

Diesel Engines: What Role Can They Play in an Emissions Constrained World?

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Outline

- Challenges and goals in California
- Diesel health effects
- Sources of diesel emissions
- Projected emissions reductions
- Light-duty diesel vehicles
 - Urban emissions
 - Global emissions
 - Competition with other technologies

4 Challenges and Goals in California

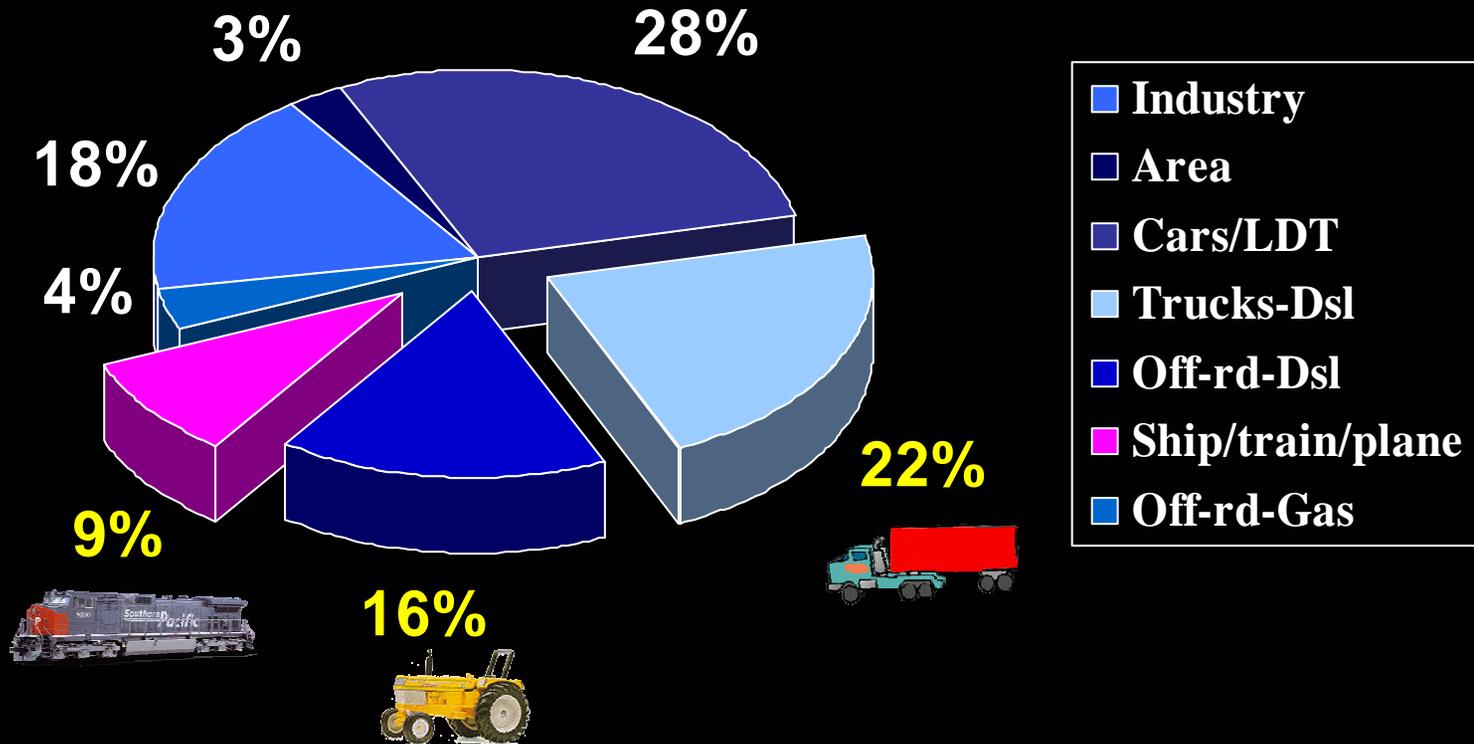
- **#1** - Eliminate ozone as a health concern
 - On track - New vehicles nearing zero emissions
 - Old vehicles the problem
- **#2** - Reduce health impacts of fine particles
 - On track - New heavy-duty diesel engines will be low emitting
 - Focus now on in-use vehicle cleanup
 - Avoid increase due to light-duty diesel emissions

4 Challenges and Goals in California (cont.)

- #3 - Do fair share in reducing global climate change emissions
 - 30% reduction new passenger vehicle CO_{2eq} emissions by 2016 proposed
- #4 - Integrate environment and energy policy
 - Reduce transportation petroleum use to 15% below current levels by 2020
 - Increase alternative fuel use to 20% by 2020

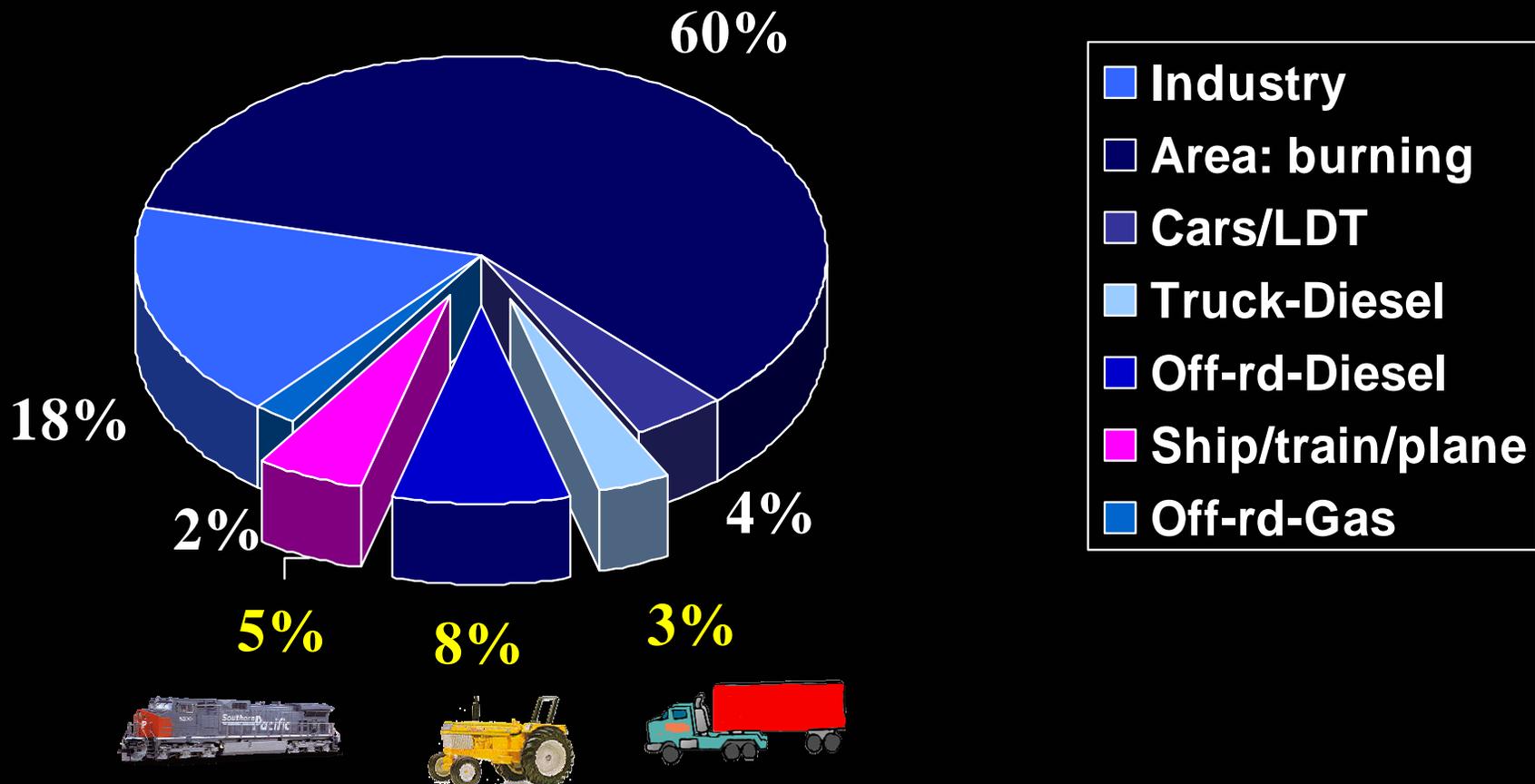
NOx Emissions

2002 Statewide (~3400 tons/day)

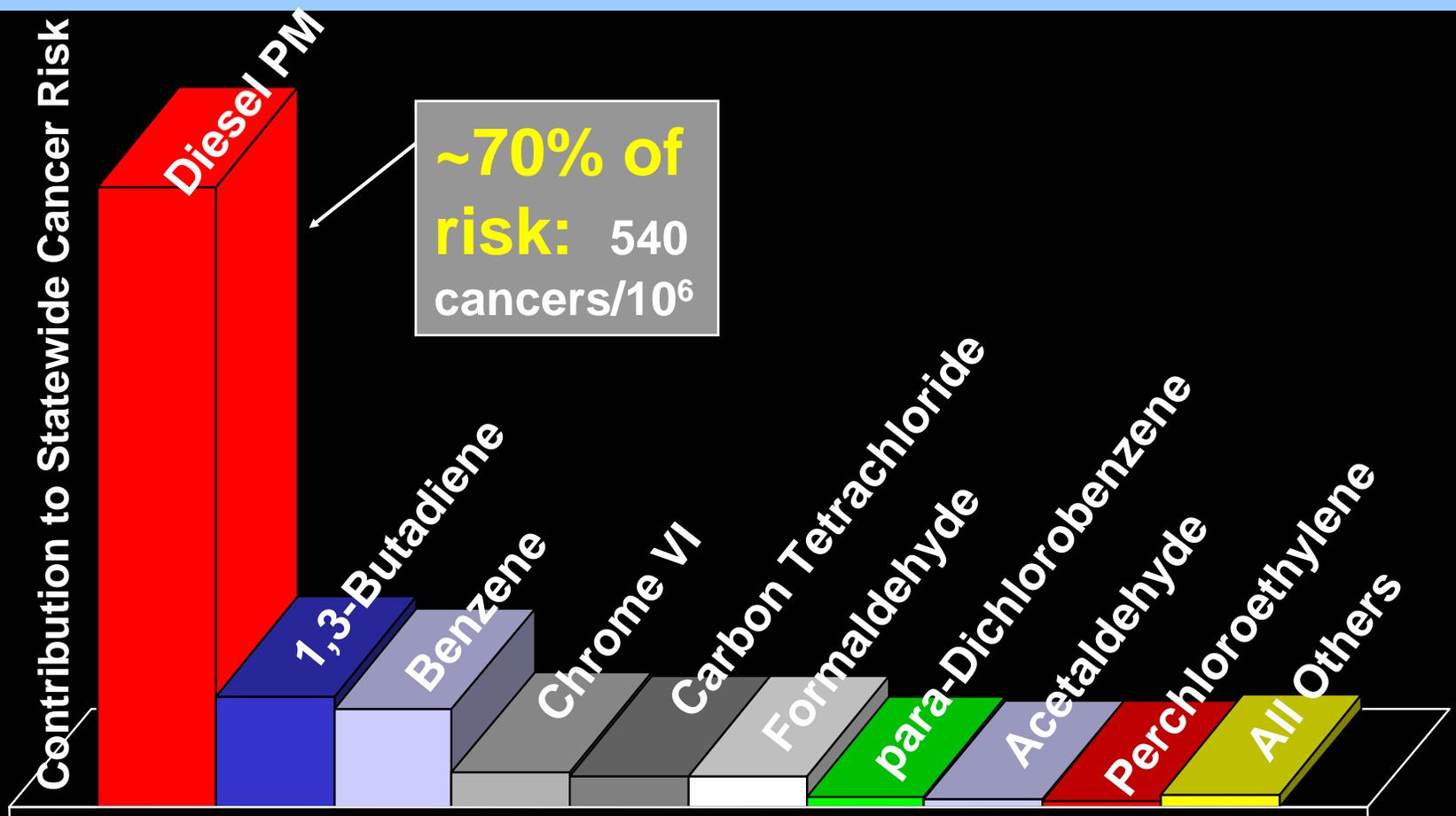


PM_{2.5} Emissions (Combustion)

2002 Statewide (~400 tons/day)



Diesels Dominate Cancer Risk from Air Toxics



Overall Health Impacts of Diesels in California

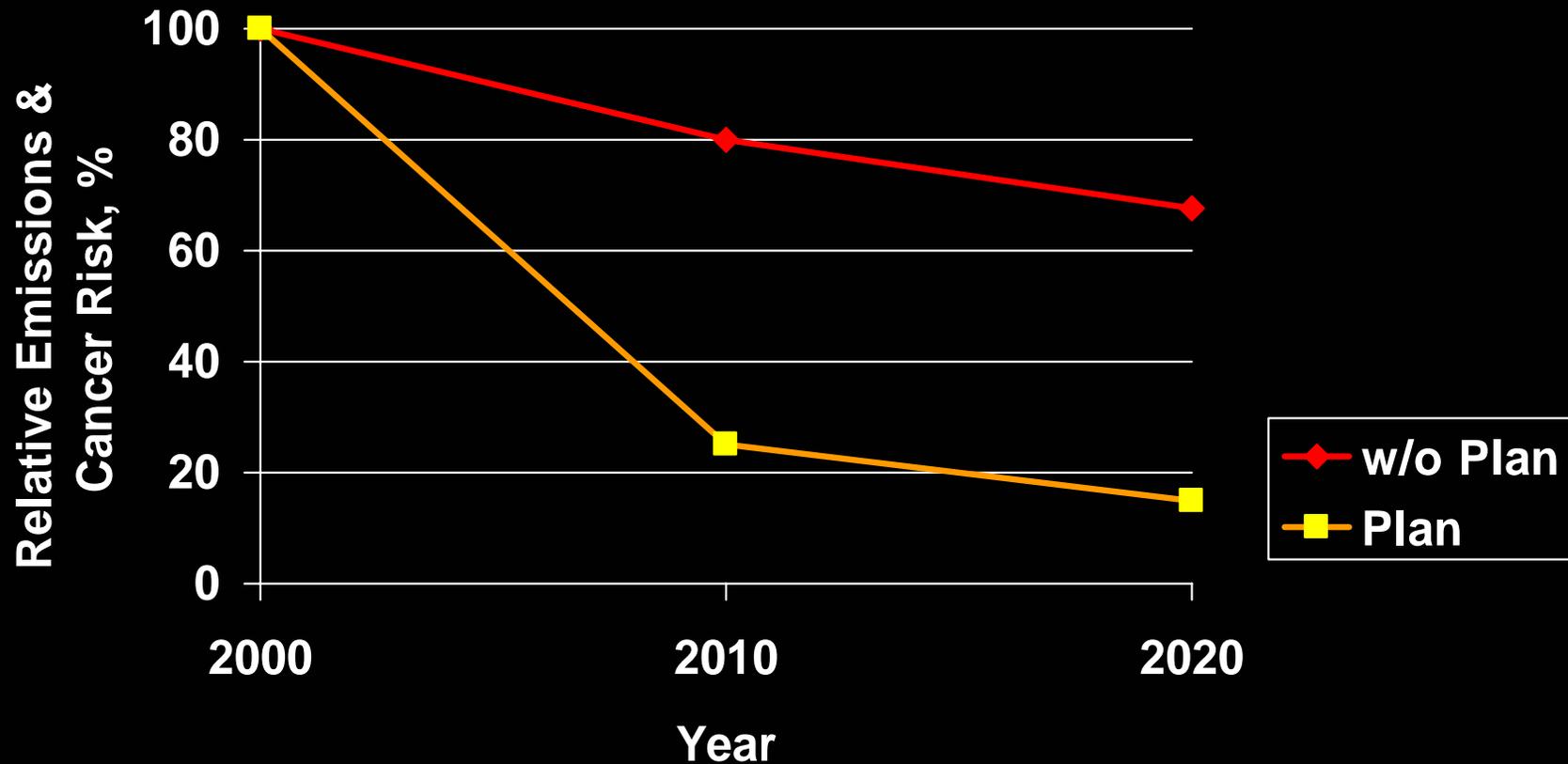
- Annual health impacts
 - 2,900 premature deaths
 - 3,600 hospital admissions
 - 240,000 asthma attacks/respiratory symptoms
 - 600,000 lost days of work
- By comparison
 - 3,700 deaths from car accidents
 - 2,000 homicides

Diesel Risk Reduction Plan

(adopted 2000)

- **Established a goal**
 - 75% reduction in diesel PM by 2010
 - 85% reduction in diesel PM by 2020
 - Additional NOx reductions
- **Four main strategies**
 - 1 More stringent new HDD engine standards
 - 2 Assure in-use compliance
 - 3 Cleaner diesel fuel; and alternative fuels
 - 4 Cleanup of existing engines

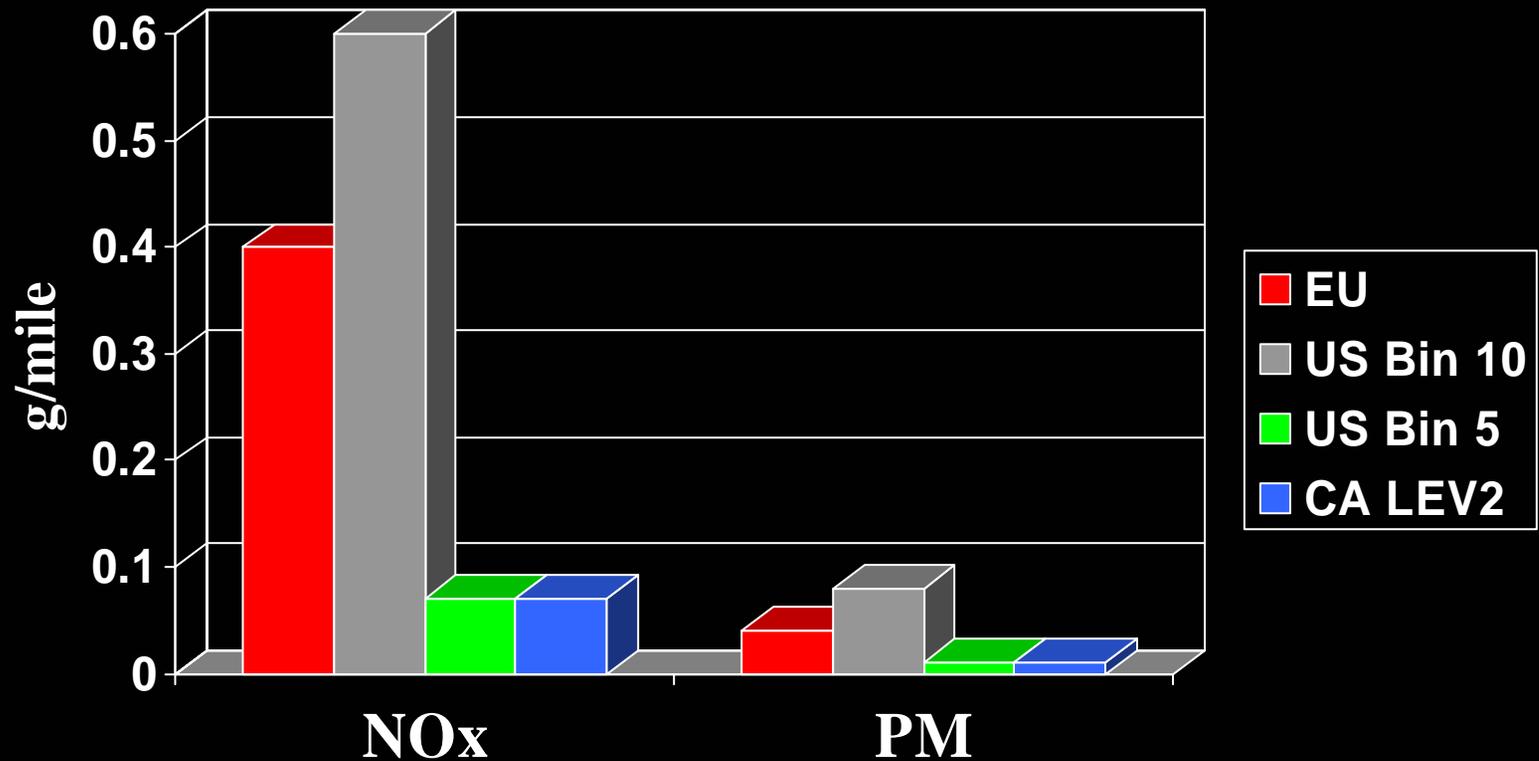
PM Emissions and Risk Reduced 75+% w/ Plan



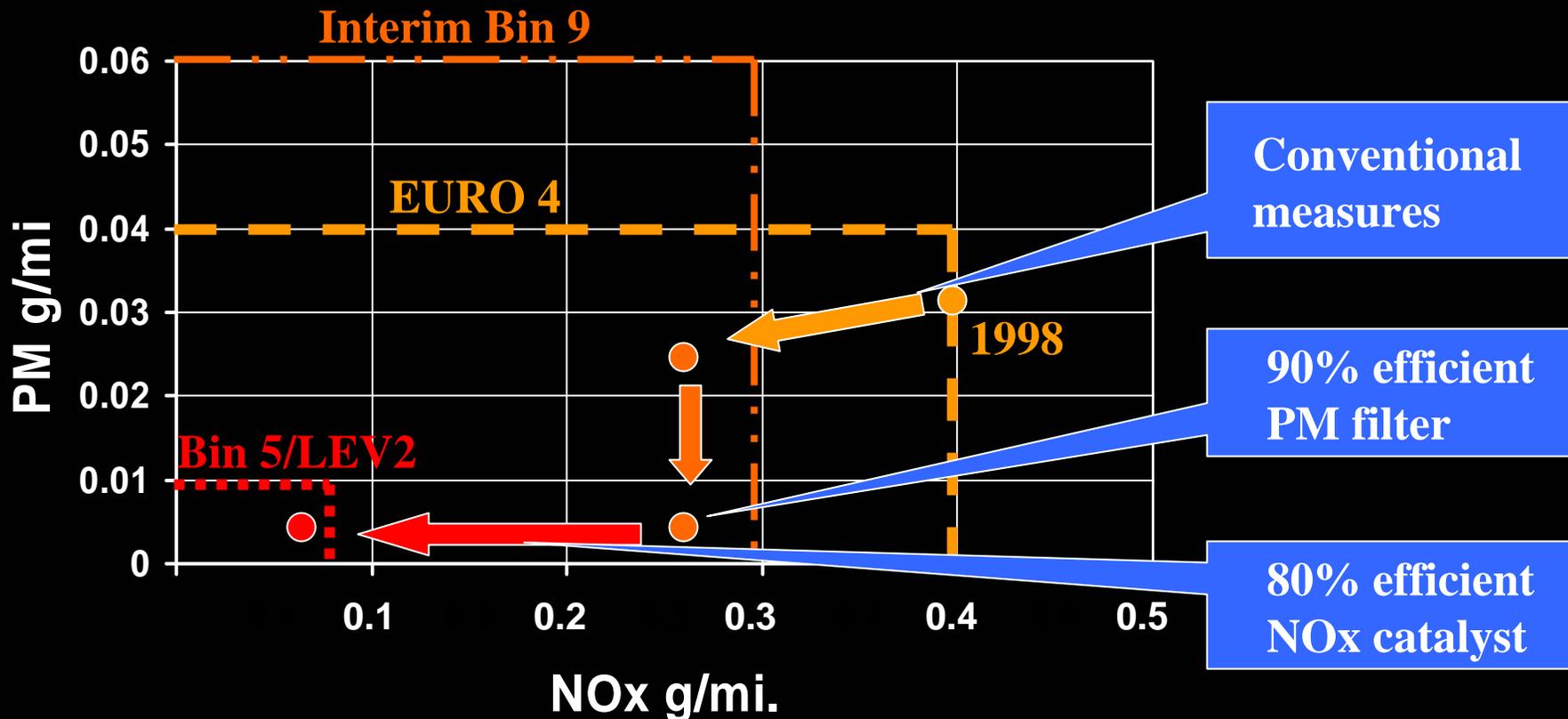
Light Duty Diesels



Light-duty Emission Standards 2005 MY



Diesel Passenger Vehicles¹: Challenge to Meet Bin 5/LEV2



Diesel Passenger Vehicles: Prospects for Meeting Bin5

FTP



Climate Change

Mt. Hood



Summer 1984



Summer 2002

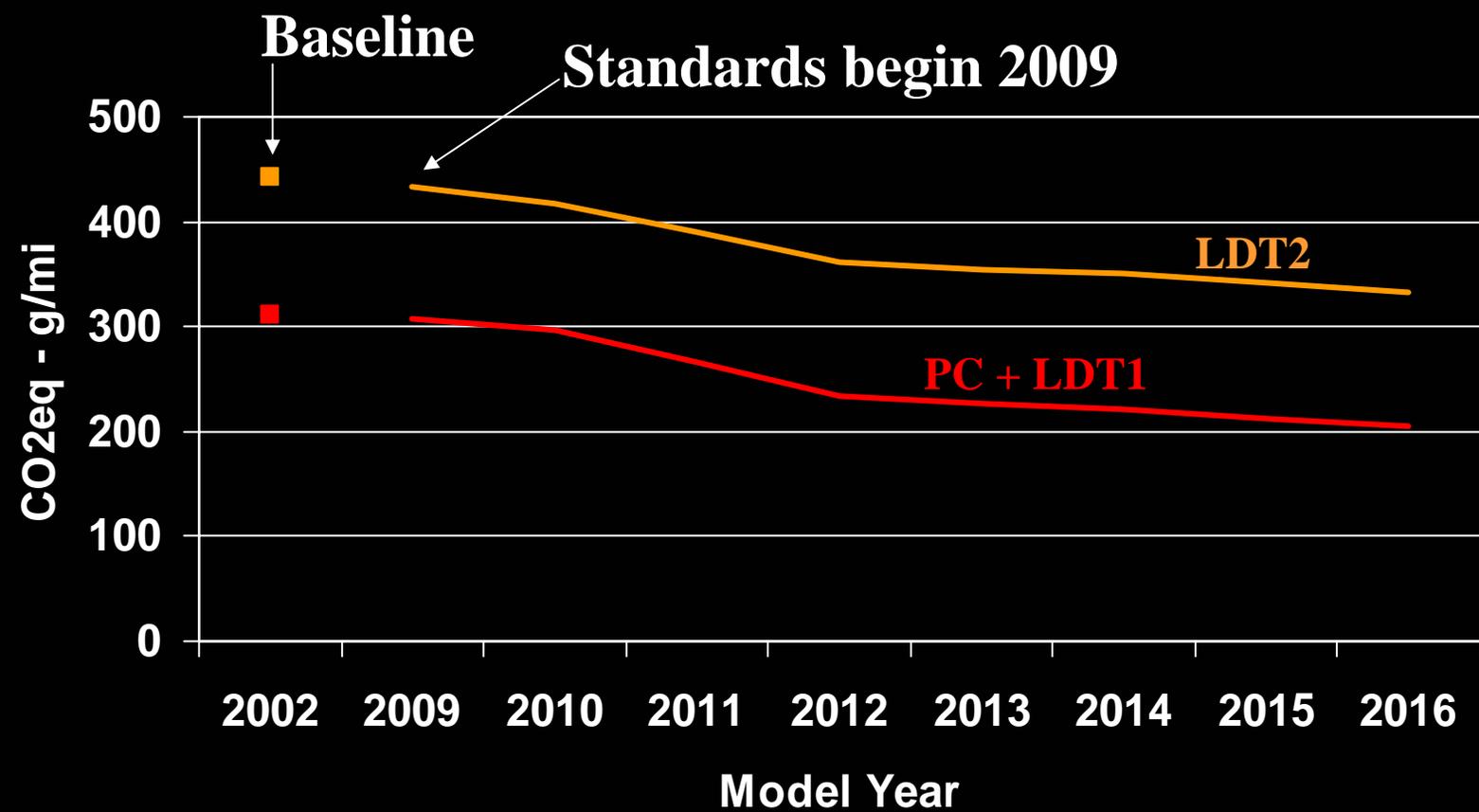
Reducing Climate Change Emissions - Passenger Vehicles

- CA Legislature: Reduce passenger vehicle climate change emissions (PC + LDT)
 - Maximum feasible reduction
 - Economical beneficial to owner
- Consider for adoption September 23, 2004
 - CO_{2eq} standards begin with 2009 models
 - Based on current & emerging technologies
 - ~20% CO_{2eq} reduction by 2012; ~30% by 2016

Proposed Emission Standards

- Expressed as manufacturer fleet average CO₂-equivalent standard
 - Separate standards: PC+LDT1; LDT2
- Includes CO₂, CH₄, N₂O, HFC
- Based on modeling of current and emerging technologies for gasoline vehicles

Fleet Average CO_{2eq} Emissions¹ As Result of Proposed Standards



¹ New vehicles

Technologies to Meet Proposed Emission Standards

- Available technologies assumed to be widely used by 2012
 - GDI-S
 - Dual cam phasing
 - Turbocharging or cylinder deactivation
 - 6 speed automated manual transmission
 - Electric power steering
 - Improved alternator
 - More efficient, low-leak A/C

Technologies to Meet Proposed Emission Standards

- Emerging technologies assumed to be widely used by 2016
 - Camless valve actuation
 - Integrated starter generator with some assist
 - Electric accessories

Available Technologies Evaluated But Not Assumed Necessary

- Technologies available to reduce CO₂ not assumed needed to meet proposed standards
 - Weight reduction
 - Alternative fuel engines
 - Mild or strong gasoline HEVs
 - Diesel
- All are alternative approaches to reduce CO₂

How Diesel Compares - Reducing Climate Change Emissions

Small Truck, Compared to 2009 Baseline

Technology ¹	CO ₂ reduction	Price increase	Payback in years
Gasoline (GDI-S, ehCVA)	24%	\$742	3
Diesel	24%	\$1141	3
Diesel HCCI (multi-mode)	18%	\$469	2
Gasoline HEV (Prius-like)	48%	\$3186	7

¹ Includes 6 spd AMT, e-PS, improved alternator, low-leak A/C; except HEV has CVT

Conclusions

- Diesel PM and NOx emissions from heavy engines being reduced dramatically
- Potential for diesel passenger vehicles meeting Bin 5/LEV2 good - this decade
- Diesel engines can contribute to reducing climate change emissions
 - Not most effective
 - Depends on cost relative to other technologies