

What is E55 & EMFAC Telling Us About HD Emissions? & What is EPA Doing?

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In-Use Diesel Engine Emissions
South Coast AQMD

Outline

- What is EMFAC saying about HD NO_x?
 - Comparisons to past EPA projections
- Tampering & Malmaintenance
- EPA In-Use Compliance Measures
- Conclusions

How EPA Models NOx the “Conversion Factor”

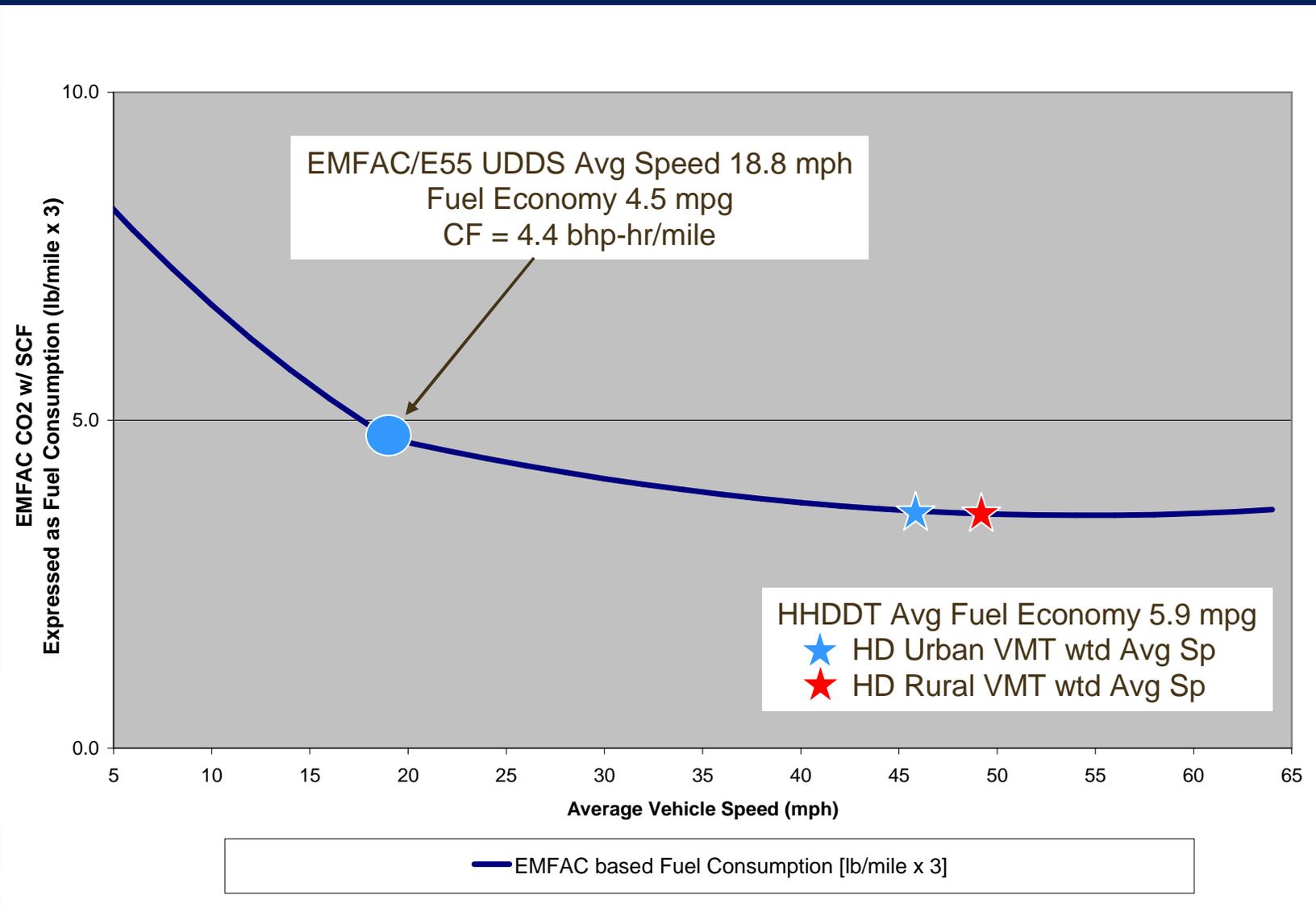
$$\text{EF (bhp-hr/mi)} = \frac{\text{Fuel Density (lb/gal)}}{\text{BSFuelCons (lb/bhp-hr) x Fuel Economy (mi/gal)}}$$

- HD engine regulation = pollution / work
- Need to relate to miles driven
- Develop Conversion Factor (CF)

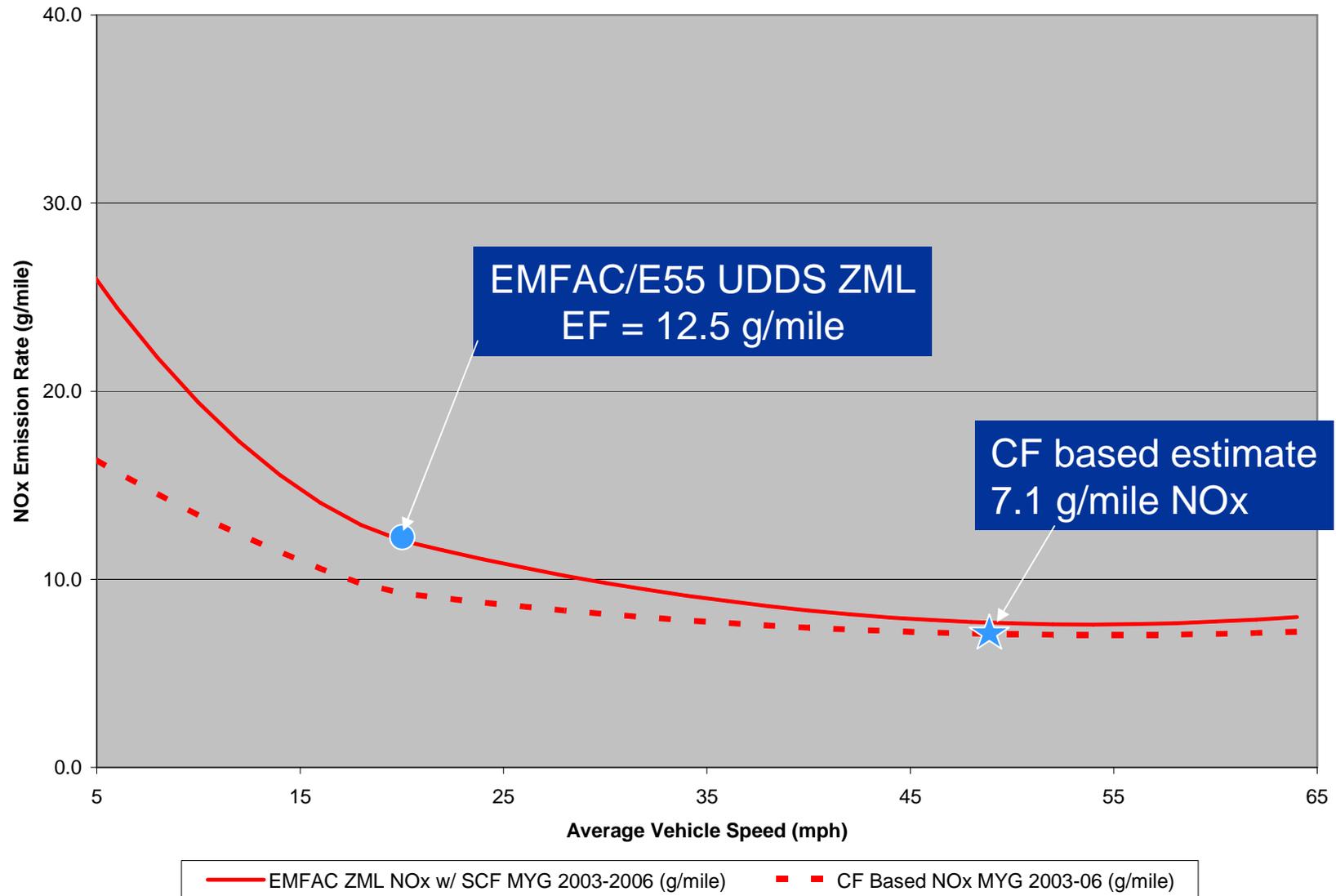
Does E55/ EMFAC Reveal an Issue?

- $CF = 7.11 \text{ lb/gallon} / [.372 \text{ lb/hp-hr} \times 5.9 \text{ mpg}]$
- $CF = 3.25 \text{ [bhp-hr/mile]}$
- For 2004 std $NO_x = 2.2 \text{ g/bhp-hr}$
- $EF = 3.25 \times 2.2 = 7.1 \text{ g/mile}$
 - Previous EMFAC version ZML = 6.7 g/mile
- New E55 based EMFAC ZML = 12.5 g/mile

E55/EMFAC is telling us much more



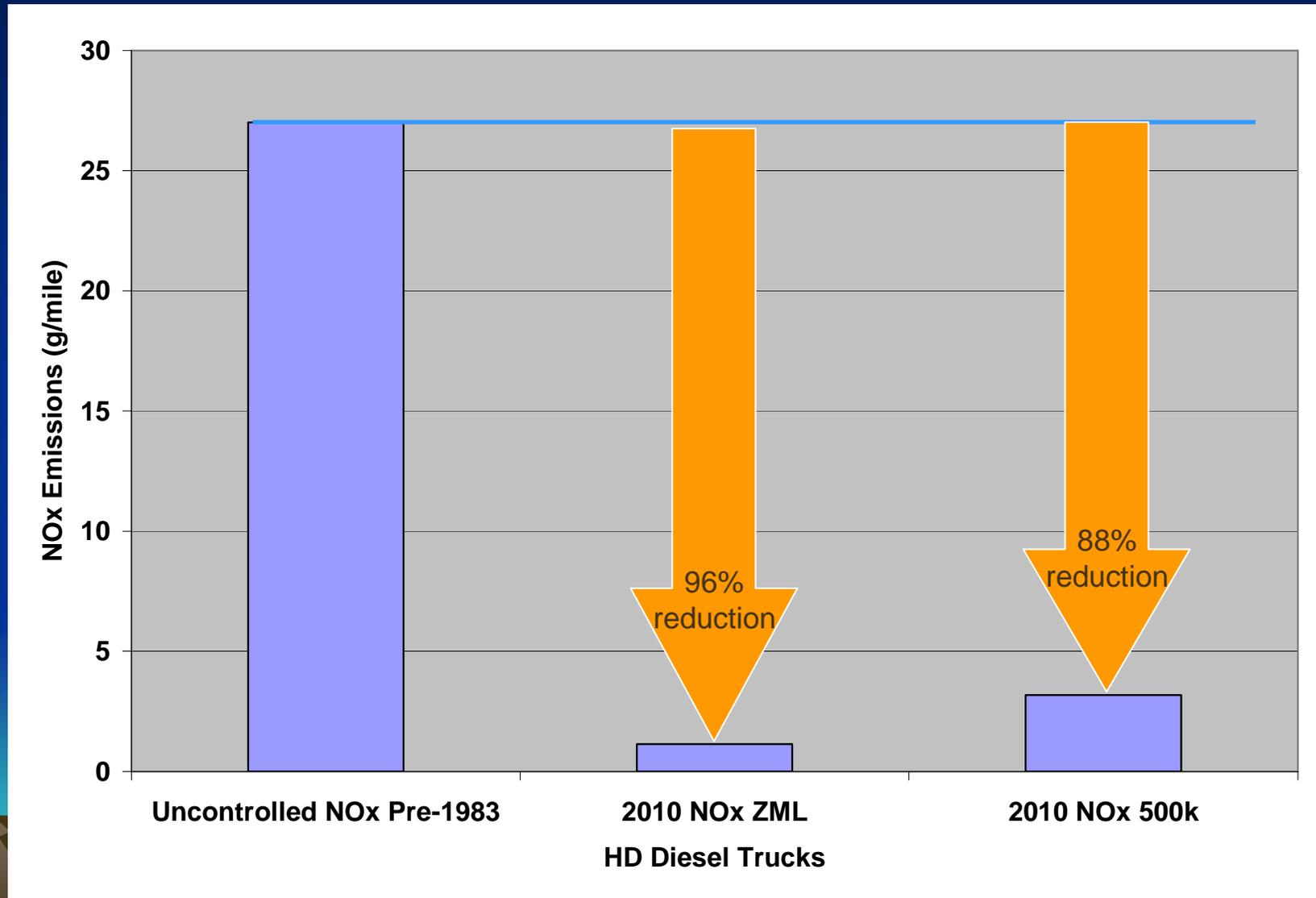
EMFAC NOx EF for 2003-06



Some Quick TakeAways

- EMFAC updates based on E55 show ZML NOx emission rates consistent with emission stds
 - Matches current MOBILE/EMFAC @ fleet avg speeds
 - Does a better job of characterizing low speed
- EMFAC/E55 reveals much more about driving cycle impacts on NOx
 - Very similar to fuel consumption
 - More stop-and-go = more NOx
 - Steady cruise = less NOx
 - absent off cycle emission effects

Tampering and Malmaintenance



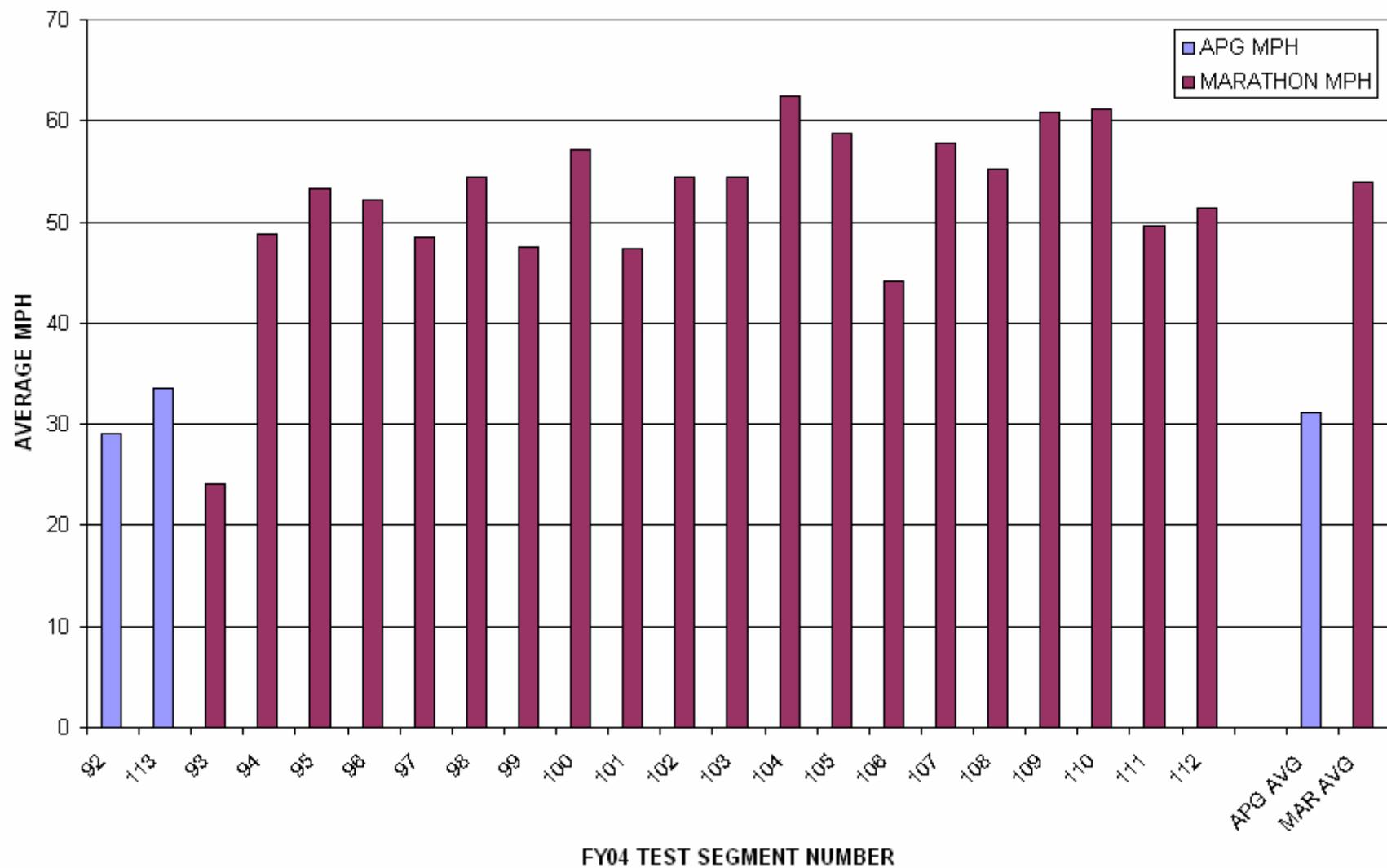
EPA Actions To Ensure Compliance

EPAs HD In-Use Compliance Program Background

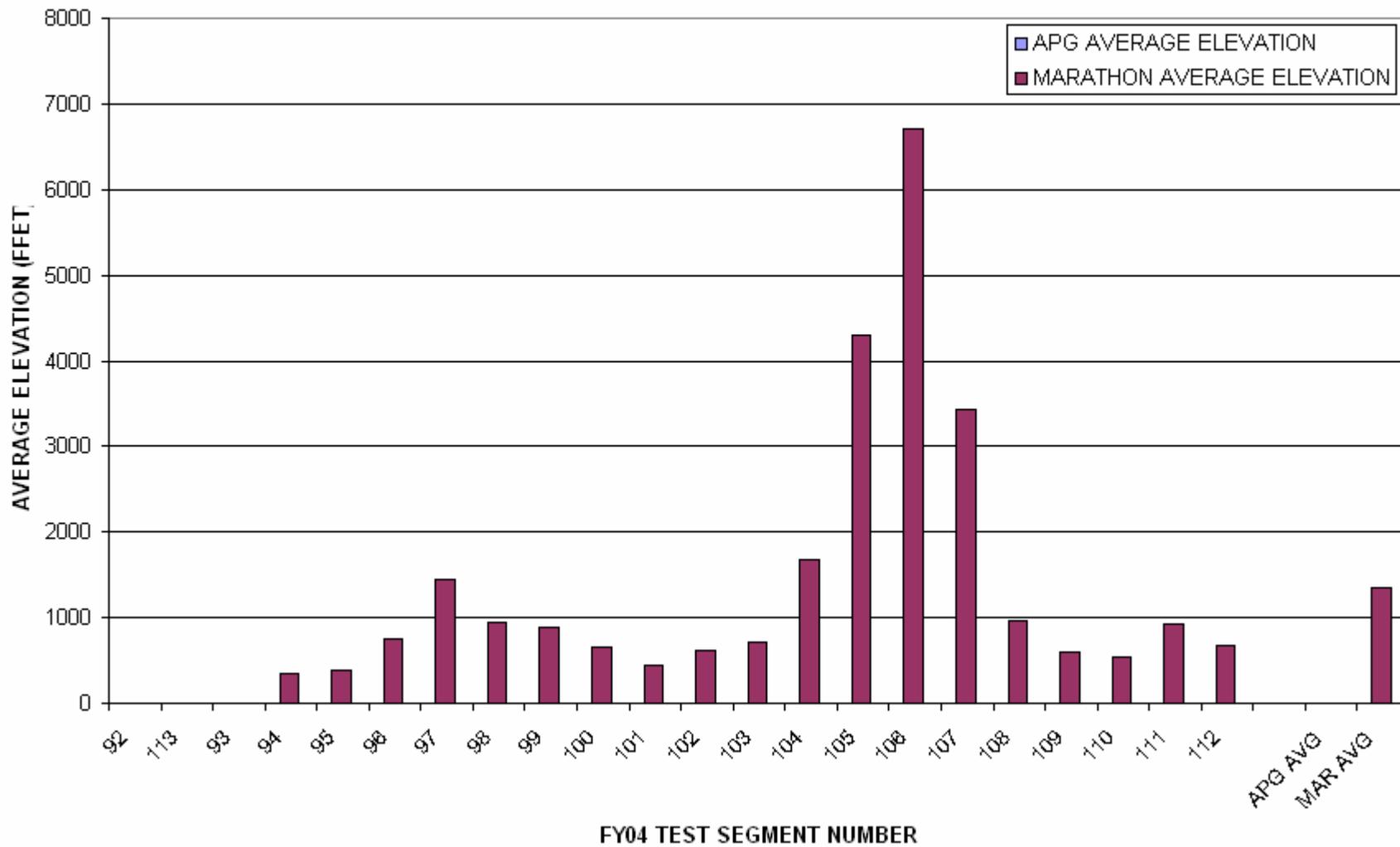
- Program to measure emissions of trucks on the road
 - Portable testing equipment, rides on the truck
 - Local driving route (2.5 hrs, 68miles), marathon (3,500 miles)
- Program started in 2001
 - Has tested 372 trucks/engines so far
 - Source of trucks: Private companies, government agencies, truck rental companies, and private individuals.
- Not-To-Exceed (NTE) test procedure
 - Covers broad range of real world operating conditions
 - Enables engine to be tested in trucks on the road
 - Required by consent decrees, 2007 regulations



APG LOOP AND MARATHON - TEST SEGMENT AVERAGE MILES PER HOUR (MPH)



APG LOOP AND MARATHON - TEST SEGMENT AVERAGE ELEVATION (FEET)

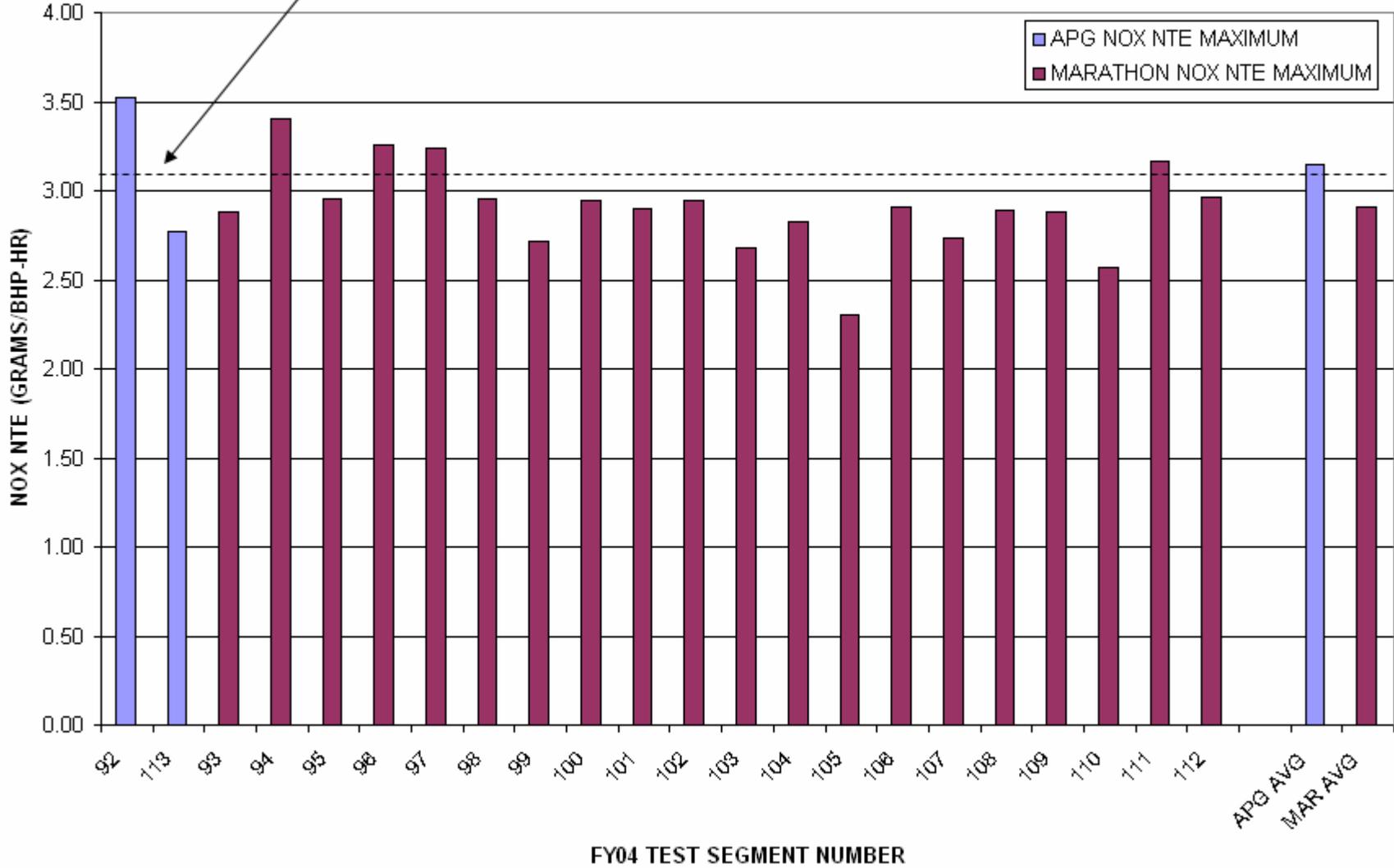


Start Location for Test Segment

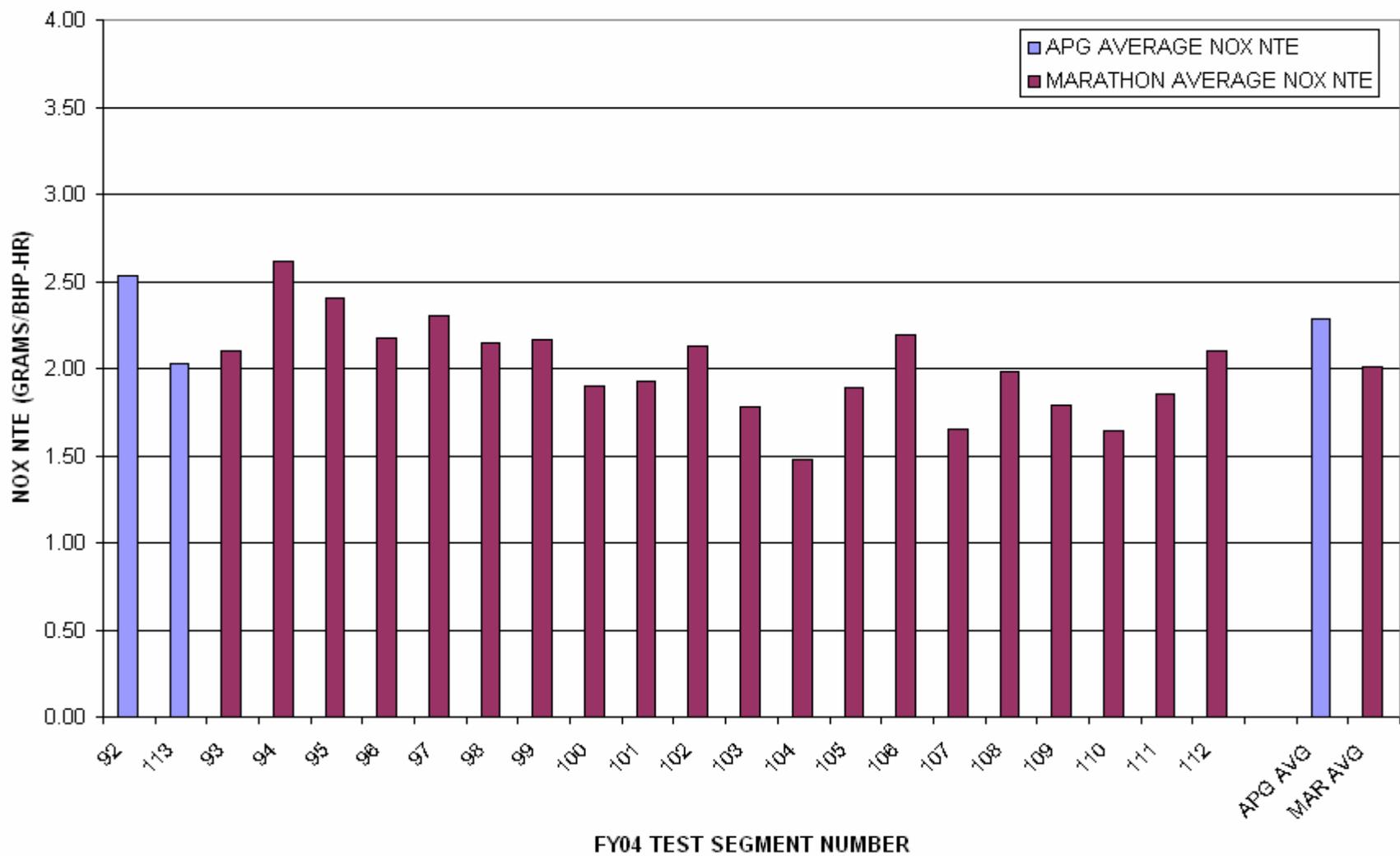
Sgmnt #	Start Location	# (cont.)	Start Location
92	APG, MD	102	St. Louis, MO
113	APG, MD	103	Fulton, MO
93	APG, MD	104	Lawrence, KN
94	Baltimore, MD	105	Colby, KN
95	Hagerstown, MD	106	Limon, CO
96	Big Springs, MD	107	CO. Springs, CO
97	Breezewood, PA	108	Abilene, KN
98	Yeager, PA	109	Blue Springs, MO
99	New Libson, OH	110	Greenville, IL
100	Indianapolis, IN	111	Indianapolis, IN
101	State Line IL/IN	112	Somerset, PA

APG LOOP AND MARATHON - TEST SEGMENT MAXIMUM NOX NTE

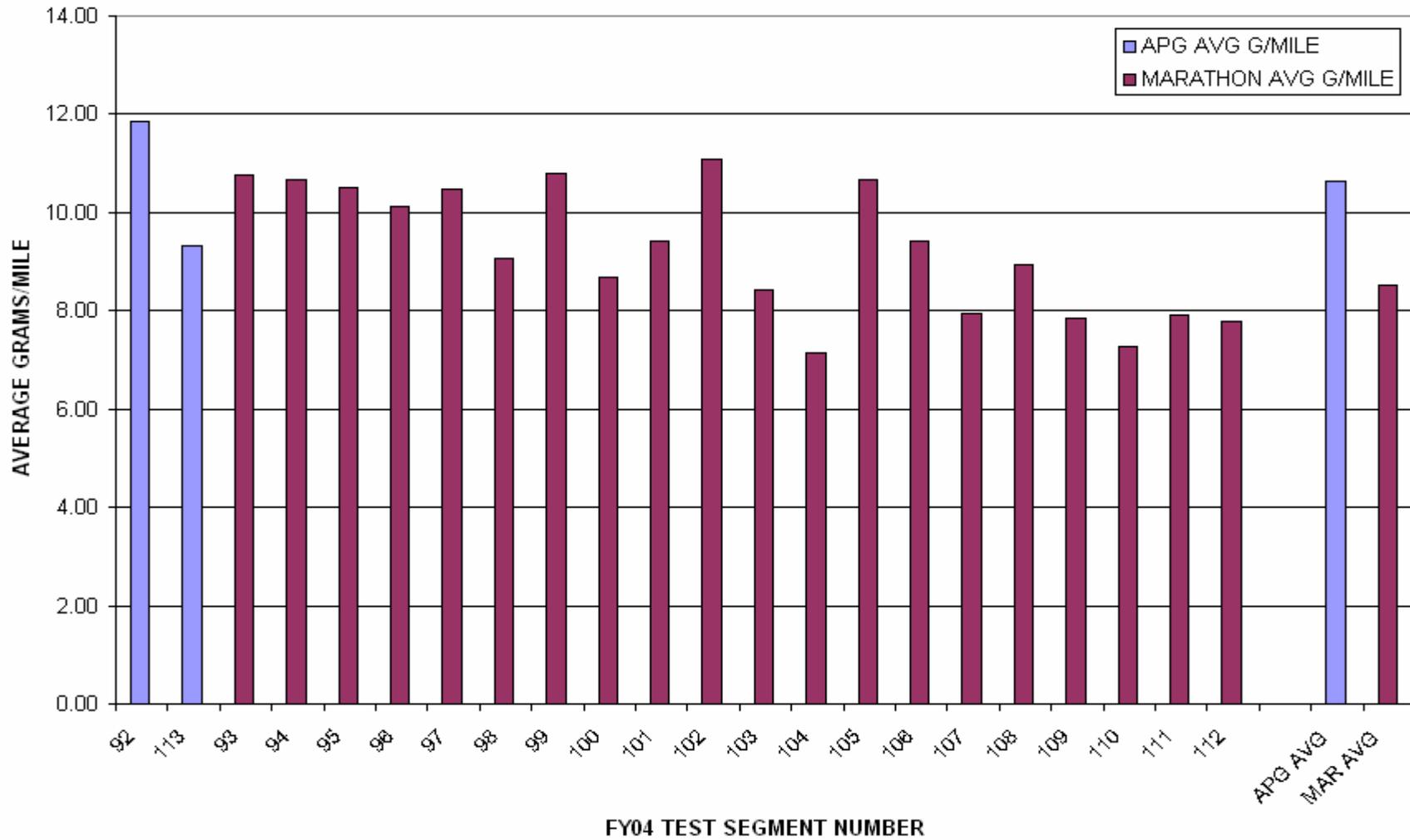
NOX NTE LIMIT = 2.5 g/bhp-hr, STD = 2.5 X 1.25 = 3.1 g/bhp-hr



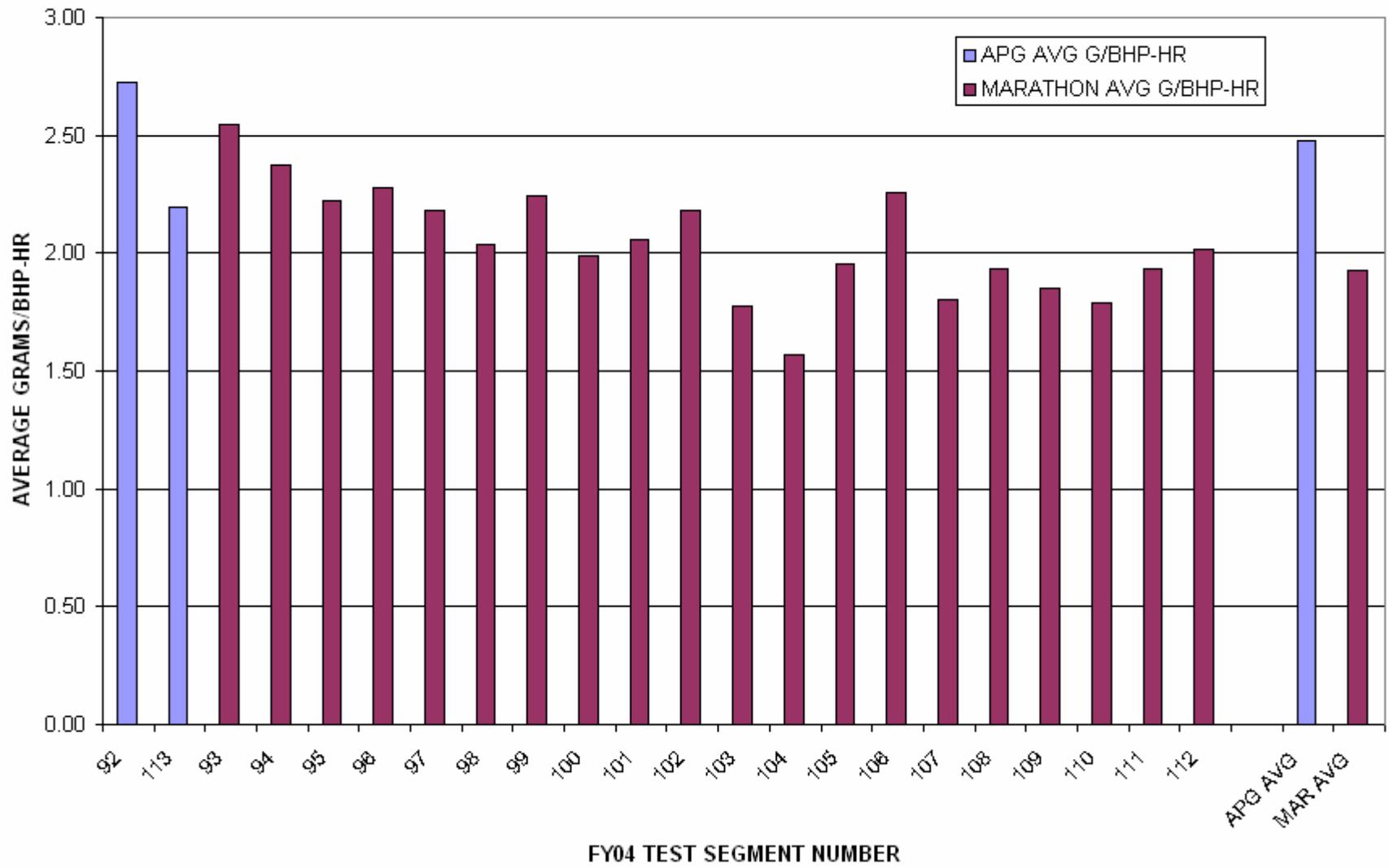
APG LOOP AND MARATHON - TEST SEGMENT AVERAGE NOX NTE



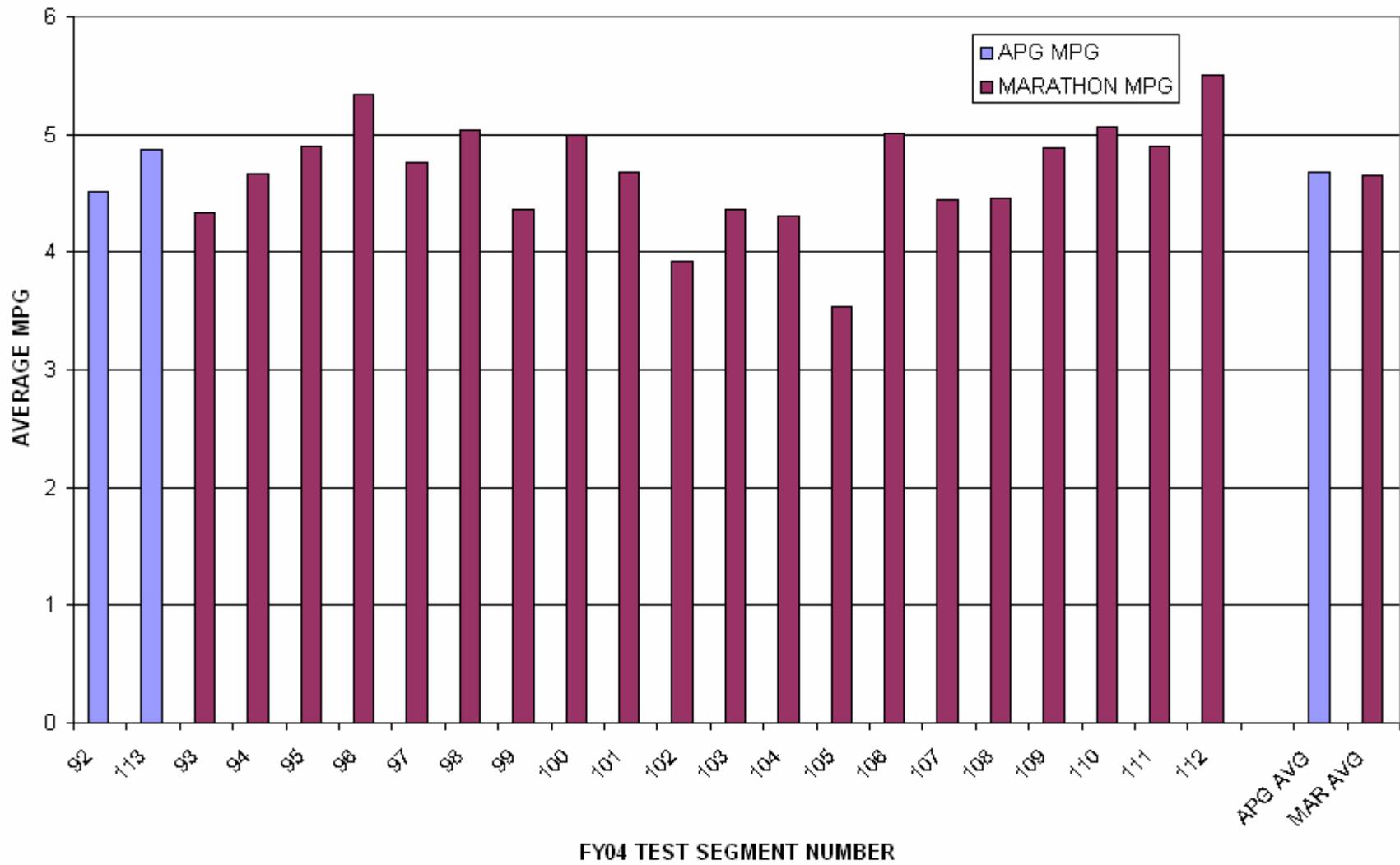
APG LOOP AND MARATHON - TEST SEGMENT NOX AVERAGE GRAMS/MILE



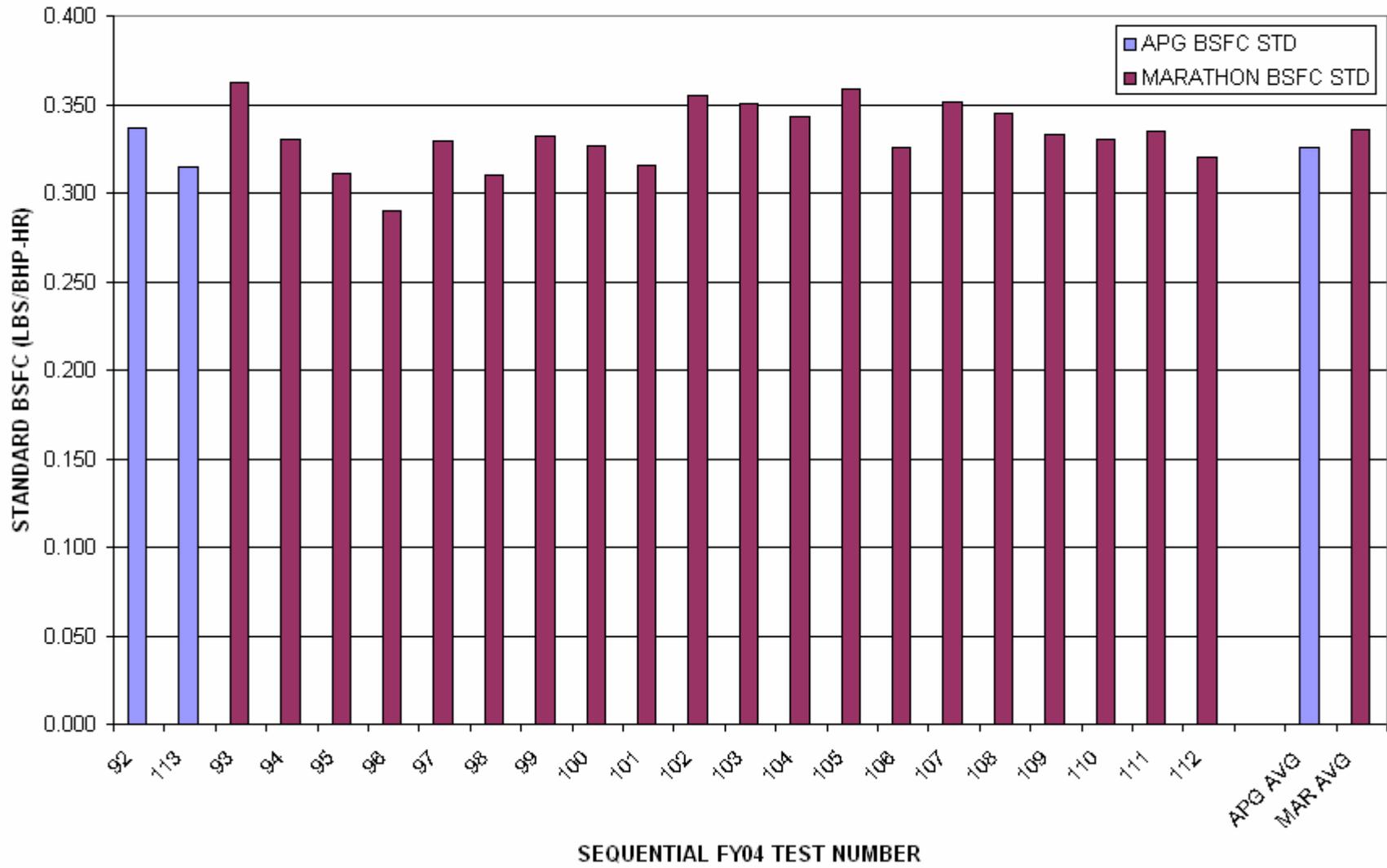
APG LOOP AND MARATHON - TEST SEGMENT NOX AVERAGE GRAMS/BHP-HR



APG LOOP AND MARATHON - TEST SEGMENT AVERAGE MILES PER GALLON (MPG)



APG LOOP AND MARATHON - TEST SEGMENT AVERAGE STD BSFC (LBS/BHP-HR)



Conclusions

- Proposed EMFAC shows NO_x reductions from New heavy-duty trucks consistent with emission standards
- Proposed EMFAC highlights the importance of maintaining emission control systems in order to maintain control of emissions
- Agencies (ARB and EPA) are working together
 - To ensure real world compliance
 - To develop best tools to predict mobile source emissions