# Hydrogen Air Quality Impact Assessment for South Coast Air Basin

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May 28th 2026

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# The Important Role of Hydrogen in CA Energy Transition

Policy target of reducing total greenhouse gas emissions by 85% from 1990 levels by 2045 (Assembly Bill 1279).

## Transportation

Long-haul, ships, aviation

## Industry

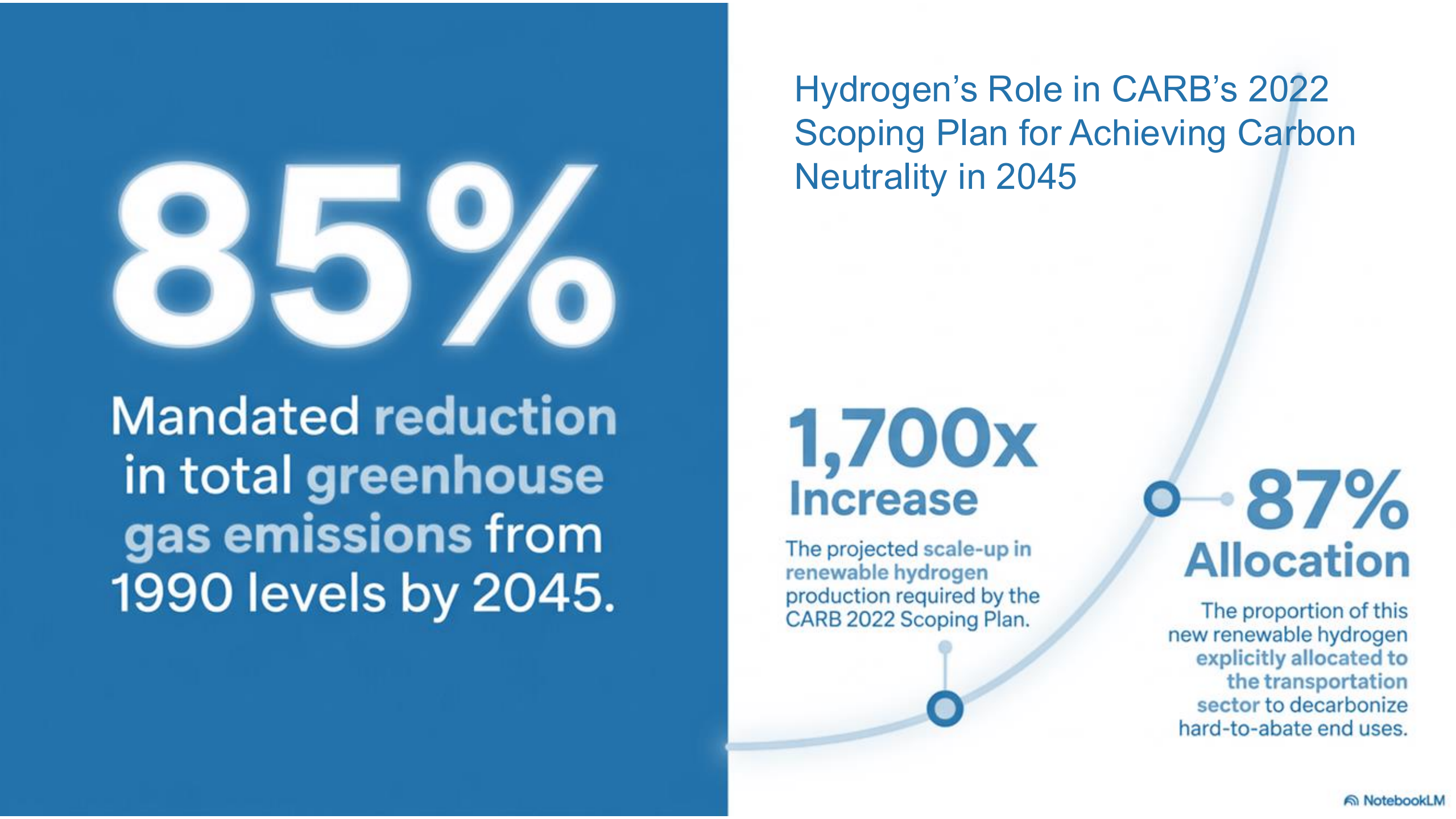
Steel, chemical manufacturing

## Power

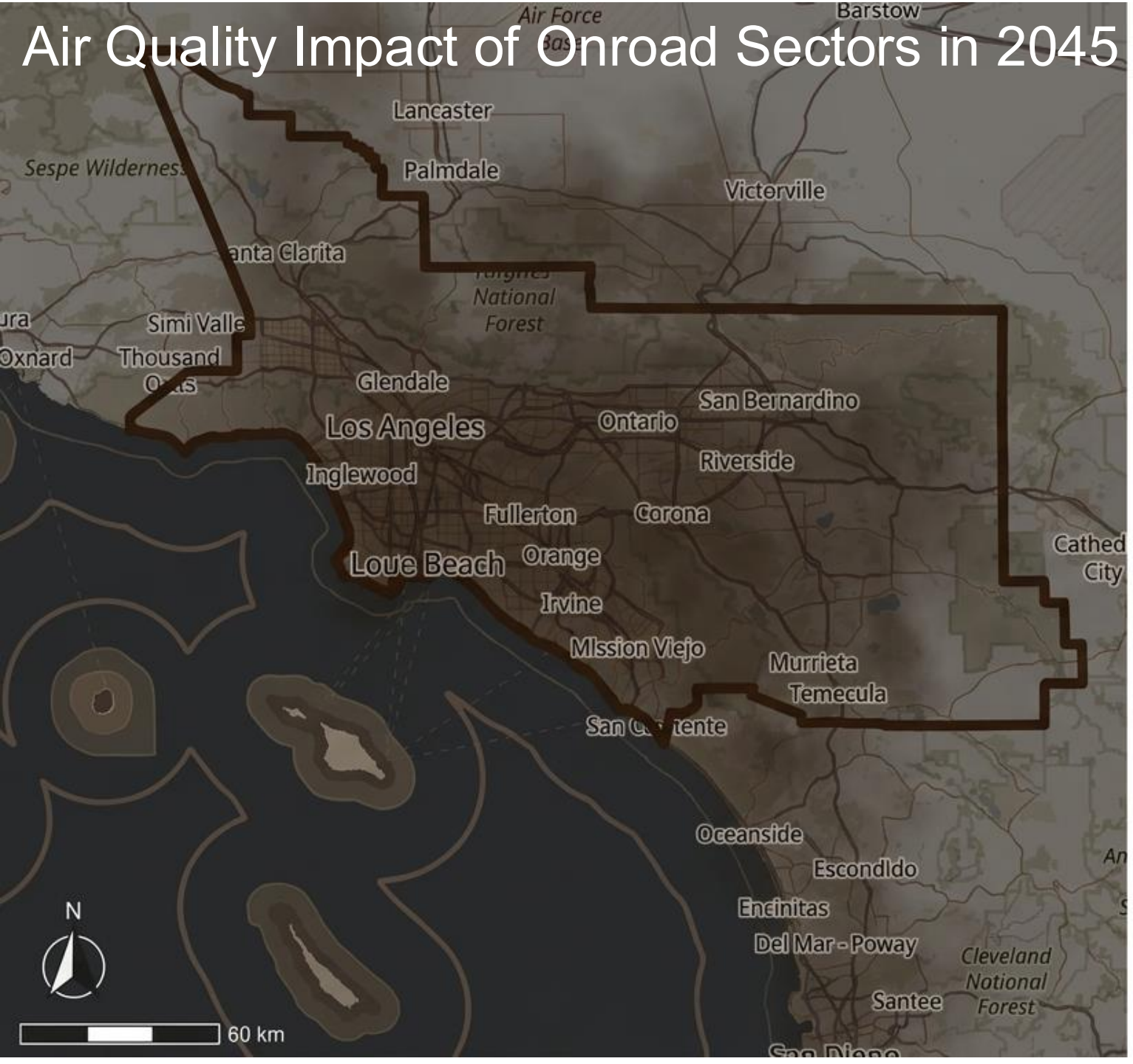
Storage and generation

**Hydrogen is structurally embedded in major energy transition plans, including the CARB Scoping Plan 2022, the federally supported ARCHES** (Alliance for Renewable Clean Hydrogen Energy Systems) **hub, and the LADWP Strategic Long-Term Resource Plan.**

# Hydrogen’s Role in CARB’s 2022 Scoping Plan for Achieving Carbon Neutrality in 2045



# Air Quality Impact of Onroad Sectors in 2045




## The Baseline Reality: The South Coast Air Basin in 2045

**17 Million People | $1.2 Trillion GDP**

A history of severe nonattainment for ozone and PM2.5.

### The Business as Usual (BAU) Nightmare (Without Intervention)

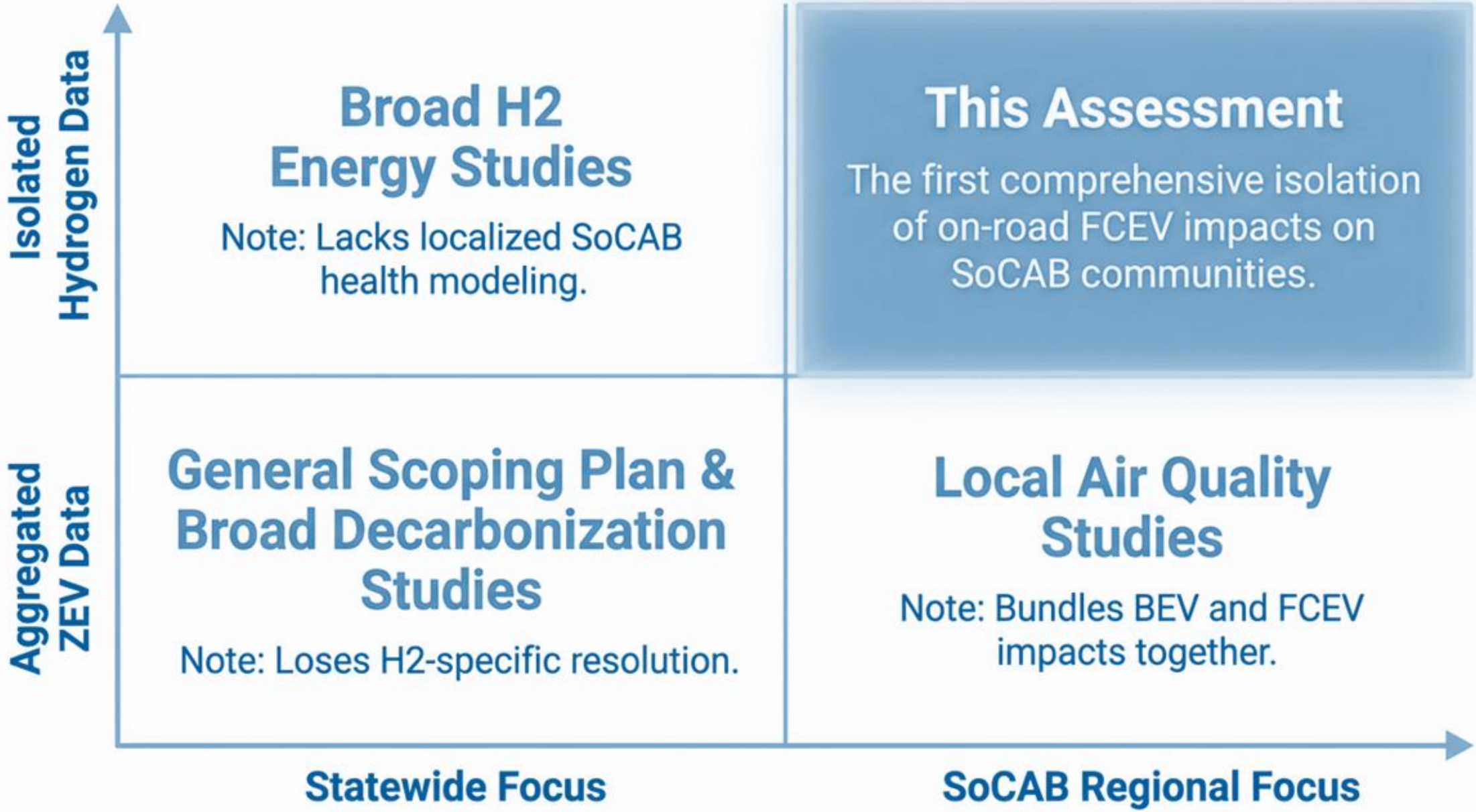
**1,631**

PM2.5-attributable deaths annually.

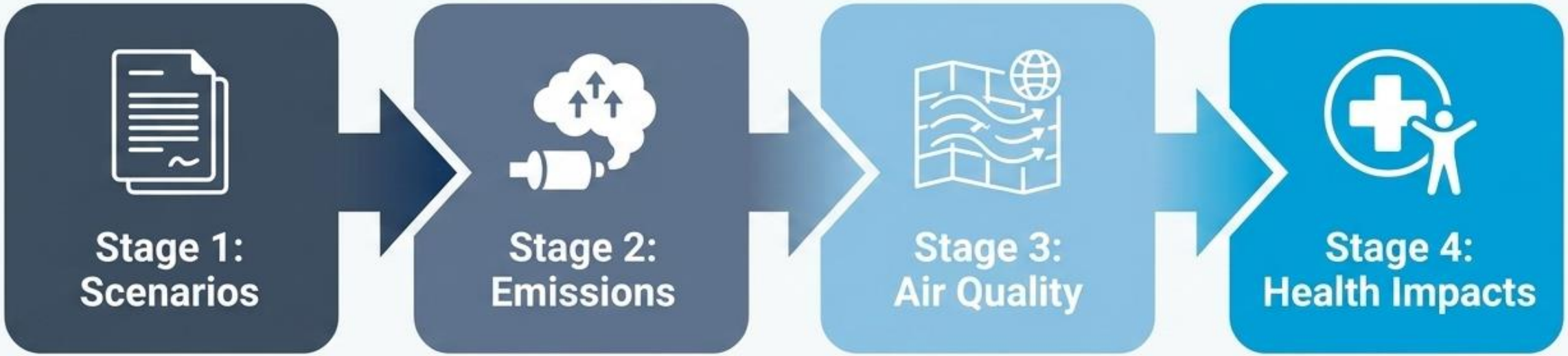
**1.2 µg/m³**

Average population-weighted PM2.5 concentrations.

**35%** of this population lives in disproportionately burdened communities.


Isolated Hydrogen Data
Aggregated ZEV Data
Broad H2 Energy Studies
Note: Lacks localized SoCAB health modeling.
This Assessment
The first comprehensive isolation of on-road FCEV impacts on SoCAB communities.
General Scoping Plan & Broad Decarbonization Studies
Note: Loses H2-specific resolution.
Local Air Quality Studies
Note: Bundles BEV and FCEV impacts together.
Statewide Focus
SoCAB Regional Focus

# Integrated Assessment Pipeline




CARB Scoping Plan vs. Business-As-Usual (PATHWAYS model).

Resolving vehicle stock changes into spatially allocated pollutants (EMFAC & ESTA at 1km² resolution).

Simulating chemical transport and changes in PM2.5 exposure (InMAP/ISRM model).

Translating exposure drops into avoided mortality and economic valuation.

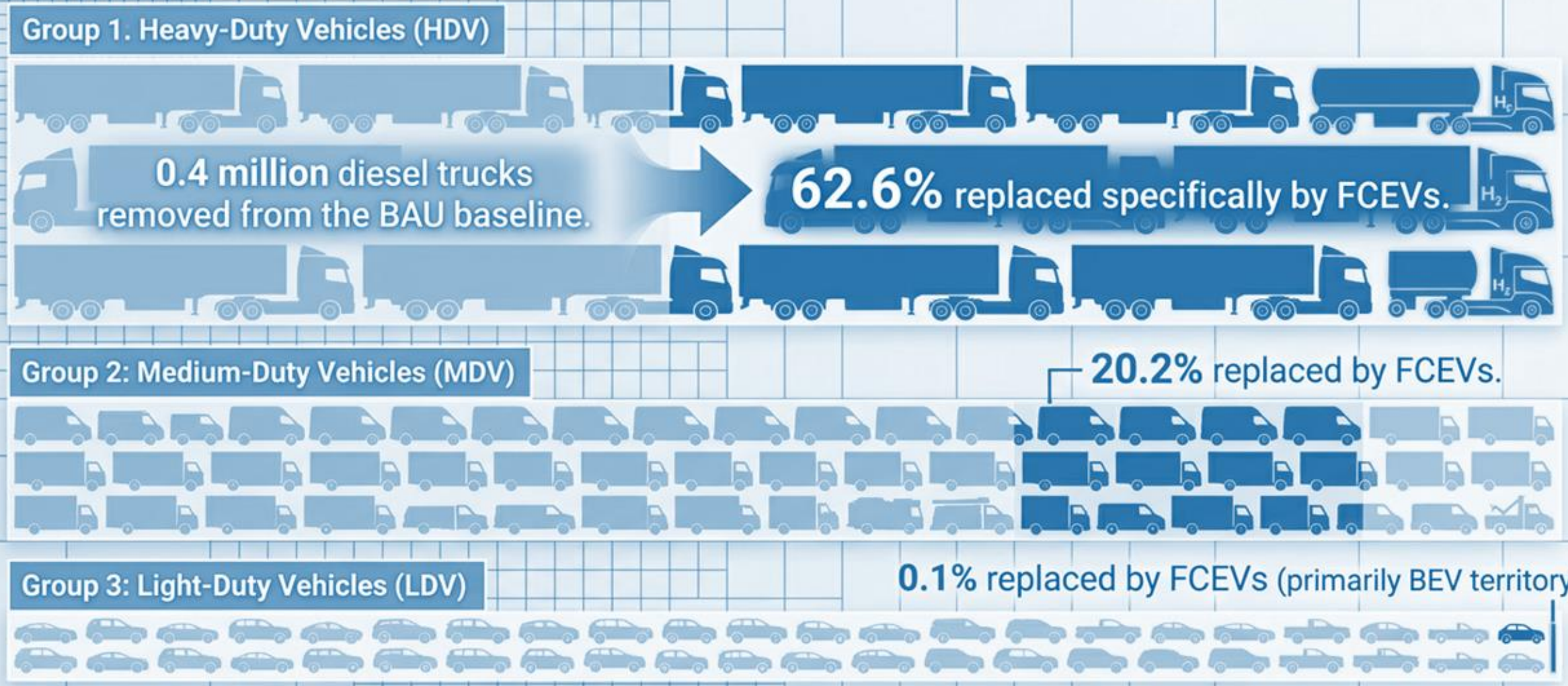
# CARB Scoping Plan Scenario for Onroad Sectors

## Zero Emission Vehicle Targets

- **100% ZEV sales** for light duty vehicles (LDV) by 2035 (mostly battery electric)
- **100% ZEV sales** for medium (MDV) and heavy duty vehicles (HDV), including hydrogen fuel cell (FCEV) vehicles by 2040
- **100% of drayage trucks** are zero emission by 2035

**PATHWAY model** *projected energy shifts and vehicle stocks in onroad sectors to 2045: 45% of heavy-duty trucks, 20% of buses, and 15% of medium-duty vehicles use hydrogen fuel cell technology.*

# Isolating Hydrogen-related Emission Reduction



# Massive Tonnage Reductions in Tailpipe Emissions

**-43%**
NOx
(Nitrogen Oxides)
10,432 tons/year removed

**-15%**
VOC
(Volatile Organic Compounds)
2,527 tons/year removed

**-18%**
NH3
(Ammonia)
1,034 tons/year removed

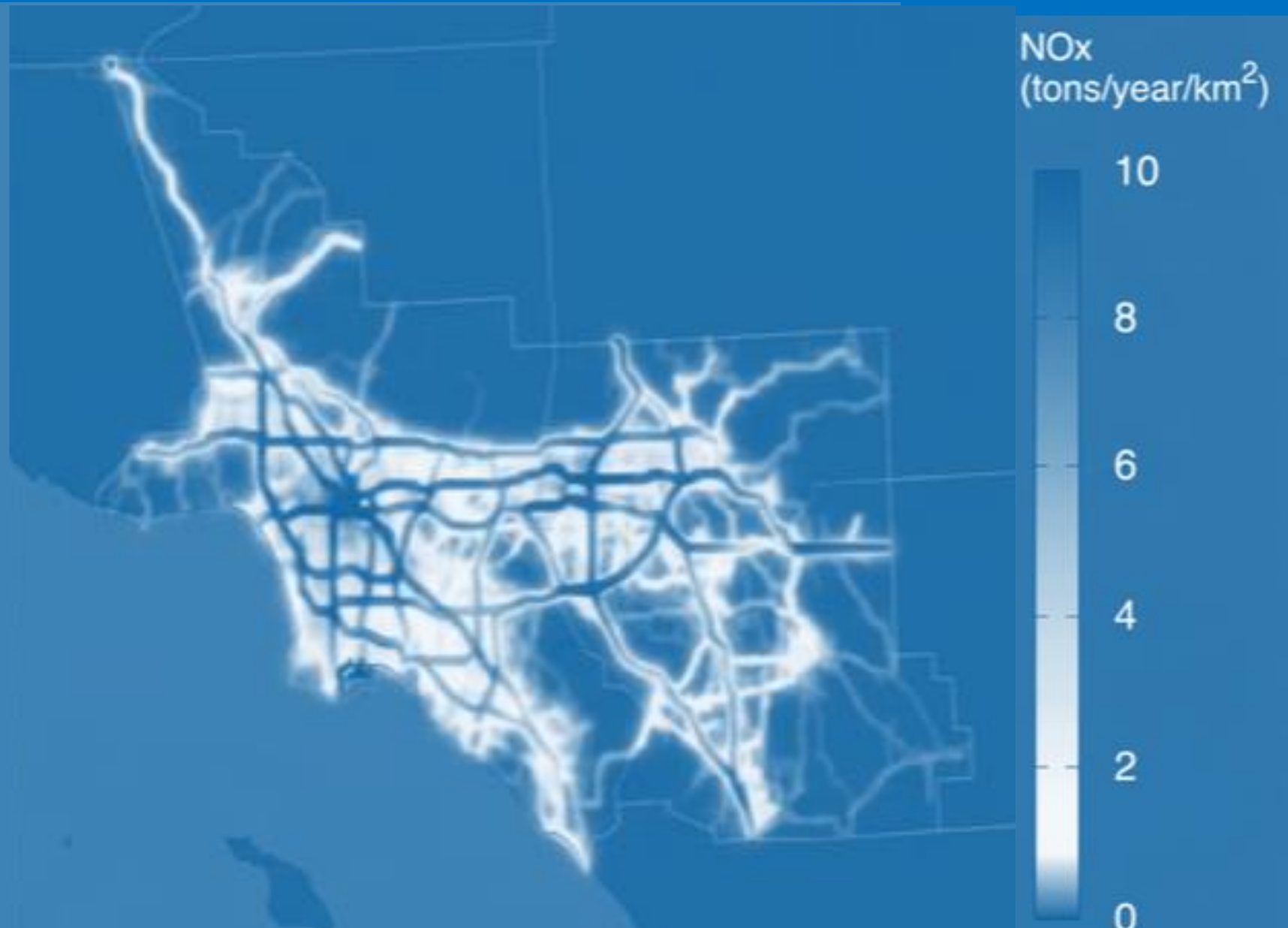
**-13%**
Primary PM2.5
262 tons/year removed

**-17%**
SOx
(Sulfur Oxides)
54 tons/year removed

# Emission Reductions Concentrated along Major Corridors

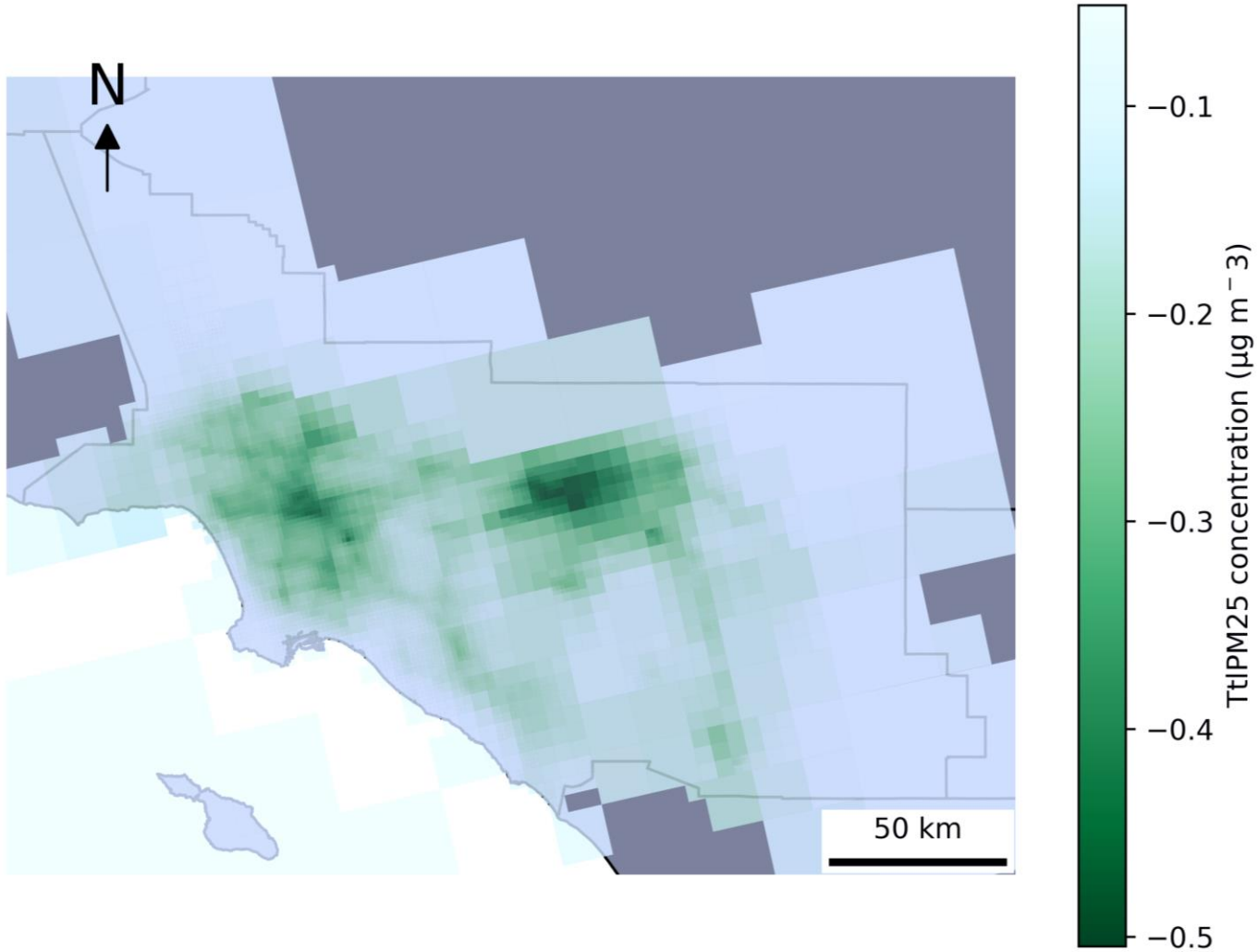
## Targeted Relief

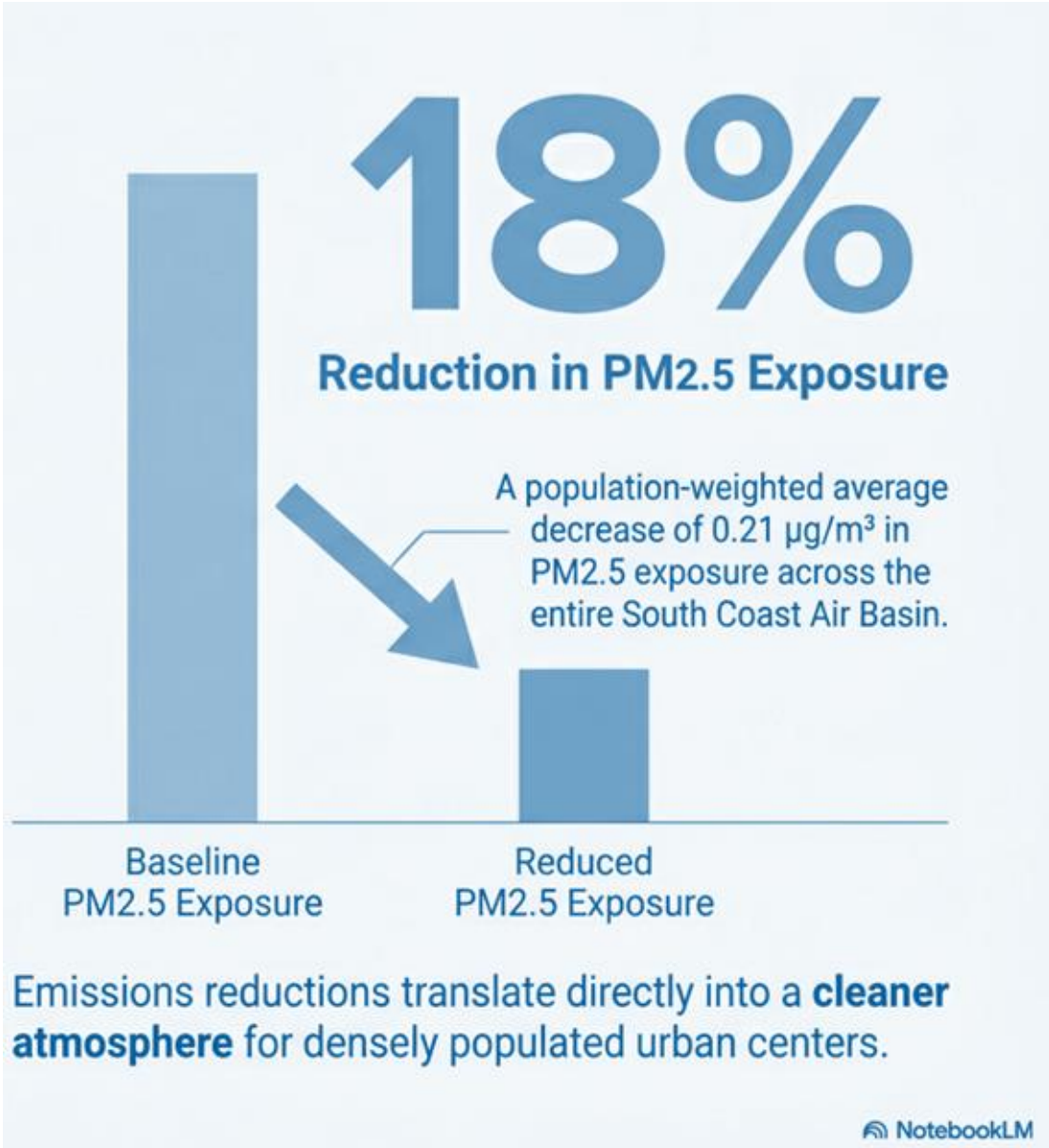
Because the majority of NOx come from HDVs and Port drayage trucks, the reductions are hyper-concentrated along major logistics corridors.



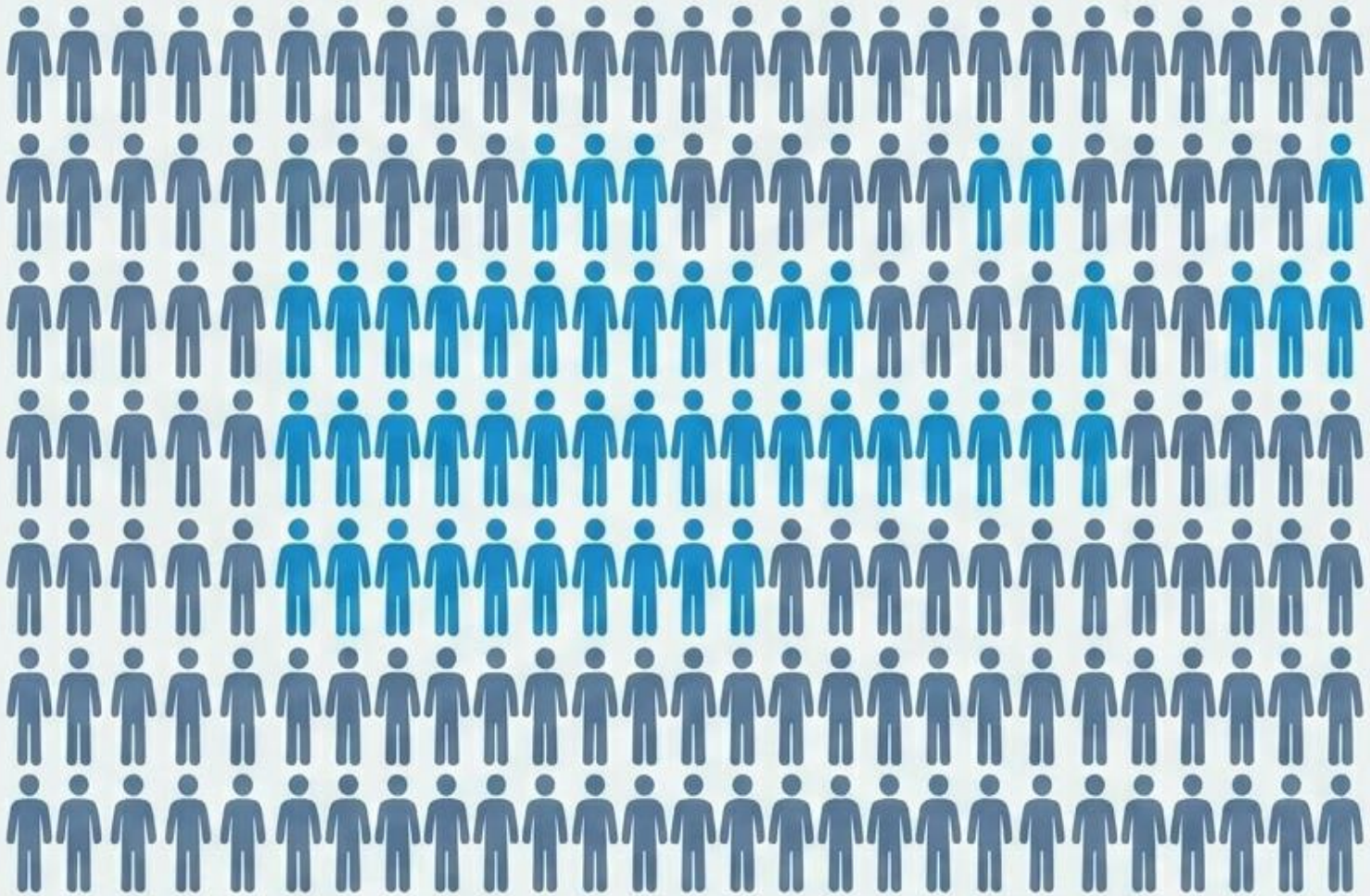
# Breathing Easier

## Hydrogen related Changes in On-road $PM_{2.5}$ Air Pollution



# Public Health Benefits



300 (High Estimate)

**296** (Primary Estimate)

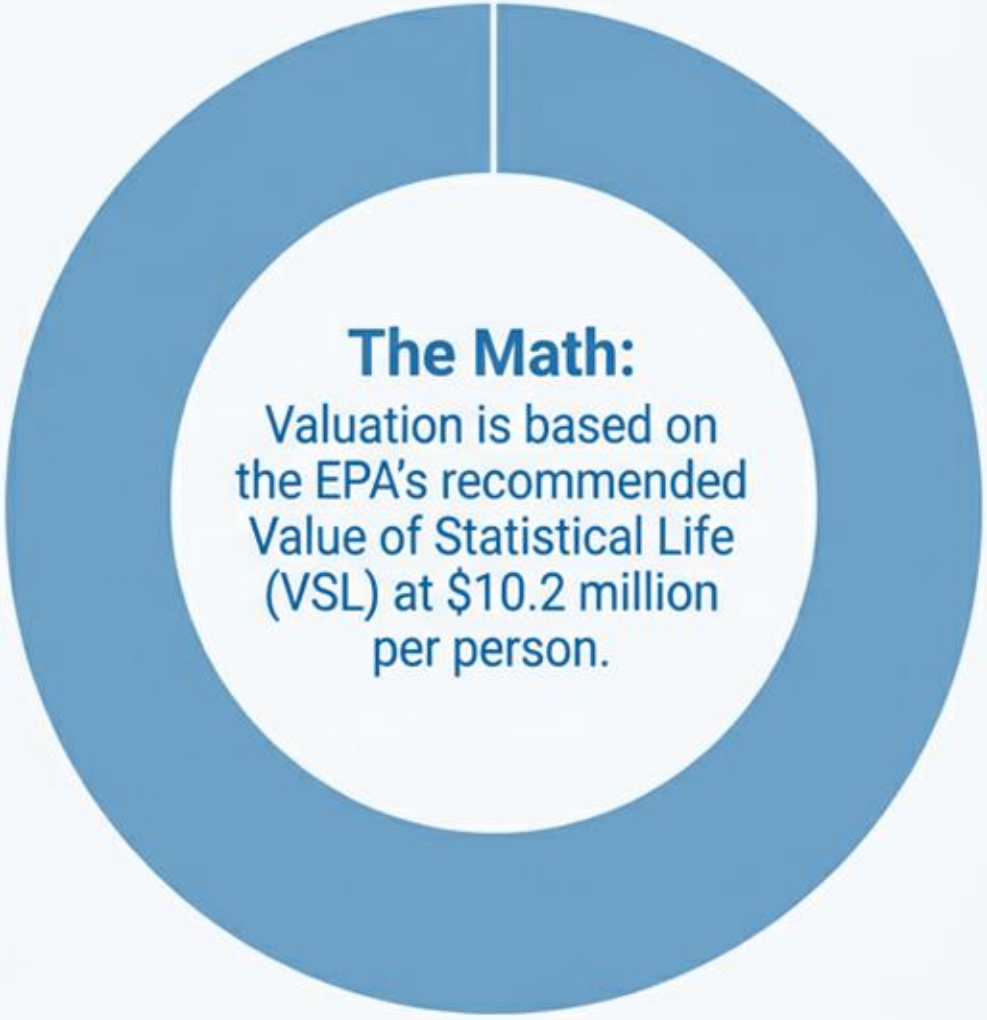
132 (Low Estimate)

The ultimate metric of clean energy transition is **human survival**. Improved ambient air quality directly prevents premature mortality, bounded by rigorous concentration-response function models.

# Economic Valuation

## $3 Billion per year in health cost savings.

Public health improvements are an economic engine. By preventing mortality and respiratory illness, hydrogen adoption shields the state economy from massive healthcare liabilities.



# Onroad Sector Scorecard

## Heavy-Duty (HDV)

**70%**

of total economic benefit

**$2.1 Billion / year**

The undisputed driver of value. Targeting heavy-duty diesel replacement yields the highest societal ROI.

## Medium-Duty (MDV)

**15.5%**

of total economic benefit

## Drayage Trucks

**8.5%**

of total economic benefit

## Light-Duty (LDV)

Minimal relative impact in the H2 model

~1%

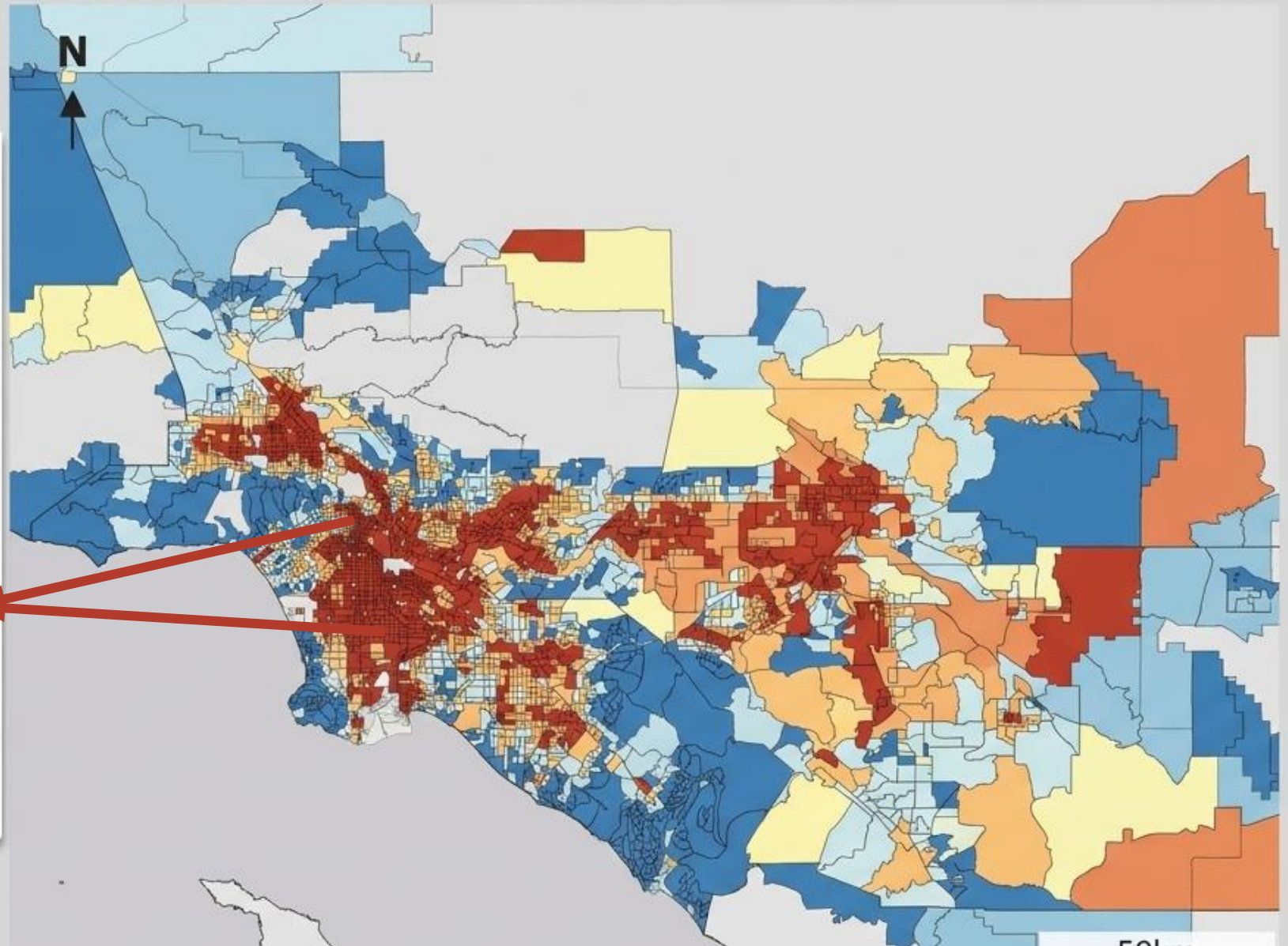
# The Equity Lens: Mapping CalEnvironScreen (CES)

## The Metric

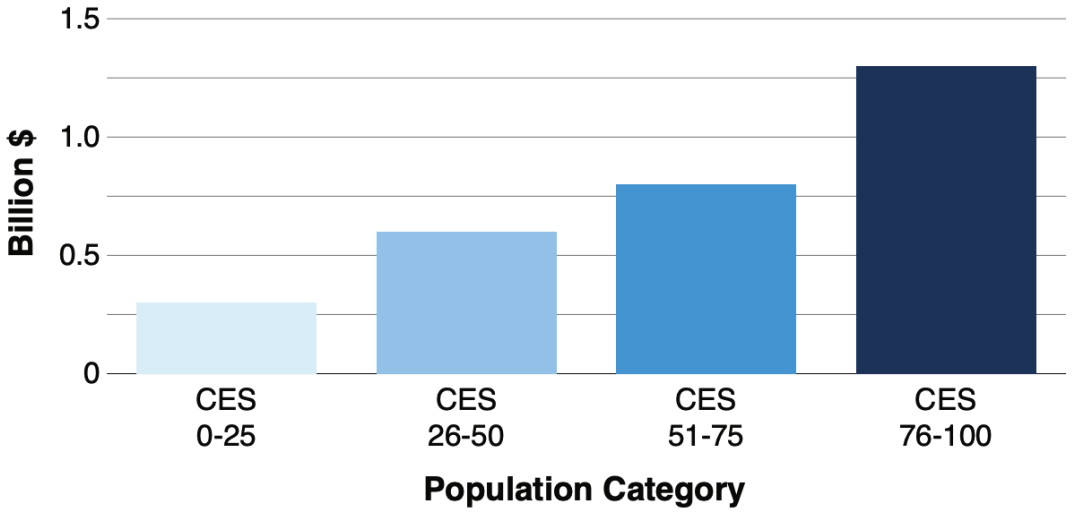
CES 4.0 identifies California communities disproportionately burdened by multiple sources of pollution.

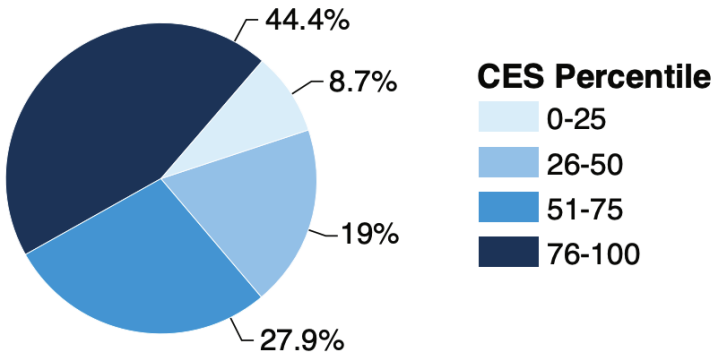
## The Reality

35% of the SoCAB population lives in highly disadvantaged communities (scoring above the 75th percentile). These areas historically bear the brunt of heavy-duty freight pollution.



# Environmental Justice Achieved




> The benefits of hydrogen are not distributed equally—they are distributed **equitably.**

**44%**

of total health and air quality benefits go to the **most disadvantaged communities (CES > 75th percentile).**

**$1.3 Billion**

per year flows directly into protecting the communities that have historically suffered the most from diesel pollution.

# Summary: the Full Value Accounting for Onroad FCEV Adoption

## The Air

**18%**

Reduction from BAU baseline in traffic-related $PM_{2.5}$ exposure across SoCAB

## The Economy

**$3.0 Billion**

Annual health cost savings from avoided mortality

## The Engine

**70%**

Of all air quality and health benefits are driven by replacing diesel Heavy-Duty Vehicles

## The Equity

**44%**

Of all air quality and health benefits flows directly to the state's most disadvantaged communities

Data and modeling drawn from:
Hydrogen Air Quality Impact Assessment for South Coast Air Basin (Sept 2025)

Project Prepared for the California Hydrogen Business Council.

**Main Contractor:** Ling Jin, Yuebin Fan, Jie Zhang, Thomas Kirchstetter (UC Berkeley).
**Scoping Plan Scenario Contributors:** Michael A Mac Kinnon, Kai Wu, Jacob Brouwer, Scott Samuelsen (UC Irvine).

# The Regional Ripple Effect

## The Insight

Air pollution does not respect county lines.

## The Data

5% of the total local health benefits realized inside the SoCAB region actually originate originate from hydrogen adoption in on-road vehicles operating outside the basin.

## Takeaway

Statewide hydrogen infrastructure adoption provides compounding, interconnected benefits to local urban centers.