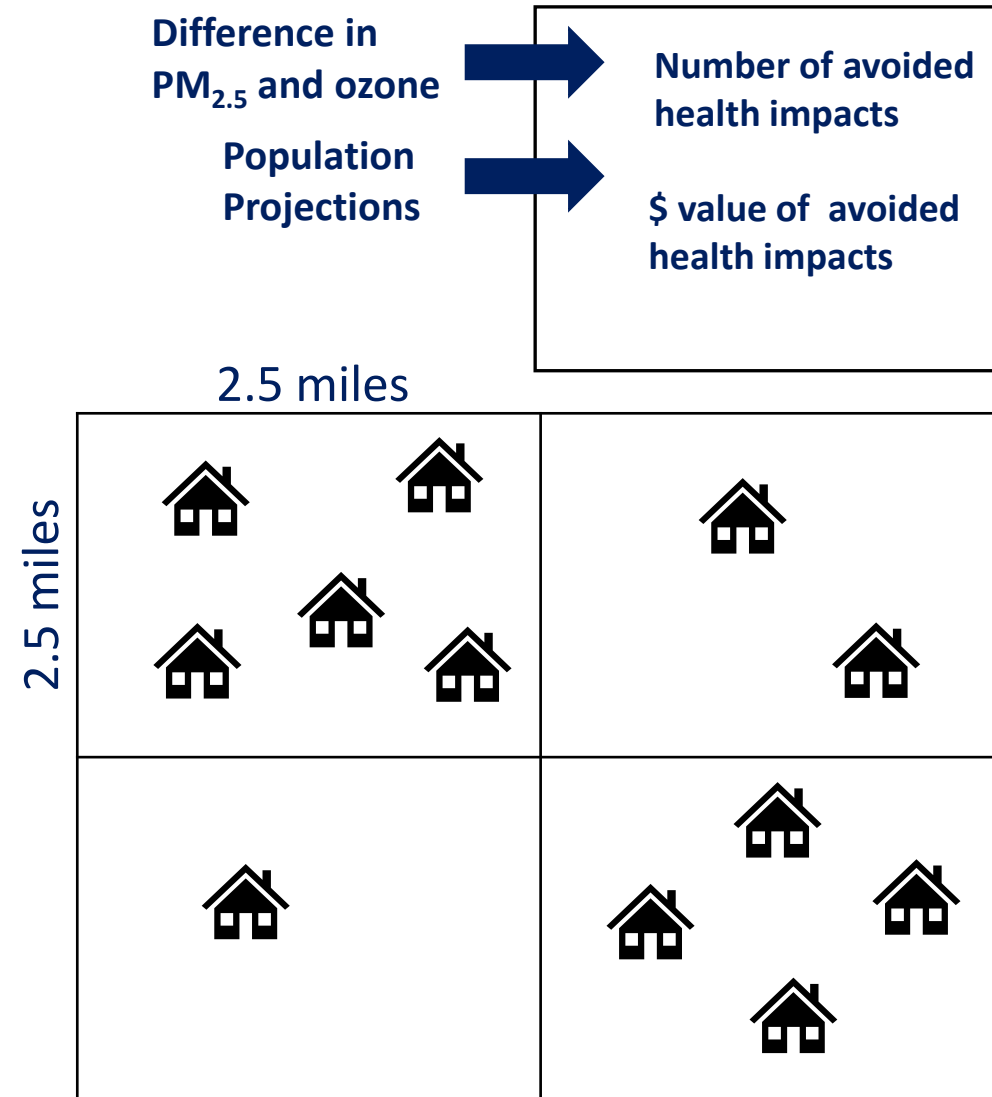
# 3. Health Impact Assessment

- **Environmental Benefits Mapping and Analysis Program (BenMAP) will be used to translate pollutant changes from CMAQ into health impacts**
    - BenMAP estimates the avoided incidences of health effects from reduced exposure to $PM_{2.5}$ and ozone that occur in California populations from the improved air quality in the SP scenario
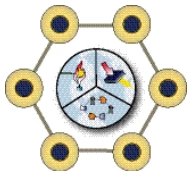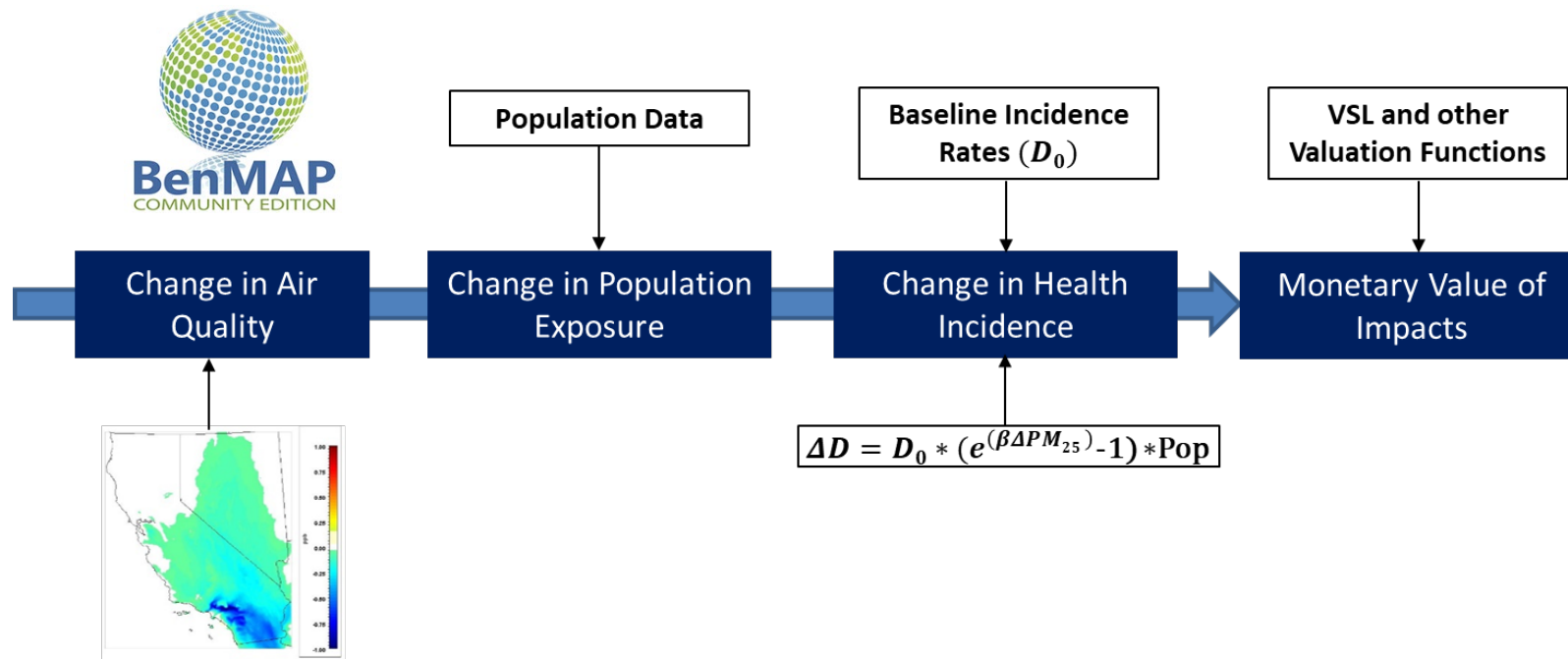
# 3. Health Impact Assessment

- **Health savings are calculated with the same resolution as the air quality and can be reasonably downscaled to the census tract level**

- <u>**Does not allow for individual source impacts to be resolved**</u>

- <u>**Does not allow for community level impacts to be resolved**</u>

**Difference in PM$_{2.5}$ and ozone** → **Number of avoided health impacts**

**Population Projections** → **$ value of avoided health impacts**

2.5 miles

2.5 miles

# 3. Disadvantaged Community (DAC) Impacts

- **Quantify and assess health benefits in DAC to provide insight into environmental justice implications of the SP scenario**
  - Identification of highly impacted or prioritized DAC using CalEnviroScreen
  - Ratio of public health benefits within DAC
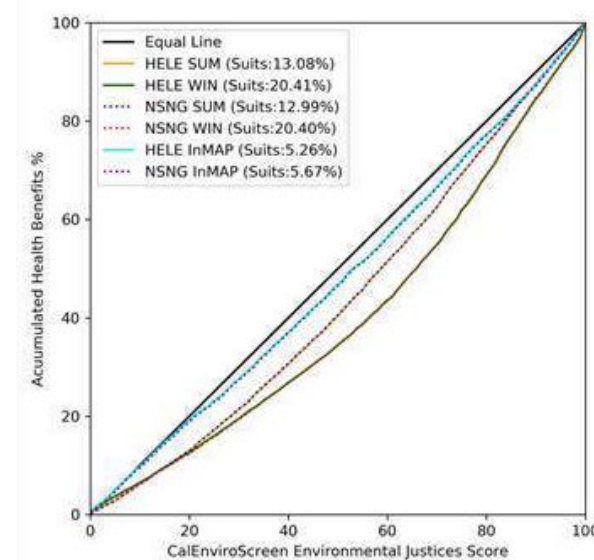  - Consider other economic metrics, e.g., Lorenz curves
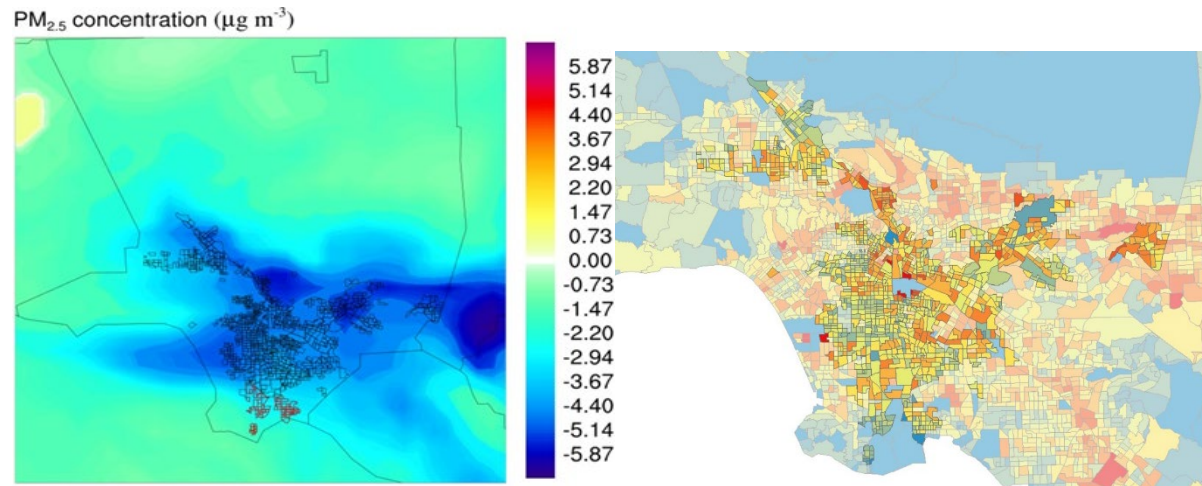


**Avoided Incidence of Mortality from PM$_{2.5}$ Exposure**

Total CA: 2651

POLA DAC: 587

Brown, Austin L., et al. "Driving California's Transportation Emissions to Zero." (2021).



**Distribution of health benefits across DAC**