

Light-duty Diesels: Clean Enough?

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California Air Resources Board

DEER - 2006

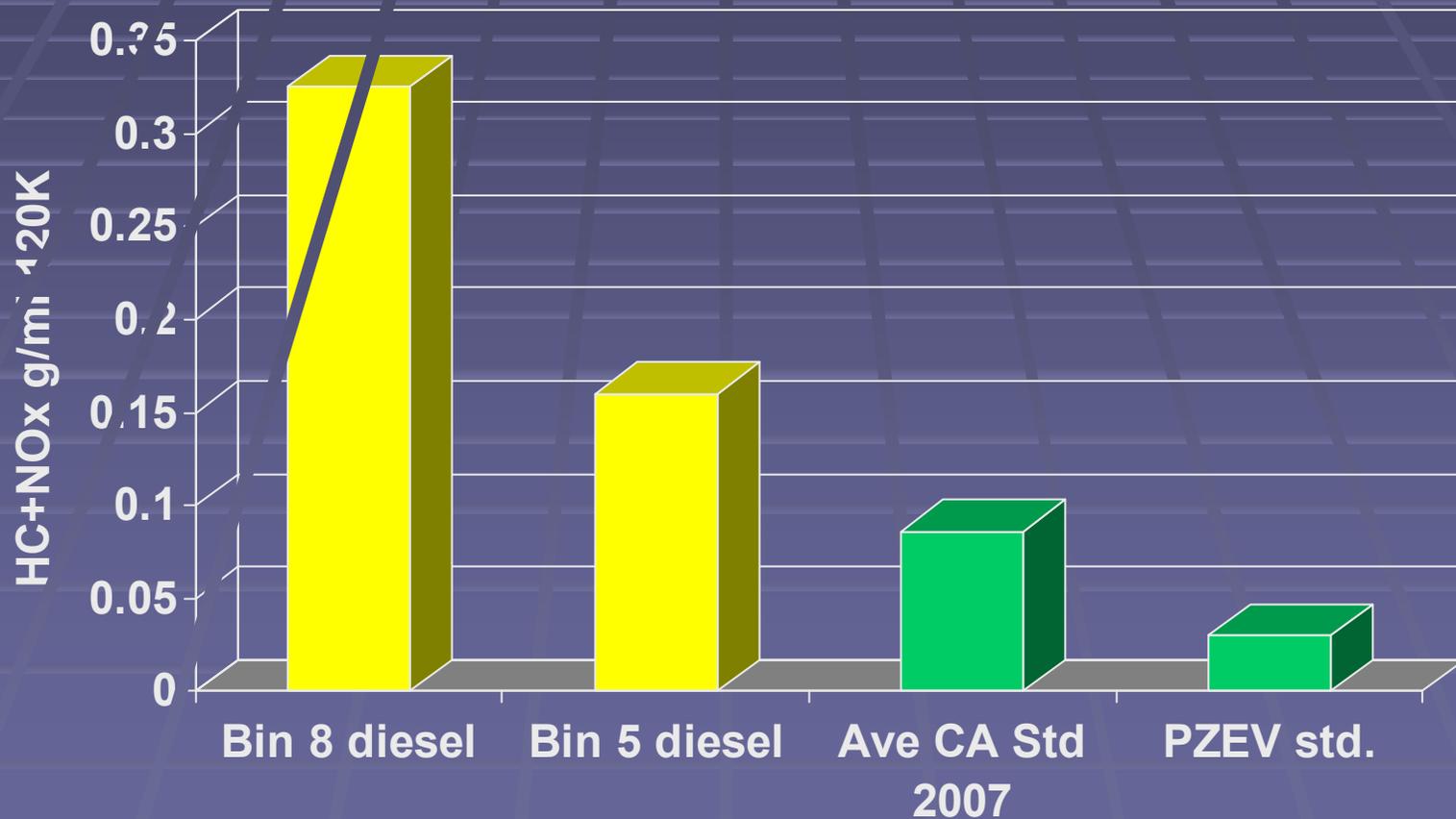
Perception Modern Diesel



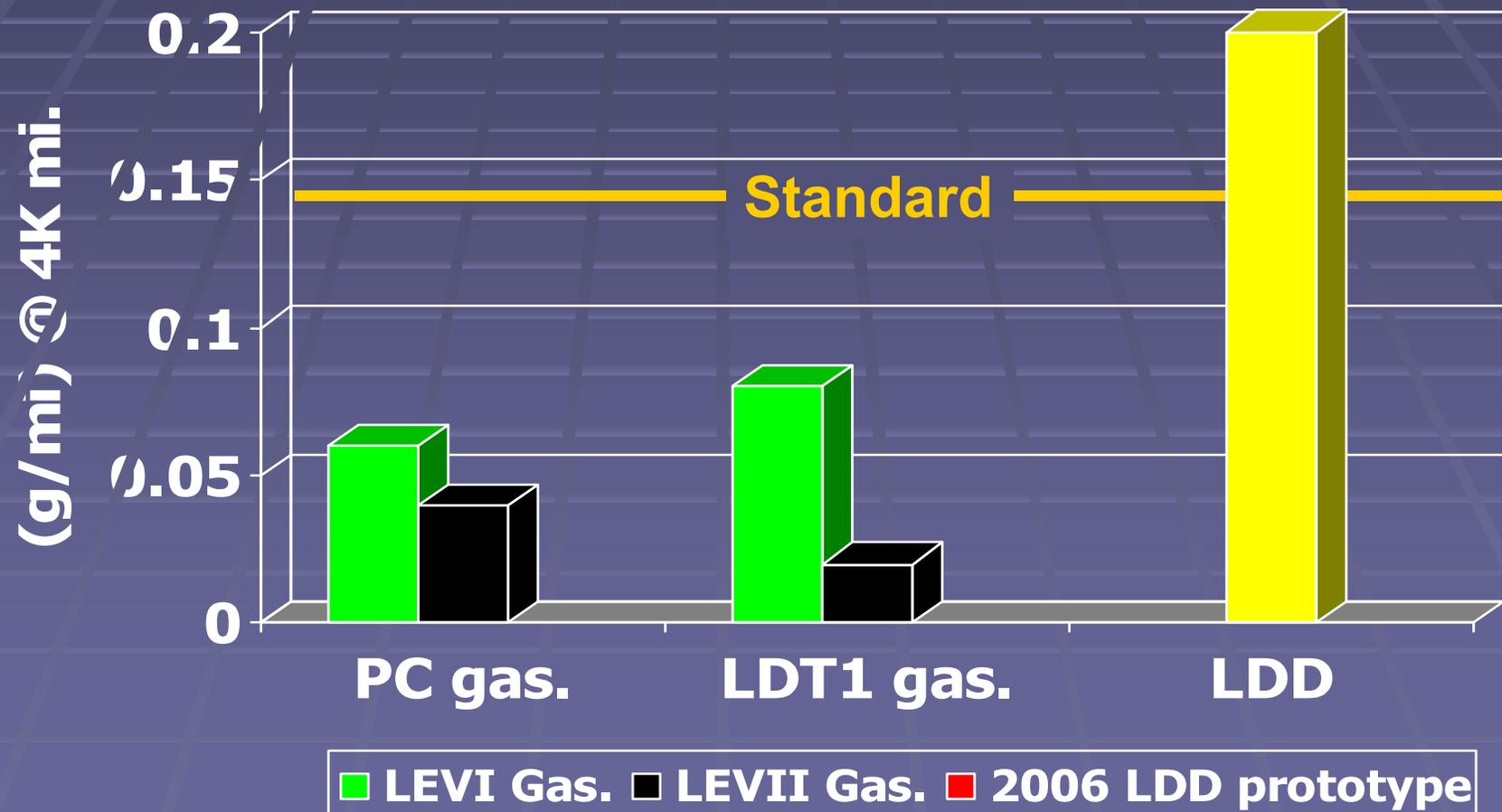
Is the Modern Diesel as Clean as a Gasoline Car?

- Urban pollutants
- Emission durability (OBD)
- CO₂ emissions

Exhaust Emissions of HC and NOx Urban Driving (FTP)

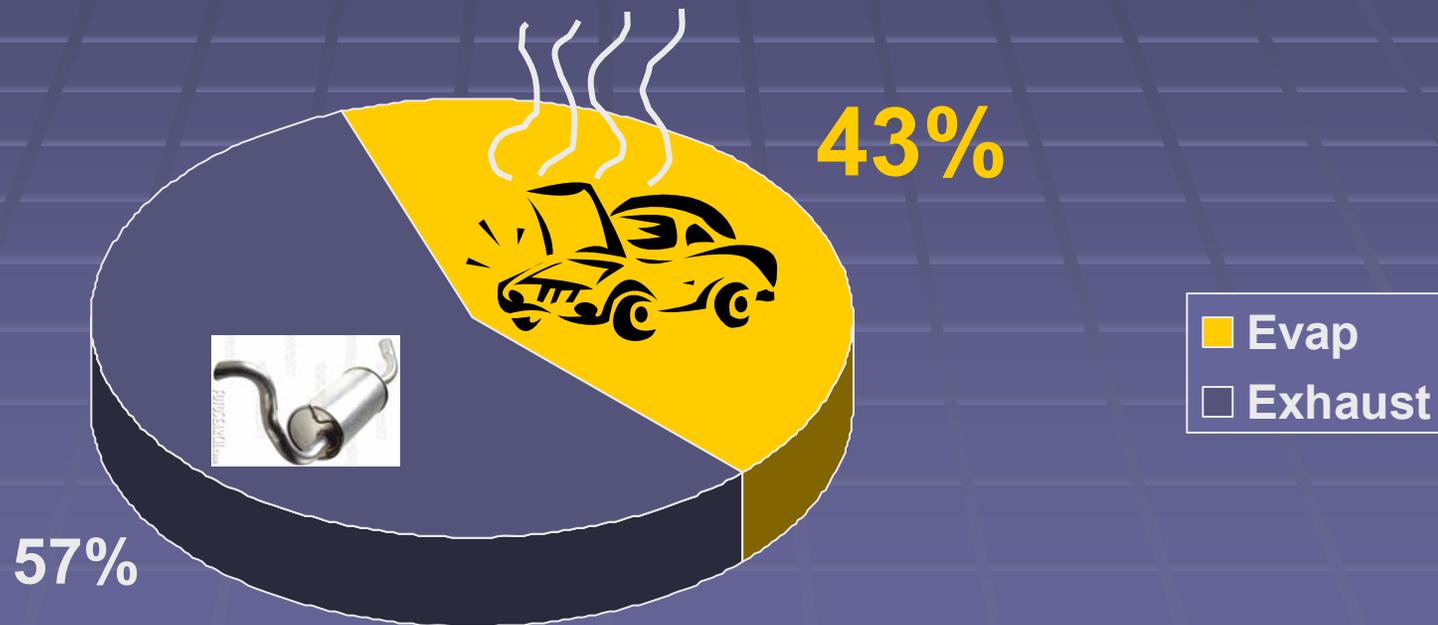


Off-cycle Exhaust Emissions HC+NOx (SFTP)



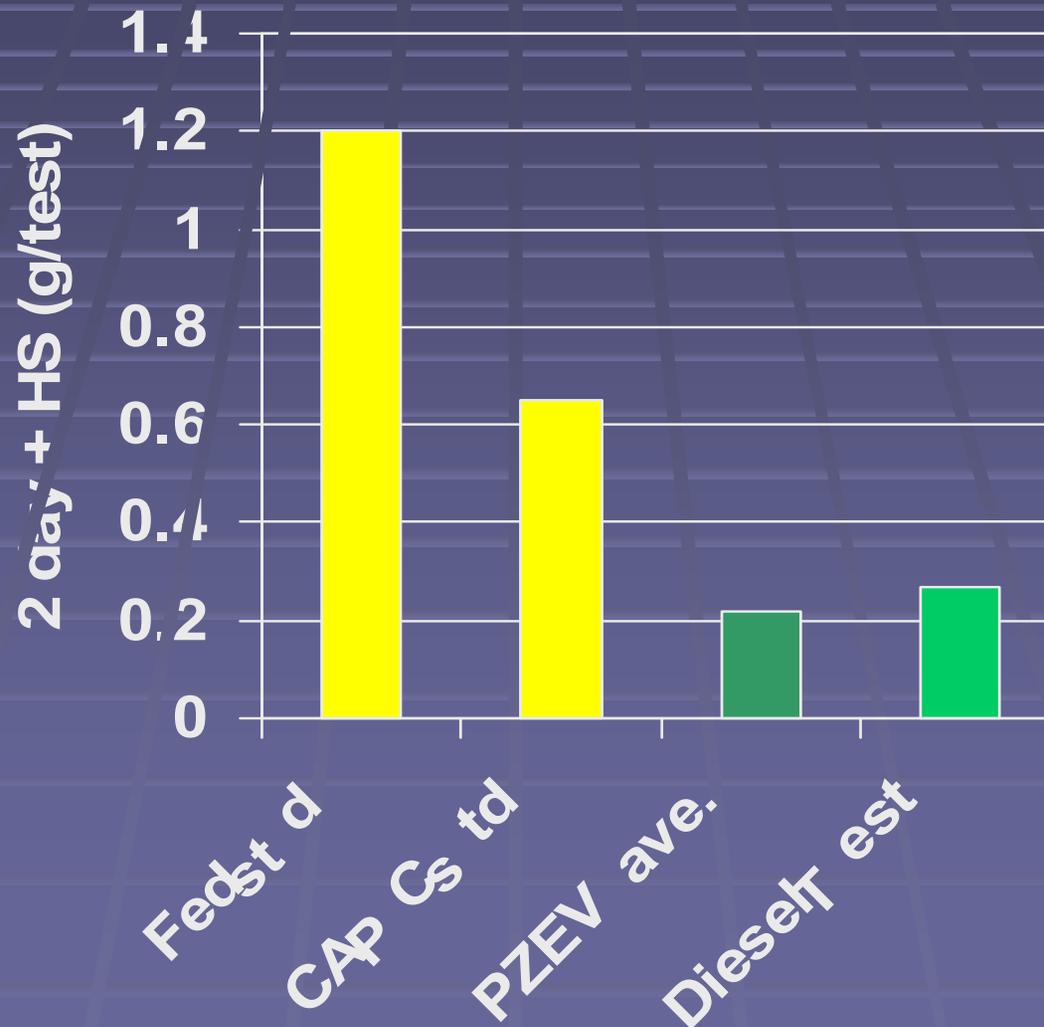
Evaporative Emissions

Light-duty Vehicles - 2004



Evaporative Emissions¹

Passenger Cars

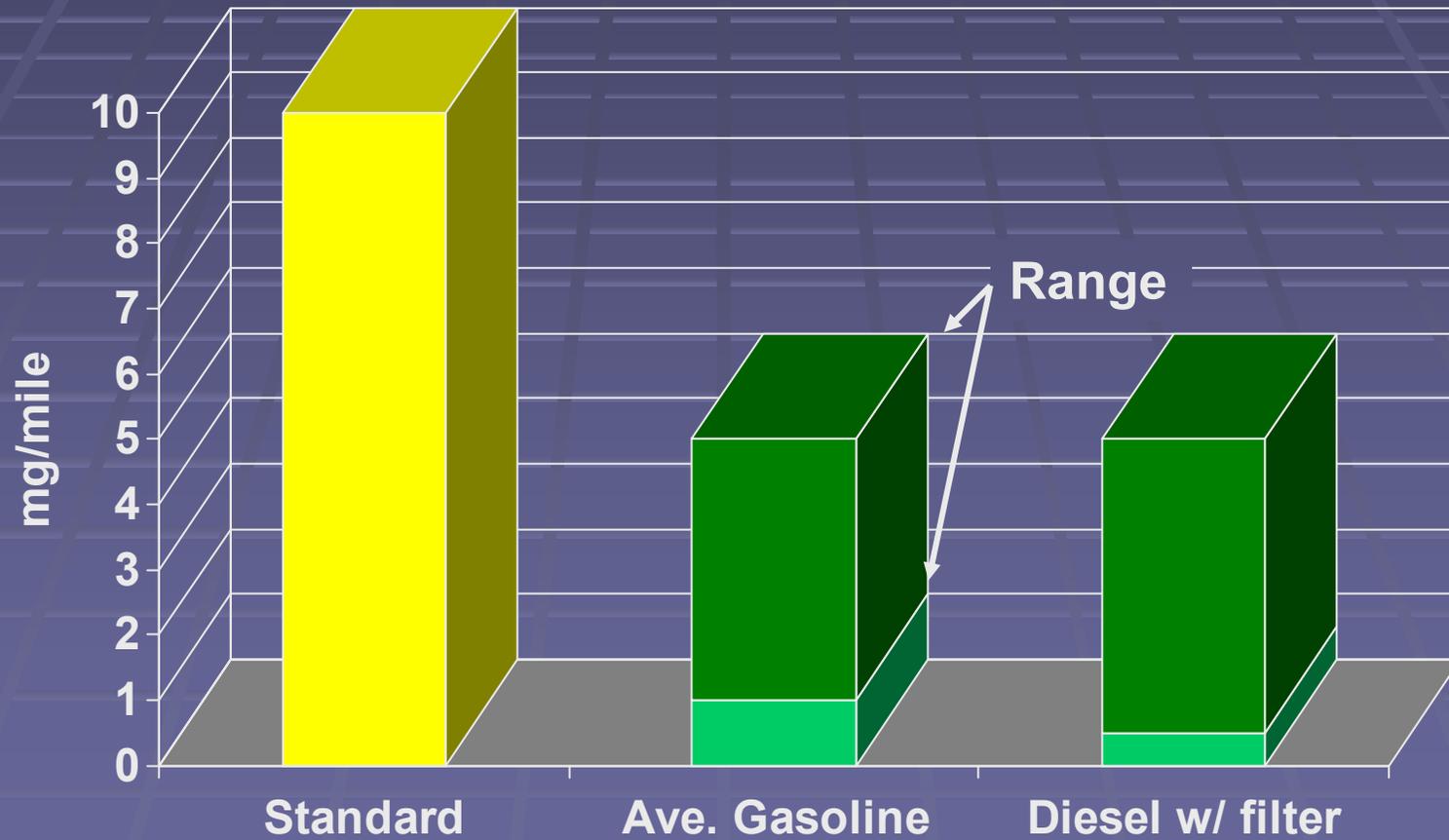


¹ Whole vehicle test

Diesel PM Emissions: Why We Are Concerned

- 3000 deaths annually caused by diesel exhaust (CA)
 - Soot and nitrates
 - Main source: Diesel trucks and equipment
- **CARB goals**
 - Reduce exposure by 85% by 2020
 - Assure LDD emissions don't make things worse

PM Emissions - Urban Driving (FTP)



Emission Durability

Durability Metric	Gasoline PZEV	Diesel LEV2
Durability demonstration	150,000 miles	120,000 miles
Warranty	150,000 miles	70,000 miles
Smog Check	yes	no
On-board diagnostics	Fully compliant	Not until 2013

Emission Durability – OBD2 Detection Thresholds

	Gasoline Threshold	Diesel Threshold Capability (multiple of FTP standard)		
Monitor	HC or NOx	HC	NOx	PM
Catalyst (3-way, oxidation, NOx SCR, or NOx Adsorber)	1.75X	3-5X	3X	n/a
PM filter	n/a	n/a	n/a	5X
All others (EGR, fuel system, etc.)	1.5X	2.5-3.5X	2.5-3.5X	2.5-5X

RED = 2007 threshold

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PM filter	n/a	n/a	n/a	5X 4X
All others (EGR, fuel system, etc.)	1.5X	2.5-3.5X 2-3X	2.5-3.5X 2-3X	2.5-5X 2-4X

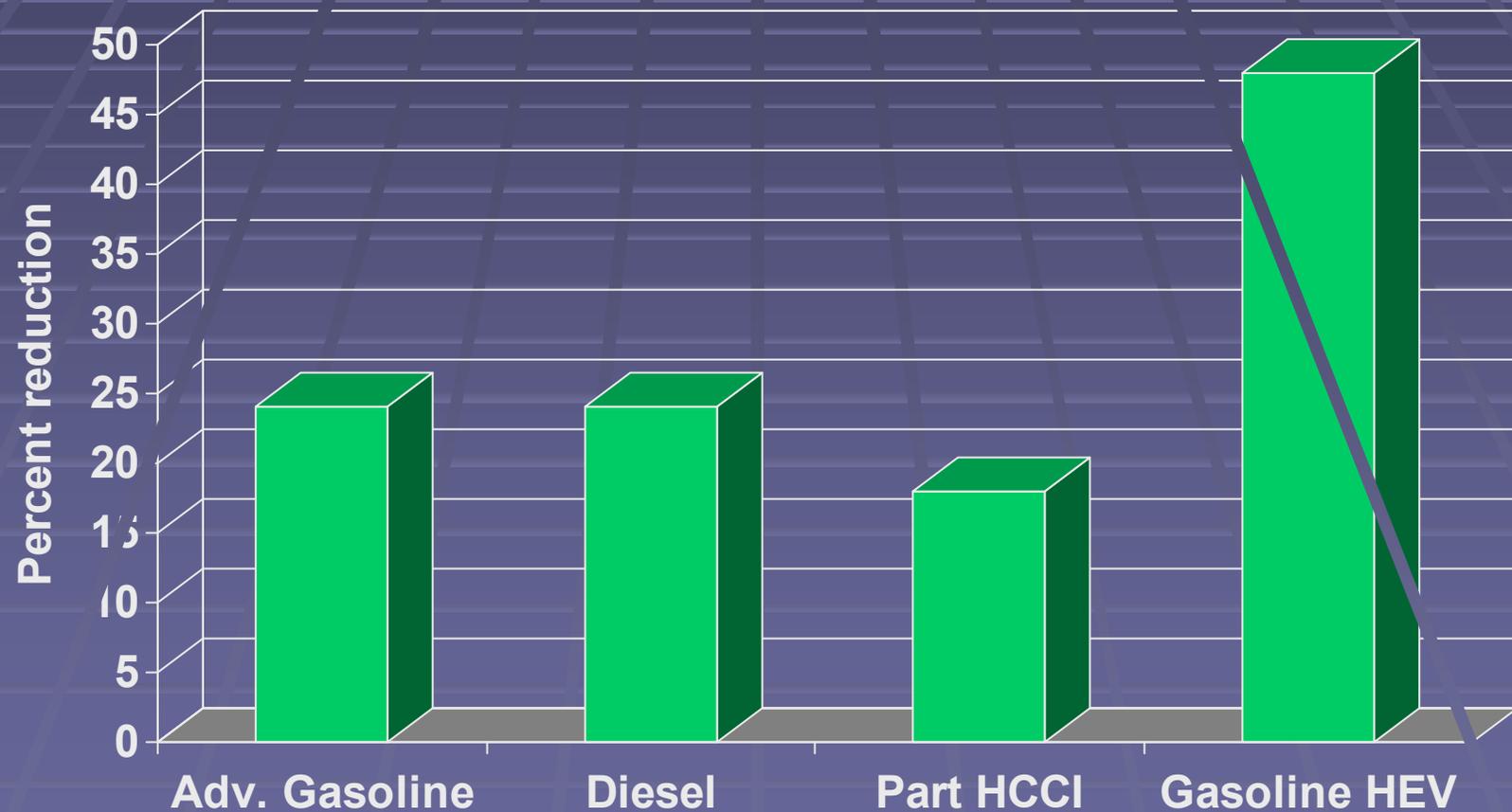
RED = 2007 threshold

YELLOW = 2010 threshold

Diesel must meet Gasoline thresholds in 2013

CO2 Emission Reductions

Small Truck, Compared to 2009 Baseline



¹ All include 6 spd AMT, e-PS, improved alternator, low-leak A/C; except HEV has C/VT

How Diesel Compares - Economics and Climate Change

Small Truck, Compared to 2009 Baseline

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

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

Summary – 2006

Diesel Compared to Gasoline

Air Quality Metric	Compared to Cleanest Gasoline Light-duty Vehicle
Exhaust NOX+HC	Not as clean
Evaporative	Equivalent
Particulate matter (PM)	Equivalent
Emission durability: OBD	Not as good
CO₂: Adv. gasoline ICE	Equivalent
CO₂: Strong gasoline HEV	Not as clean

Prospects for Diesels

- Expect 1st CA-compliant LD diesel in 2007¹
 - More models in 2008-09
- Catching up with gasoline vehicles
 - Exhaust NO_x+HC
 - Manuf. Working on PZEV diesel
 - Durability: OBD
 - ARB req. requires gasoline equivalence by 2013
 - Low CO₂ emissions of gasoline HEVs
 - Strong diesel HEV

¹ Likely not fully OBD compliant