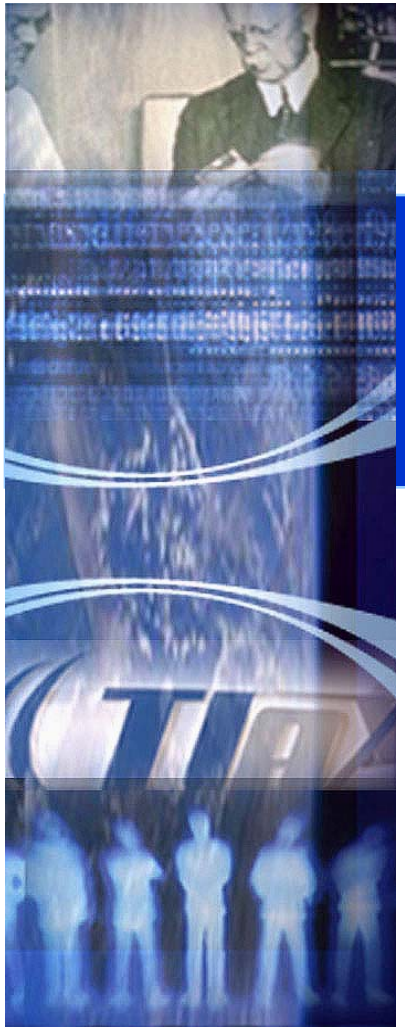

In-Use Emissions Performance of On- and Off-Road Vehicle Applications

Presented at
Ozone Air Quality Forum and Roundtable Discussions
October 31, 2006
South Coast Air Quality Management District
Diamond Bar, California

Michael Jackson
TIAX LLC
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Agenda

1. Mobile Emissions Inventories
2. Light-Duty Vehicles
3. Heavy-Duty Vehicles
4. Summary

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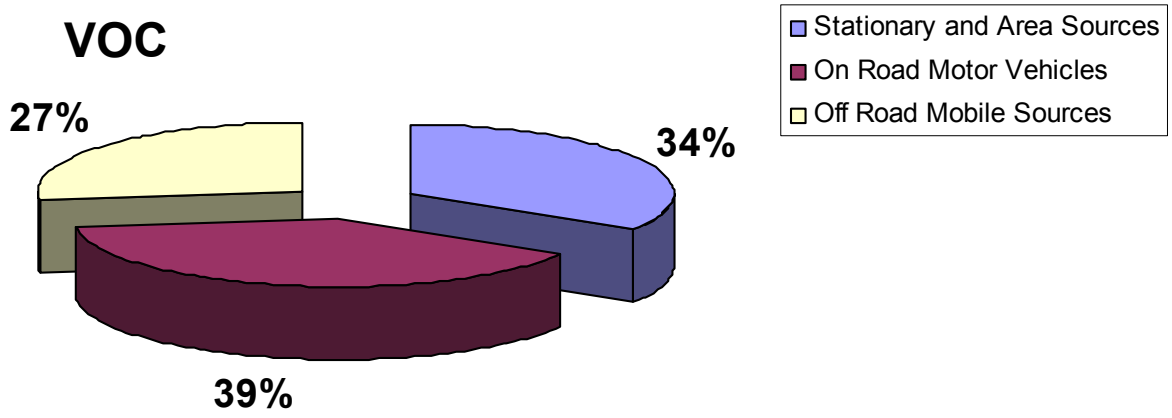
1 Emissions Inventories

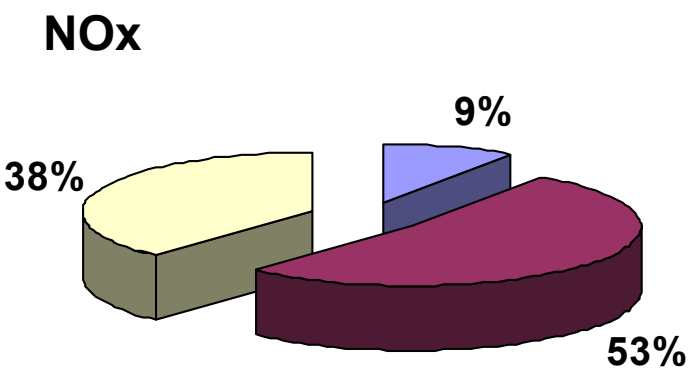
2 Light-Duty Vehicles

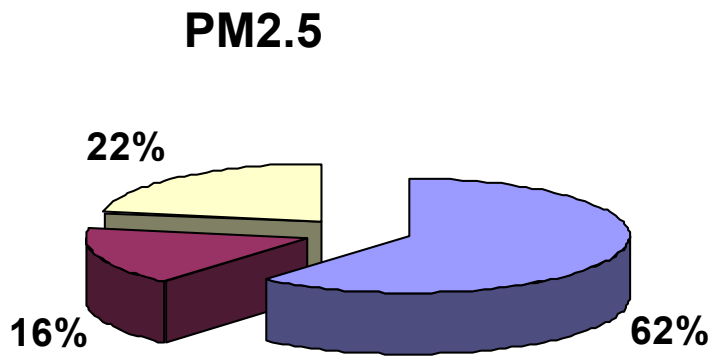
3 Heavy-Duty Vehicles

4 Summary

Inventory Contributions 2008 Summer Planning

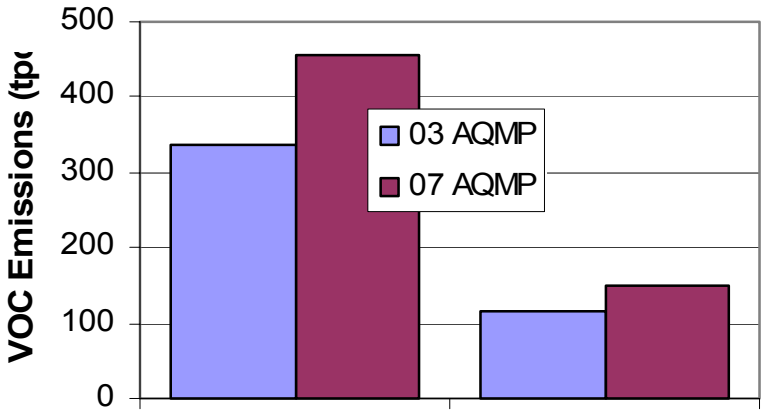


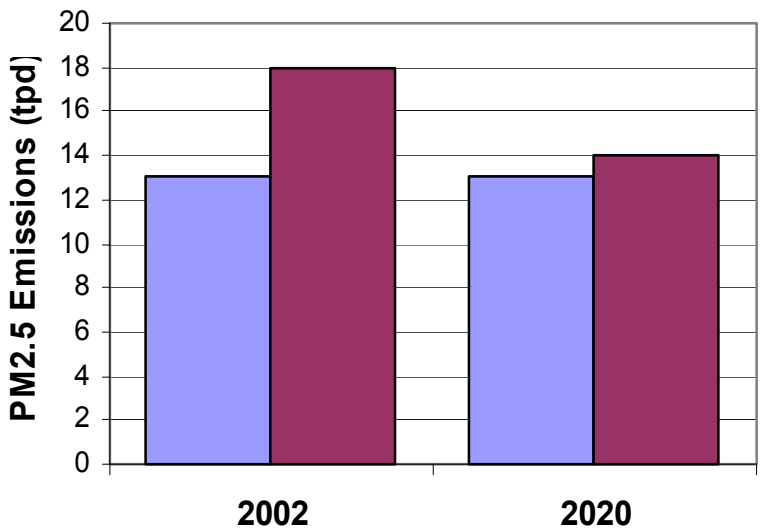


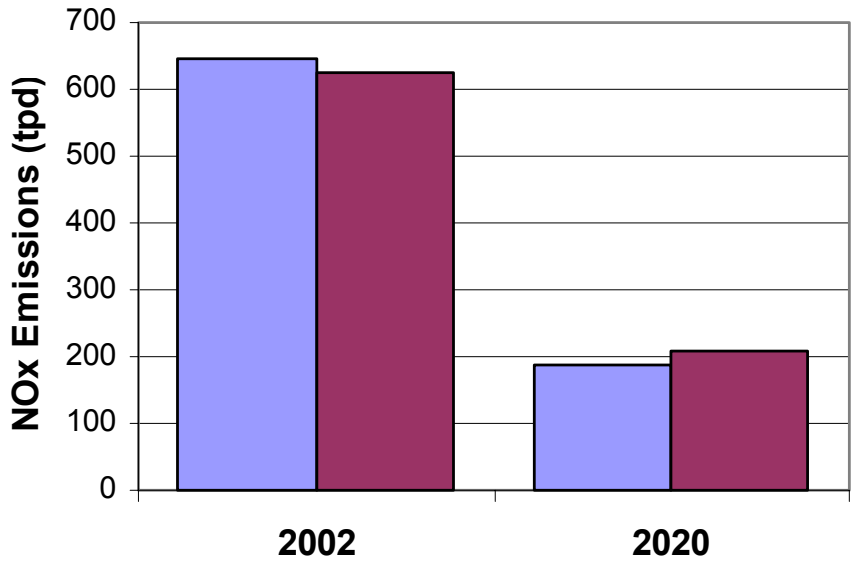


Source: SCAQMD 2007 AQMP, Appendix III, Attachment B

Comparison of On-Road Emission Inventories

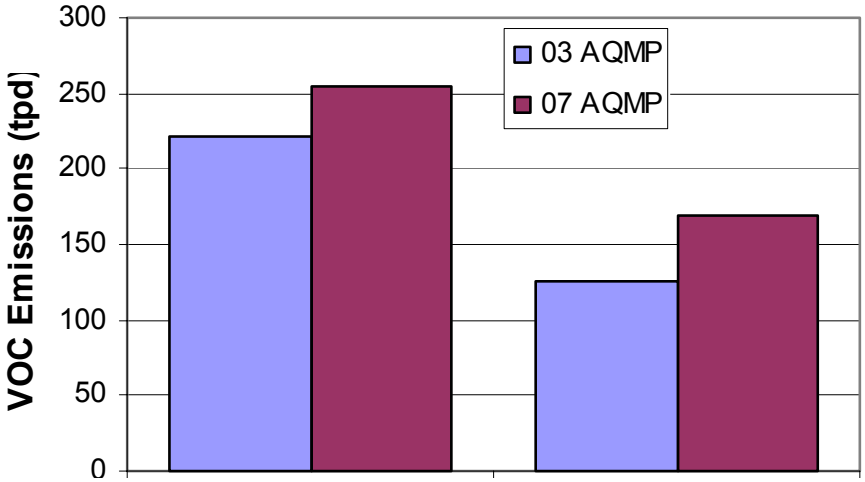


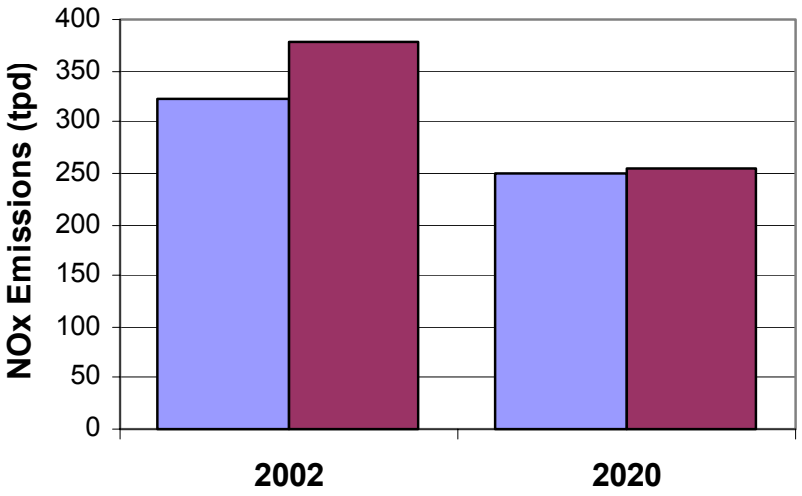


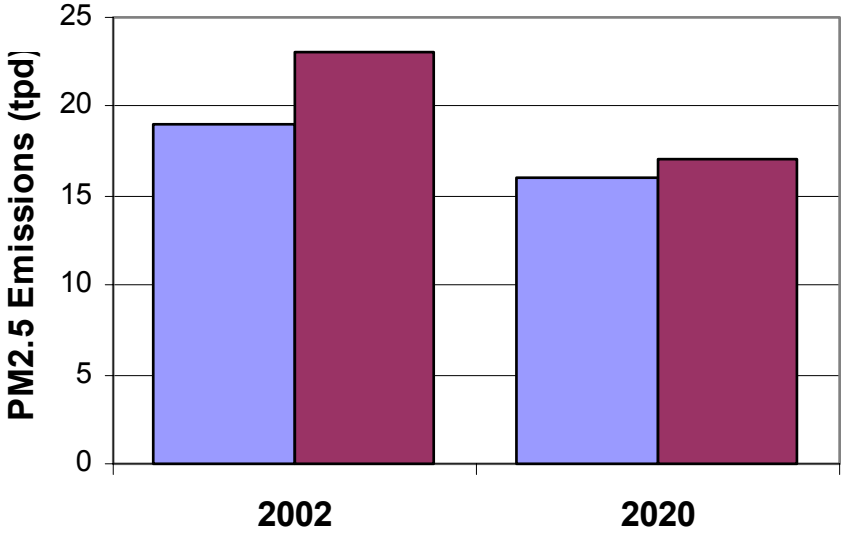


Source: SCAQMD 2007 AQMP, Appendix III

Comparison of Off-Road Emission Inventories







Source: SCAQMD 2007 AQMP, Appendix III

Agenda

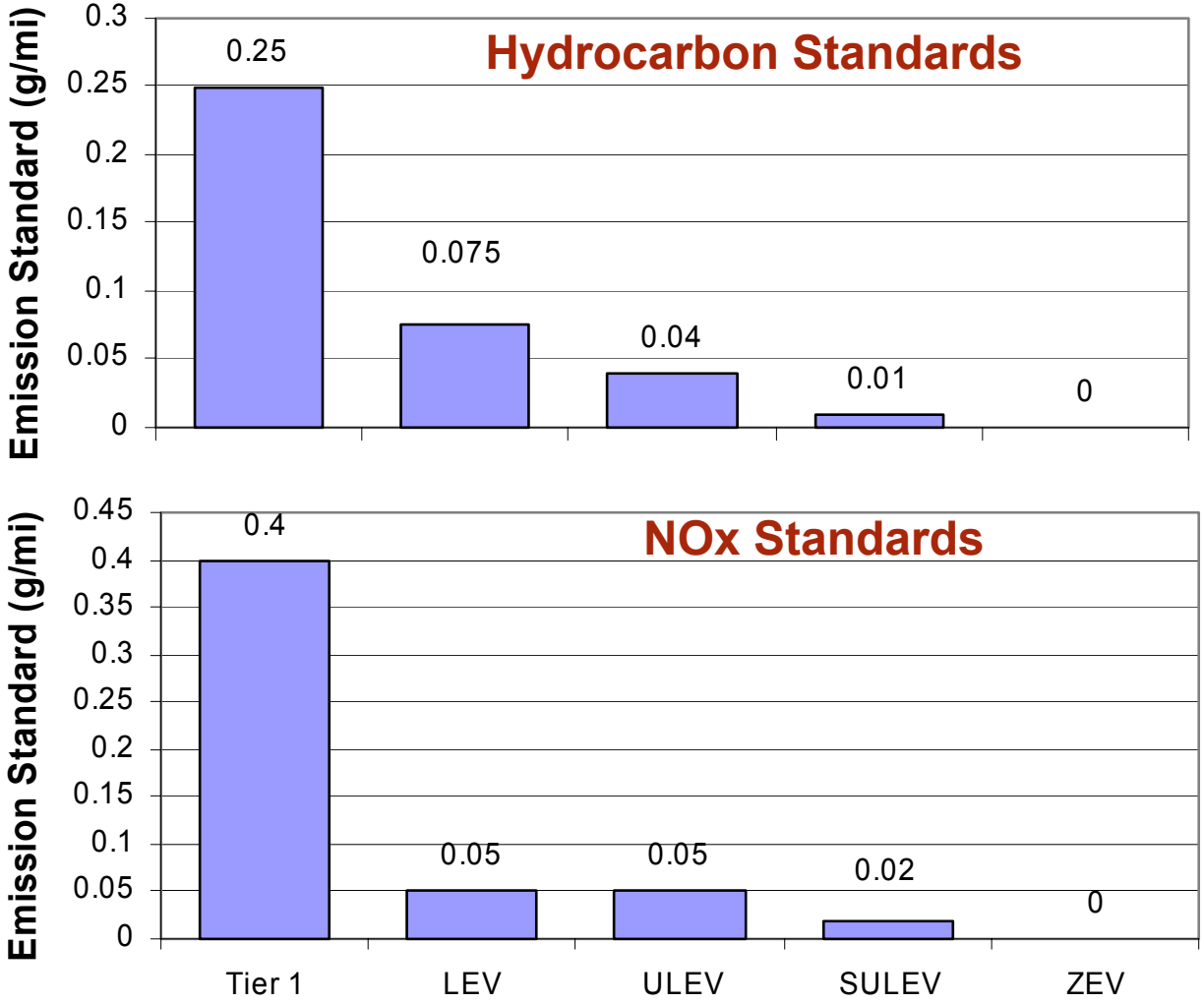
1 Mobile Emissions Inventories

2 Light-Duty Vehicles

3 Heavy-Duty Vehicles

4 Summary

Lower HC and NOx Emissions Achieved With Cleaner Fuels and Advanced Catalyst Technology

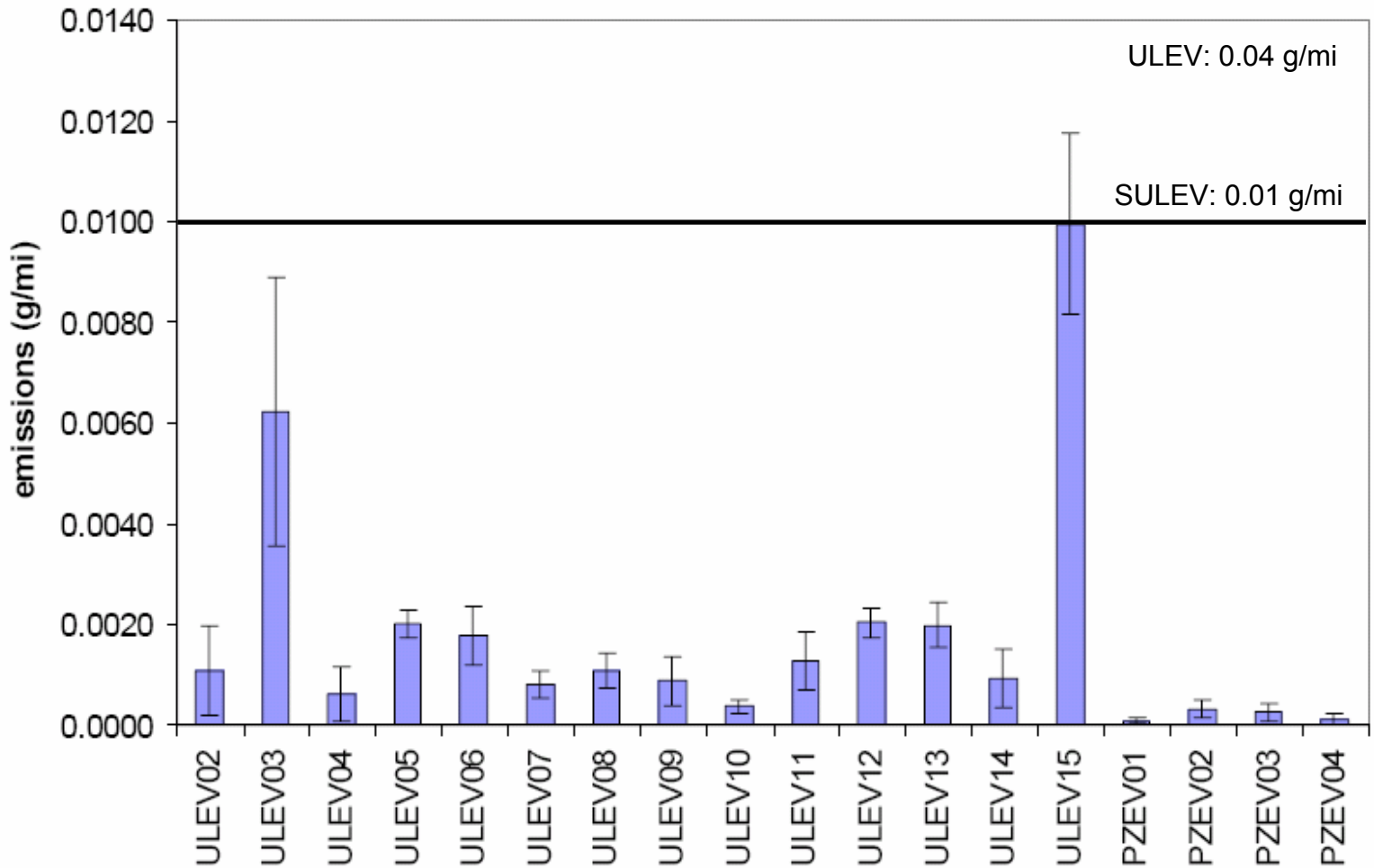


UC Riverside Testing of Ultra-Low Emission Vehicles

Vehicle ID	Certification	Model Year	Make	Model	Odometer
ULEV01	ULEV	2002	Acura	3.2TL	32,344
ULEV02	ULEV	2002	Buick	Regal	21,184
ULEV03	ULEV	2001	Ford	Focus	35,089
ULEV04	ULEV	2002	Ford	Mustang	23,894
ULEV05	ULEV	2002	Honda	Civic	26,632
ULEV06	ULEV	2003	Honda	Civic Hybrid	13,700
ULEV07	ULEV	2001	Mazda	Protégé	27,114
ULEV08	ULEV	2002	Mitsubishi	Galant	22,350
ULEV09	ULEV	2002	Mitsubishi	Lancer	13,300
ULEV10	ULEV	2002	Nissan	Altima	13,747
ULEV11	ULEV	2002	Saturn	L200	14,888
ULEV12	ULEV	2002	Toyota	Camry LE	13,098
ULEV13	ULEV	2003	Toyota	Corolla	21,835
ULEV14	ULEV	2003	Honda	Civic Hybrid	13,700
ULEV15	ULEV	2001	Volkswagen	Jetta GLS	101,049
ULEV16	ULEV	2000	Dodge	Neon	87,766
ULEV17	ULEV	1999	Honda	Accord LX	80,436
PZEV01	PZEV	2003	Honda	Accord EX	7,731
PZEV02	PZEV	2003	Honda	Civic Hybrid	1,502
PZEV03	PZEV	2003	Toyota	Camry LE	2,600
PZEV04	PZEV	2003	Honda	Civic GX	15,191

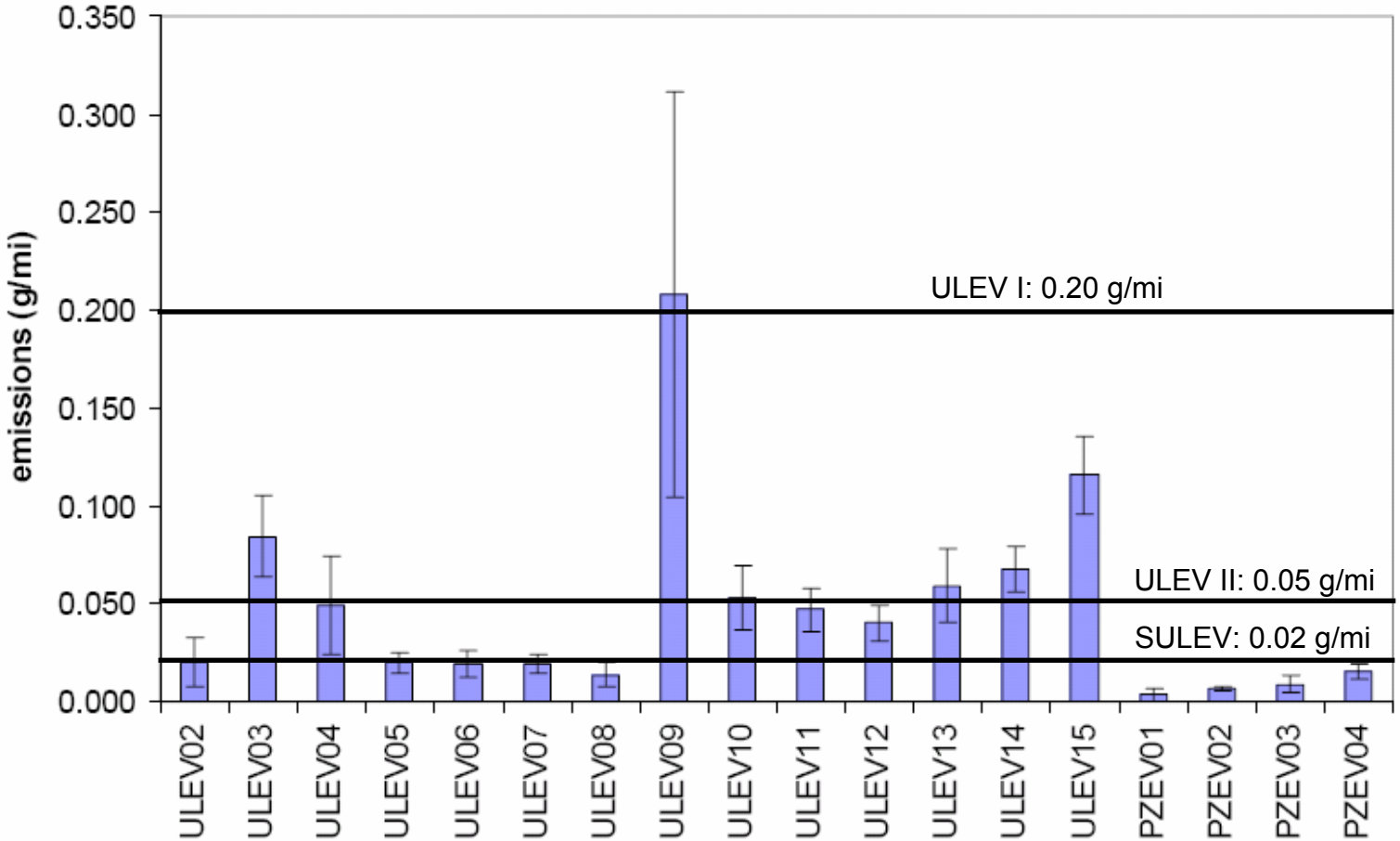
Source: A Summary of the Study of Extremely Low Emitting Vehicles Operating on the Road in California (Norbeck et al, 2005)

On-Road NMHC Emissions



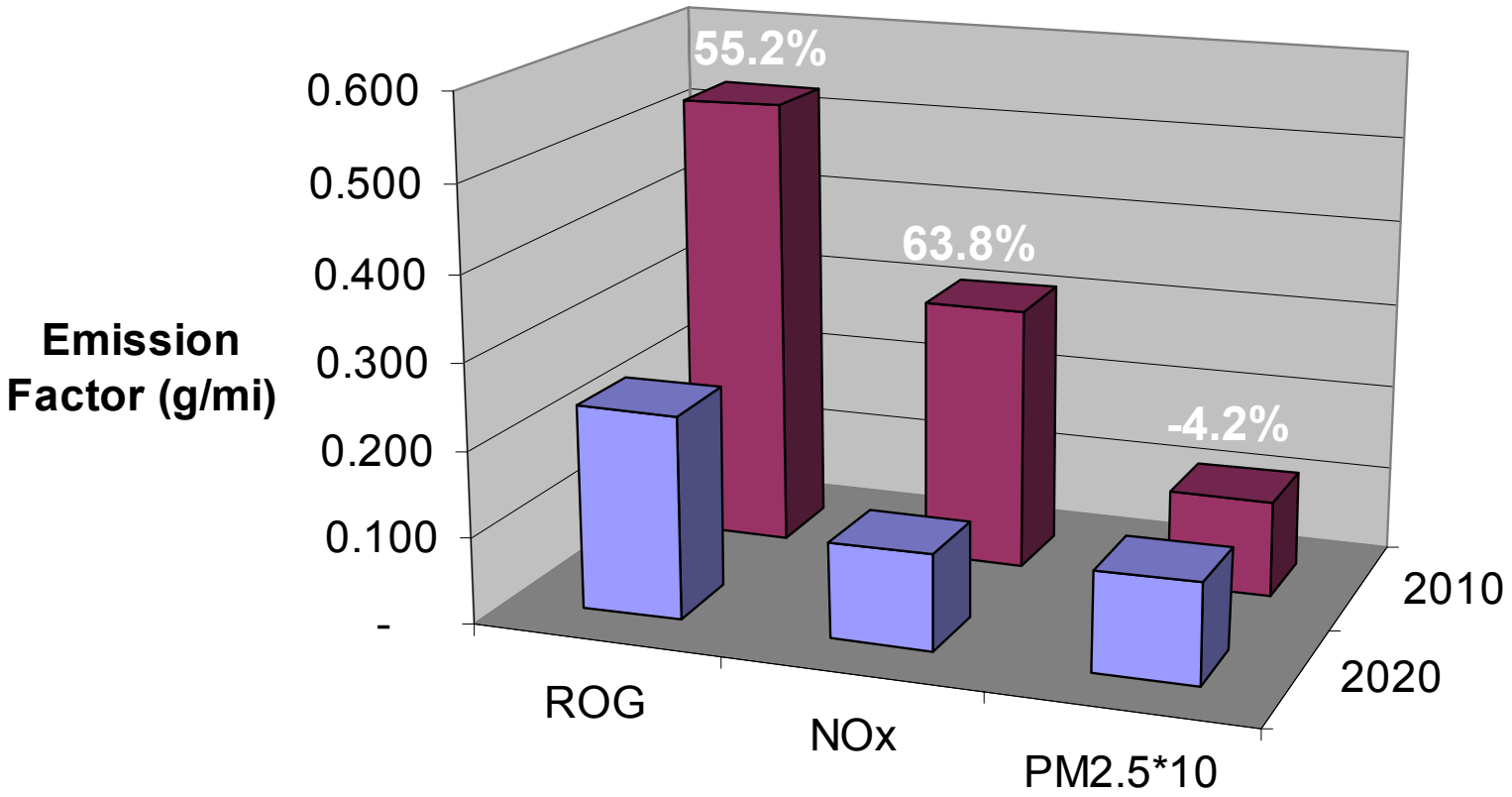
Source: A Summary of the Study of Extremely Low Emitting Vehicles Operating on the Road in California (Norbeck et al, 2005)

On-Road NOx Emissions



Source: A Summary of the Study of Extremely Low Emitting Vehicles Operating on the Road in California (Norbeck et al, 2005)

Passenger Car Emission Reductions in EMFAC2007



Source: SCAQMD 2007 AQMP, Appendix III, Attachment E

Most Light-Duty Emissions from High Emitting Vehicles

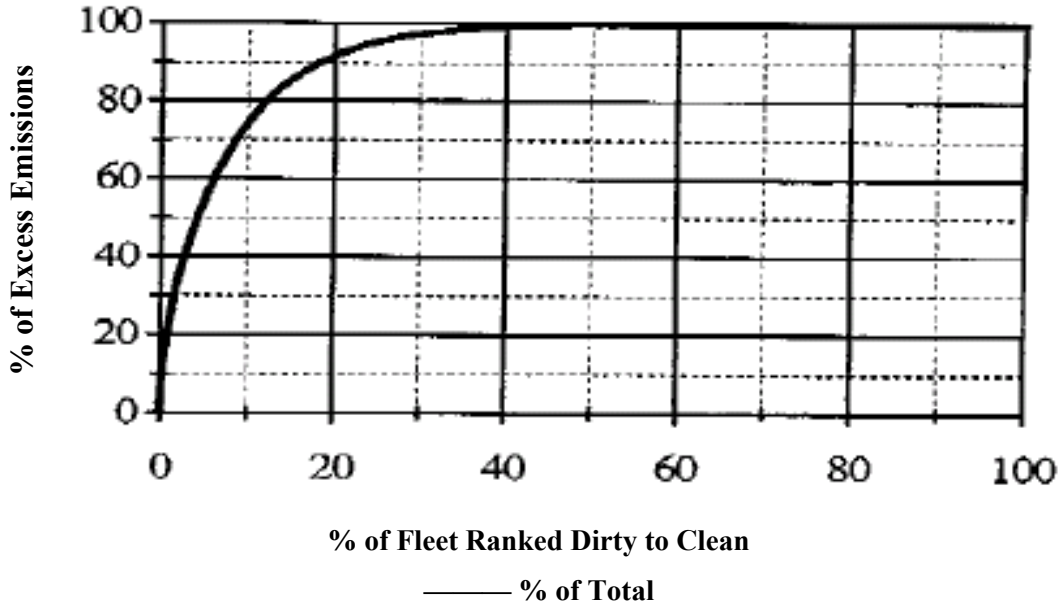


FIGURE 1-9 Aggregated excess FTP CO, HC NO_x emissions from the California I/M pilot study rank-ordered from highest to lowest emitters. Excess emissions for each pollutant are aggregated using the equation (1/7(CO) + NO_x + HC).

Source: Evaluating Vehicle Emissions Inspection and Maintenance Programs (NRC, 2001)

Agenda

1 Mobile Emissions Inventories

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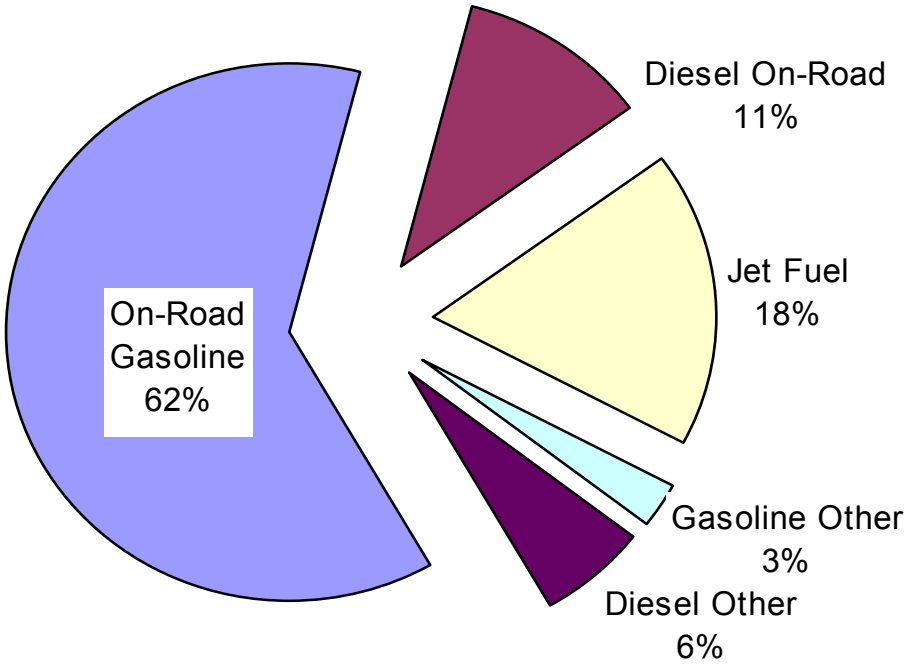
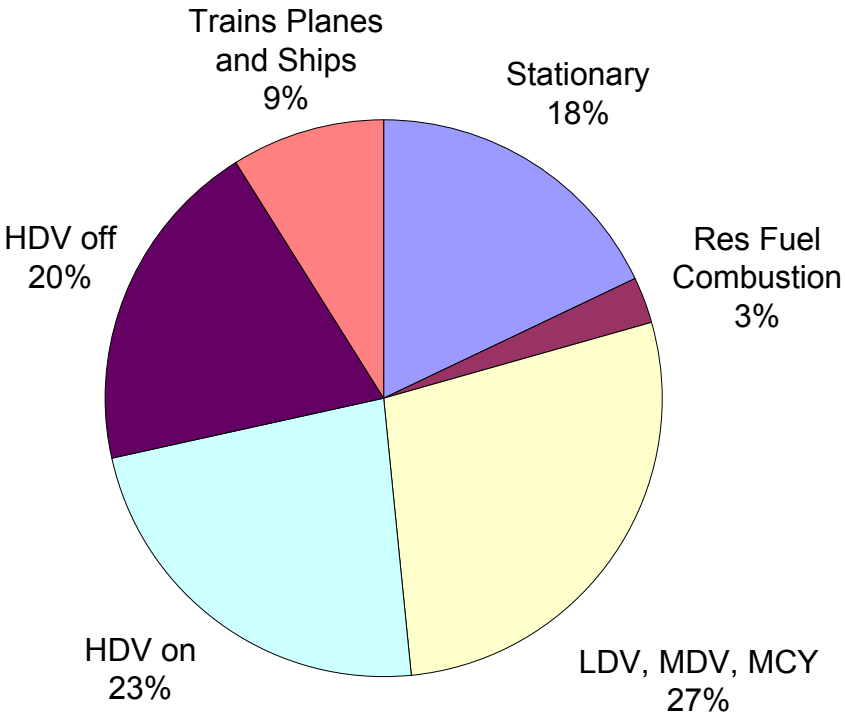
4 Summary

Diesel Applications Dominate NOx Emissions



Fuel Consumed



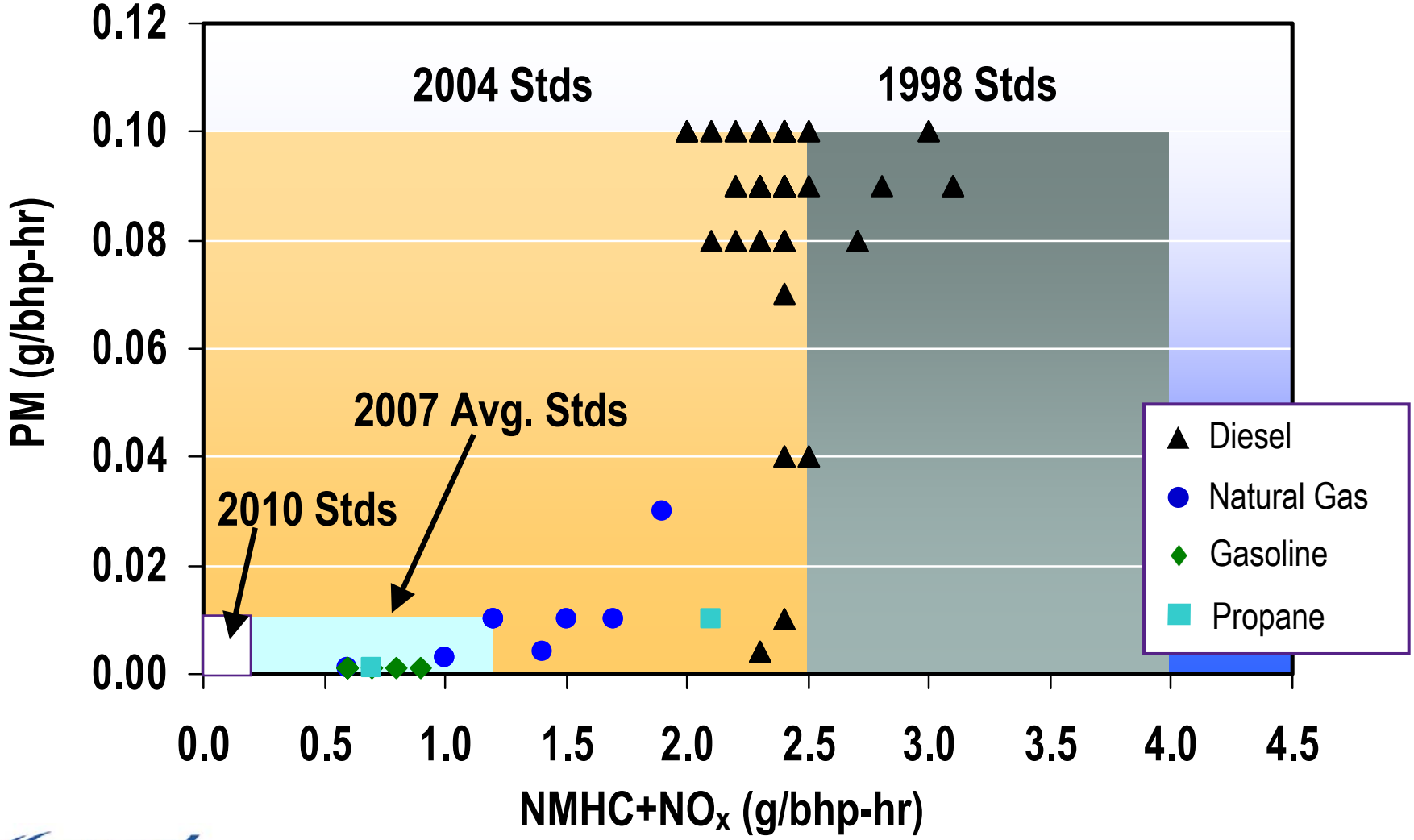
NO_x Emissions

Source: California ARB

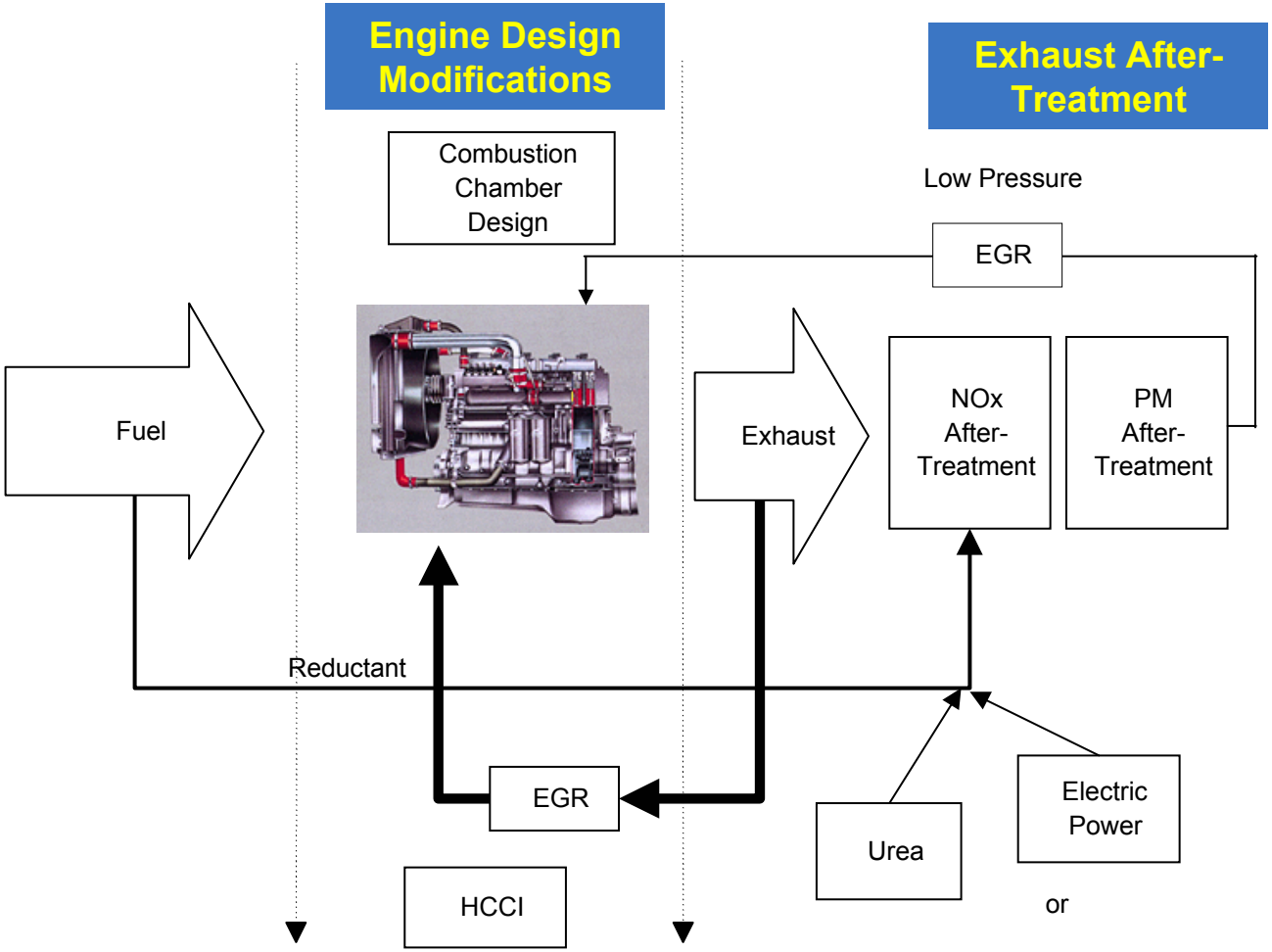
Diesel engines provide high efficiency/fuel economy

- Diesel engines predominate heavy-duty on-road, off-road, and marine applications
  - Good torque/hp performance over operating conditions
  - Extremely reliable and durable — “million mile engines” in over the road trucking applications
  - Excellent fuel economy in variety of applications from light-duty passenger cars and trucks to on-road heavy duty and off-road heavy duty vehicles
  - Excellent overall life-cycle costs in variety of applications

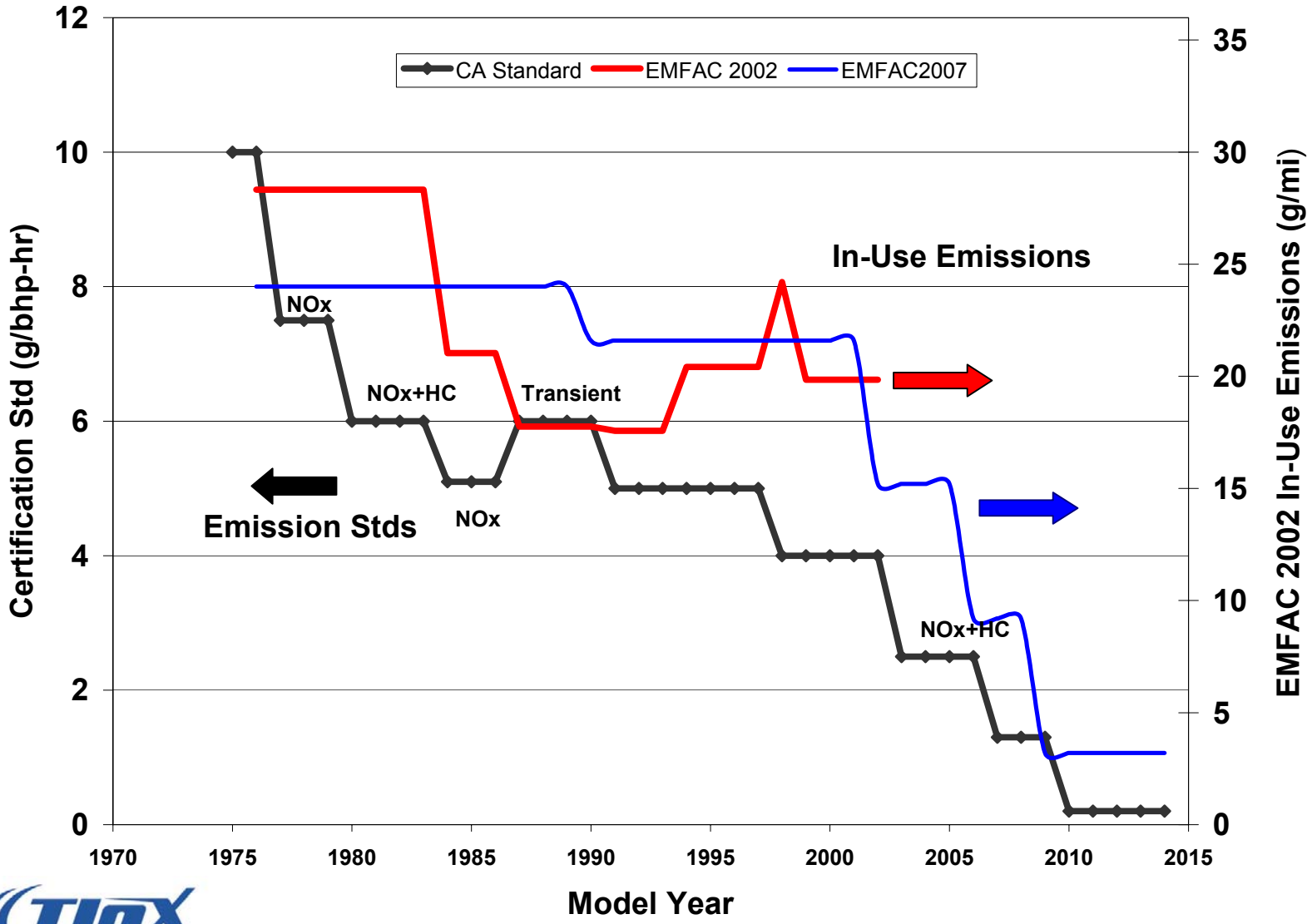
2005 heavy-duty engine certifications (as of June 17, 2005)



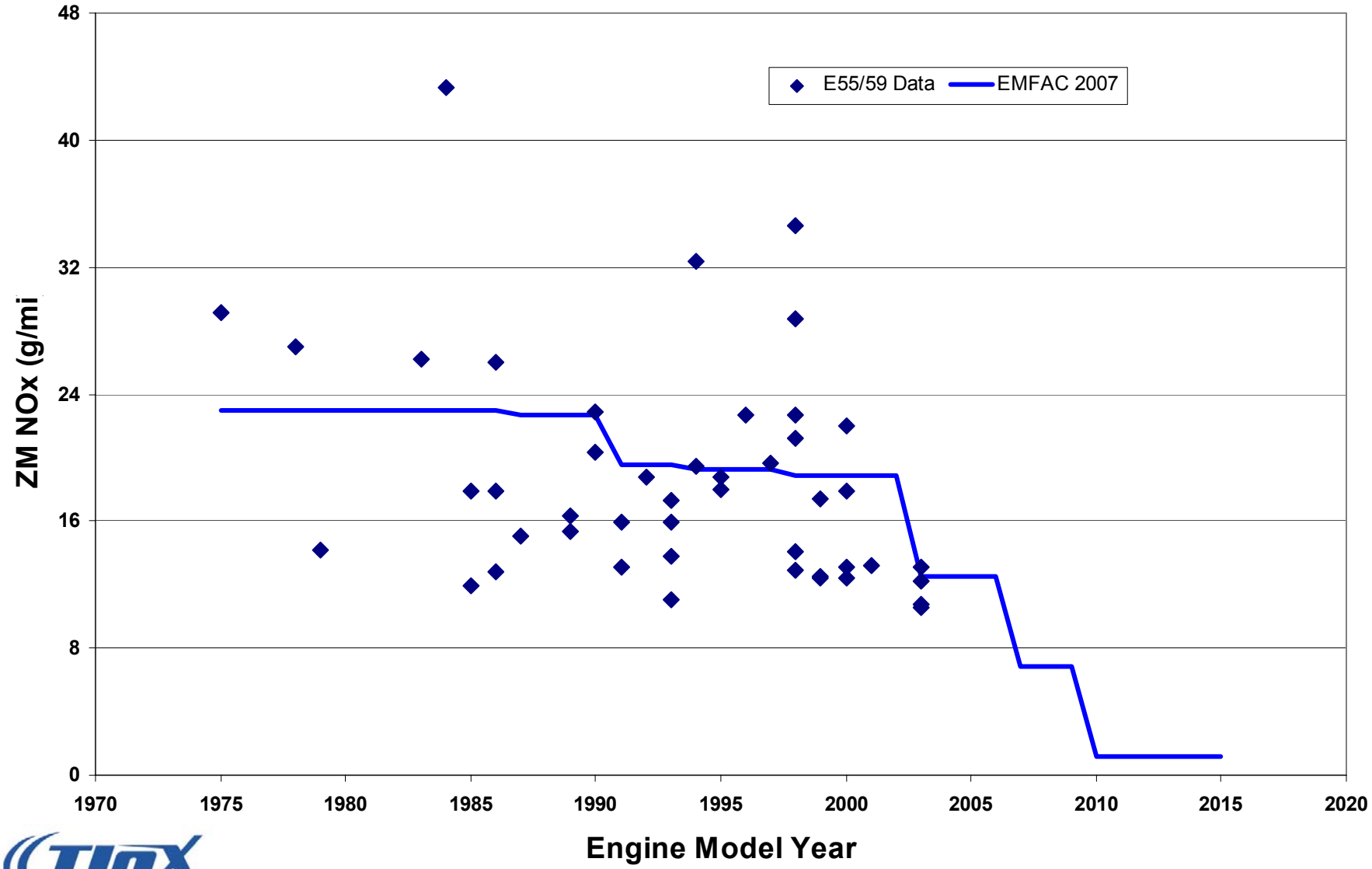
Technologies used to reduce NOx and PM from heavy-duty diesel applications center on three areas:



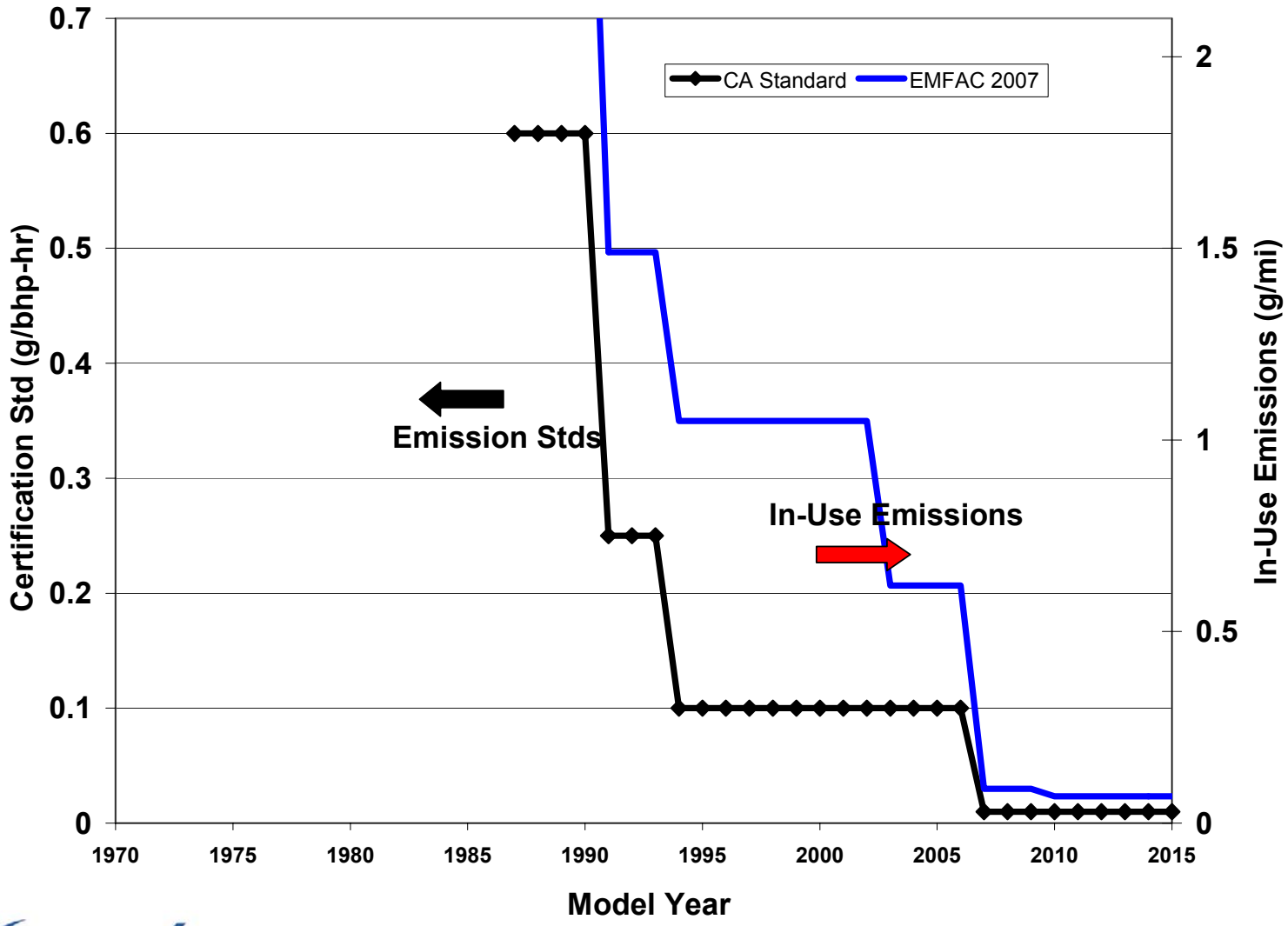
NO_x engine standards and in-use emissions



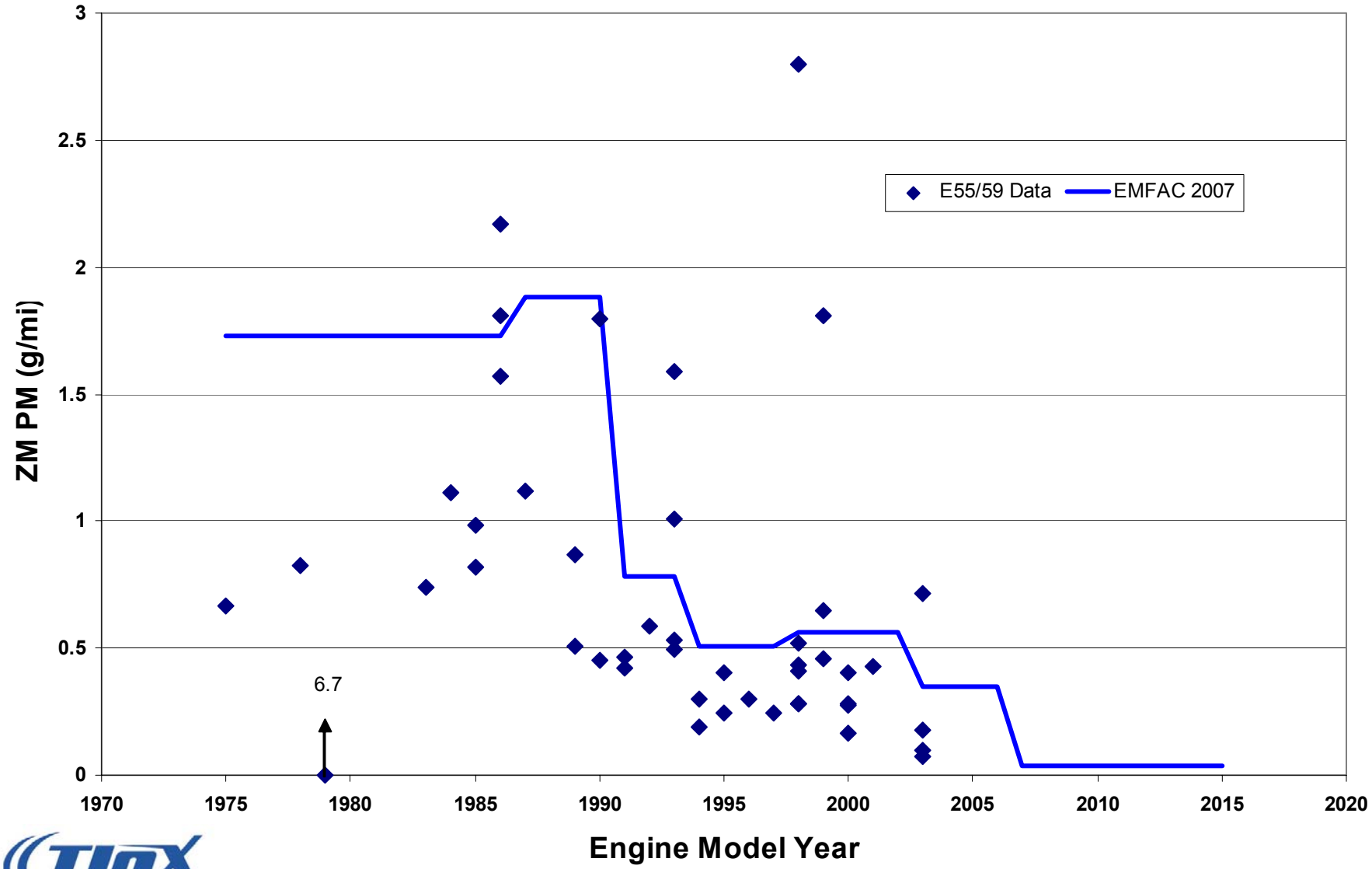
Comparison of In-Use Chassis Data to EMFAC2007



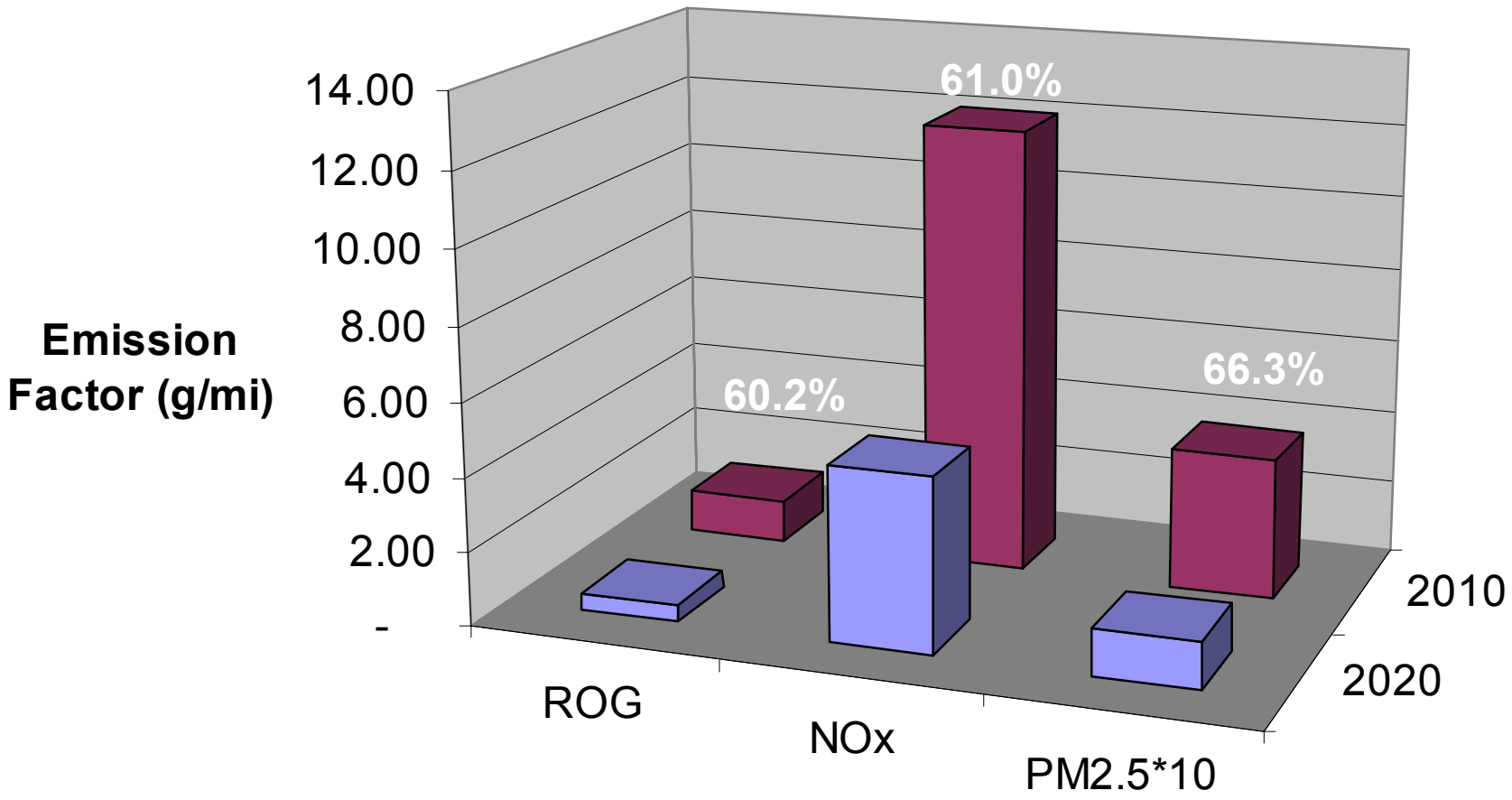
PM standards and in-use emissions



Comparison of In-Use Chassis Data and EMFAC2007



Heavy-Duty Truck Emissions Reductions in EMFAC2007

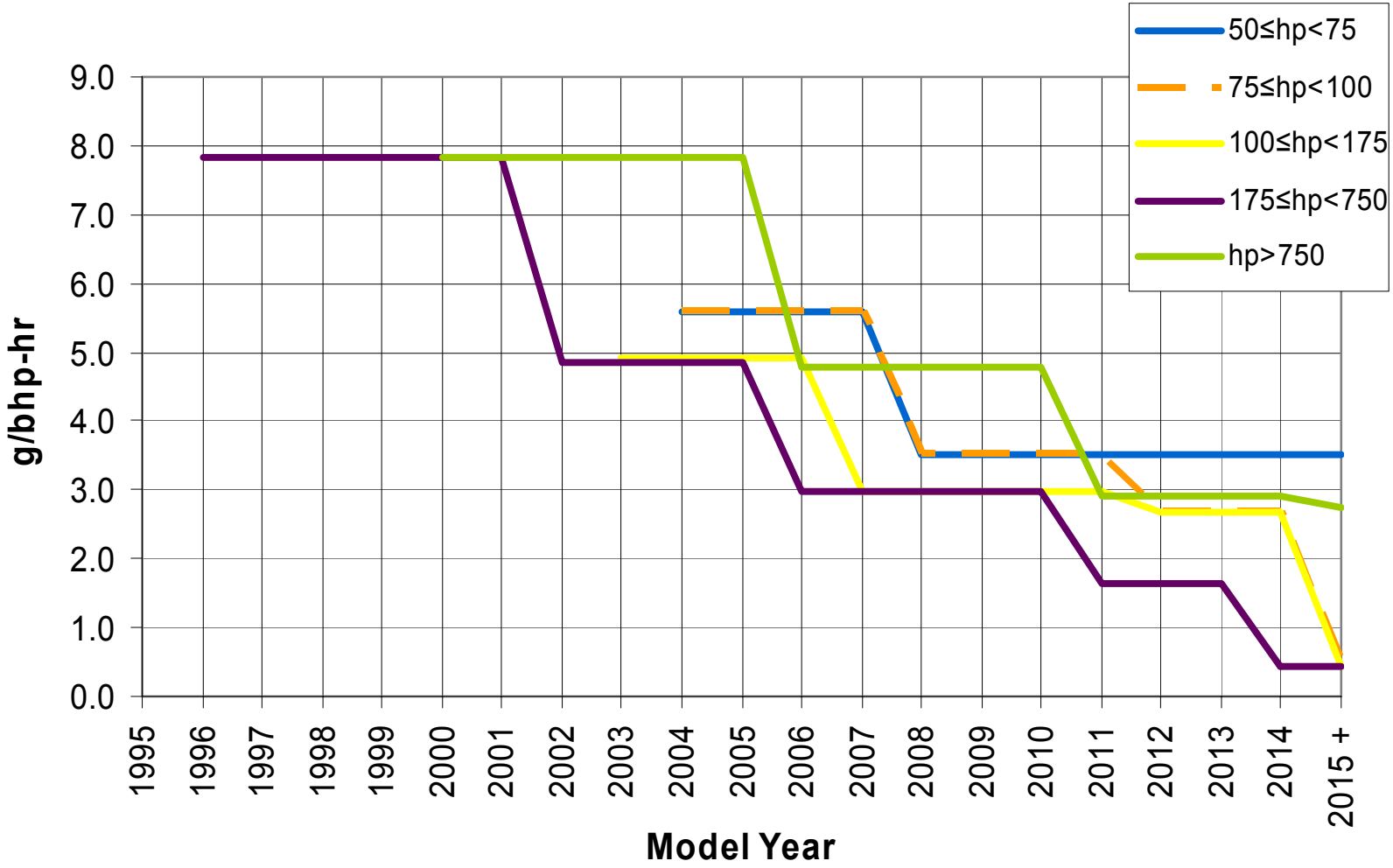


Source: SCAQMD 2007 AQMP, Appendix III, Attachment E

Example of Off-Road Construction Equipment

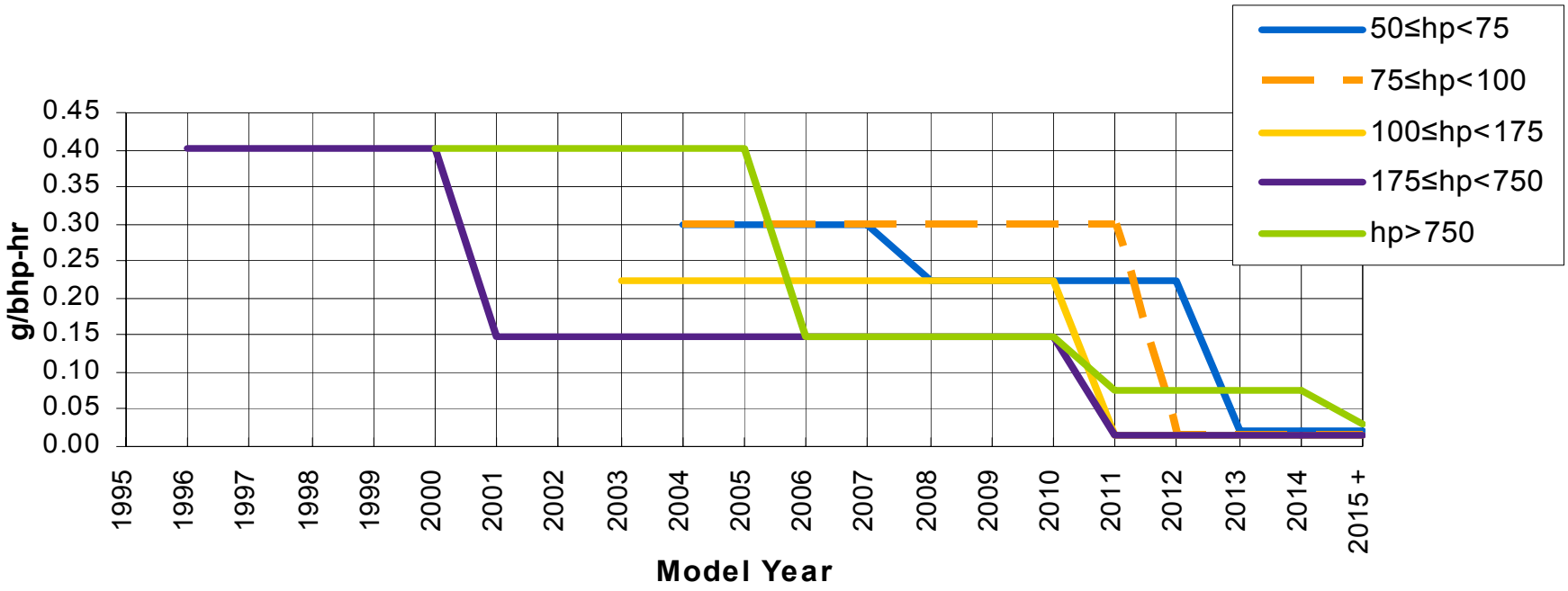
Source: eBay

Off-Road NMHC + NOx Emissions Standards



To obtain NOx emissions levels, multiply NMHC + NOx number by default fraction factor 0.95

Off-Road PM Emissions Standards



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Control of In-Use Emissions from Engines and Vehicles Needed

- Attainment of PM2.5 and Ozone standards will require substantial emission reductions from mobile sources
- Cleaner fuels and advanced technologies may provide needed reductions for attainment, but engine and vehicle standards will have to be achieved in-use and over their useful lives.
- Emissions from light duty vehicles have been dramatically reduced
  - New ultra-low, emission technology is appearing more robust
  - Still hard to find and reduce missions from gross polluters
  - Smog Check Program, On-Board Diagnostics (OBD), and fleet turn over may reduce impact of gross polluters
- New emissions standards for heavy-duty, on- and off-road vehicles will considerably reduced NOx and PM2.5 emissions
  - Need reductions in-use
  - Need emissions reductions over vehicle and equipment useful life
  - NTE requirements, road side testing, and OBD may reduce in-use impact

Thank You For Your Attention

Contact Michael D. Jackson
Jackson.michael@tiaxllc.com
408-517-1560