

# 2022 Scoping Plan Update: Initial Air Quality & Health Impacts and Economic Analyses Results Workshop



---

APRIL 20, 2022

# Initial Economic Modeling of California's Scoping Plan

Macroeconomic impacts across the four Scoping Plan scenarios

APRIL 20, 2022

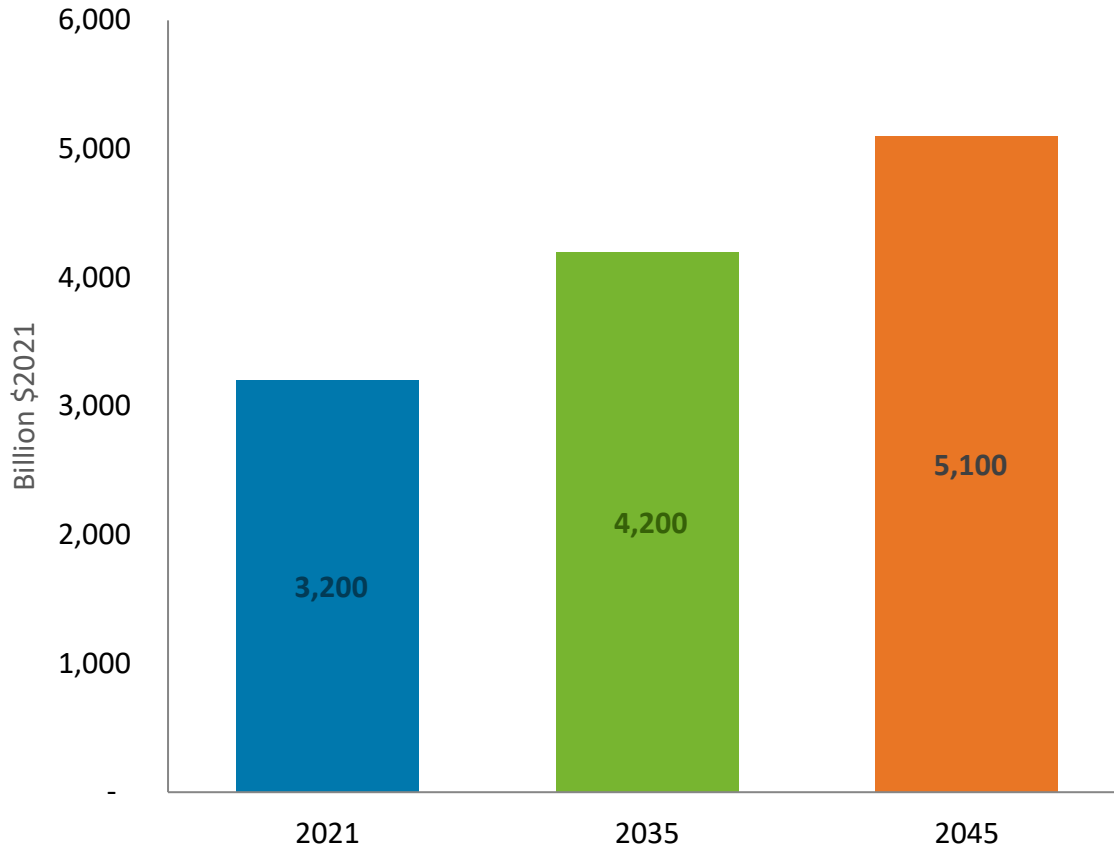
**Emily Wimberger**  
Climate Economist  
ewimberger@rhg.com

# Projections of California Economic and Job Growth, 2035 and 2045

CARB projections based on Department of Finance forecasts

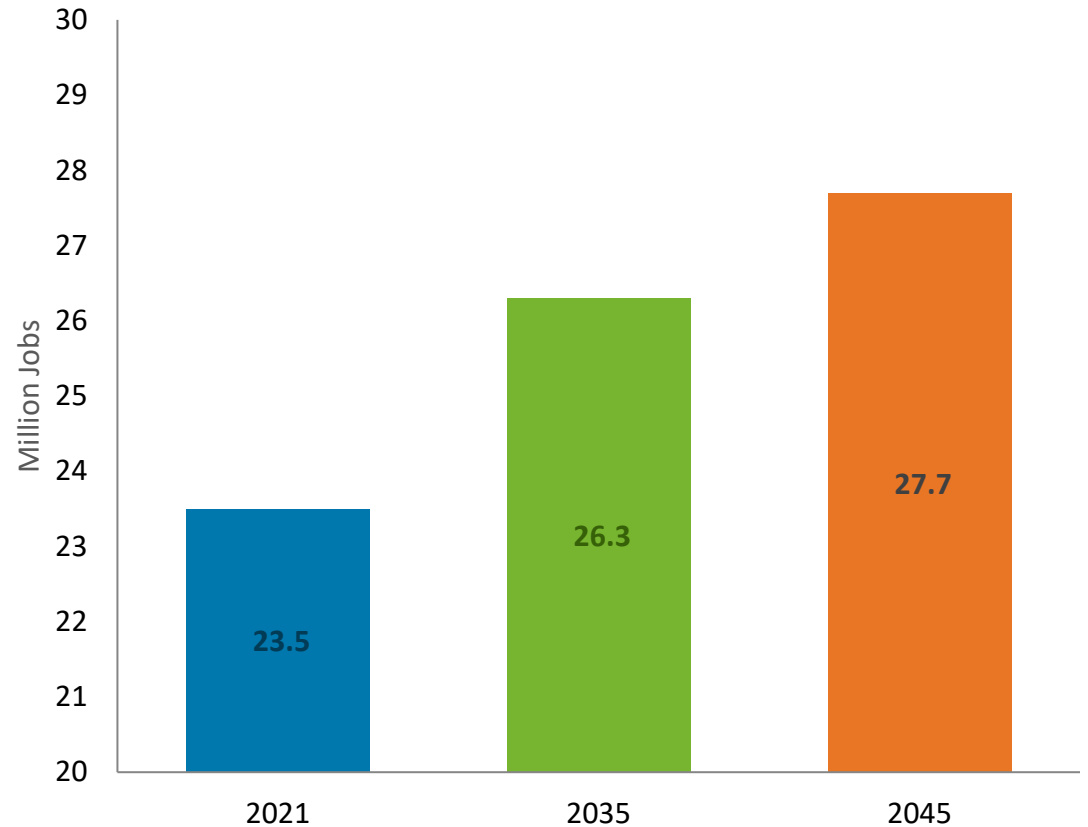
## California Gross State Product Growth, 2035 and 2045

CARB forecast in billion \$2021



## California Employment Growth, 2035 and 2045

CARB forecast



Source: California Air Resources Board

# Translation of PATHWAYS direct costs to IMPLAN

## Carbon Dioxide Removal

- PATHWAYS direct costs for liquid solvent Direct Air Capture (DAC) technology powered by off-grid solar
- PATHWAYS costs are modeled by changing expenditures in the solar electricity industry
- The cost of DAC is passed through to consumers, reducing household spending

## Stock costs

- Modeled as changes in commodity by subsector (residential lighting, light duty vehicles, commercial cooking, etc.)
- Changes in commercial ventilation from PATHWAYS are modeled as changes to air purification and ventilation equipment in IMPLAN
- The cost of stock is passed through to consumers, reducing household spending

## Demand change measure costs

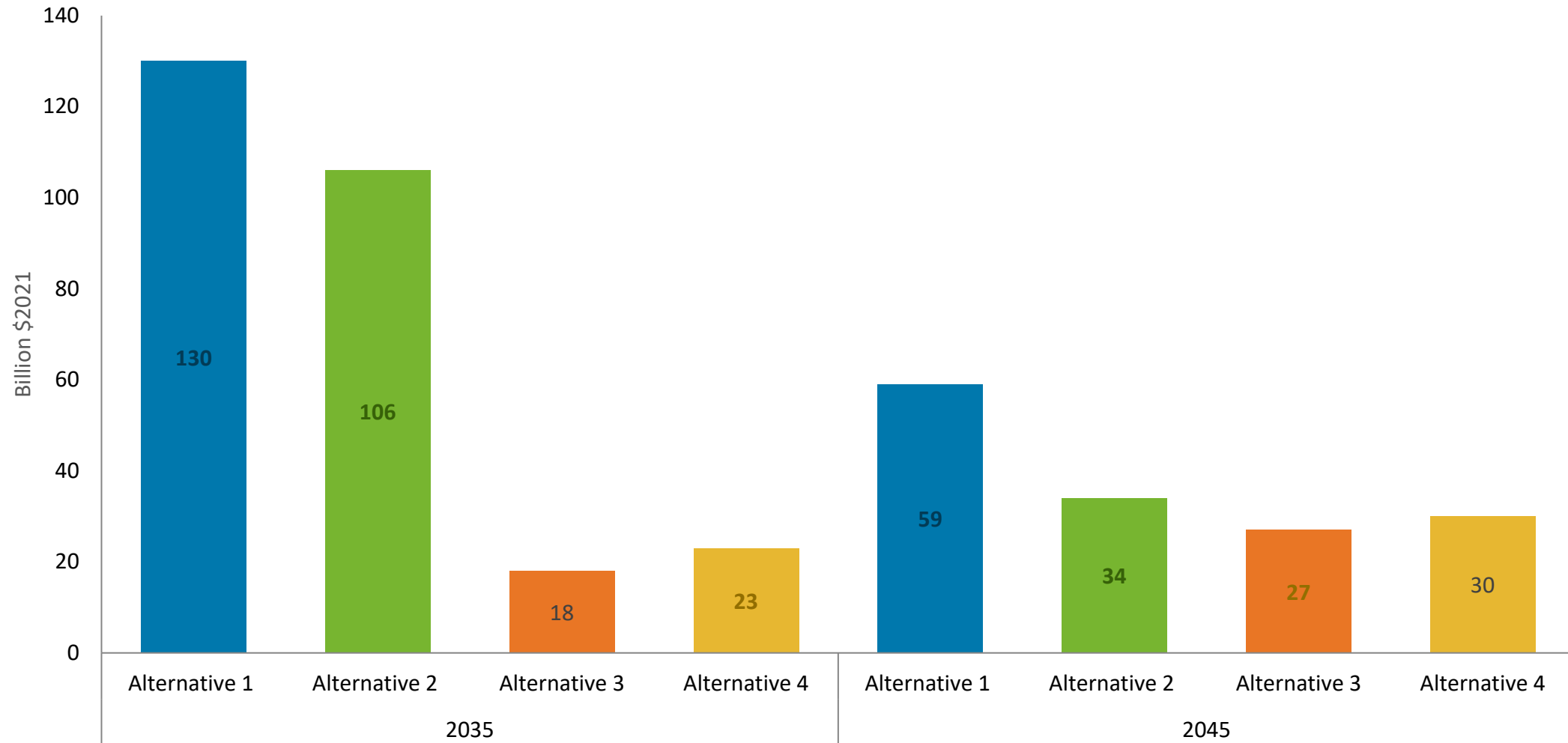
- Reflect energy efficiency across subsectors
- Modeled as changes in industry by subsector
- For example, a cost for a demand change in fabricated metal is modeled as a change in the output of fabricated metal
- The cost of the demand change is passed through to consumers, reducing household spending

## Fuel costs

- Changes in expenditures across fuel and energy categories (electricity, gasoline, diesel, pipeline gas, etc.)
- The impact of a change in energy or fuel cost is modeled as a change in the industry that produces the fuel or energy
- A reduction in diesel costs in heavy duty trucking is modeled as a change in the petroleum refining industry in IMPLAN

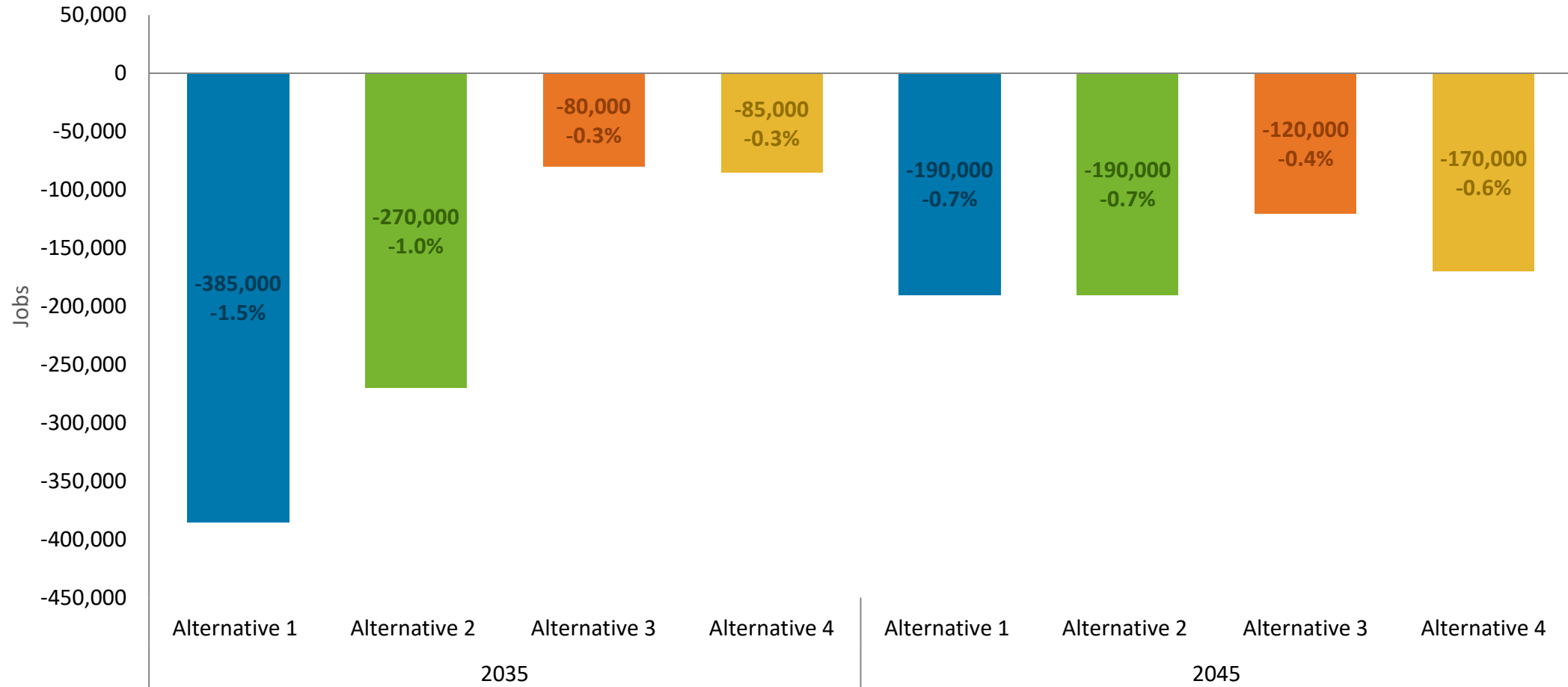
# Direct Cost by Scenario, 2035 and 2045

Costs from PATHWAYS in a single year relative to the growing California economy



# Employment by Scenario Including CDR, 2035 and 2045

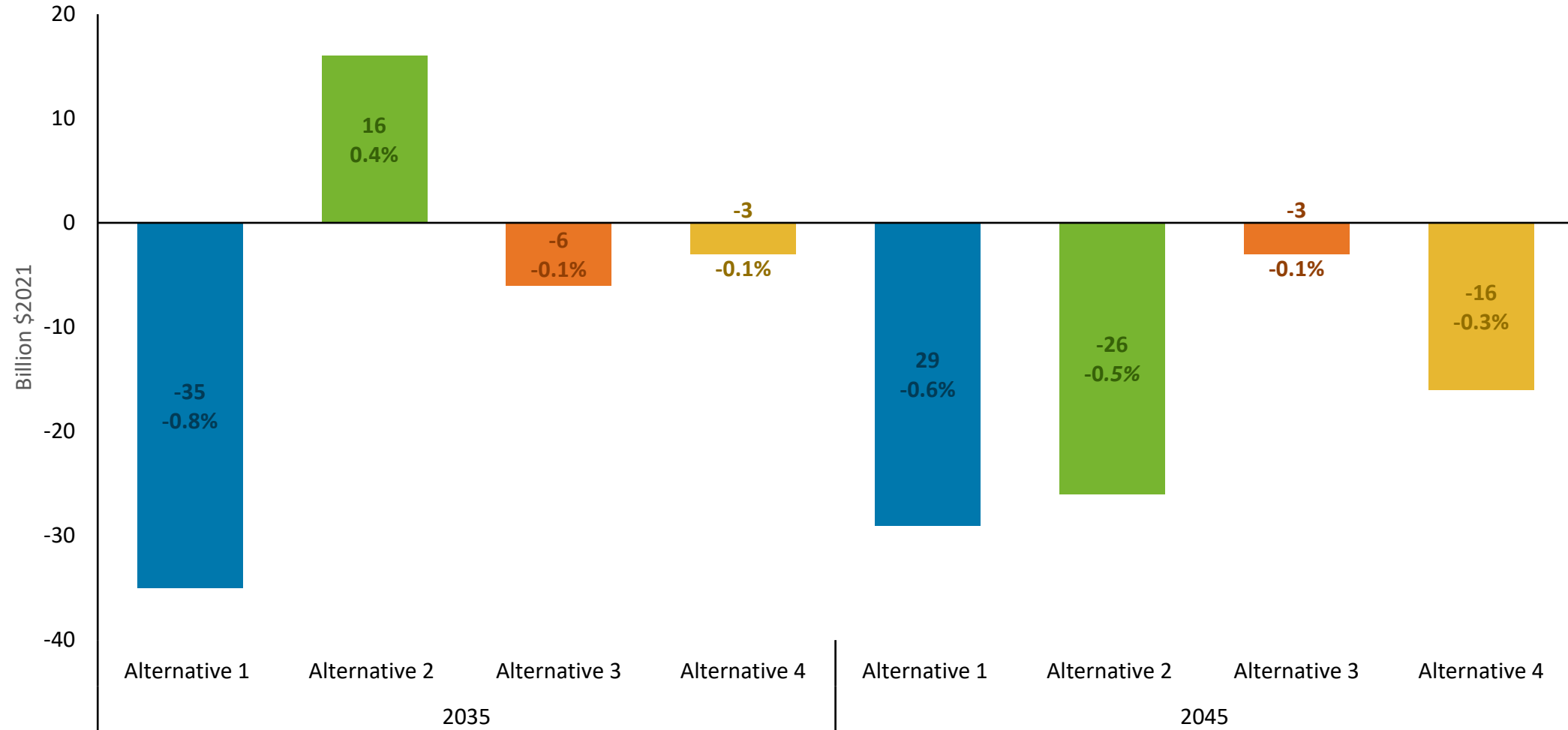
Impact from IMPLAN in a single year relative to California employment that grows from 23.5 million in 2021 to 27.7 million in 2045



Initial results from PATHWAYS costs assuming CDR is liquid solvent DAC technology powered by off-grid solar relative to BAU. Jobs are defined in IMPLAN as an annual average that accounts for seasonality and follows the same definition used by the BLS and BEA. Percentage change is relative to CARB 2035 and 2045 employment forecasts.

# Gross State Product by Scenario Including CDR, 2035 and 2045

Impact from IMPLAN in a single year relative to the California economy that grows from \$3.2 trillion in 2021 to \$5.1 trillion in 2045



Initial results from PATHWAYS costs assuming CDR is liquid solvent DAC technology powered by off-grid solar relative to BAU. IMPLAN reports value added which is equivalent to an industry's contribution to Gross State Product or GSP. Percentage change is relative to CARB 2035 and 2045 Gross State Product forecasts.

# Data Observations

Initial macroeconomic impacts across scenarios including CDR

## Future Employment Growth

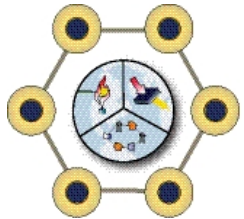
- The California workforce is forecast to grow from today's levels through 2045
- All alternatives slow the growth of employment, but the impact is small, resulting in at most a 1.5% slowing of job growth relative to projected levels in 2035 and 2045
- Alternative 1 has the largest impact on California job growth, resulting in nearly a 5-time greater slowing of job growth in 2035 than Alternative 3
- Alternative 3 has the smallest impact on job growth in 2035 and 2045
- As modeled, Direct Air Capture in California can result in 35,000 to 260,000 jobs in California in 2035 and 12,000 to 17,000 jobs in 2045

## Future California Economic Growth

- All scenarios have a relatively small impact on the California economy which is forecasted to grow from today's levels through 2045
- The impact is less than a 1% slowing of economic growth in 2035 and 2045 (when CARB forecasts the economy to grow by 3.3% each year)
- Alternative 2 shows a positive impact on the California economy in 2035 due to the large reliance on CDR which results in growth in the solar industry, providing a net benefit to California
- Across scenarios, Direct Air Capture in California can provide \$2 to \$21 billion to the California economy in 2035 and \$2 to \$6 billion in 2045



# Air Quality and Public Health Benefits of the DRAFT Scoping Plan Scenarios

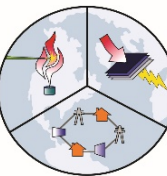
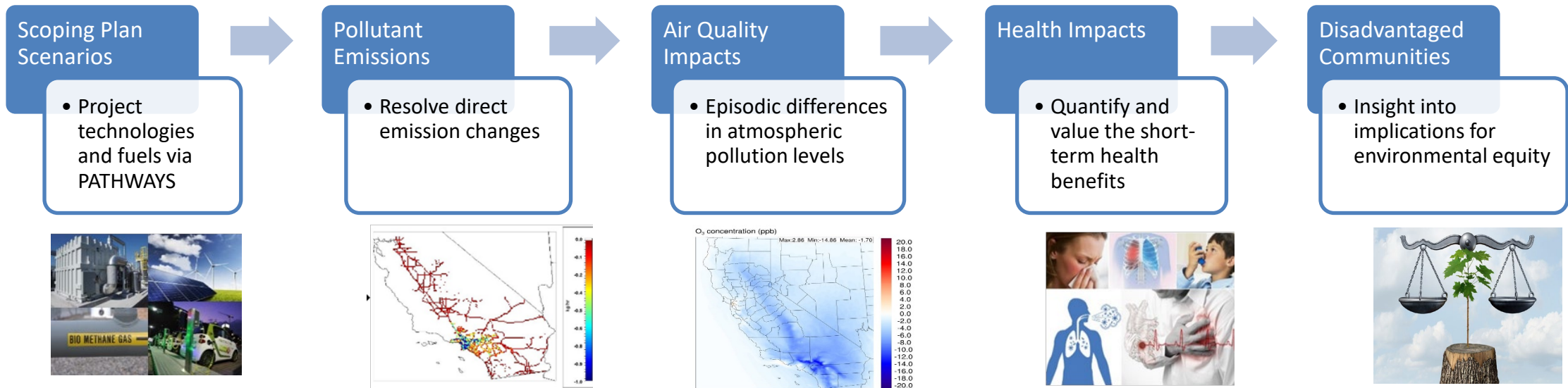


**ADVANCED POWER  
& ENERGY PROGRAM**  
UNIVERSITY of CALIFORNIA • IRVINE

**Michael MacKinnon, Shupeng Zhu, Scott Samuelsen**  
**Draft Scoping Plan Air Quality Workshop**  
**April 20, 2022**

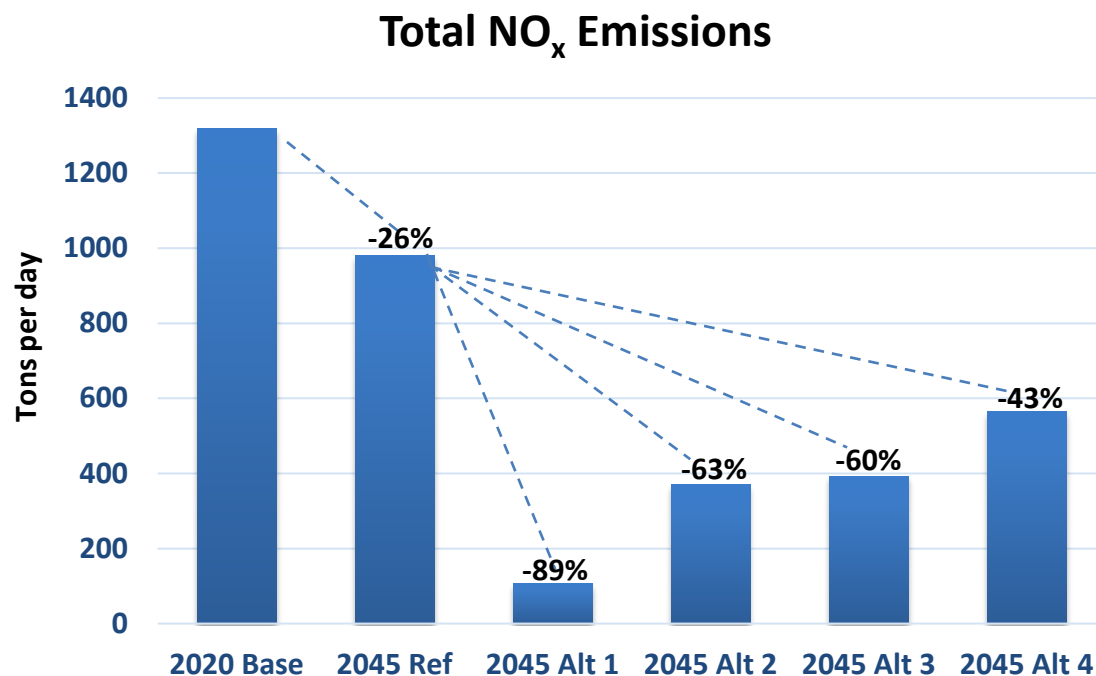
# Approach

- **Develop and utilize an integrated modeling approach to comprehensively determine and spatially resolve impacts on pollutant emissions, air quality, and public health**
  - Scope and scale of the assessment requires regional-scale modeling

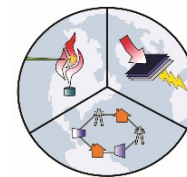
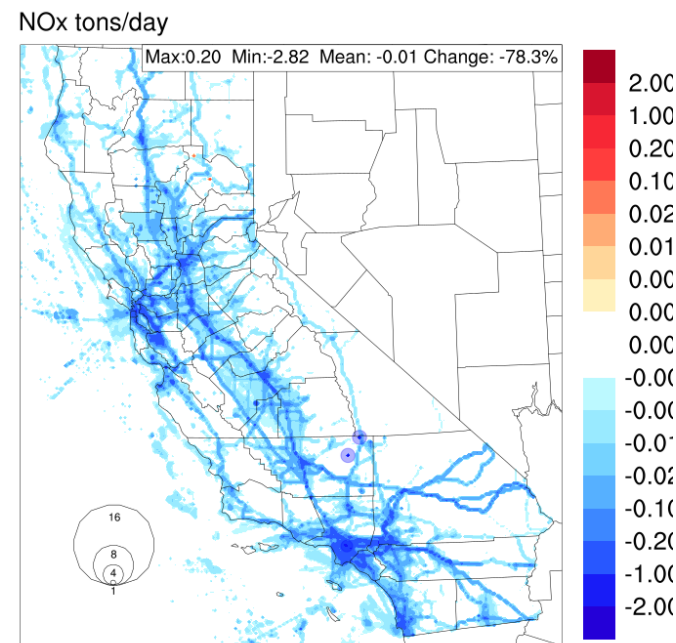


# 1. Emissions Modeling

- **Scenarios achieve large emission reductions in 2045 due to shifts to zero pollutant emission fuels and reductions in total energy consumption**
  - Reductions in total NO<sub>x</sub> from the Reference scenario range from 89% in Alt 1 to 43% in Alt 4
  - Emission reductions are then applied to the locations of source activity



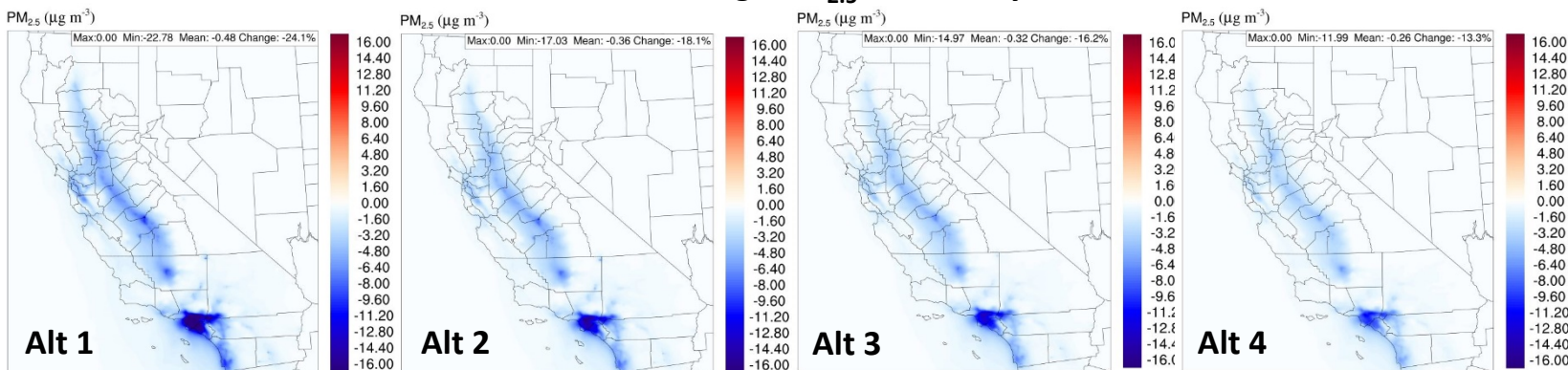
## Reductions in 2045 NO<sub>x</sub> for Alt 2



## 2. Air Quality Results – PM<sub>2.5</sub>

- Results present the difference in PM<sub>2.5</sub> in July and January 2045 relative to the Reference Scenario

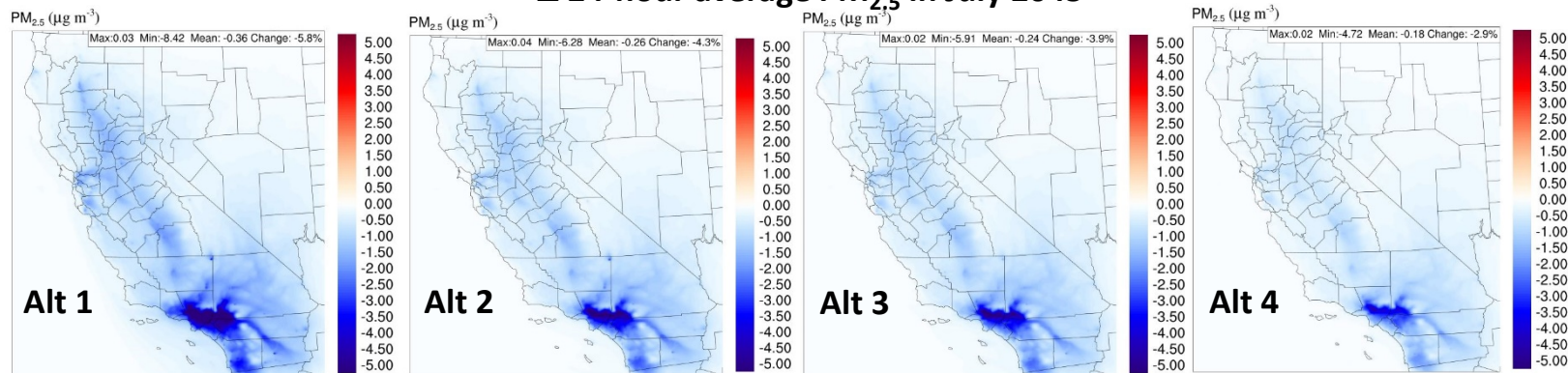
Δ 24-hour average PM<sub>2.5</sub> in January 2045



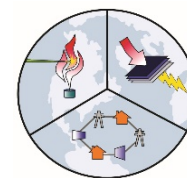
Peak Δ 24-hour average PM<sub>2.5</sub>

	Alt 1	Alt 2	Alt 3	Alt 4
January	-22.8	-17.0	-14.9	-11.9
July	-8.4	-6.3	-5.9	-4.3

Δ 24-hour average PM<sub>2.5</sub> in July 2045



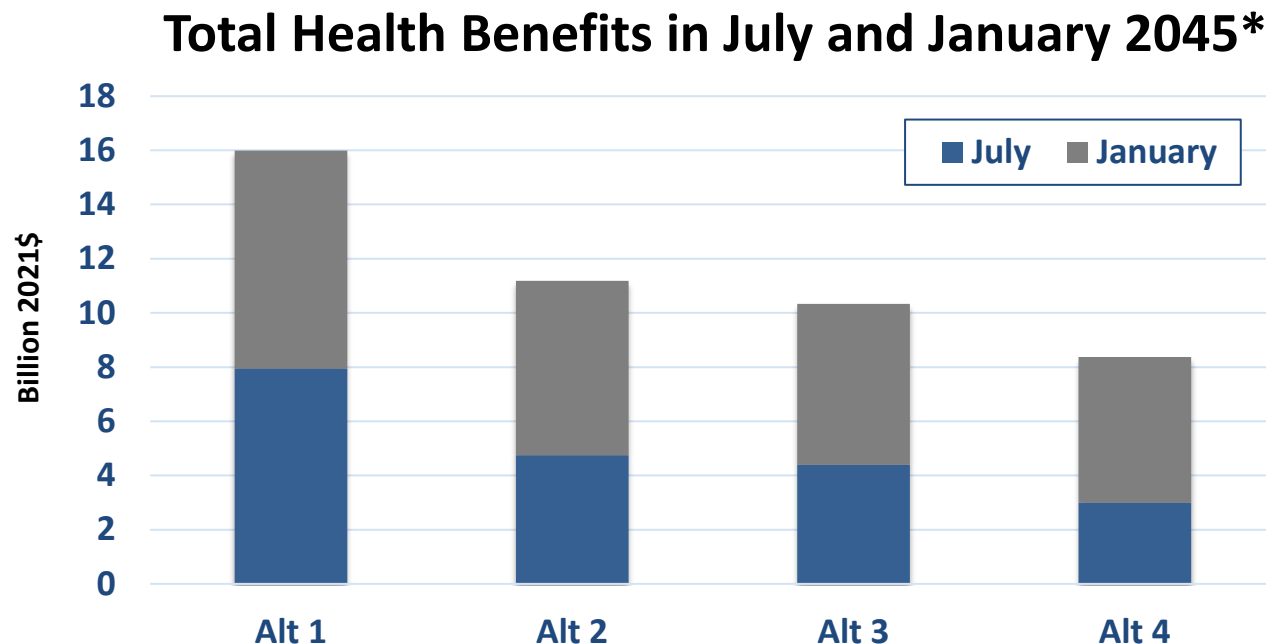
- Peak January reductions occur in the South Coast Air Basin (SoCAB) and Central Valley
- Peak July reductions occur in the South Coast Air Basin (SoCAB)



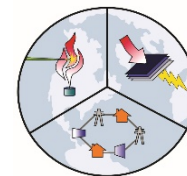


### 3. Health Impact Results

- The implementation of the Scoping Plan scenarios achieves notable public health benefits relative to the Reference Scenario
  - Total combined benefits range from \$8.3 billion in Alt 4 to \$15.9 billion in Alt 1 in July and January 2045
  - Improvements in winter PM<sub>2.5</sub> provide significant health benefits

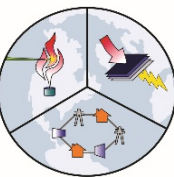
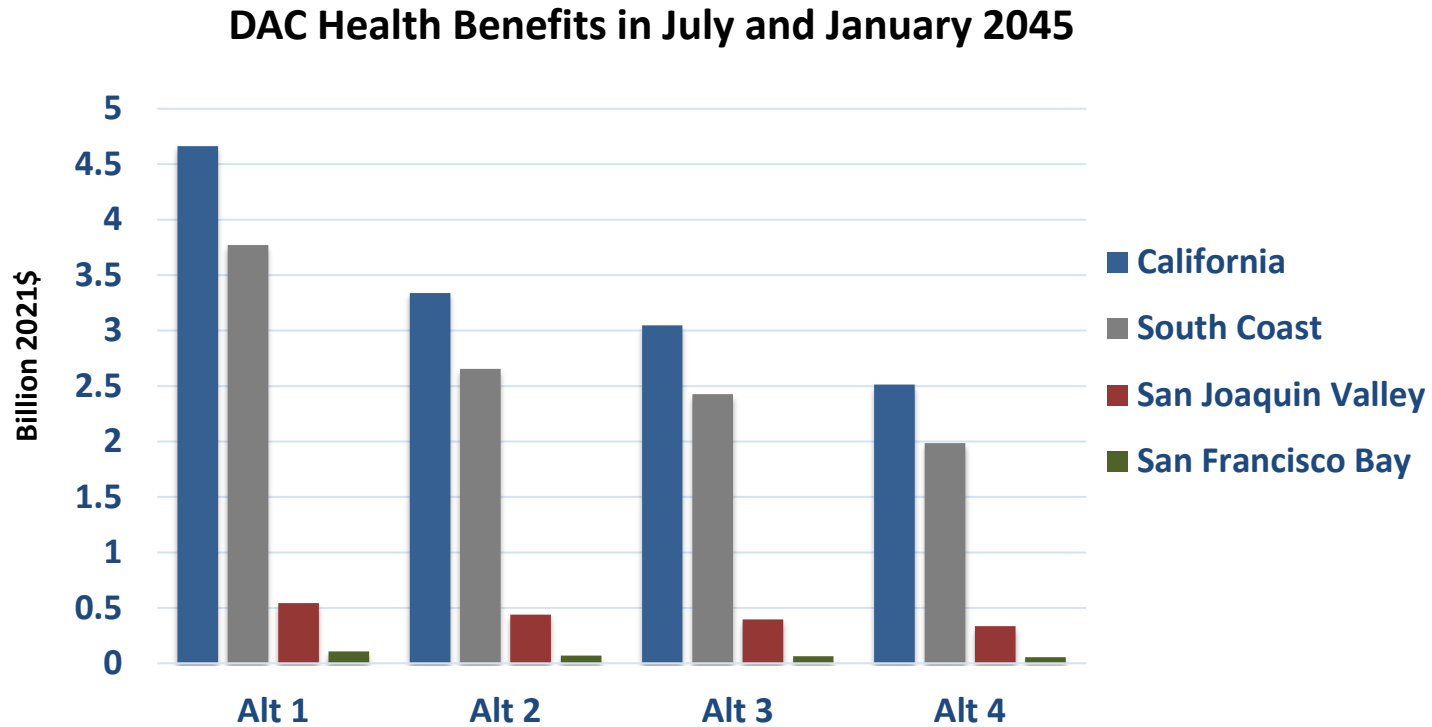


\*Represents the mean value reported by BenMAP



# 3. DAC Impacts

- **CalEnviroScreen 4.0 used to quantify health benefits within census tracts identified as socially and economically disadvantaged communities (DAC)**
  - Scenarios attain benefits within DAC ranging from \$2.5 billion to \$4.7 billion combined
  - Communities in the SoCAB benefit more due to pre-existing air quality challenges, significant emission sources and activity, and large, dense populations



# Conclusions

- **Episodic evaluation of the air quality and health benefits demonstrates that all proposed Scoping Plan Scenarios achieve important benefits**
  - All four scenarios significantly reduce air pollution and incidence of pollution-related mortality and morbidity
- **Health benefits approximately scale with scenario aggressiveness**
  - Alt 1 attains the highest benefits due to the elimination of combustion emissions
  - In 2045, Alt 2 and Alt 3 attain similar benefits
  - Comparatively, Alt 4 achieves the lowest benefits, but they are still significant in total
- **Health benefits are most pronounced in the South Coast Air Basin due to pre-existing air quality challenges, the presence of significant emission sources, and the large, dense urban population**
- **Scenarios attain important benefits within socially and economically disadvantaged communities that are most impacted by, and vulnerable to, degraded air quality**
  - Benefits within DAC are most pronounced within impacted communities in the South Coast Air Basin

