

**Cleaning Up**  
**Non-Road Diesel Vehicles:**  
**A Public Health Imperative**

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Union of Concerned Scientists

# Cleaning up Non-Road Diesel Engines

- Public health threats
  - Over 8,500 lives saved per year if nonroad standards harmonized with highway
- Over 5.5 million non-road engines, many 10 to 20 years old
  - 10% in CA
- High emissions of NO<sub>x</sub> and PM
  - 20% of NO<sub>x</sub> from mobile sources
  - 1/3rd of PM from mobile sources

# **STAPPA/ALAPCO Study:**

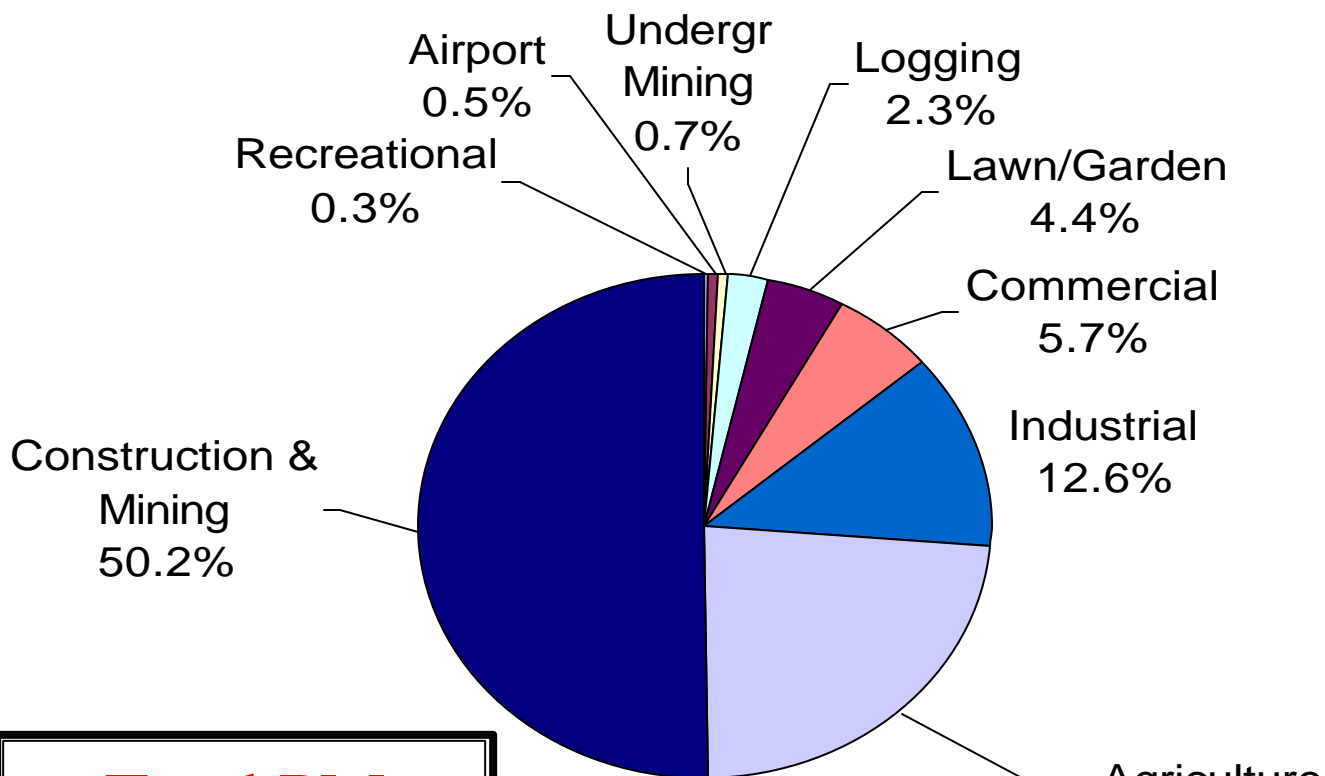
## **Benefits of Regulating Non-Road Diesel**

- Premature mortality: 8,522
- Chronic bronchitis: 5,467
- Hospital admissions: 4,928
- Asthma attacks: 180,598
- Work loss, days: 1,580,512
- Respiratory symptoms, children: 396,618
- Monetary: \$67.5 billion

# Non-Road Diesel Population U.S. and California

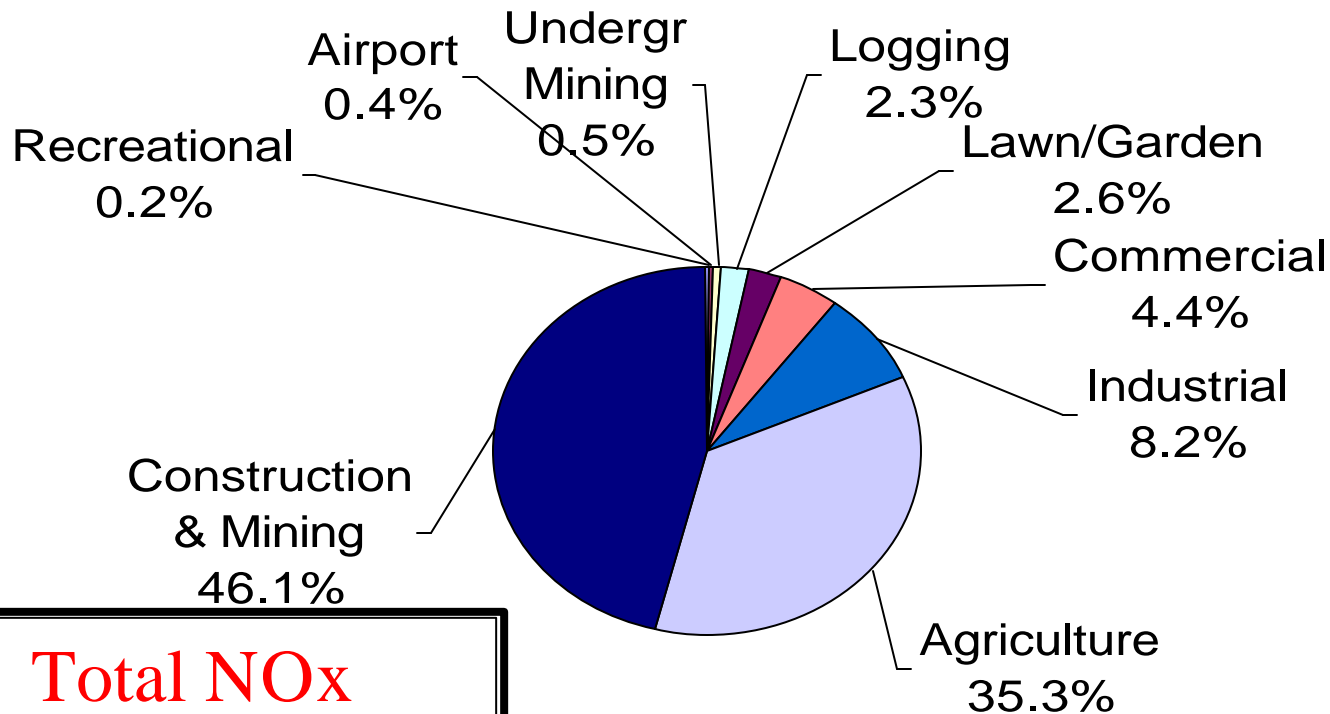
<b>Category</b>	<b>U.S. 2000</b>	<b>CA 2002</b>	<b>% in CA</b>
Agricultural	1,946,374	197,908	10%
Airport Ground Support	13,209	2,074	16%
Commercial	903,334	55,092	6%
Construction	1,654,866	173,270	10%
Industrial	456,997	12,437	3%
Lawn & Garden	606,473	45,552	8%
Logging	20,888	2,785	13%
<b>Grand Total</b>	<b>5,602,141</b>	<b>534,826</b>	<b>10%</b>

# PM from Non-Road Diesel



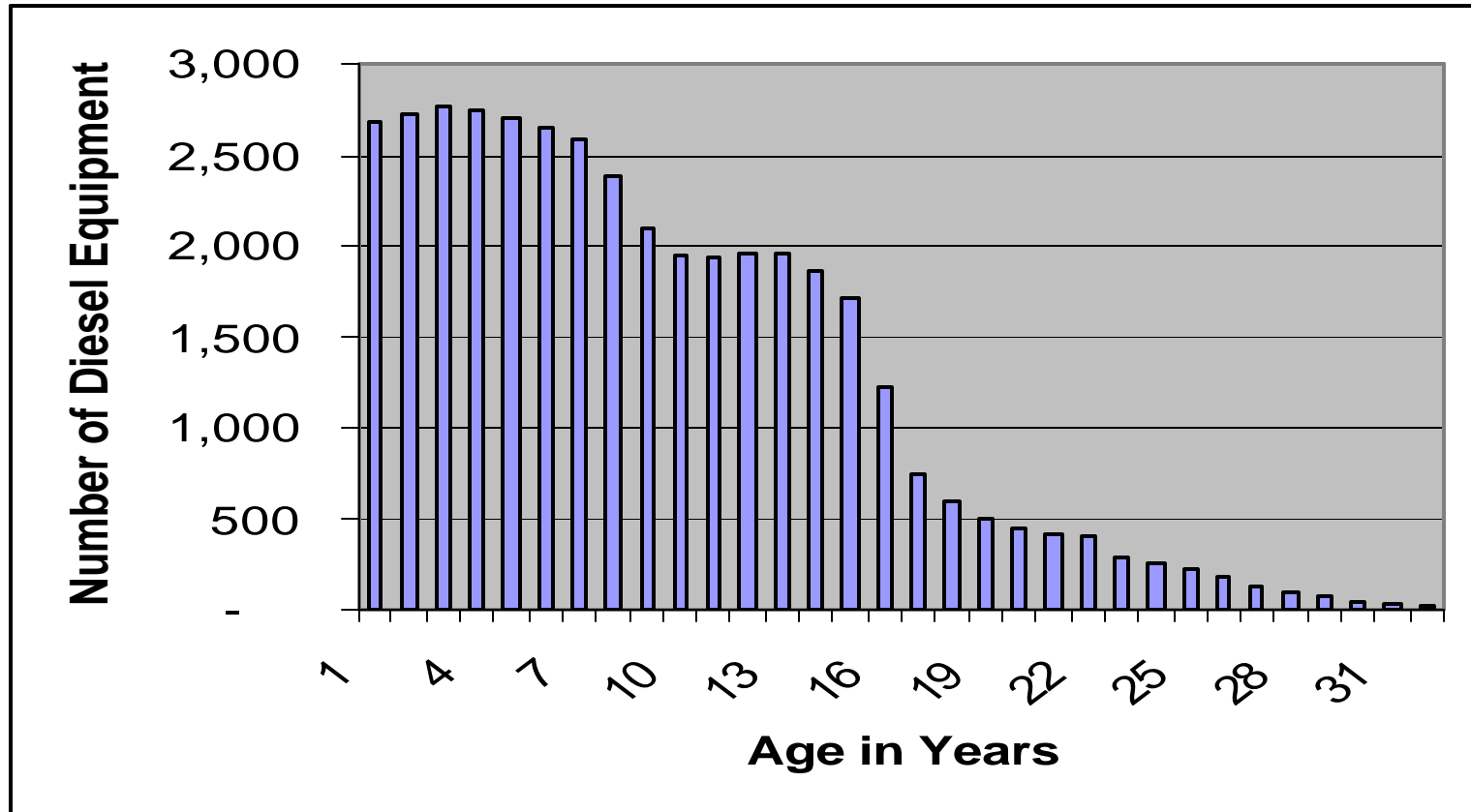
**Total PM  
Releases: 245  
thousand tons**

# NOx from Non-Road Diesel



**Total NOx  
Releases: 2,677  
thousand tons**

# Age Distribution of CA's Non-Road Equipment



# Non-Road Challenges

- Large population of engines, many smaller hp
- Older engines
  - Retrofits critical
- Wide variety of engine types
  - eg, bulldozers, excavators, portable generators, tractors, combines, irrigation pumps, airport
- Variable cycles
- Variable environmental conditions



# Conclusions

- Health impacts of non-road diesel emissions argue for harmonization of emissions standards w/highway
- ECT for nonroad face significant technical challenges
- Retrofitting of existing fleet w/ECT critical
- Non-road is the next hurdle facing ECT manufacturers, w/big public health payoff

**Light Duty Diesel Vehicles:  
Why the European Model Doesn't  
Work in the U.S.**

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# Light Duty Diesel Vehicles

- Fuel economy vs. health tradeoff
  - The European approach
  - Light duty diesel in the US
- Tailpipe standards
- Challenges facing ECT for LDD
  - Technical, economic, infrastructure, pollution
- Can LDD compete with advanced technology gasoline, like hybrid electrics?

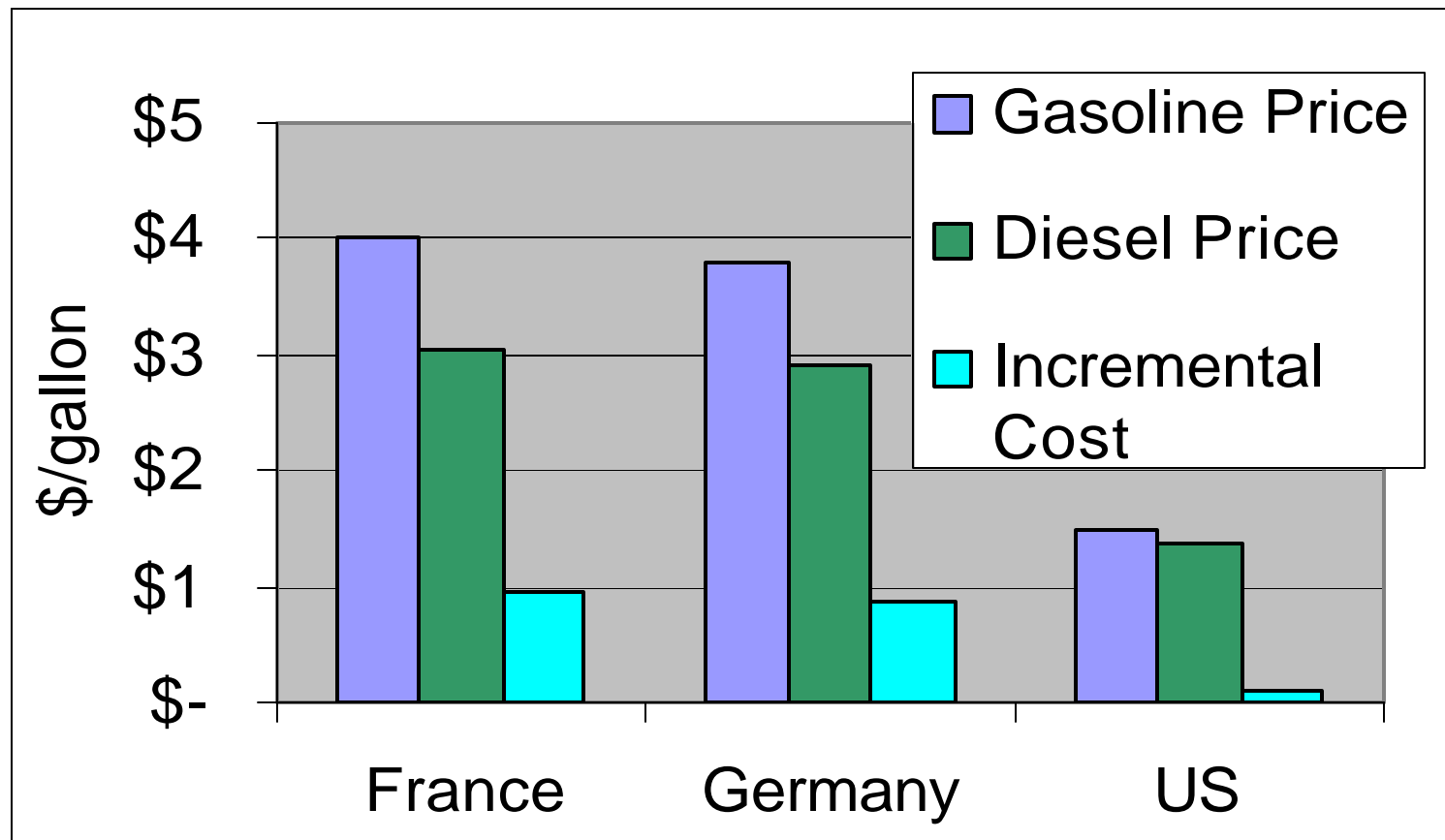
# Comparing VW Diesel & Gasoline Cars

Maximum Emission Levels (grams per mile)		
	Gasoline	Diesel
Vehicle Emission Class	Ultra Low Emission Vehicle (ULEV)	Small Truck Diesel
NMOG	0.055	0.32
NO <sub>x</sub>	0.3	1.25
PM	0.04	0.1
CO <sub>2</sub> Emissions (g/m)	440	327
MGP, gasoline gal equiv	23 city/29 hwy	31 city/40 hwy

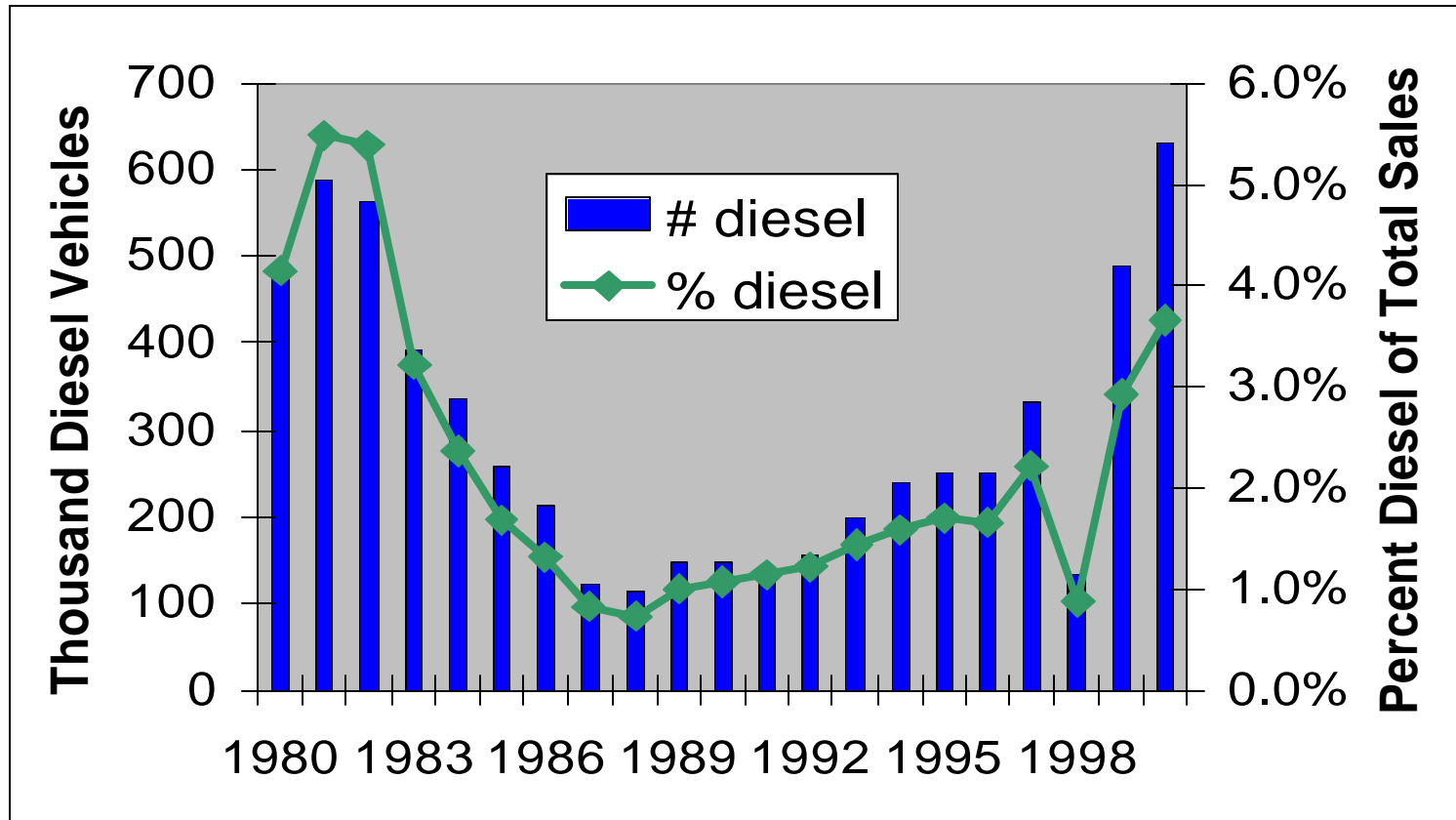
# Comparing U.S. and Europe's Diesel Vehicles and Fuel

	U.S.	Europe
Light Vehicle Market Share	Less than 4%	33%
Cost of gasoline/gallon	\$1.50	\$3-\$4
Cost of diesel/gallon	\$1.45	\$2-\$3
Maximum Allowable NO <sub>x</sub> for Diesel Vehicles	0.97 to 1.53 g/m today 0.2 in 2009	0.8 to 1.04 g/m today 0.4 to 0.5 g/m in 2006
Maximum Allowable PM for Diesel Vehicles	0.1 g/m today .02 g/m in 2009	0.08 to 0.11 g/m today 0.04 to 0.06 g/m in 2006
Diesel sulfur content (parts per million)	500 today 15 in 2007	350 today 50 in 2005

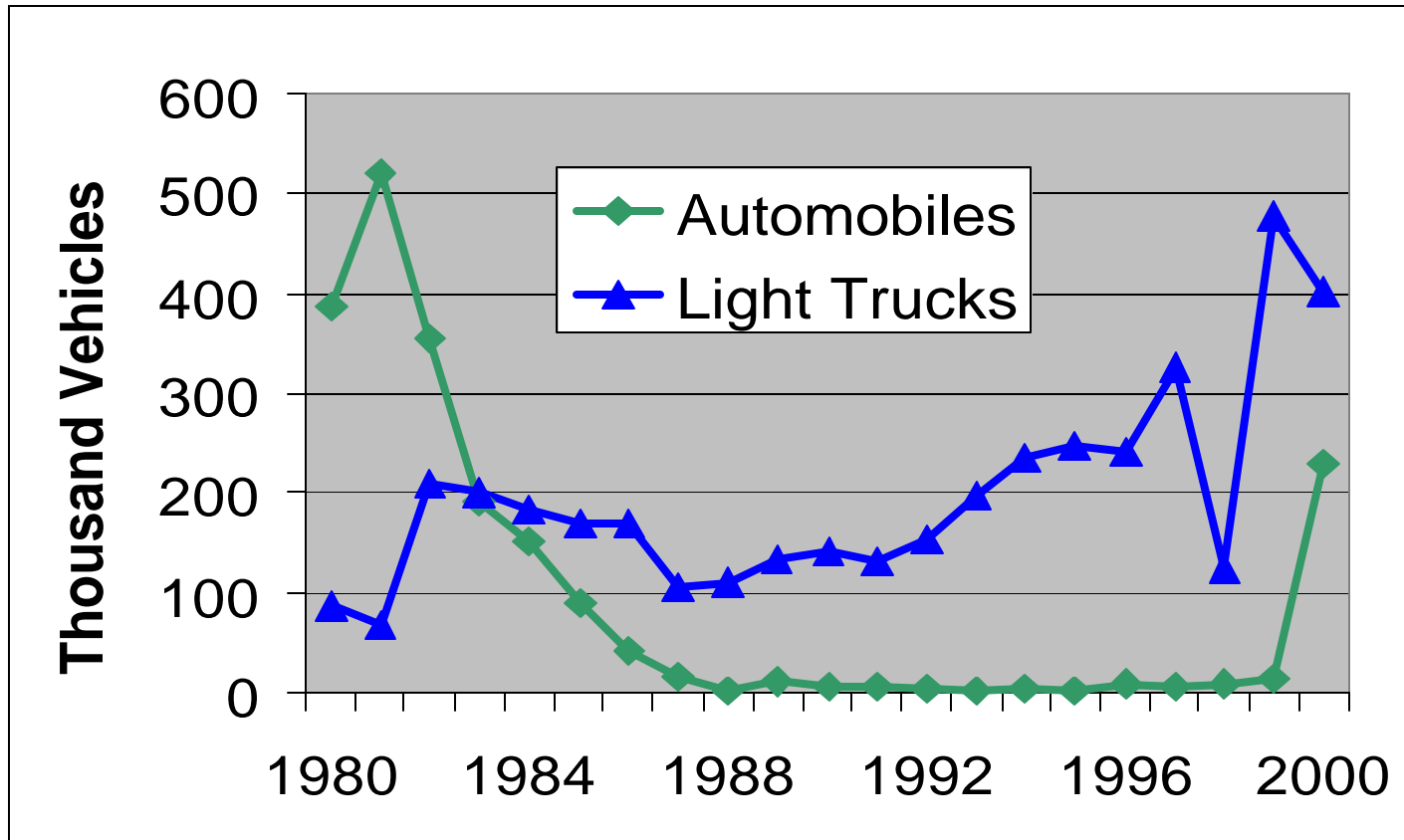
# Comparing Gasoline and Diesel Prices in Selected Countries



# Diesel Light Duty Vehicle Sales, 1980 - 2000



# Diesel Automobile & Light Truck Sales, 1980 - 2000





# Medium Duty Passenger Vehicles and Diesel

- 38% of MDPV pickups are diesel
- 11% of MDPV Vans/SUVs are diesel
- 33.1% of all MDPVs are diesel

**Source: J. Kliesch, American Council for an Energy Efficient Economy**

# Today's Domestic Diesel Passenger Vehicles

- **Passenger Cars**

- VW Golf TDi
- VW Jetta TDi
- VW Jetta Wagon TDi
- VW New Beetle TDi

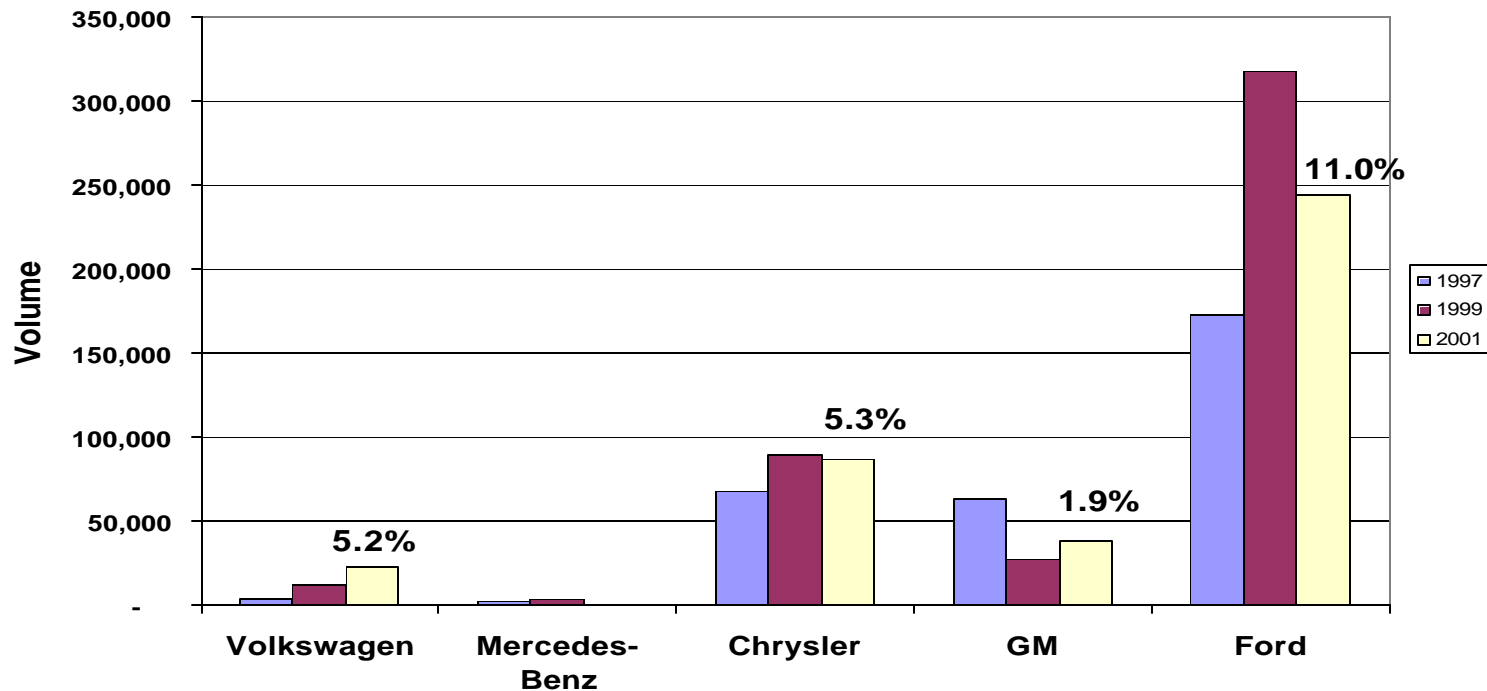
- **(Sort of) Light Trucks**

- Ford Excursion
- Ford F-250/350 Super Duty
- Chevrolet Silverado 2500/3500 Heavy Duty
- GMC Sierra 2500/3500 Heavy Duty
- Dodge Ram 2500/3500

**Source: J. Kliesch, American Council for an  
Energy Efficient Economy**

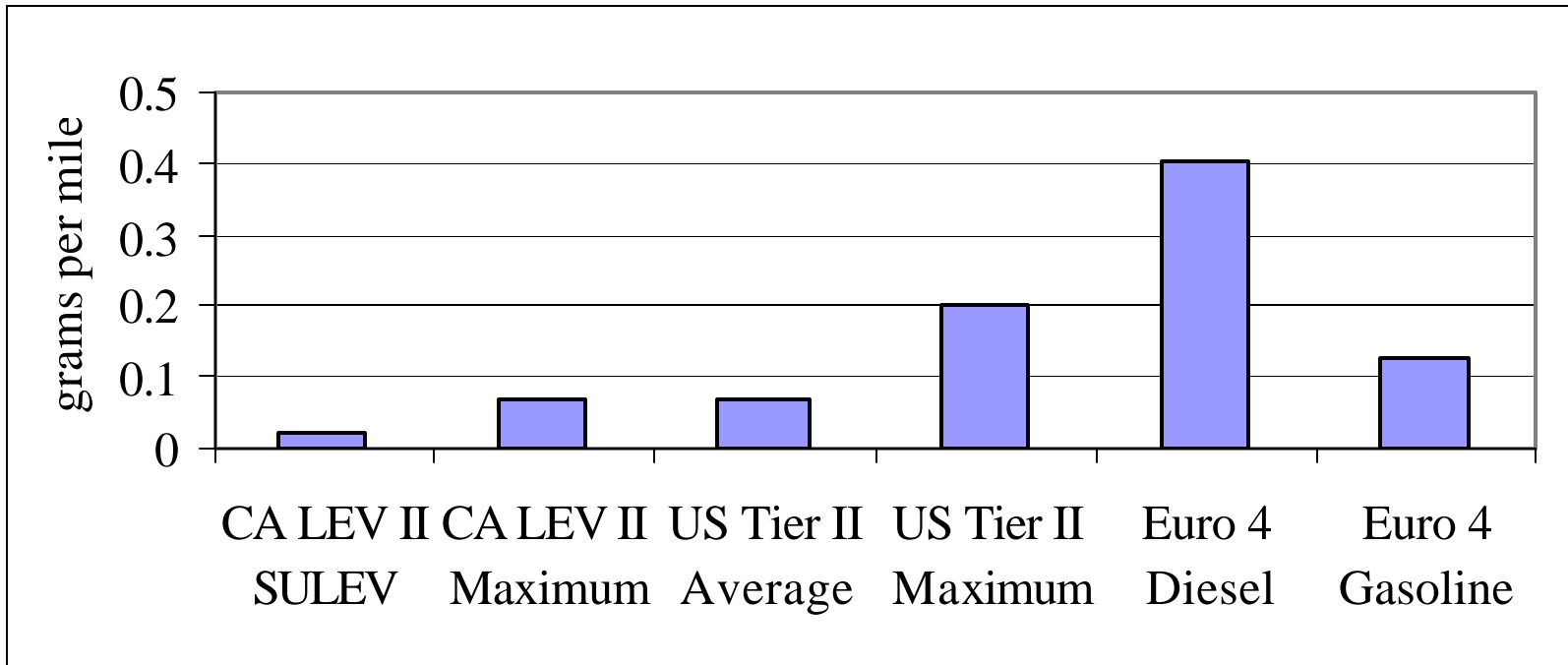
# Diesel Sales by Manufacturer

Light Duty Diesel Sales by Manufacturer,  
Model Years 1997, 1999, 2001

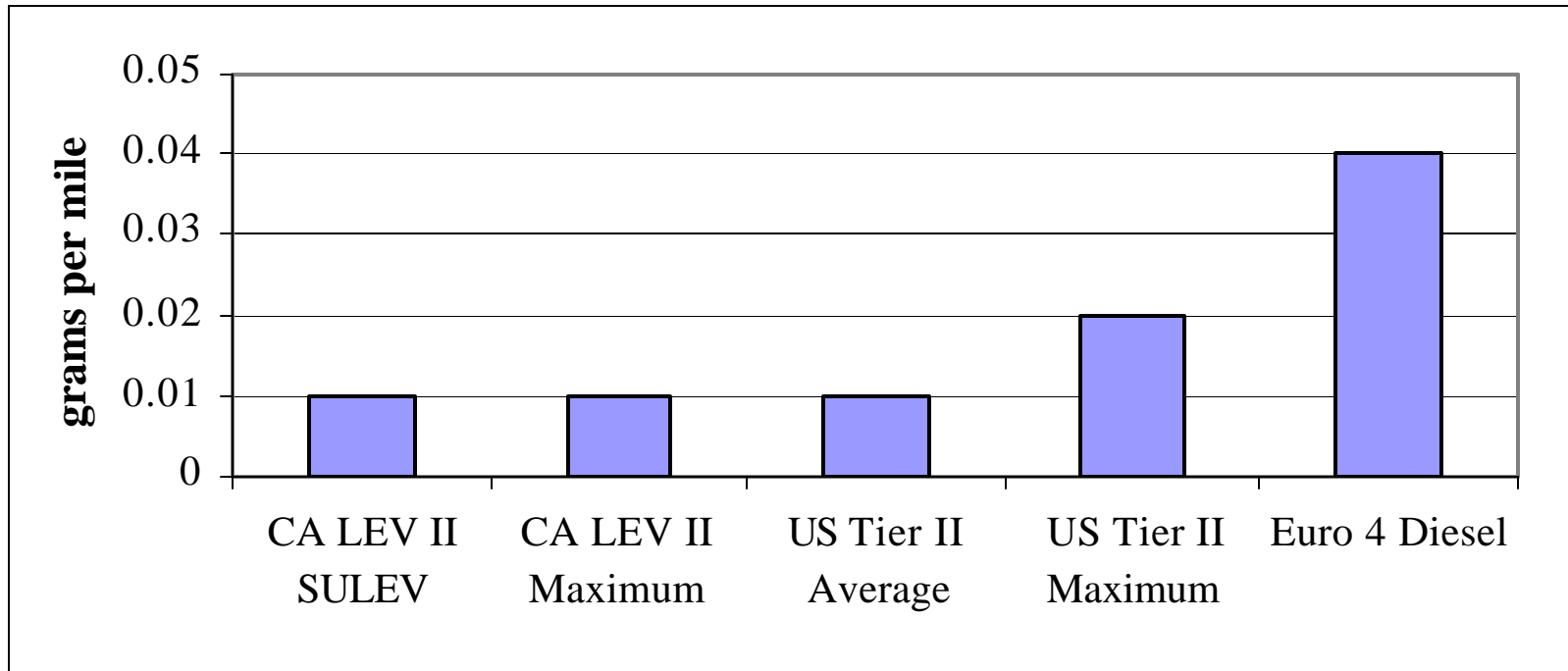


Source: J. Kliesch, American Council for an  
Energy Efficient Economy

# Europe vs. US Standards for Passenger Cars: NO<sub>x</sub>



# Europe vs. US Standards for Passenger Cars: PM



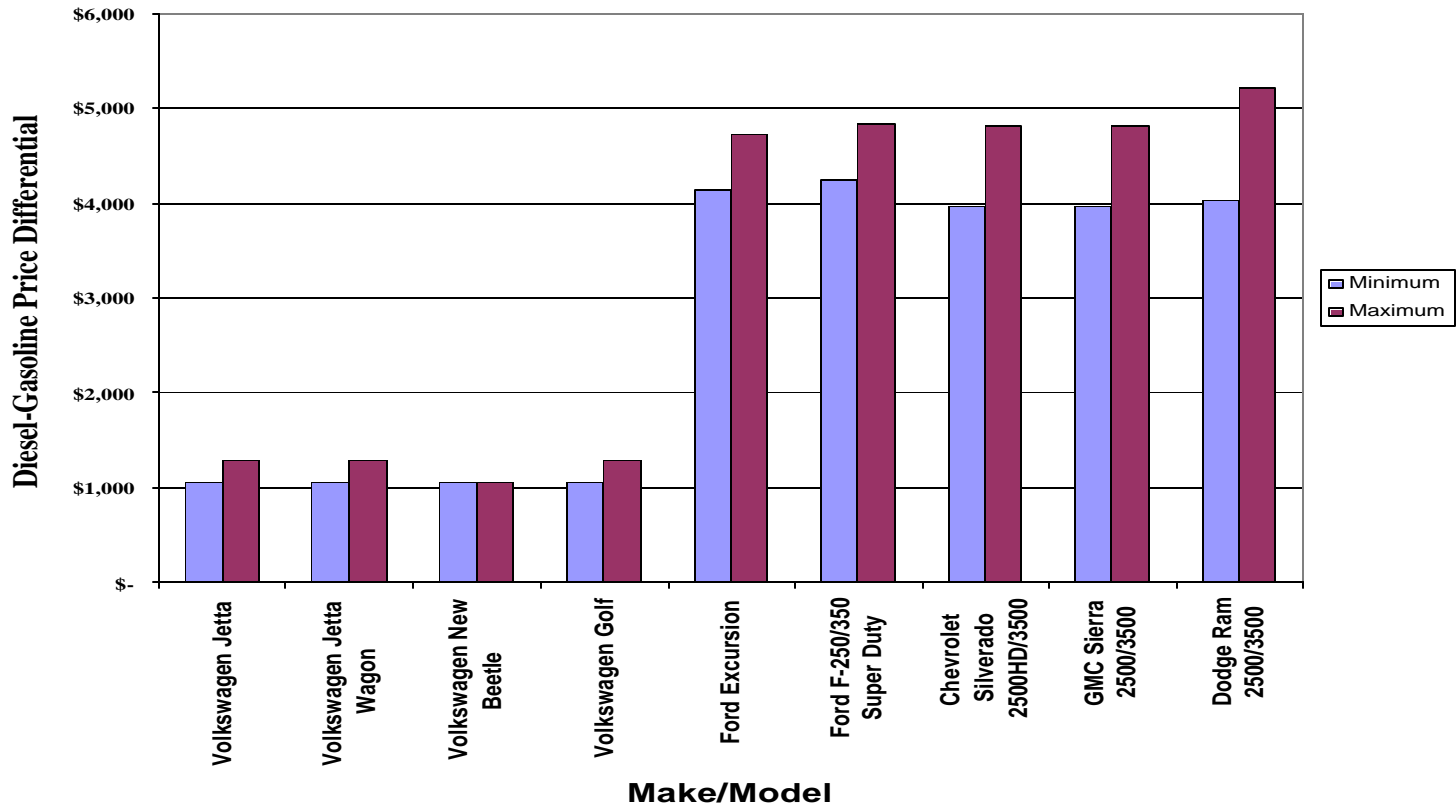
# Maximum NO<sub>x</sub> Emissions Under Tier 1 & 2

Year Range	Federal Standard	Fuel	Passenger Cars and Truck-1	Truck-2	Truck-3	Truck-4	Medium-duty passenger vehicles
2002-03	Tier 1	diesel	1.25	0.97	0.98	1.53	?
		gasoline	0.6	0.97	0.98	1.53	?
2004-06	Tier 2	gas or dsl	0.6	0.6	0.6	0.6	0.9
2007	Tier 2	gas or dsl	0.2	0.2	0.6	0.6	0.9
2008	Tier 2	gas or dsl	0.2	0.2	0.6	0.6	0.9
2009+	Tier 2	gas or dsl	0.2	0.2	0.2	0.2	0.2

# Maximum PM Emissions Under Tier 1 & 2

Year Range	Federal Standard	Fuel	Passenger Cars and Truck-1	Truck-2	Truck-3	Truck-4	Medium-duty passenger vehicles
2002-03	Tier 1	diesel	0.1	0.1	0.1	0.12	?
		gasoline	0.1	0.1	0.1	0.12	?
2004-06	Tier 2	gas or dsl	0.08	0.1	0.1	0.12	?
2007	Tier 2	gas or dsl	0.02	0.02	0.1	0.12	?
2008	Tier 2	gas or dsl	0.02	0.02	0.08	0.08	0.12
2009+	Tier 2	gas or dsl	0.02	0.02	0.02	0.02	0.02

# Diesel Incremental Costs



Source: J. Kliesch, American Council for an Energy Efficient Economy



# Diesel clean up technologies show promise, but doubts remain

- Technical challenges:
  - NO<sub>x</sub> reduction
  - PM traps: NO<sub>2</sub> generation
- Cost of new technologies
  - Can diesel compete with hybrid-electric gasoline vehicles?
- Infrastructure requirements
- Pollution challenges

# Current and New Health Concerns

- Near term (through 2008): Criteria pollutants ( $\text{NO}_x$ , PM,  $\text{SO}_x$ )
- Longer term: Nanoparticles from advanced technologies like EGR, high fuel injection pressure
- Longer term:  $\text{NH}_3$  slip from SCR
- Longer term:  $\text{N}_2\text{O}$  from  $\text{NO}_x$  slip cats at 250-300C

# Diesel Engines and Global Warming

- Diesel releases about 25% less CO<sub>2</sub> per mile traveled (based on VW Jetta)
- New studies (Jacobson) indicate carbon is a potent greenhouse gas
  - Estimates carbon responsible for 15 to 30% of global warming, second only to CO<sub>2</sub>
  - Concludes that diesel vehicles warm climate more than gasoline

# Conclusions

- Future of domestic diesel far from certain
  - Technical, economic, infrastructure, and pollution challenges remain
- To assure diesel does not compromise public health, it is critical to:
  - Maintain Tier 2/LEV II standards
  - Reduce diesel sulfur content
  - Address emerging emissions concerns

# **Thank You**

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