

# Drivers for the Development of Next Generation Natural Gas Engines

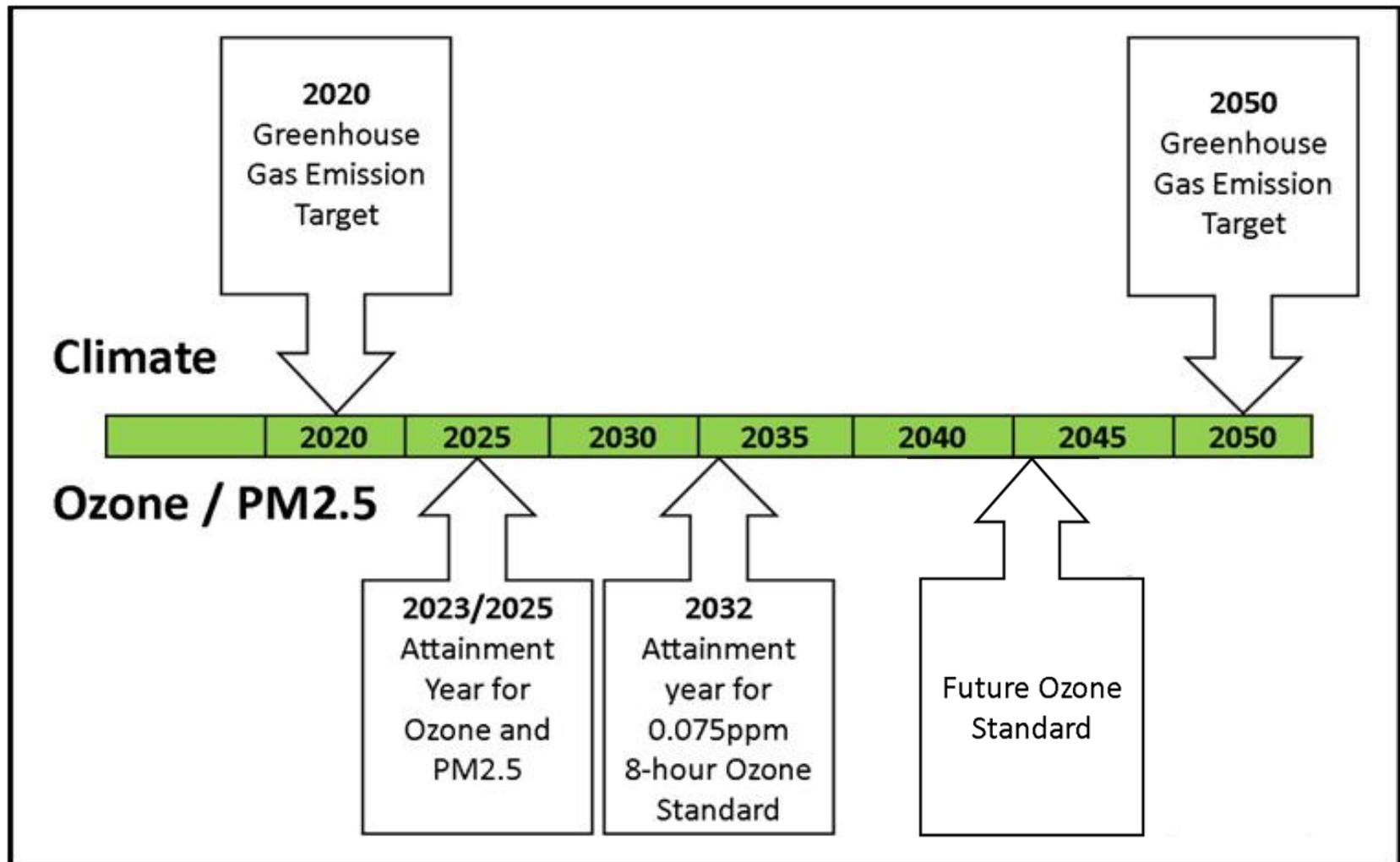


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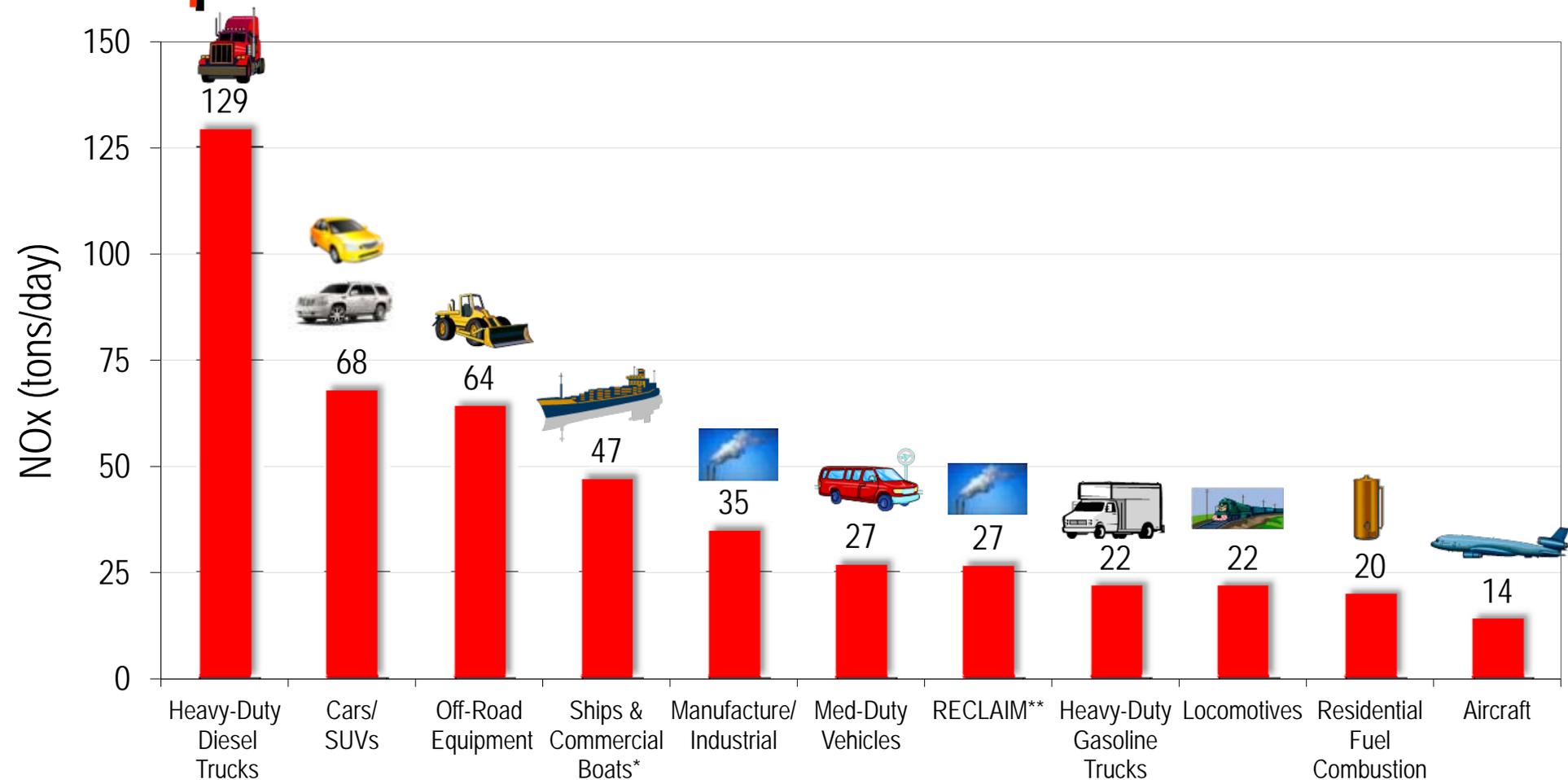
Panel 4: Natural Gas Engines, Trucks, and Fleet Use

*Electric and Natural Gas Vehicles in California*  
*IEPR Lead Commissioner Workshop*  
Sacramento, CA  
June 23, 2014

# Air Quality Attainment Dates/ Climate Goals



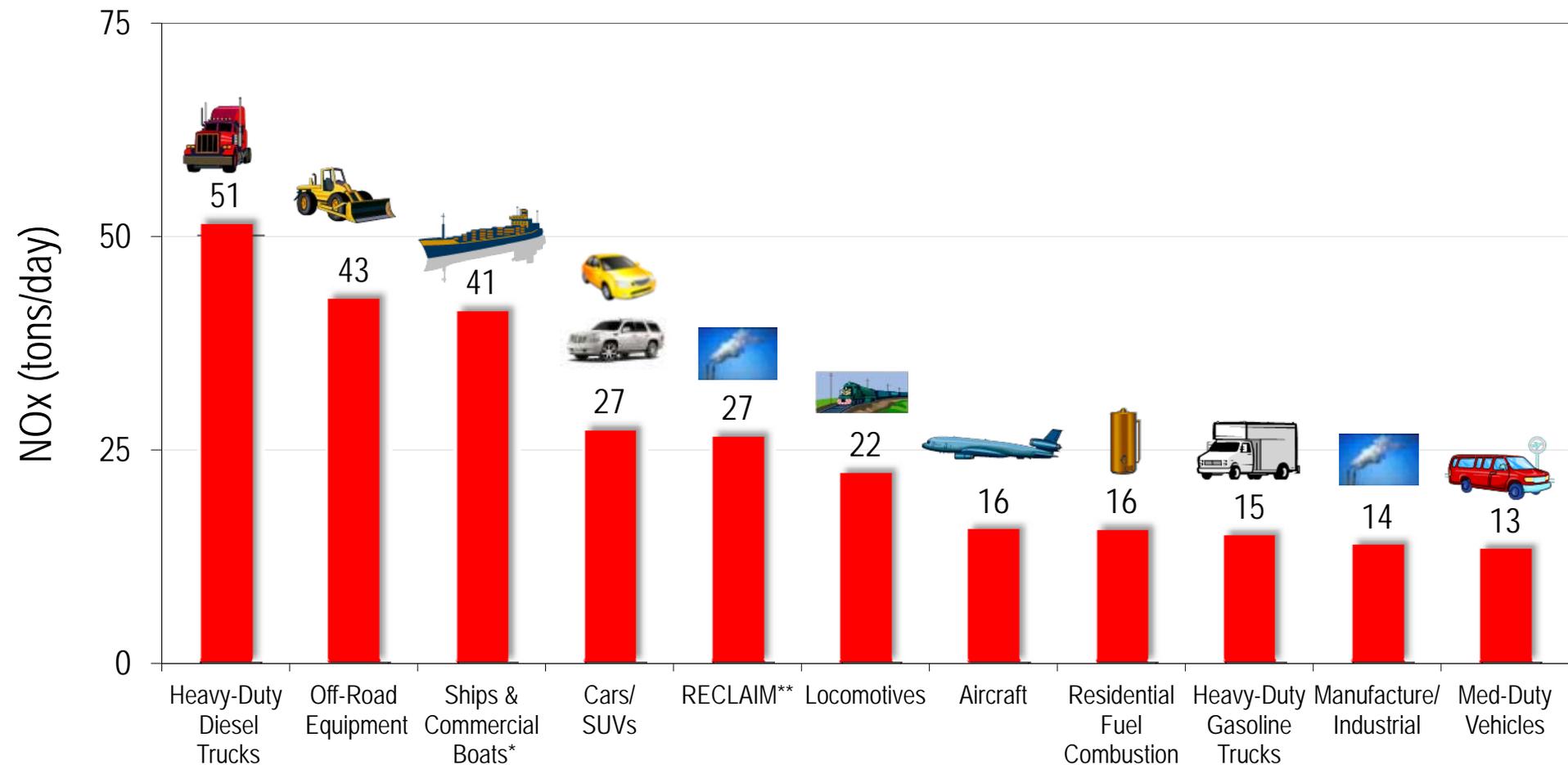
# Top NOx Emissions Sources in 2014



\* Ocean-going vessels = 35 tons/day

\*\*RECLAIM: 320 largest stationary sources, including all refineries and power plants

# Top NOx Emissions Sources in 2023

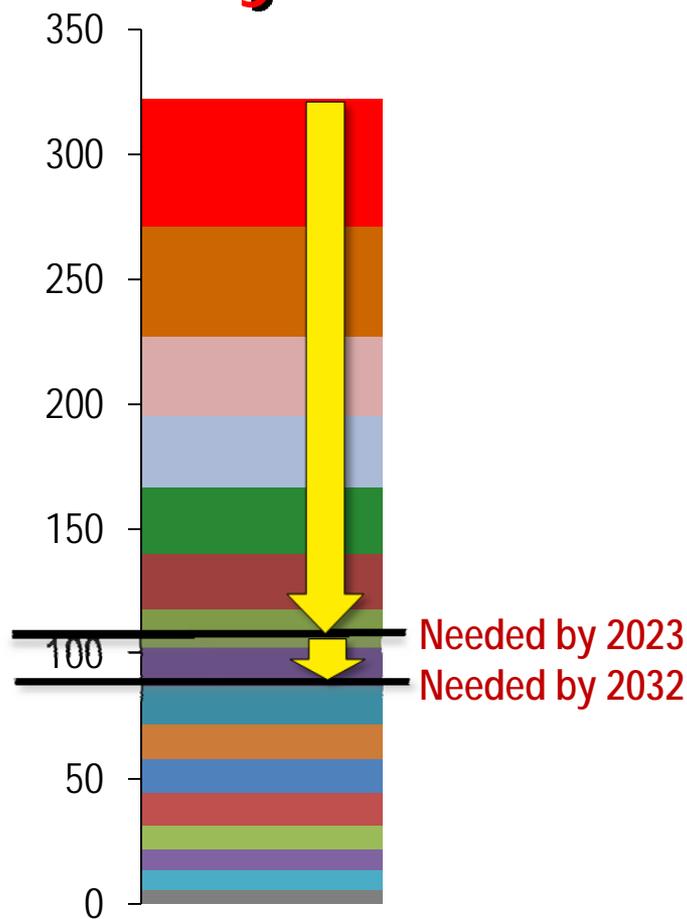


\* Ocean-going vessels = 32 tons/day

\*\*RECLAIM: 320 largest stationary sources, including all refineries and power plants

# Needed Pollution Reduction to Meet Ozone Air Quality Standards

- Heavy-Duty Diesel Trucks
- Off-Road Equipment
- Ocean-going Vessels
- Other
- RECLAIM (Large Stationary)
- Locomotives
- Aircraft
- Residential Fuel Combustion
- Heavy-Duty Gasoline Trucks
- Light-Duty Vehicles
- Medium-Duty Trucks
- Light-Duty Trucks
- Manufacturing and Industrial
- Commercial Boats
- Service/Commercial



# Vision for Clean Air:

## *Framework for Air Quality and Climate Planning*

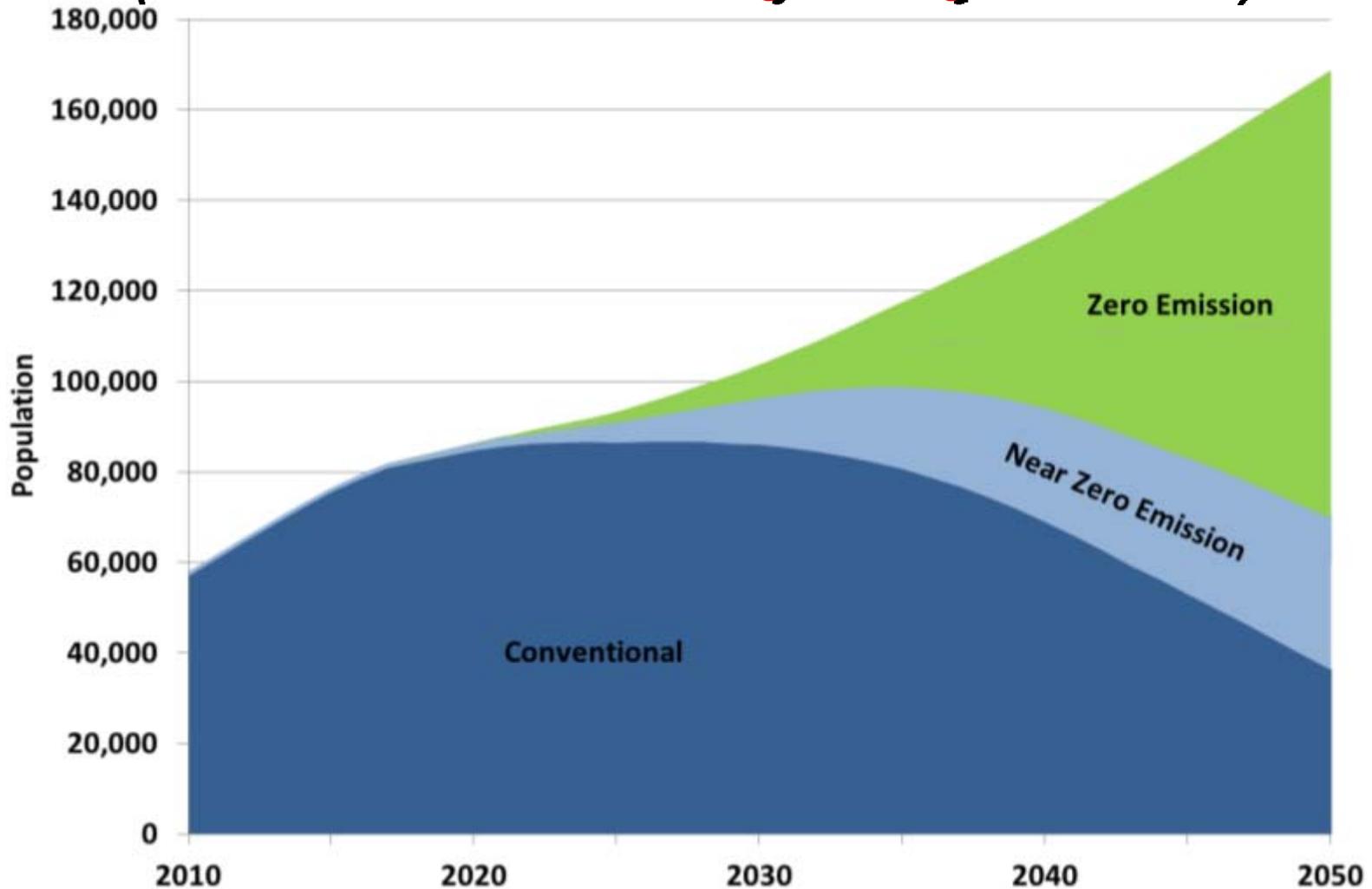
- Short-, Mid-, and Long-Term Visioning to Integrate Multi-Pollutant, Multi-Deadline Air Quality Planning
- Resource Document for
  - SIP (PM2.5 & Ozone)
    - ✓ Targets (2023, 2032 – Ozone)
  - Climate Change Scoping Plan Update
    - ✓ Targets (2020, 2050 - GHG)
  - CARB Freight Sustainability Strategy Document
- Air Toxic Reduction - Co-Benefits



# Coordinated Air Quality and Climate Planning: *Key Concepts*

- Technology Transformation
- Early Action
- Cleaner Combustion
- Multiple Strategies
- Federal Action
- Efficiency Gains
- Energy Transformation

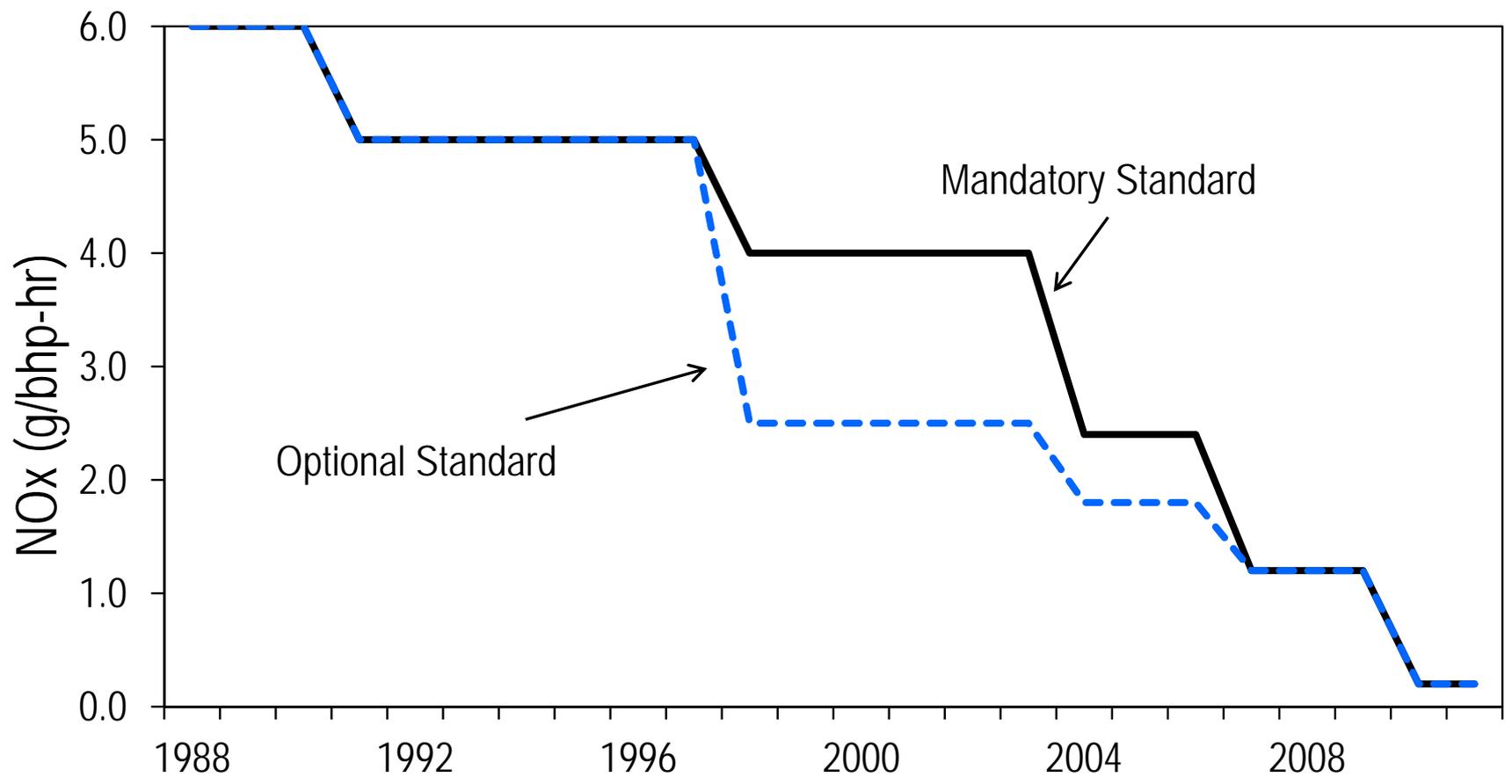
# Technology Transformation (South Coast Heavy-Duty Trucks)



# Optional NOx Exhaust Emission Standards

- Provide Early Emission Targets for Development of Advanced Engine Control Technologies
- Early, Limited Deployment of Engines
  - Evaluate Engine Performance
  - Provide End-User Experience with New Technology
- Enable Funding Incentives for Cleaner Engines

# On-Road Heavy-Duty Engine Exhaust Emissions Standards



# Current Optional NOx Exhaust Emission Standards

NOx Exhaust Emissions Level (g/bhp-hr)	Percent Below Current Standard
0.2 (Current)	
0.1	50%
0.05	75%
0.02	90%

# Demonstration Projects

- CEC, SCAQMD, and So Cal Gas Sponsorship
  - Commercialization of 0.02 g/bhp-hr NO<sub>x</sub> Natural Gas Heavy-Duty Engine
- California Air Resource Board Sponsorship
  - Demonstrate 0.02 g/bhp-hr NO<sub>x</sub> Diesel and Natural Gas Heavy-Duty Engine Technologies

# Summary

- Early Commercialization of Cleaner Engines
  - Provide Products Needed to Help Meet Air Quality Goals in the Near-Term
  - Develop End-User Confidence in Product Performance
  - Enable the Transition to Longer-Term Advanced Control Technologies