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Regional Workshop on Reducing Vehicle Emissions: Fuel Quality and Alternative Fuels

Update on California's Motor Vehicle Programs

- **Dean C. Simeroth**
- **California Air Resources Board**
- **May 2001**

California Environmental Protection Agency



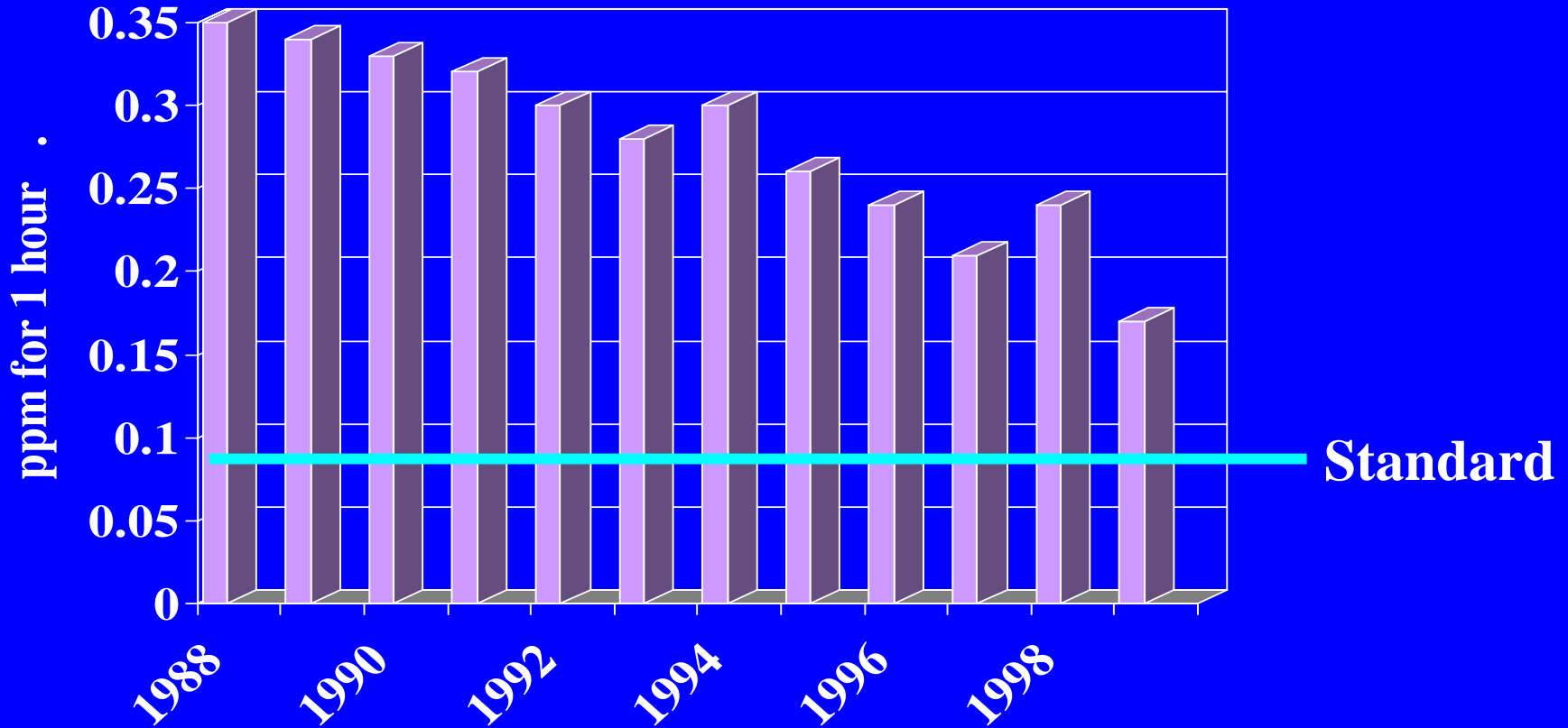
Air Resources Board

Outline

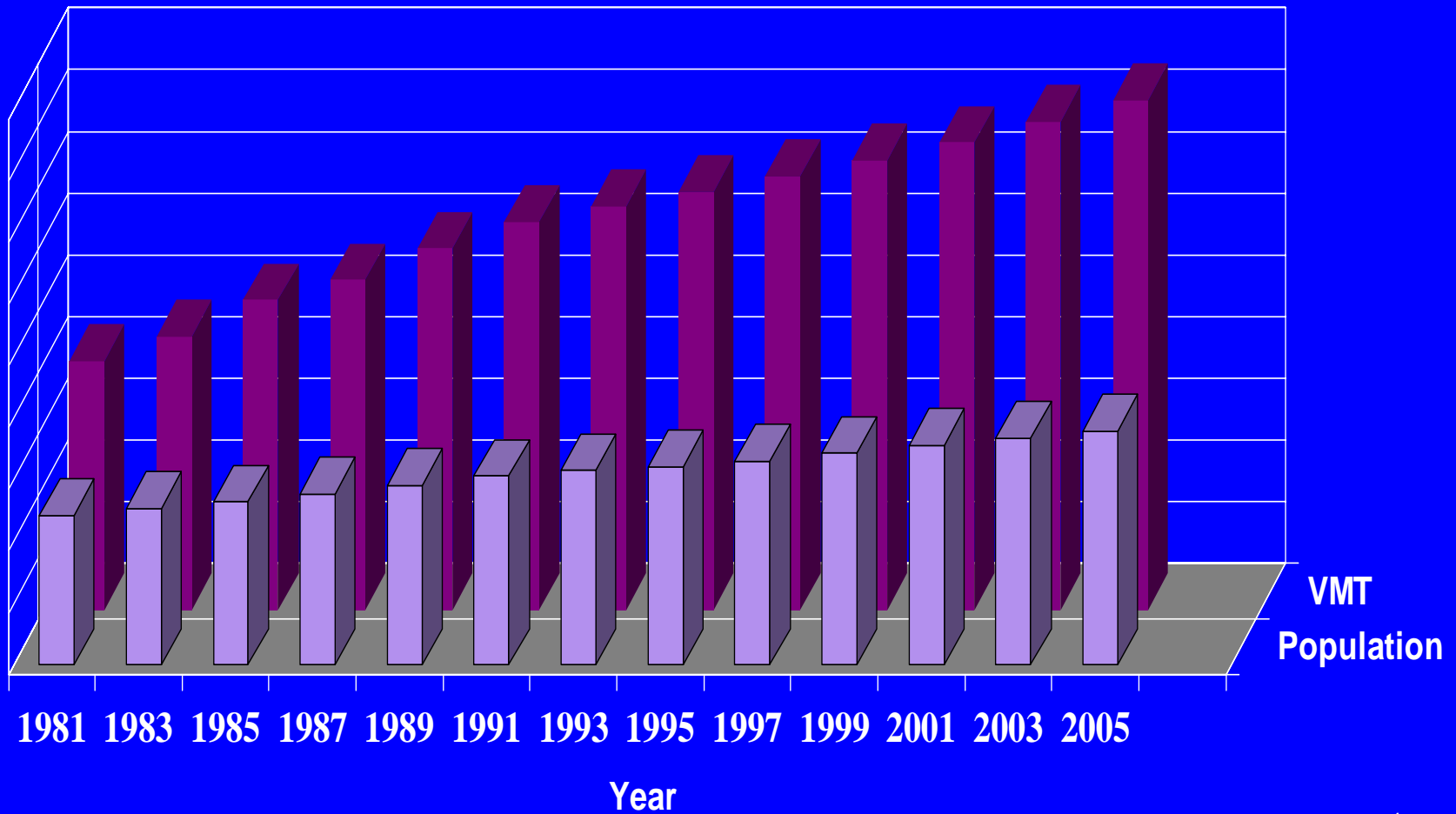
- Background: trends and goals
- On-Road Motor Vehicle Control Programs
 - Low-emission vehicles
 - Zero-emission vehicles
- California Fuel Cell Partnership overview
- Vision for the Future

Air Quality Trends

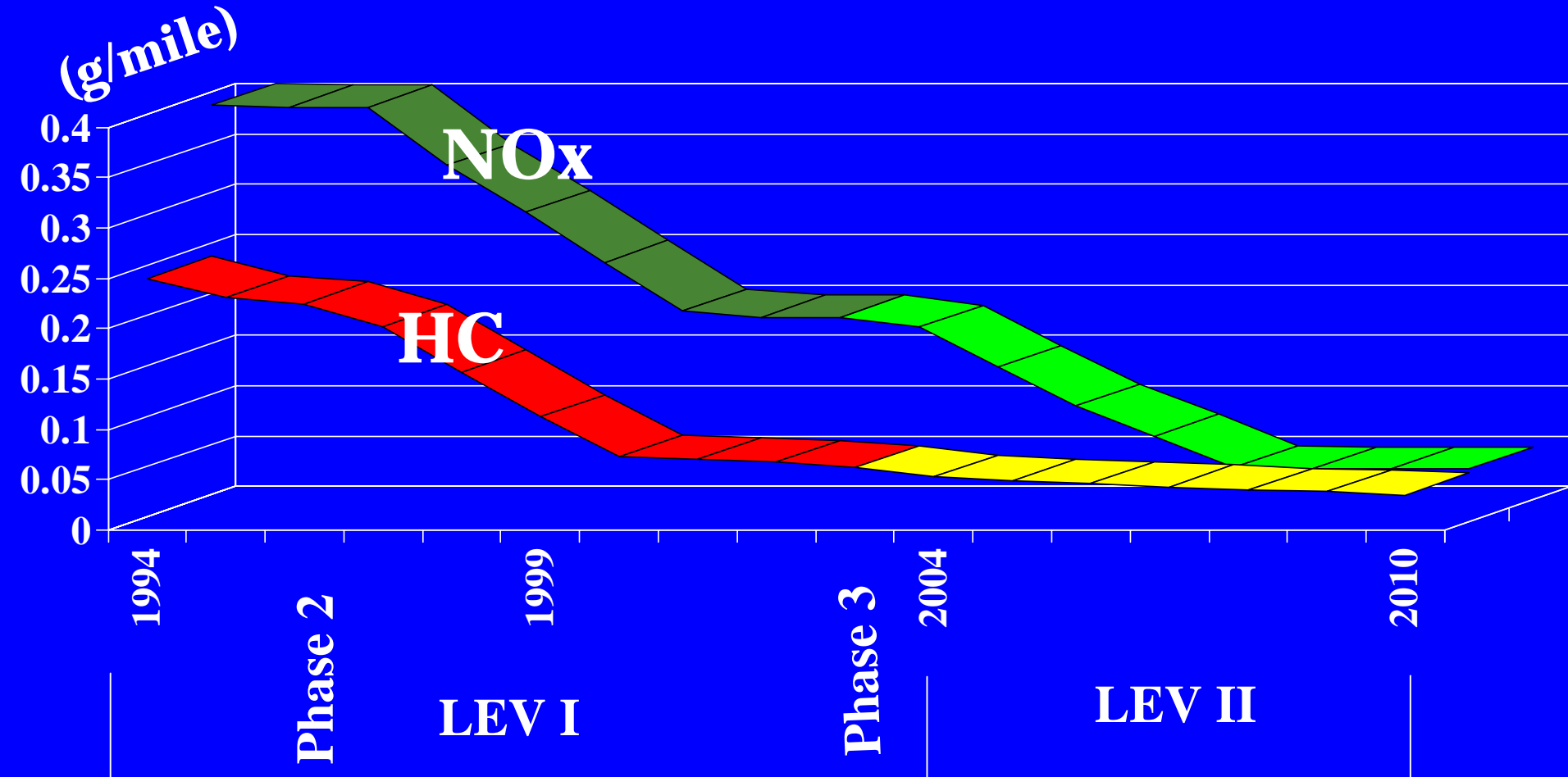
Highest Ozone: Greater Los Angeles



Daily VMT Increasing Faster Than Population



Goal: "Zero" Emissions



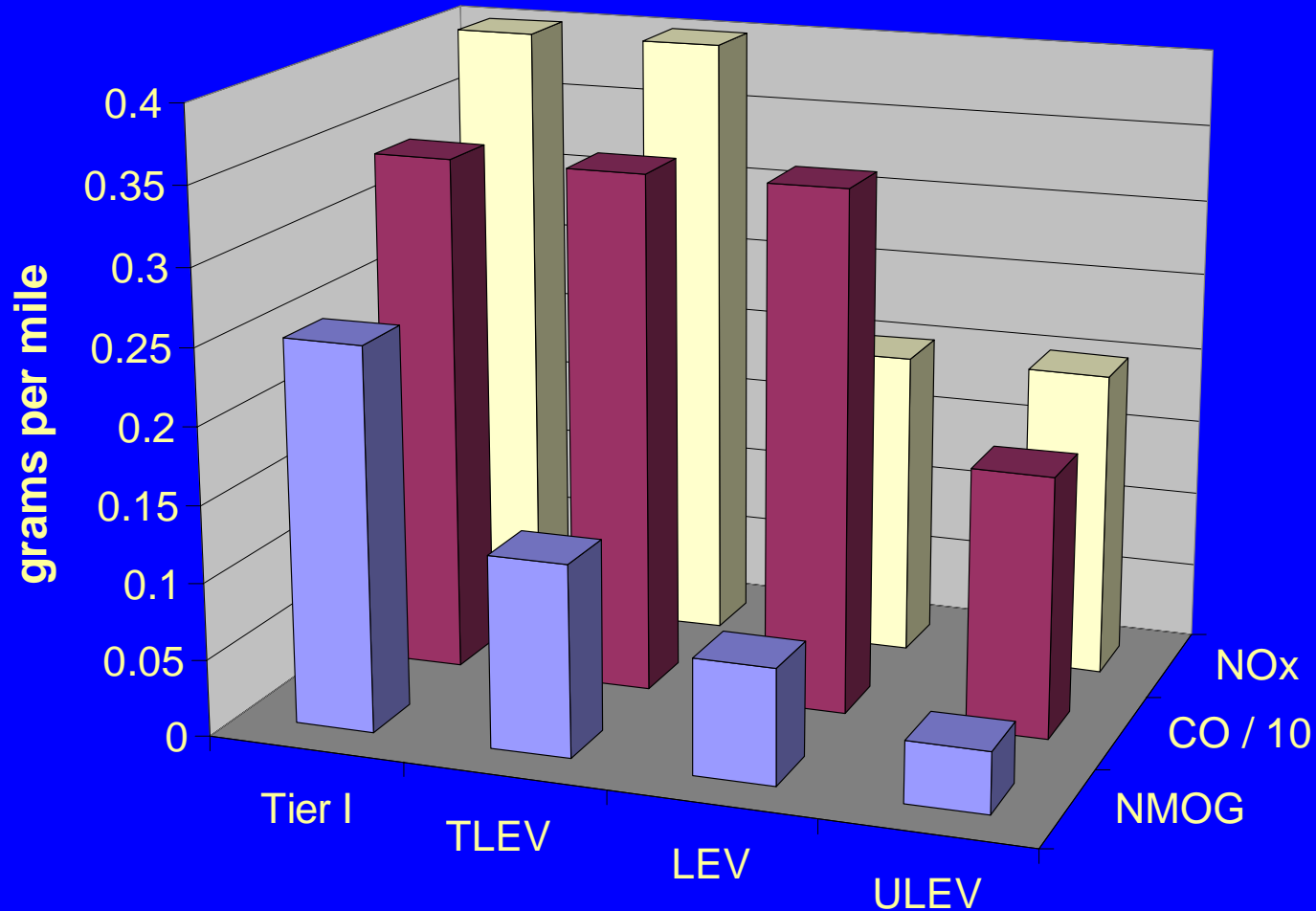
On-road Motor Vehicle Control Program

- Low-emission vehicle program (LEV)
 - LEV I implementation in 1994
 - LEV II implementation in 2004
- On-board diagnostics (OBD)
 - Requirements implemented in 1996
- Zero-emission vehicle (ZEV) requirement

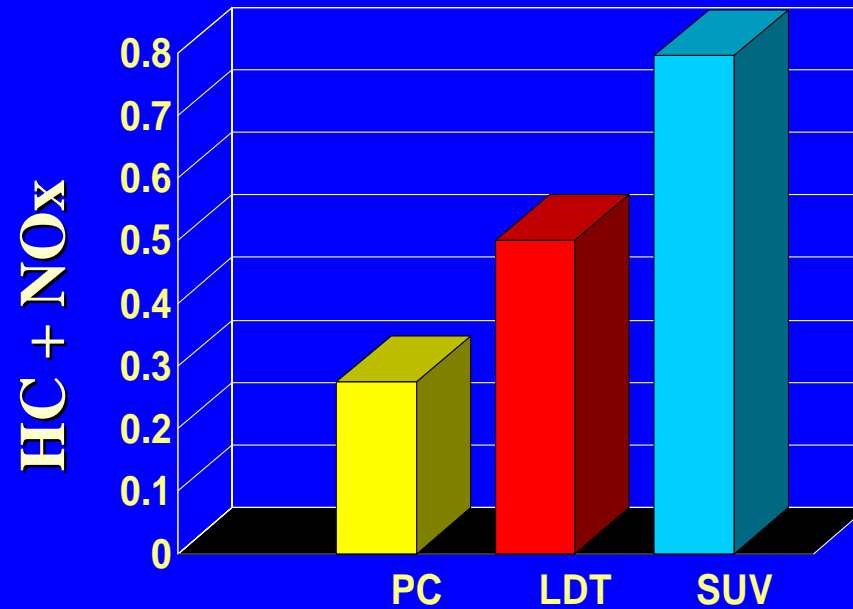
LEV I Program: Features

- Adopted 1990
- Considered vehicle & fuel as system
- Applicable to light- and medium-duty vehicles
- 4 new vehicle emission categories
- Declining fleet average NMOG emission requirements
- Reactivity adjustment factors (RAFs) for clean fuels

LEV I Program: Emission Standards



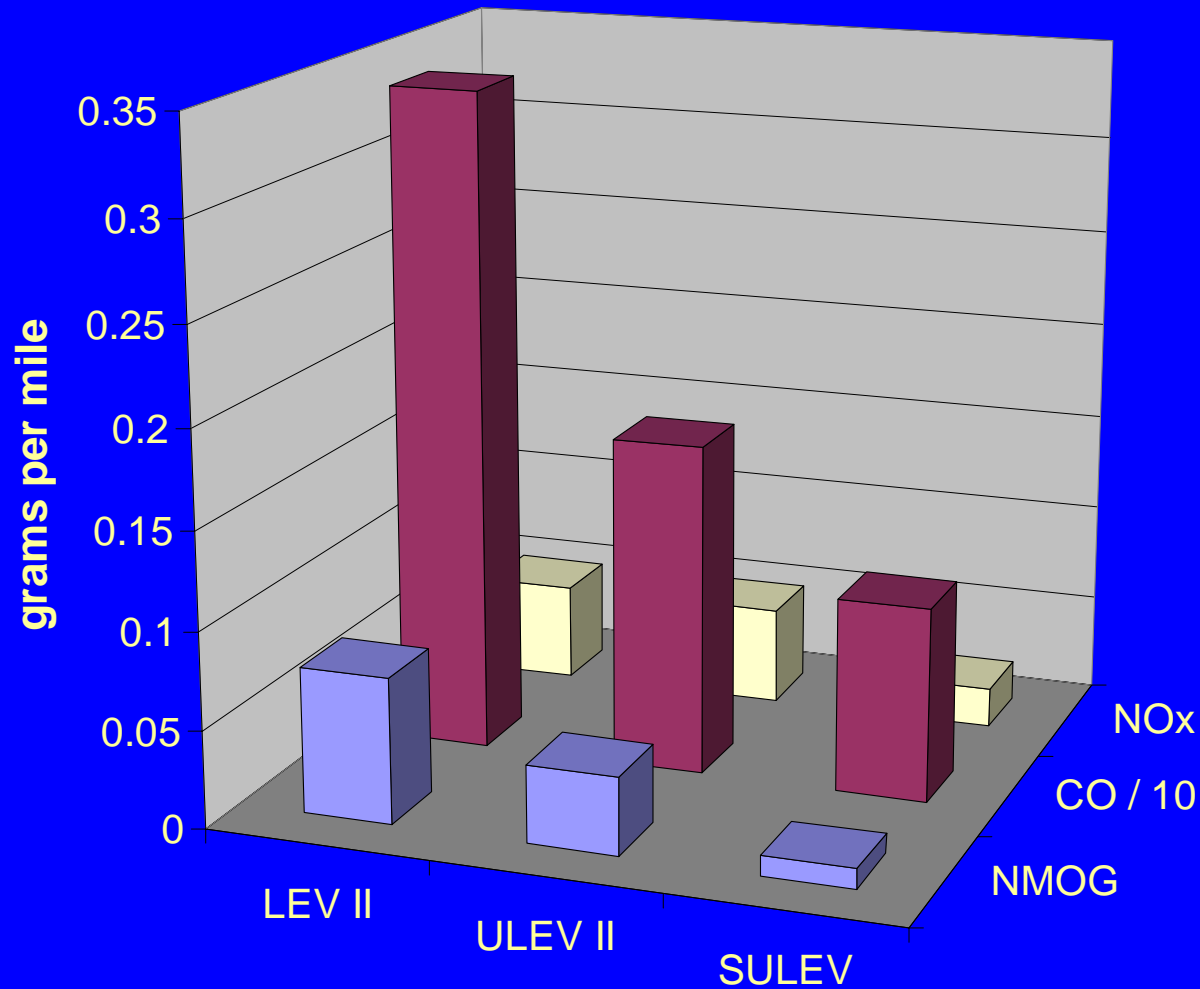
LEV I Emission Standards Comparison



LEV II Program: Features

- Adopted in 1998
- Sport utility vehicles (SUVs) and pick-up trucks meet passenger car standards
- Lower emission stds. for all vehicle categories
 - NO_x
 - NMOG fleet average
- Addition of SULEV category for passenger cars
- Remove TLEV standard beyond 2003
- Partial ZEV allowance for SULEVs

LEV II Tailpipe Emission Standards



Future Technologies for Further Reducing Tailpipe Emissions

- Individual cylinder fuel control
- Universal exhaust gas sensors
- Retarded spark timing at startup
- HC trap
- Heated fuel injectors
- Greater mixture turbulence
- Dual spark plugs/cylinder
- Higher cell density catalysts

Potential Future Evaporative System Enhancements

- Fuel tank
 - Improved barrier layer (plastic)
 - Use of injection molding (plastic)
 - Lower-permeating seals and gaskets
- Canister: increased compartments
- Design (e.g., reduce length of fuel hoses, and number of hose and fuel tank connections)

On-Board Diagnostics (OBD) Program

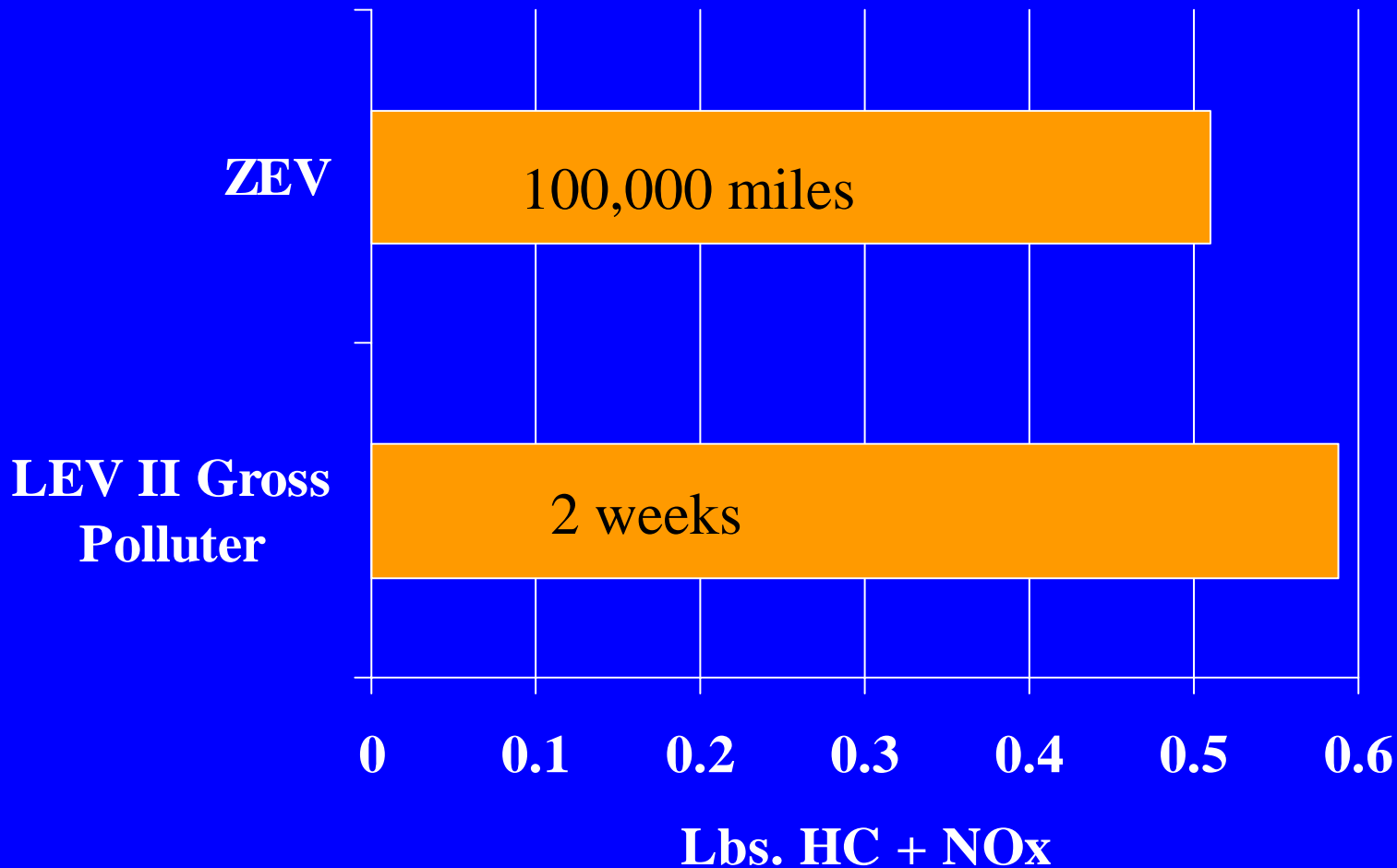
- 1996 and newer light and medium duty vehicles
- Virtually all emission control systems and components that can affect emissions must be monitored
- Malfunctions must be detected before emissions exceed standards by a specified threshold (generally 1.5 X std)
- In most cases, malfunctions must be detected within 2 driving cycles
- Standardized features for diagnosis and repair

California's ZEV Program:

Features

- Adopted as part of LEV I program in 1990
- Large manufacturers:
 - 4% of car/light trucks in 2003+
 - Battery electric, hydrogen fuel cell vehicles
- Additional 6% ZEV requirement
 - Super-clean gasoline engines, hybrids, etc.
- MOA: 2,300 advanced battery vehicles placed since 1996

Emissions Comparison-- ZEV vs. LEV II Gross Polluter



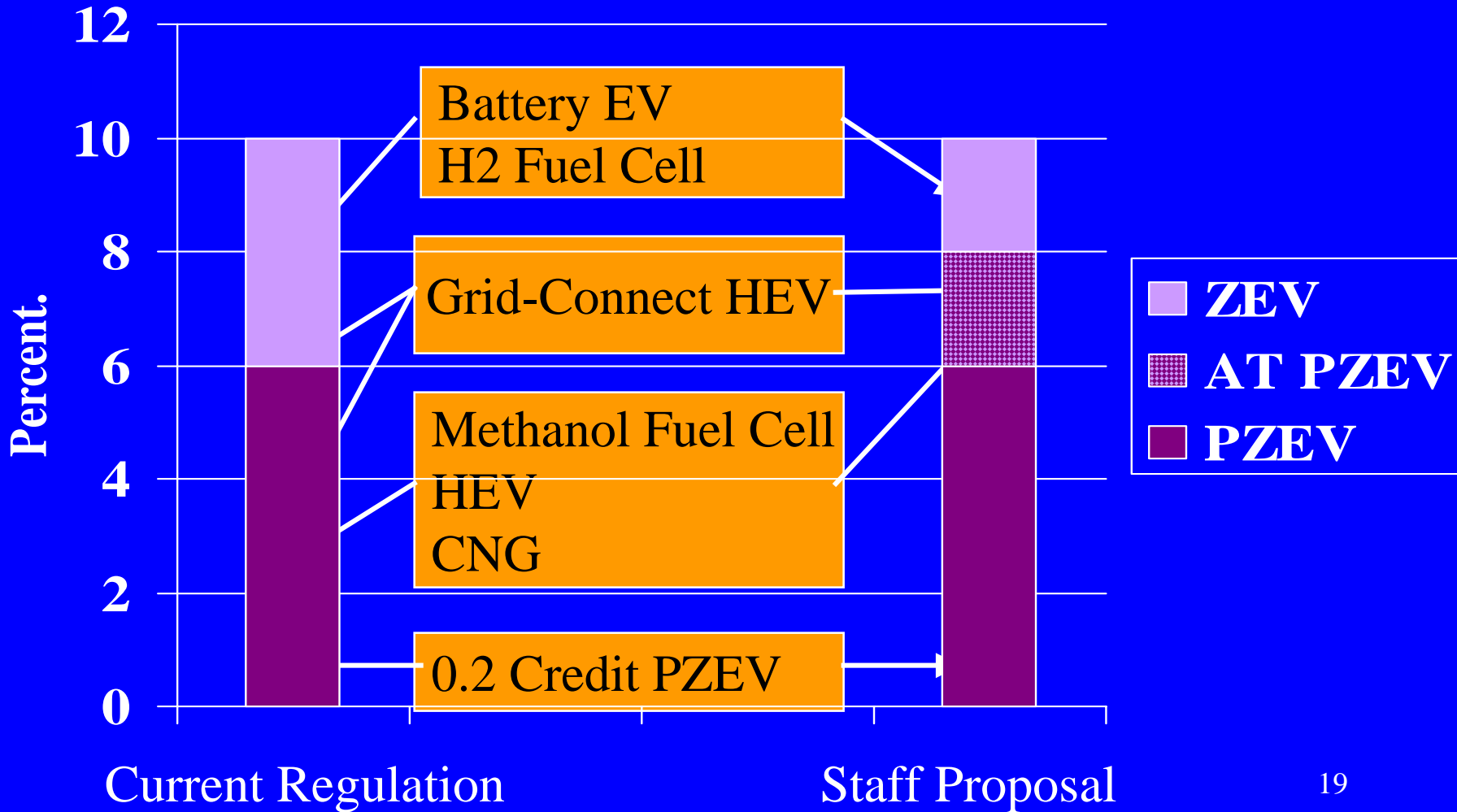
September 2000 Board Meeting

- Reaffirmed commitment to the ZEV requirements
- Directed staff to address:
 - Cost
 - Near-term vehicle availability
 - Market stability
 - Public education

Staff Proposal

- Reduce number of ZEVs needed
- Allow further reduction if manufacturers backfill with advanced technology vehicles
- Reduce number of PZEVs needed in early years
- Gradually increase ZEV requirement

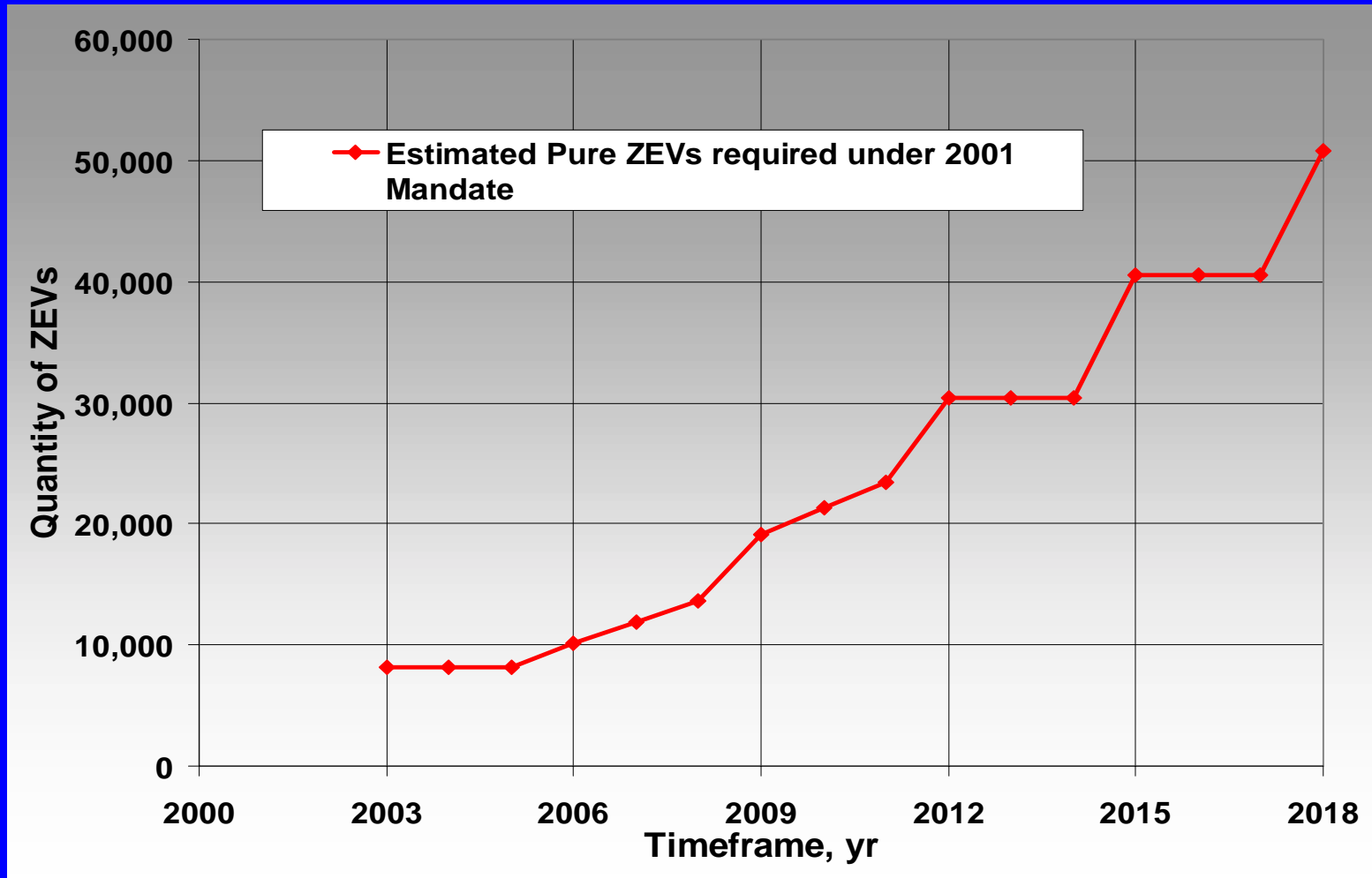
Staff Proposal



January 2001 Board Meeting

- Increase number of vehicles required
 - Include heavier vehicles in base
 - Additional modifications to result in 2X staff proposal
 - Phase in changes beginning in 2007
- Remove grid connect hybrid vehicles from top 2 percent

Zero Emission Vehicle (ZEV) Mandate



Future Challenges

- Overcome technical hurdles
- Develop necessary infrastructure
- Reduce cost through volume production
- Establish appropriate incentives
- Reduce global impacts

California Fuel Cell Partnership



Environmental and Energy Statement of Intent:

The California Fuel Cell Partnership is committed to promoting fuel cell vehicle commercialization as a means of moving toward a sustainable energy future, increasing energy efficiency and reducing or eliminating air pollutants and greenhouse gas emissions

Adopted by the CaFCP Steering Team, July 2000

California Fuel Cell Partnership



- Benefits of Fuel Cell Vehicles
 - Zero or near-zero emissions
 - Reduce greenhouse gases
 - Improved fuel efficiency and lower maintenance costs
 - Allows the use of electric drive systems
 - Extended driving range

California Fuel Cell Partnership



- Primary Partnership Goals
 - Demonstrate vehicle technology
 - Evaluation in “real-world” conditions
 - Demonstrate alternative fuel infrastructure
 - Fuel station design and construction
 - Fuel standards and specifications

California Fuel Cell Partnership



- Primary Partnership Goals:
 - Explore the path to commercialization
 - Fuel Infrastructure, Codes and Standards, Consumer Research, Emergency Response
 - Increase public awareness
 - Vehicle Demonstrations, Outreach to Schools, News Marketing, Facility Tours, Stakeholder Briefing

California Fuel Cell Partnership



- Key Dates:
 - Partnership announced April 20, 1999
 - Office and public gallery opened November 1, 2000



California Fuel Cell Partnership



- Project Phases:
 - Phase 1: 1999: Project Development
 - Phase 2: 2000-2001
 - ~20 light-duty vehicles; Up to 5 transit buses
 - Hydrogen fueling



California Fuel Cell Partnership



- Project Phases:
 - Phase 3: 2002-2003
 - ~60 light-duty vehicles; Up to 20 transit buses
 - Methanol and potentially Gasoline-type fueling



California Fuel Cell Partnership



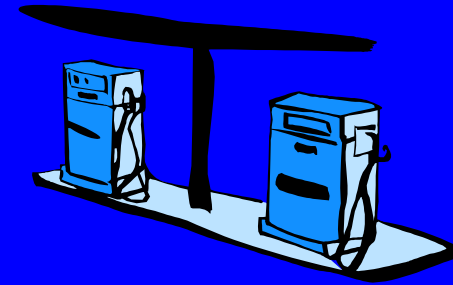
- Road Map Study
 - Cooperative effort among CaFCP members
 - Examine opportunities and
 - barriers to commercializing FCVs
 - Consider several fuel options but **WILL NOT** pick winners / losers
 - Expect draft report completed Spring 2001



California Fuel Cell Partnership



- Full Partners: Energy Providers
 - Shell Hydrogen
 - BP
 - Texaco
- Full Partners: Automakers
 - DaimlerChrysler
 - Ford
 - Honda
 - Nissan
 - Volkswagon
 - Toyota
 - General Motors



California Fuel Cell Partnership



- Full Partners: Government
 - California EPA: Air Resources Board
 - South Coast Air Quality Management District
 - California Energy Commission
 - US Department of Transportation
 - US Department of Energy
- Full Partners: Technology
 - Ballard Power Systems
 - International Fuel Cells
 - XCELLSiS

California Fuel Cell Partnership



- Associate Partners:
 - Air Products and Chemicals, Inc.
 - Praxair
 - Methanex
 - Sunline Transit Agency
 - AC Transit Agency
 - Proton Energy Systems, Inc.
 - Hydrogen Burner Technology
 - Stuart Energy
 - Pacific Gas and Electric Company

Vision for the Future

- Continued reductions in emissions from internal combustion engines
- Zero and near-zero emission vehicles
- Improved efficiency for lower CO₂ emissions
- Sustainable fuel supply: H₂ for fuel cells; renewables for electricity
- Clean, healthful air

Future Vision

CALIFORNIA and HYDROGEN

EXTRA SLIDES

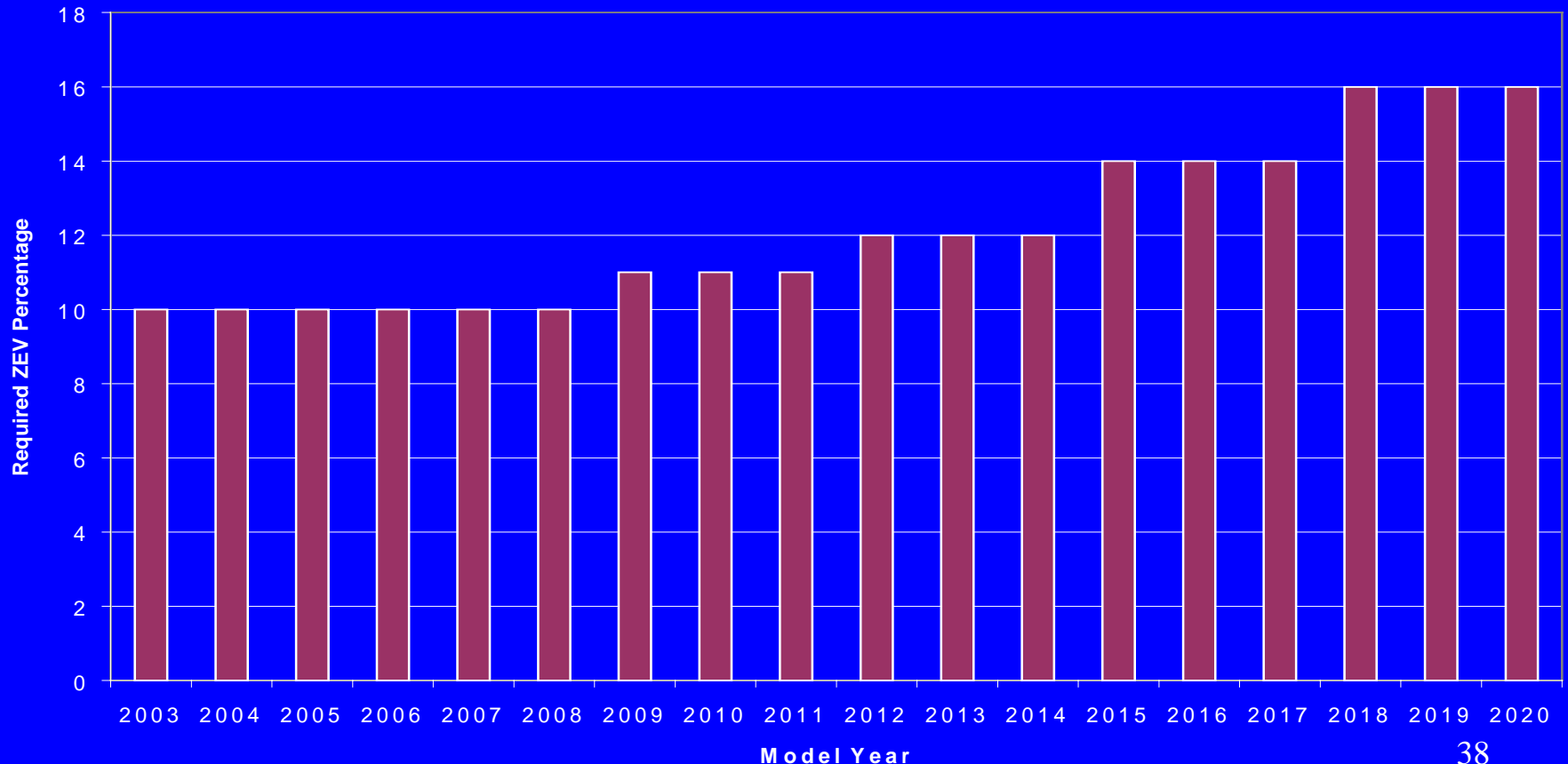
Provided for Reference

Abbreviations Used

- ZEV – Zero Emission Vehicle
- PZEV – Partial Zero Emission Vehicles
- AT PZEV- Advanced Technology Partial Zero Emission Vehicle
- PPM – Parts Per Million
- VMT – Vehicle Miles Traveled
- G/mile – grams per mile
- LEV – Low Emission Vehicle Regulations
- CBG – Cleaner Burning Gasoline
- LEV II – 1998 amendments to LEV program
- HC – Hydrocarbon
- NO_x – Oxides of Nitrogen
- Lbs. HC+NO_x – pounds of hydrocarbons and oxides of nitrogen
- CO₂ – Carbon Dioxide
- MOA – Memorandum of Agreement
- EV – Electric Vehicle
- H₂ – Hydrogen
- HEV – Hybrid Electric Vehicle
- CNG – Compressed Natural Gas Vehicle
- Ca FCP – California Fuel Cell Partnership

Zero Emission Vehicle (ZEV) Mandate

Increased fleet percentage requirements
over time:



Current California Hydrogen Production

- Total merchant capacity about 297 MMSCFD*
 - Air Products (gas and liquefaction)
 - Praxair (liquefaction)
 - Sunline Transit (variety of processes including Hythane)
- Total captive capacity about 383 MMSCFD
 - Chevron, Exxon, Henkel Corp., Lone Star Gas, Mobil, San Joaquin Refining, Shell, Texaco, and Tosco

*285 MMSCFD committed to refineries

California-Based Hydrogen Technology Providers

- Partial list includes
 - Harvest Energy Technology
 - Hydro Environment Resources
 - Hydrogen Burner Technology
 - Hygen Industries
 - IMPCO Technologies
 - Procyon Power Systems
 - Stuart Energy
 - Technip USA