

INSPECTION AND MAINTENANCE

AS ESTIMATED BY THE EMFAC EMISSIONS INVENTORY MODEL

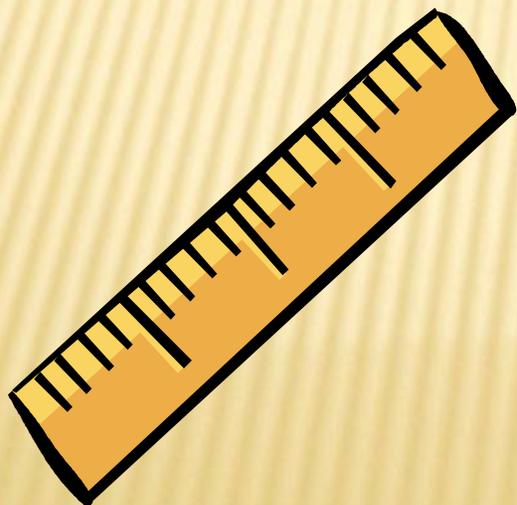
Presented by
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Saint Malo Solutions (SMS, LLC)

March 2007

SCAQMD SMOG CHECK TECHNOLOGY FOURM and ROUNDTABLE DISCUSSION

CALIFORNIA'S **EMISSION FACTOR** MODEL

- ✘ EMFAC has been used for almost 30 years
- ✘ Major Revisions in 1980s and 2000
- ✘ Model is Data Driven (Empirical)
- ✘ Analyses are Quantized



HISTORY OF CALIMFAC

- ✘ Developed in the 1980s as a Tool for Assessing the Relative Benefits of Different I/M Options.
- ✘ Borrowed Heavily from US EPA's Tech IV Model but used California Specific Data
- ✘ Major Revision in the 1990s to Reflect New Program Elements

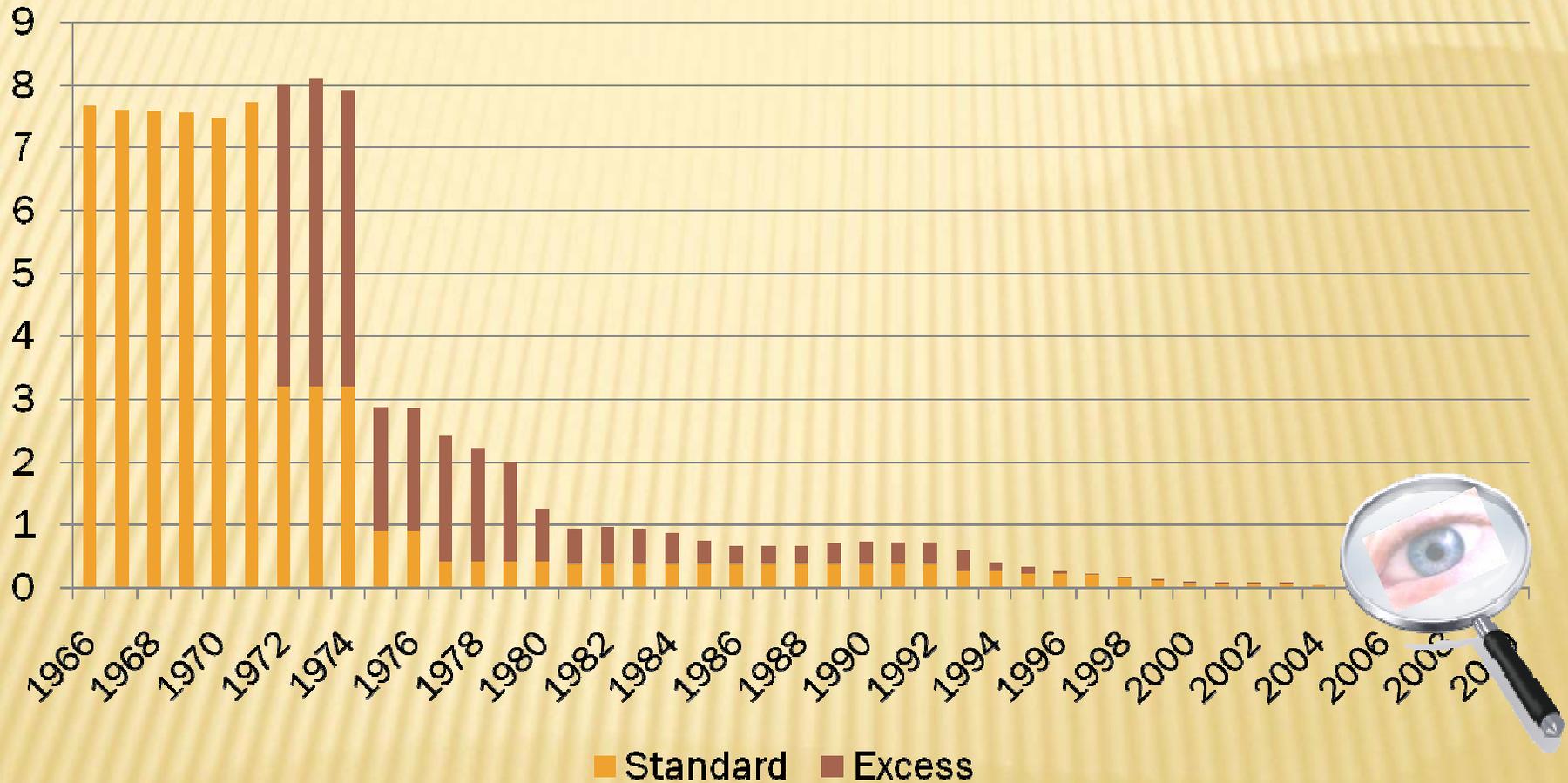


BASIC INVENTORY CALCULATION

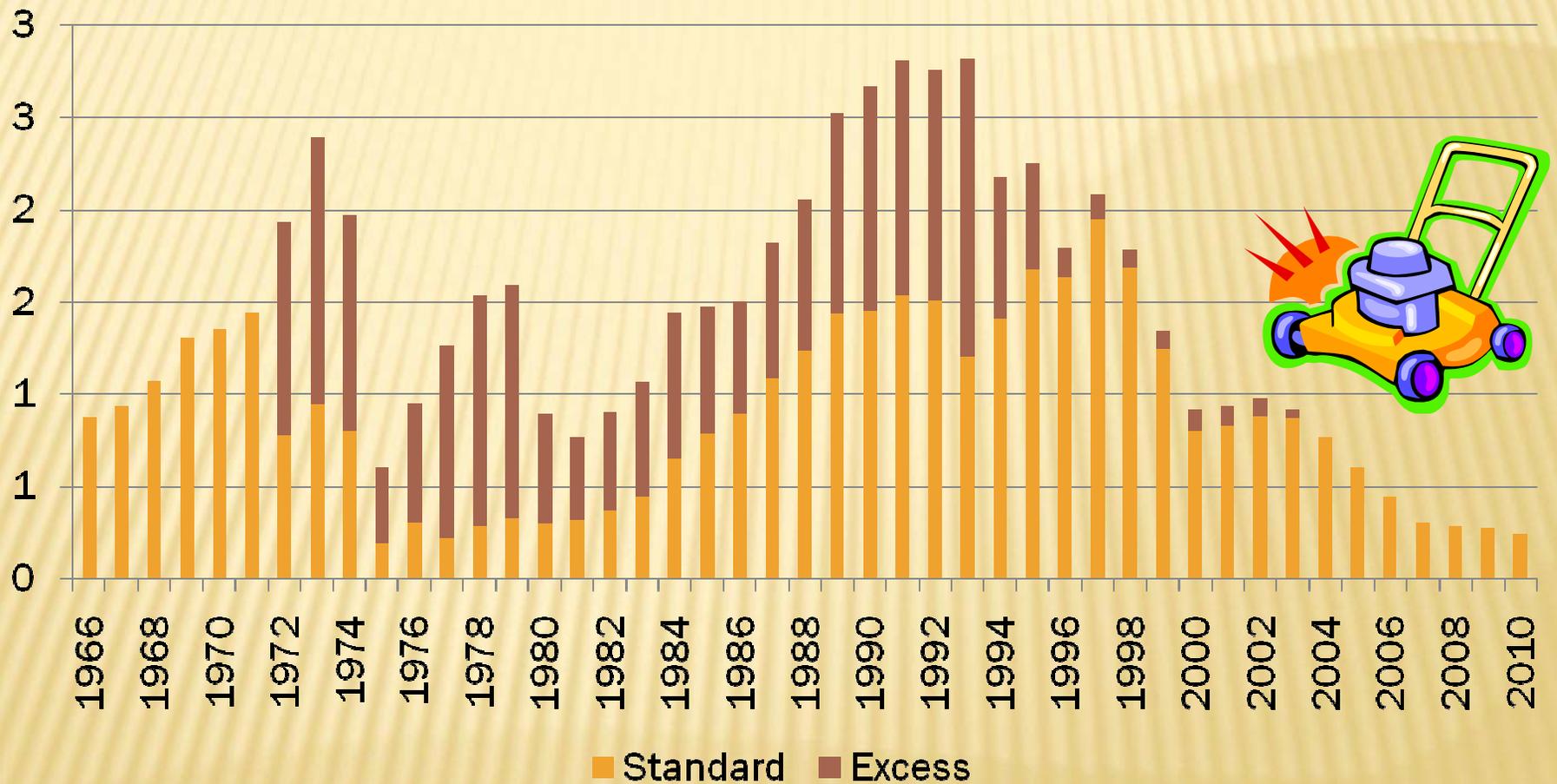
- ✘ **Tons per Day = Emissions * Population * Activity * Correction Factor(s)**

- ✘ **Emissions** - From Vehicle Testing
- ✘ **Population** - From DMV
- ✘ **Activity**
 - **Mileage Accrual** - From BAR
 - **Speed** - From COGs and MPOs
 - **VMT** - From COGs and MPOs
- ✘ **Corrections** - Speed/Temp/Fuel/Humidity/Altitude/(I/M)

HYDROCARBON EMISSIONS (GRAMS/MILE)



HYDROCARBON EMISSIONS (TONS/DAY)



EMFAC 2007 I/M SCREENSHOT

The screenshot displays the Emfac2007 software interface. At the top, the title bar reads "Emfac2007 -- Editing data". Below it is a menu bar with "File", "Run", and "Help". The main header features the California Air Resources Board logo and the text "Emfac2007 V2.3 Nov 1 2006".

The main window is titled "MAIN" and contains a "List of Available Scenarios" on the left, which lists "01 South Coast Air Basin Avg Summer CY 2010". To the right of this list is the "Current Scenario Data" section, showing:

- Number: 1 of 1
- Name: South Coast Air Basin Avg Summer CY 2010 Default Title
- Calendar Year: 2010
- Season: Summer
- Type: Burden

Below the current scenario data are buttons for "IM Program Parameters", "Save", "Save As...", "Add New Scenario", "Run", "Edit Scenario", "Finish Editing", "Delete Scenario", and "Cancel".

An "I/M Programs" dialog box is open in the foreground, displaying a list of programs:

- BAR 1984 (1984) Biennial
- CDO 1984 (1984) Change of Ownership Only
- BAR 1990A (1990) Biennial
- CDO 1990A (1990) Change of Ownership Only
- BAR 1990B (1990) Biennial
- CDO 1990B (1990) Change of Ownership Only
- Enhanced Basic (1998) Biennial
- CDO Basic (1998) Change of Ownership Only
- Enhanced Interim (2001) Biennial
- Enhanced Basic (2005) Biennial
- CDO Basic (2005) Change of Ownership Only
- Enhanced Interim (2005) Biennial
- Add program...

The dialog box also includes a "Reset List to Defaults" button, a "Double-click program to view/edit" instruction, and "Cancel" and "Done" buttons at the bottom.

The Windows taskbar at the bottom shows the system clock at 11:13 PM and the date as 11/1/2006.

EMFAC 2007 I/M SCREENSHOT

The screenshot displays the EMFAC 2007 software interface. At the top, the title bar reads "Emfac2007 -- Editing data". Below it is a menu bar with "File", "Run", and "Help". The header features the California Air Resources Board logo and the text "Emfac2007 V2.3 Nov 1 2006".

The main window is titled "MAIN" and contains several panels:

- List of Available Scenarios:** A list box showing "01 South Coast Air Basin Avg Summer CY 2010".
- Current Scenario Data:** A text box showing "Number: 1 of 1", "Name: South Coast Air Basin Avg Summer CY 2010 Default Title", "Calendar Year: 2010", "Season: Summer", and "Type: Burden".
- IM Program Parameters:** A set of buttons including "Save", "Save As...", "Run", "Finish Editing", "Cancel", "Add New Scenario", "Edit Scenario", and "Delete Scenario".

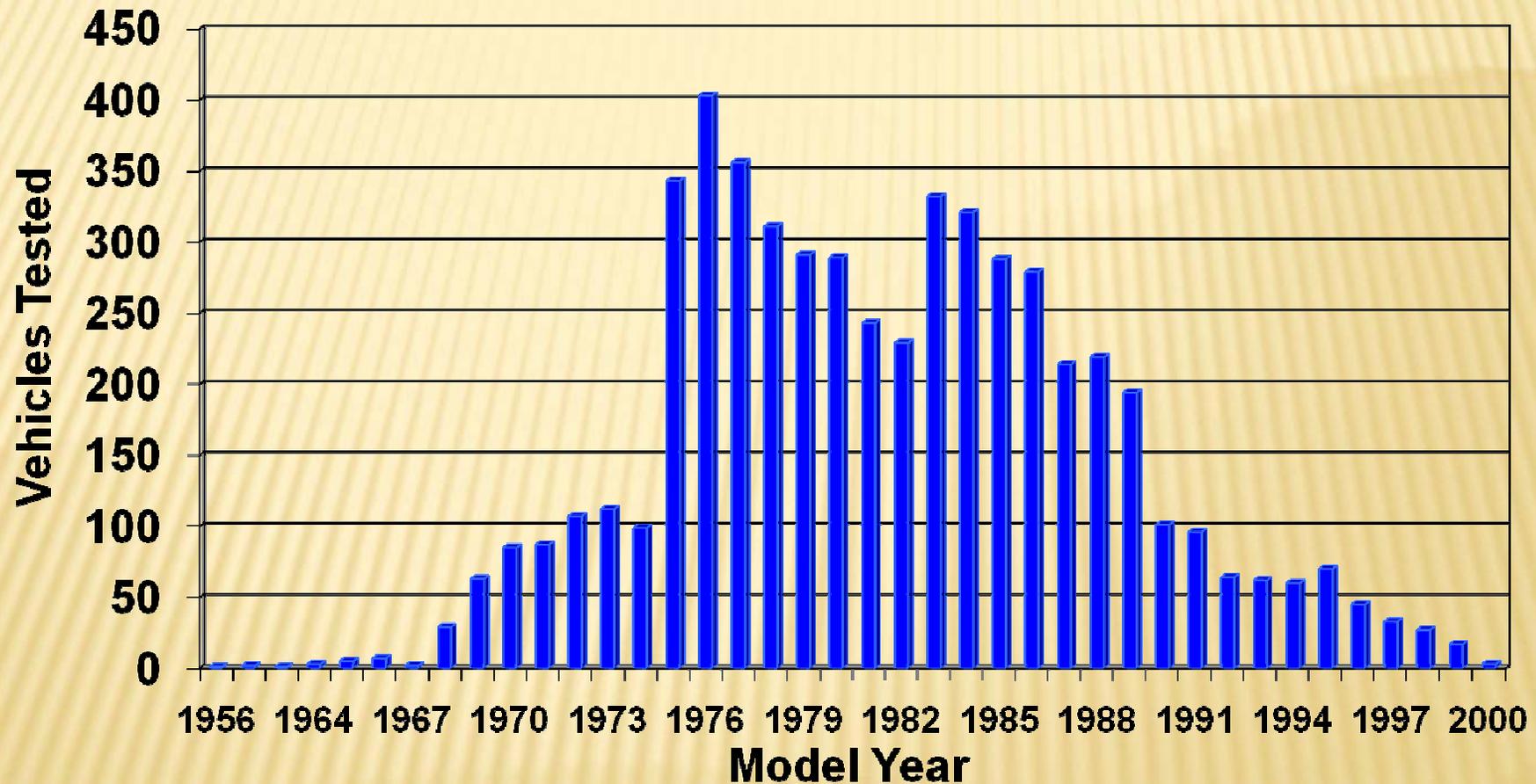
Three dialog boxes are open over the main window:

- I/M Programs:** A list box titled "All I/M Programs" containing various program codes and descriptions. The "Enhanced Interim (2005)" program is selected.
- I/M Program:** A dialog box titled "Details for selected I/M" showing "Description: Enhanced Interim (2005)". It includes a "Subprograms" list with "1) Idle/2500_HDGV_Biennial" and "2) ASM_LDA_LDT_MDV_Biennial" selected. It also has a "Delete this I/M Program" button.
- I/M Subprogram:** A detailed configuration window for the selected subprogram. It includes:
 - Program Basics:** "Inspection Frequency" set to "Biennial", "Model Years" from 1976 to 2040, "Ages" from 00 to 45, "Years Before First Inspection" set to 6, and "Free Years After Pass" set to 0.
 - Vehicles:** Checkboxes for "Light-duty Autos", "Light-duty Trucks", "Medium-duty", and "Heavy-duty" (checked).
 - Tests and Repairs:** A series of dropdown menus for "Exhaust Test" (Idle/2500), "Exhaust Cutoffs" (96 Cutoffs), "Evaporative Emissions Tests" (Gas-Cap Check), "Visual/Functional Checks" (Full), "Cost Limits" (\$450-CAA), "Mechanic Inspection Effectiveness" (ENHANCED), and "Mechanic Repair Effectiveness" (ENHANCED).
 - Alternative Detection:** Input fields for "Change of Ownership Rate" (0.17), "Min Age" (4), "Tamper ID Rate" (0), "RSD ID Rate" (0), and "Random Roadside ID Rate" (0).

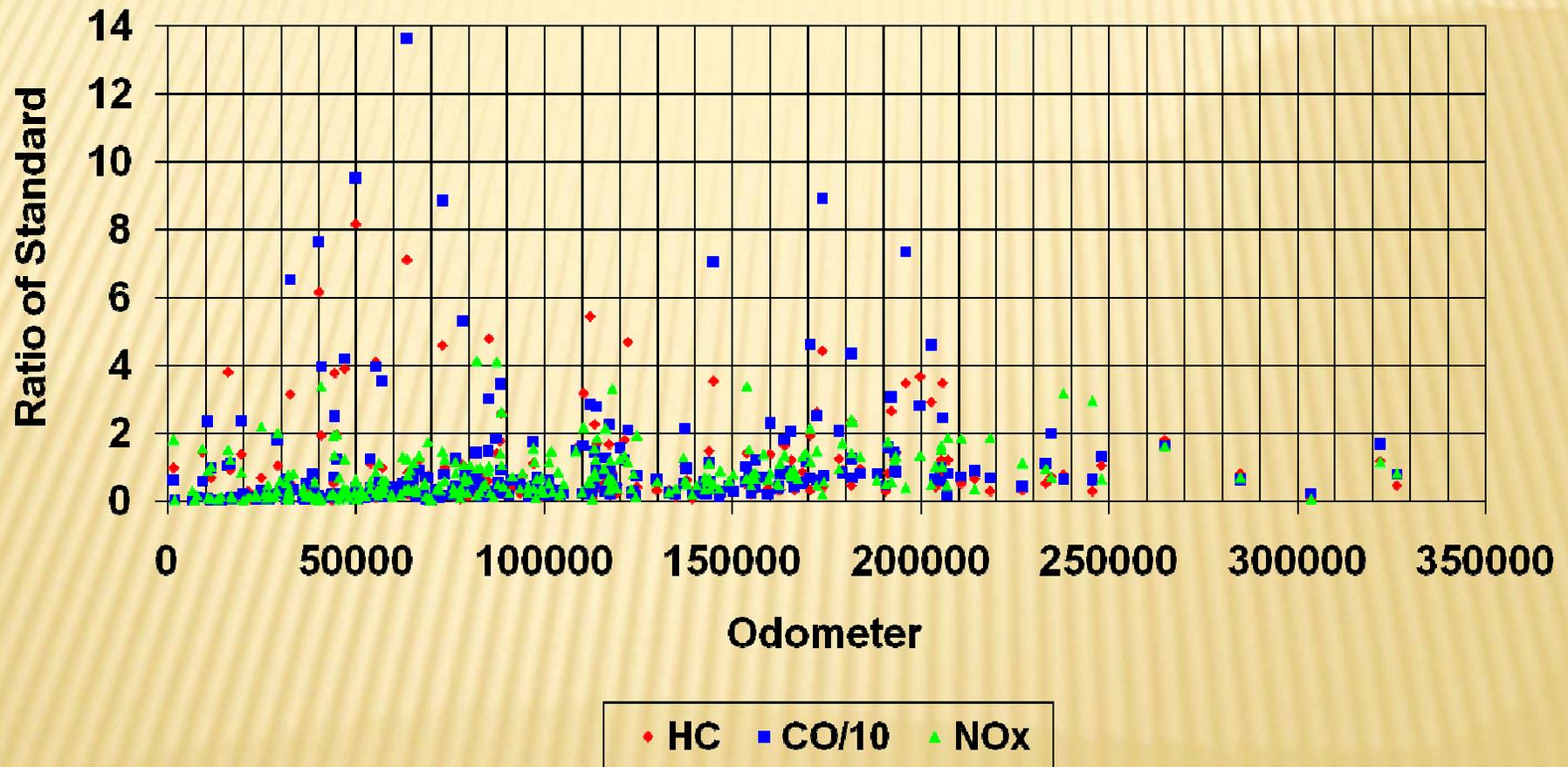
The Windows taskbar at the bottom shows the system clock as 11:16 PM.

MODEL YEAR DISTRIBUTION

(ARB'S LIGHT-DUTY SURVEILLANCE DATABASE)



EMISSIONS AS A FUNCTION OF MILEAGE

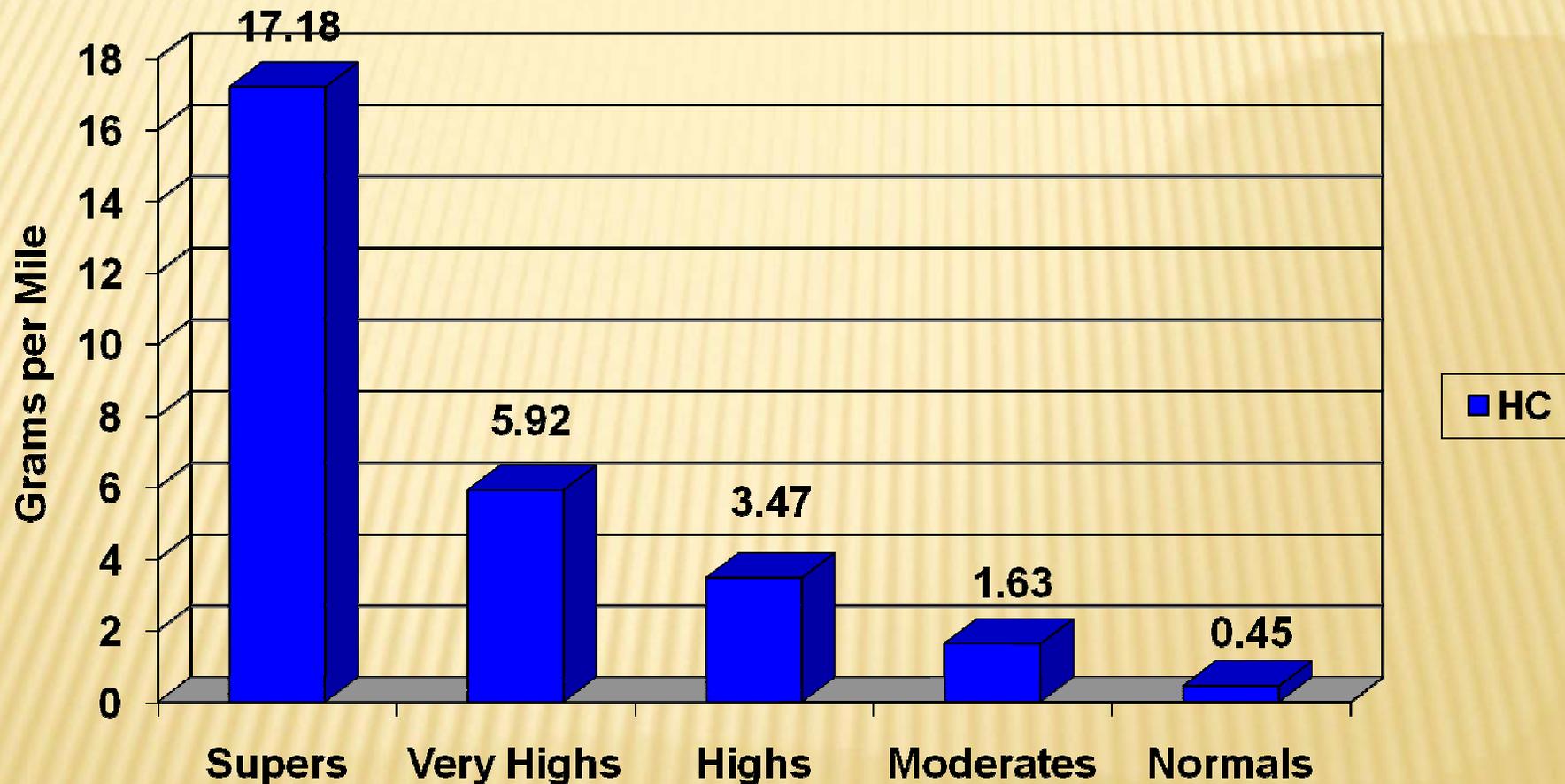


EMISSION REGIMES

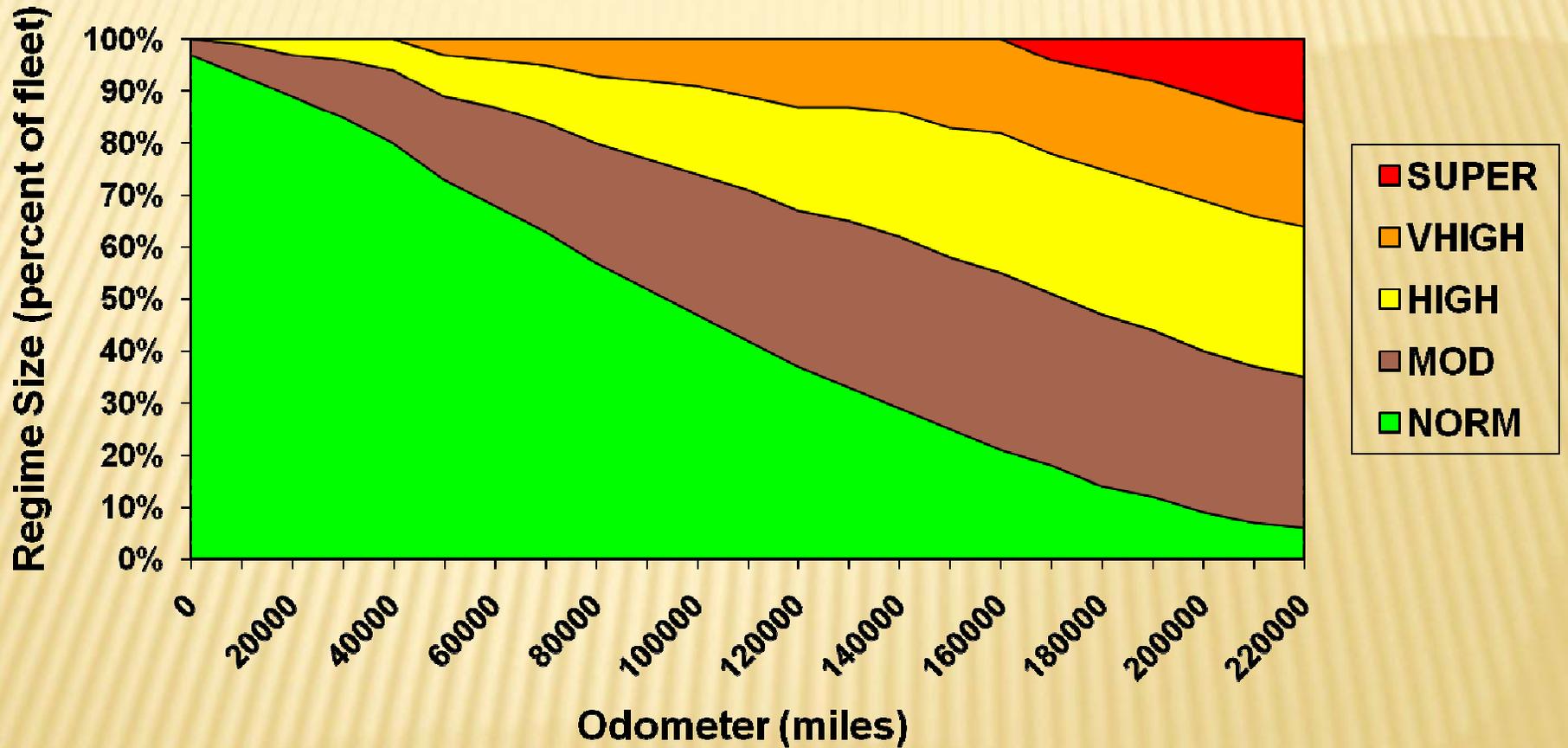
(MULTIPLES OF THE STANDARD)

Regime	HC	CO	NO _x
Super	>9	>10	>4
Very High	< or = 9	< or = 10	< or = 4
High	< or = 5	< or = 6	< or = 3
Moderate	< or = 2	< or = 2	< or = 2
Normal	< or = 1	< = 1	< = 1

REGIME SPECIFIC EMISSION RATE



REGIME GROWTH FUNCTION

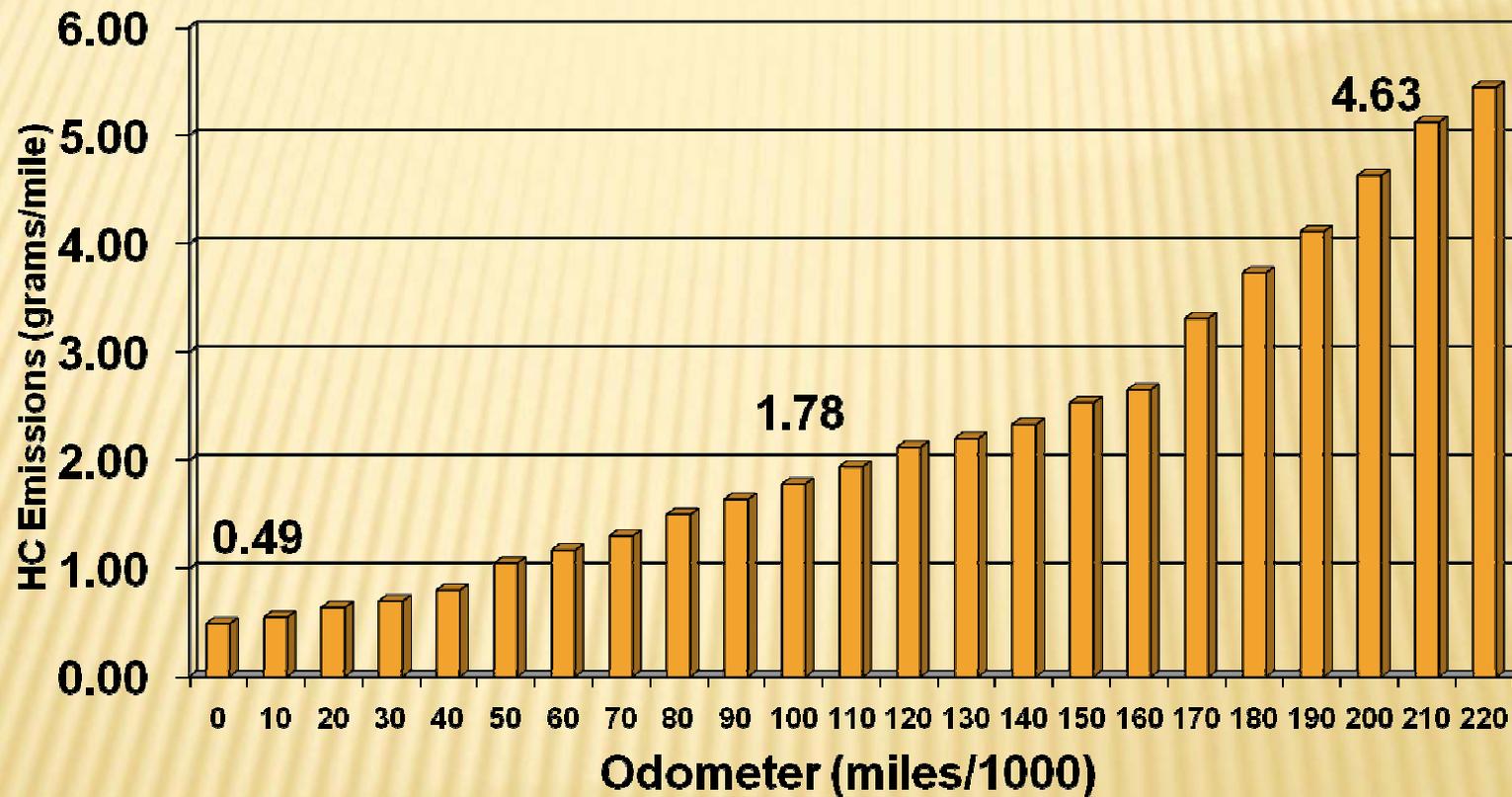


EMISSIONS CALCULATION

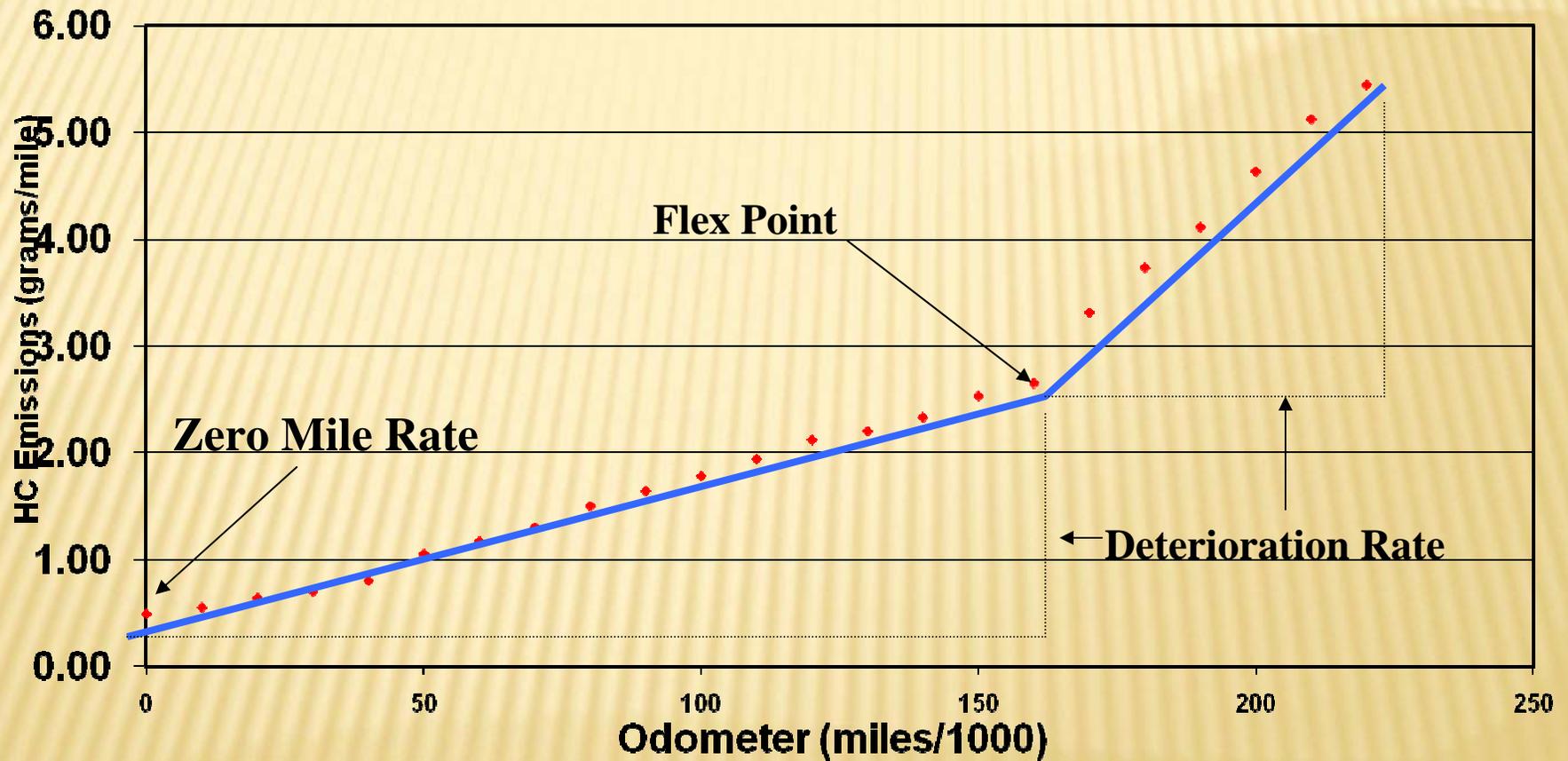
(EXHAUST HYDROCARBONS)

	Norm	Mod	High	V-High	Super
Emissions (gms/mi)	0.45	1.63	3.47	5.92	17.18
Regime (% of fleet)	47%	27%	17%	9%	0%
@100,000 miles	$(.47*.45+.27*1.63+.17*3.47+.09*5.92+0*17.18) = 1.78$				
Emissions (gms/mi)	0.45	1.63	3.47	5.92	17.18
Regime (% of fleet)	9%	31%	29%	20%	11%
@200,000 miles	$(.09*.45+.31*1.63+.29*3.47+.2*5.92+.11*17.18) = 4.63$				

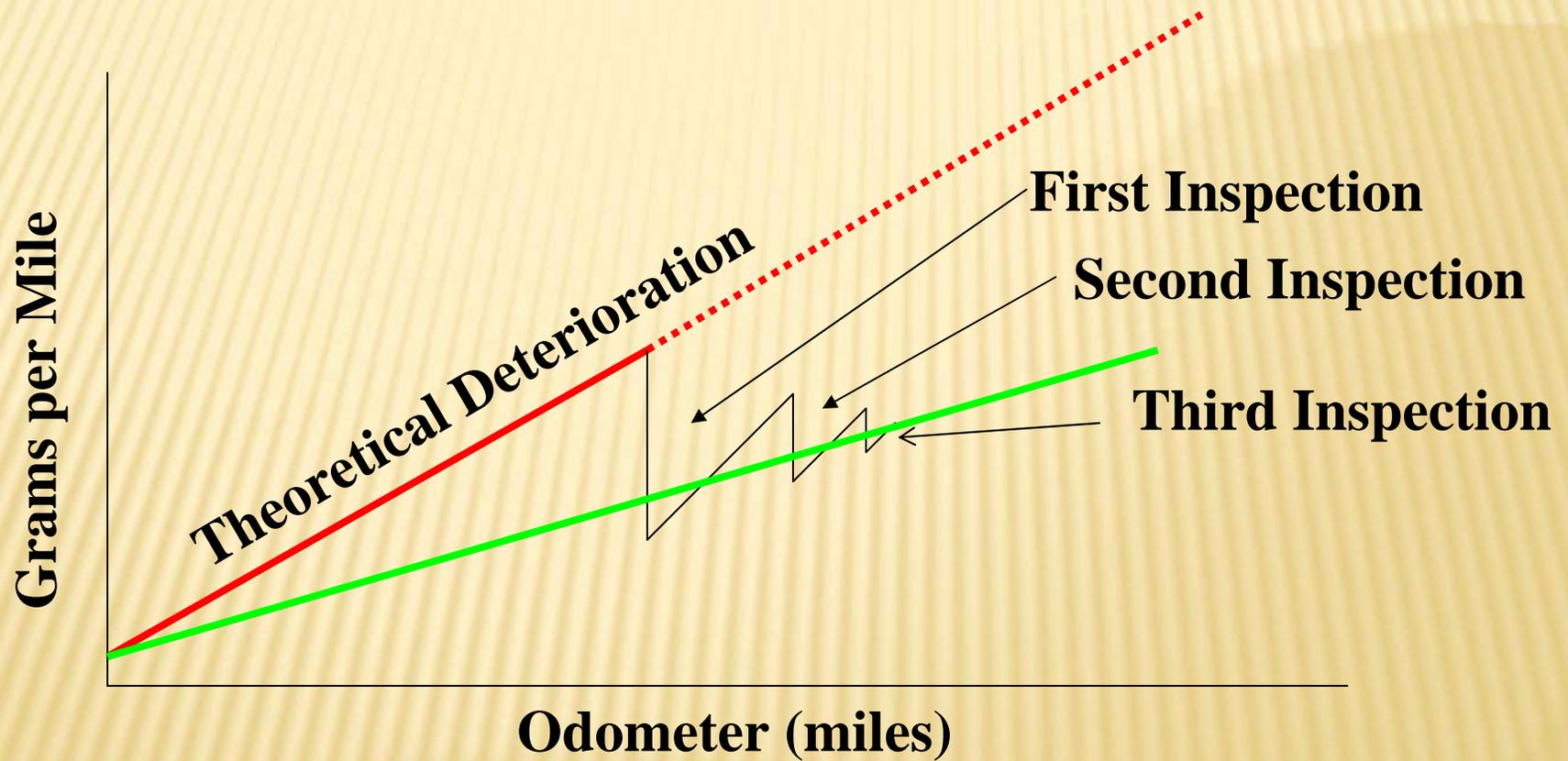
HYDROCARBON EMISSION FACTOR



HYDROCARBON EMISSION FACTOR (ILLUSTRATION)

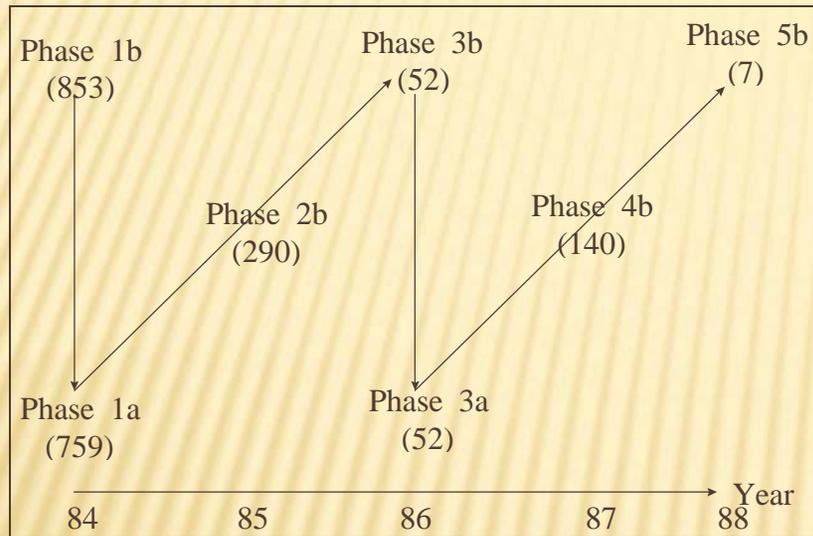


I/M SAWTOOTH

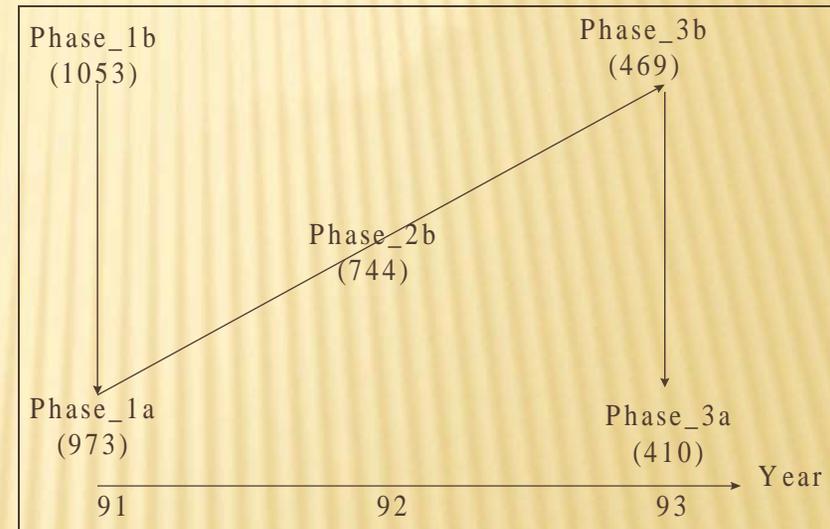


I/M EVALUATION DATA

1984 Program



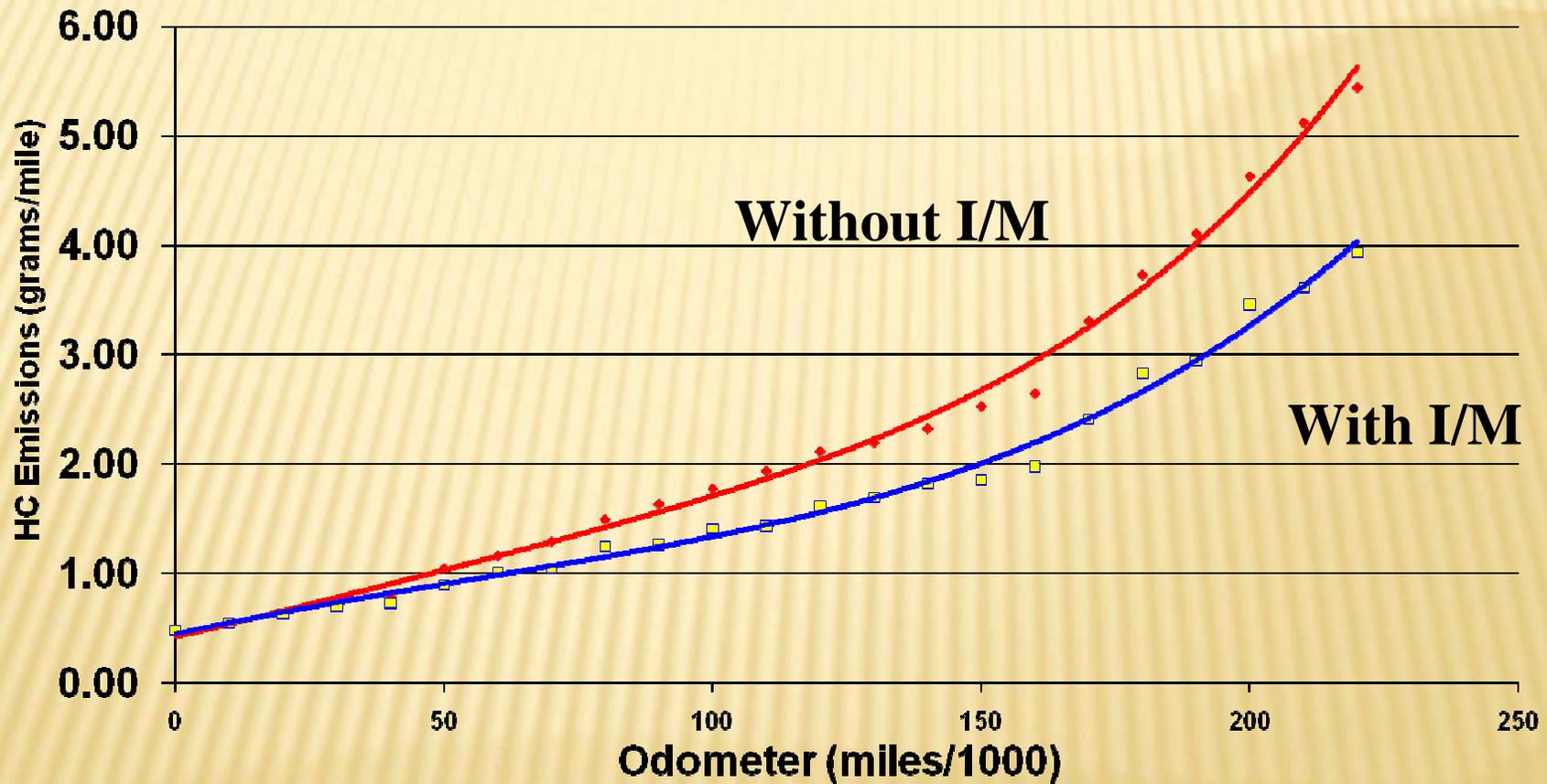
1990 Program



Enhanced Program

- ID rates based on 600+ vehicles

HYDROCARBON EMISSION BENEFIT (ILLUSTRATION)



I/M BENEFIT CALCULATION

2.2% Reduction	Norm	Mod	High	V-High	Super
Emissions	0.45	1.63	3.47	5.92	17.18
Regime	47%	27%	17%	9%	0%
Before I/M	$(.47*.45+.27*1.63+.17*3.47+.09*5.92+0*.1718) = 1.78$				
Emissions	0.45	1.63	3.47	5.92	17.18
Regime	48%	27%	16%	9%	0%
After I/M	$(.48*.45+.27*1.63+.16*3.47+.09*5.92+0*.1718) = 1.74$				

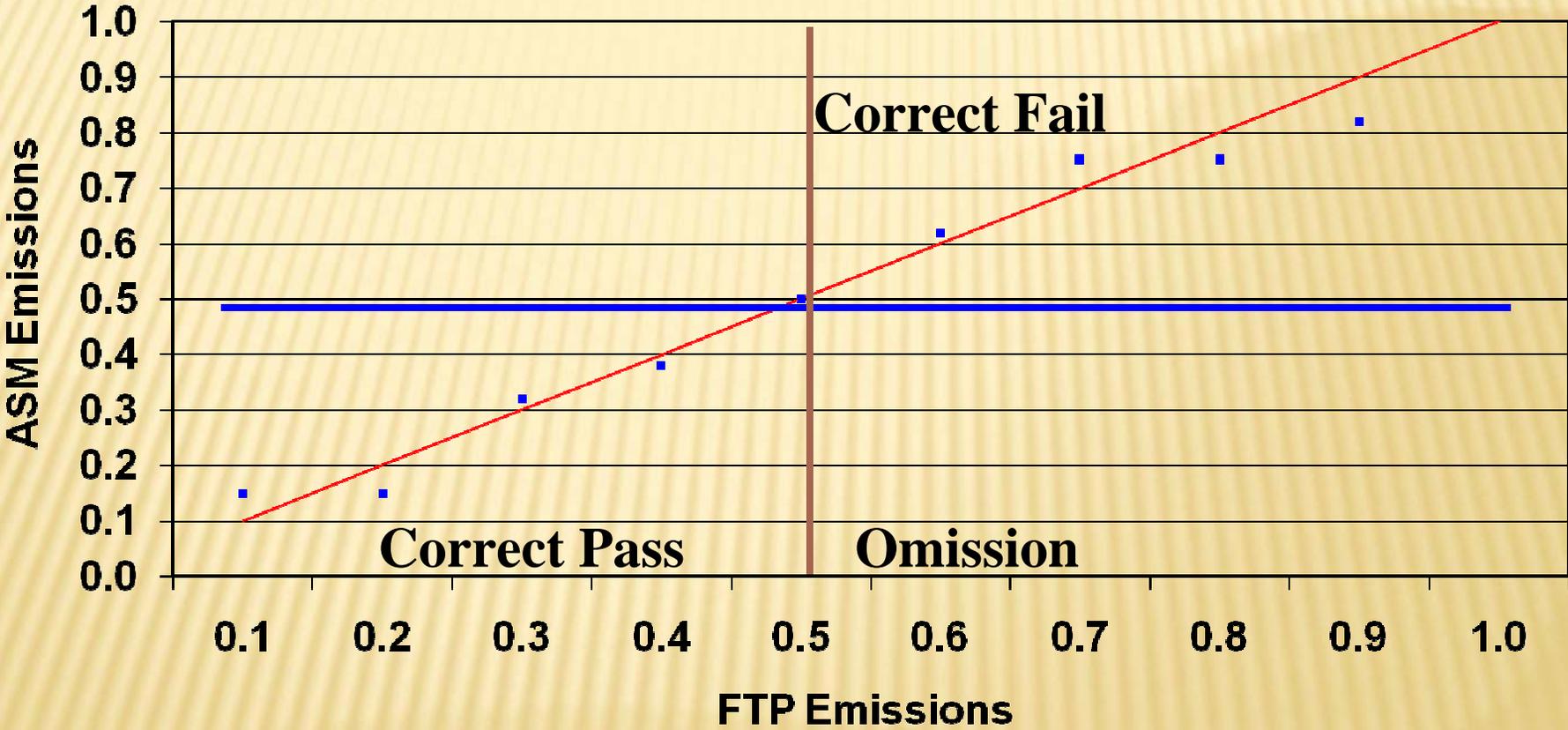
ESTIMATING I/M BENEFITS

ER	100K	Initial Test			Post Repair Regime				
		ID	Pass	Fail	N	M	H	VH	S
S	0	82%	0	0	0%	0%	13%	58%	29%
VH	9	66%	3	6	2%	4%	21%	67%	6%
H	17	69%	5	12	4%	7%	75%	13%	1%
M	27	39%	16	11	4%	87%	9%	0%	0%
N	47	3%	46	1	85%	15%	0%	0%	0%
Total	100		70	30					

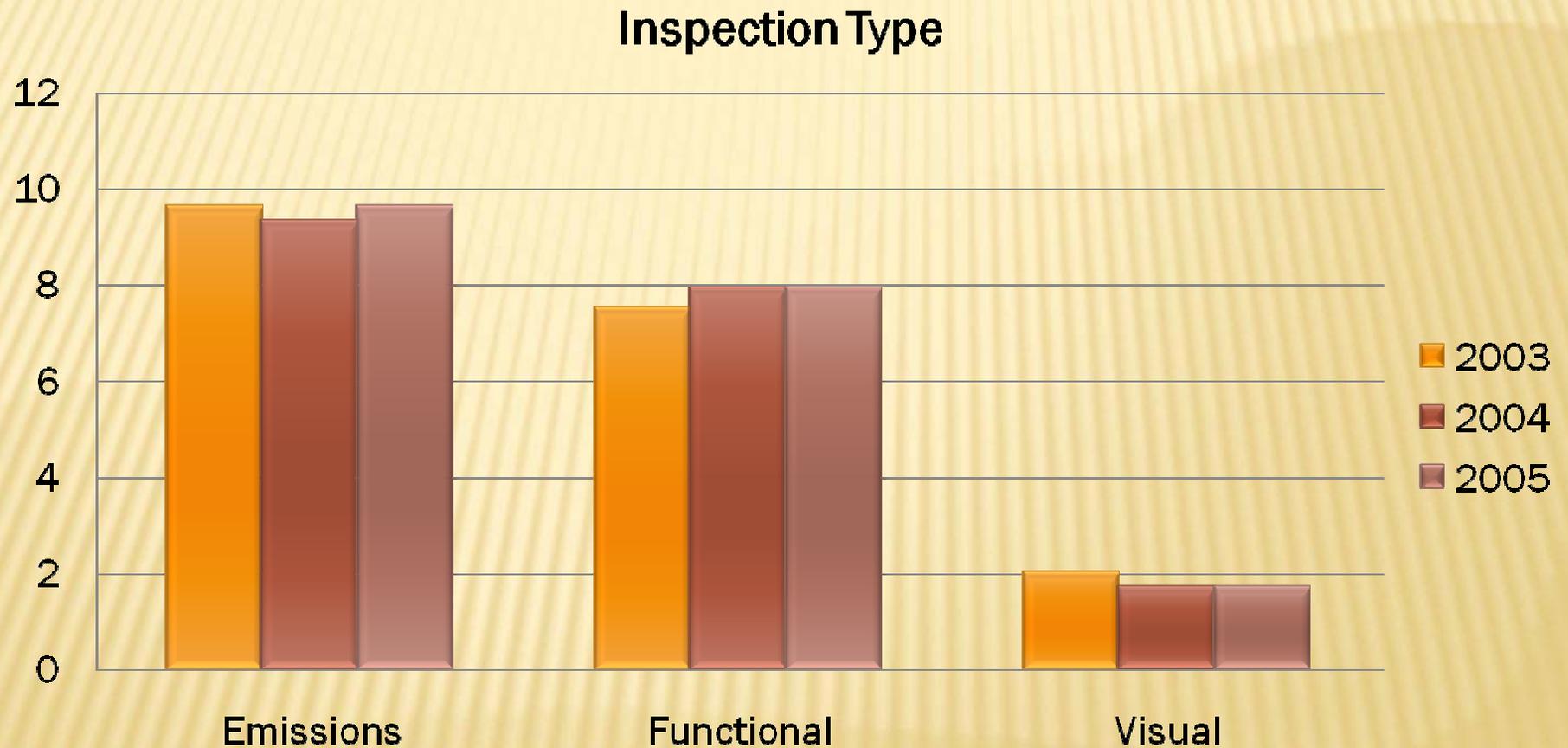
FACTORS IMPACTING I/M BENEFITS

- ✘ Probability of Failing
 - + Function of Cut points/Test Type/Technology /Mileage
- ✘ Probability of Detection
 - + Emissions vs. Visual/Functional/Technology(OBD)/Station Type*
- ✘ Probability of Proper Repair
 - + Mechanic Efficiency
 - + Repair Cost Limit
 - + Station Type*

ASM CUTPOINT ANALYSIS

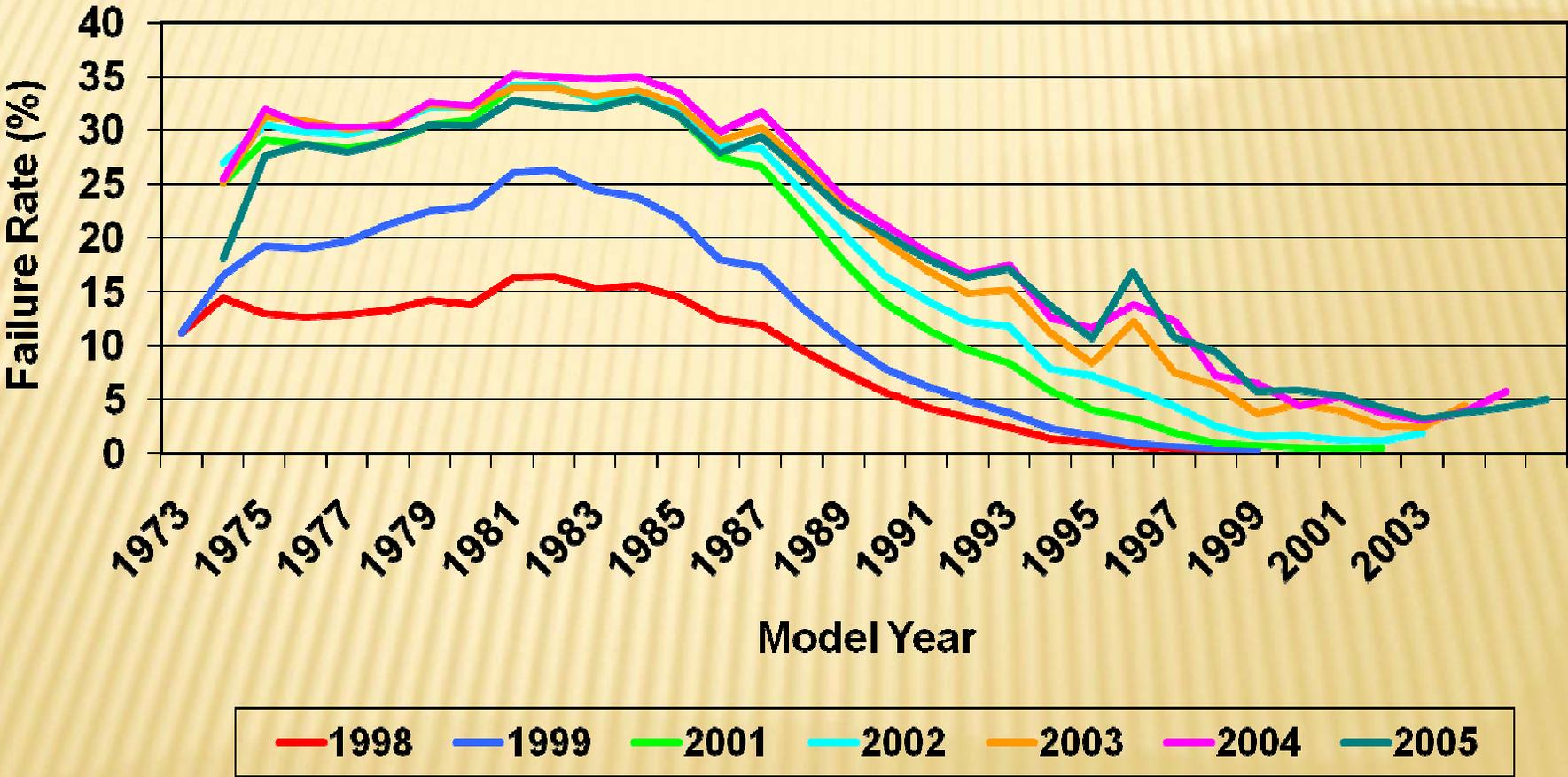


COMPARATIVE FAILURE RATES

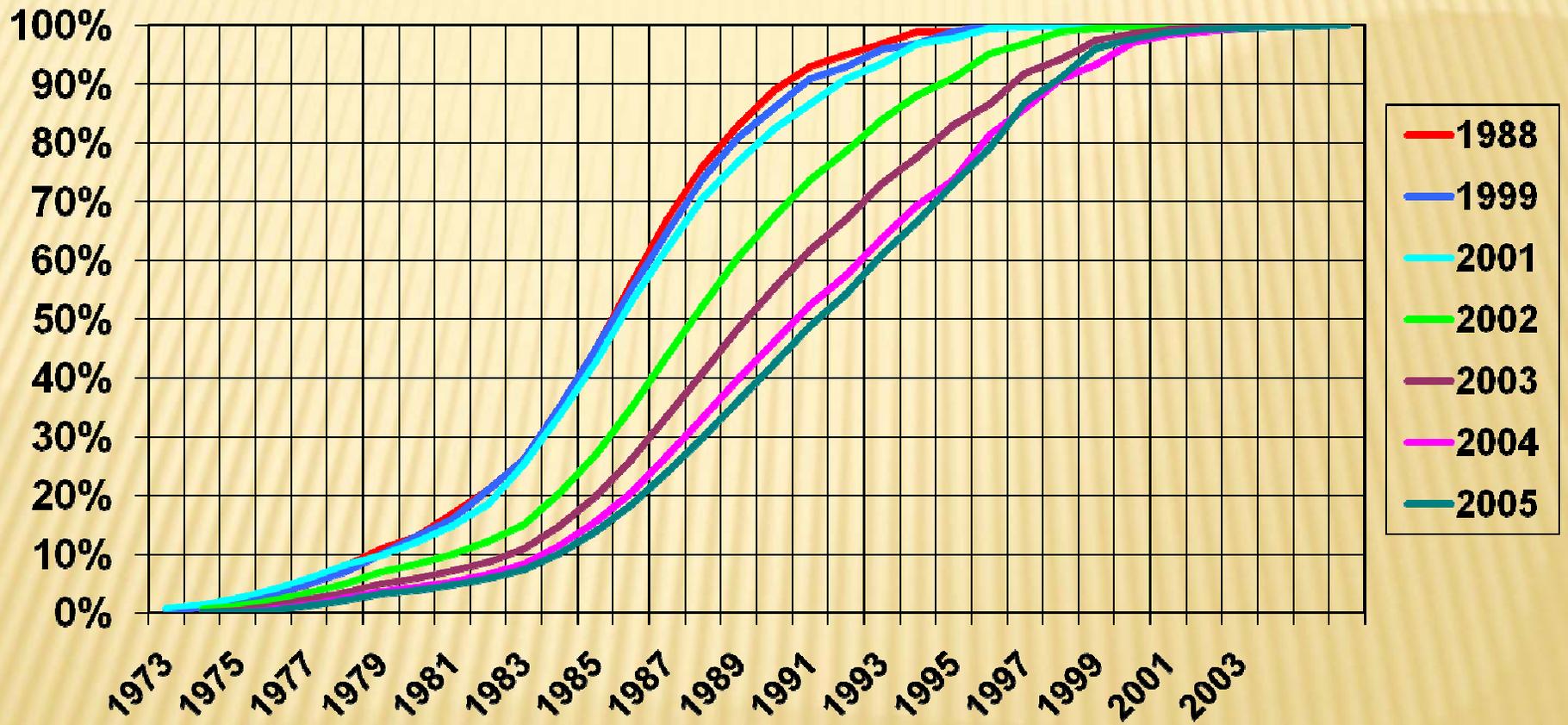


ANALYSIS OF BAR DATA

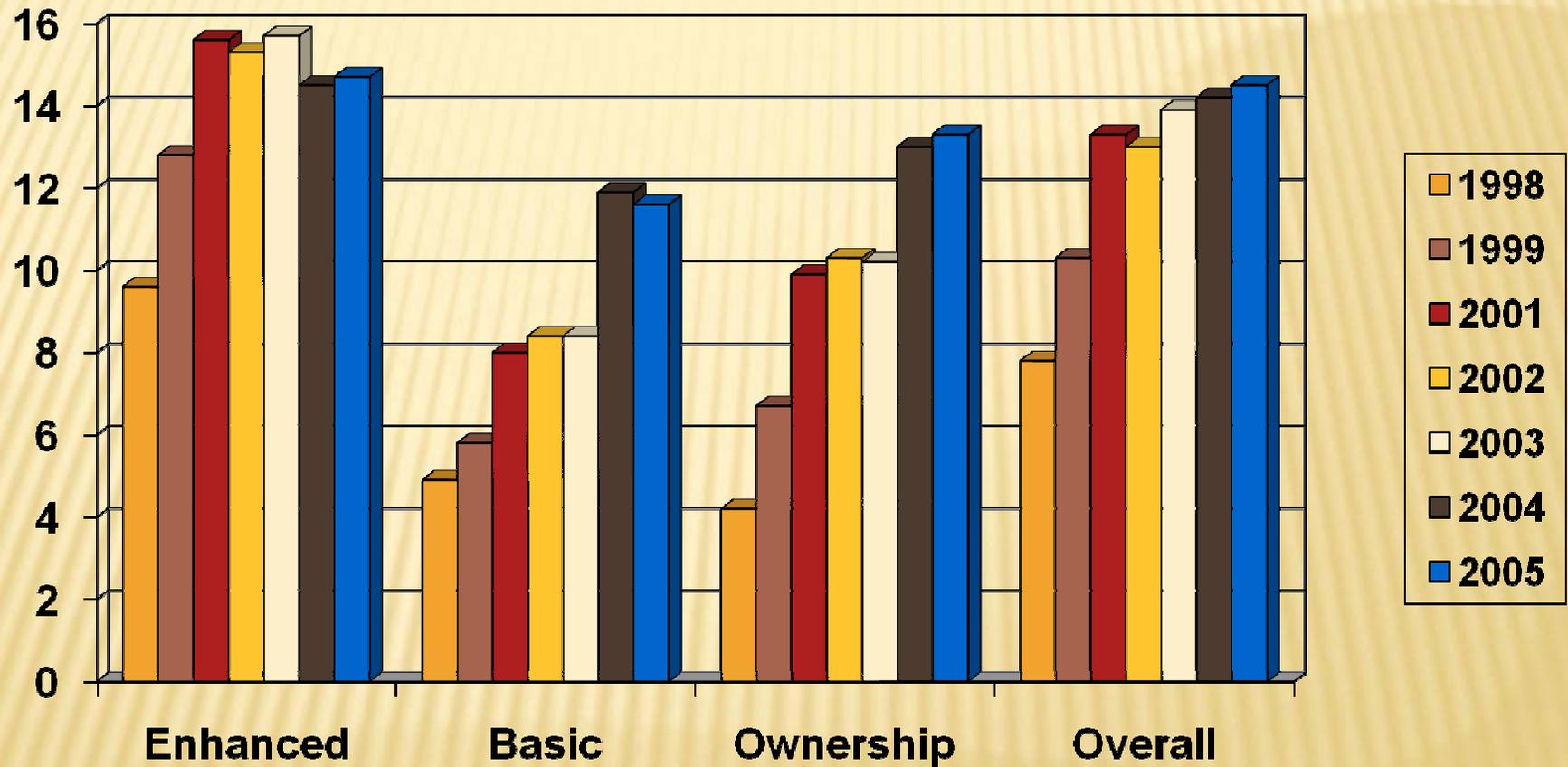
FAILURE RATE BY MODEL YEAR



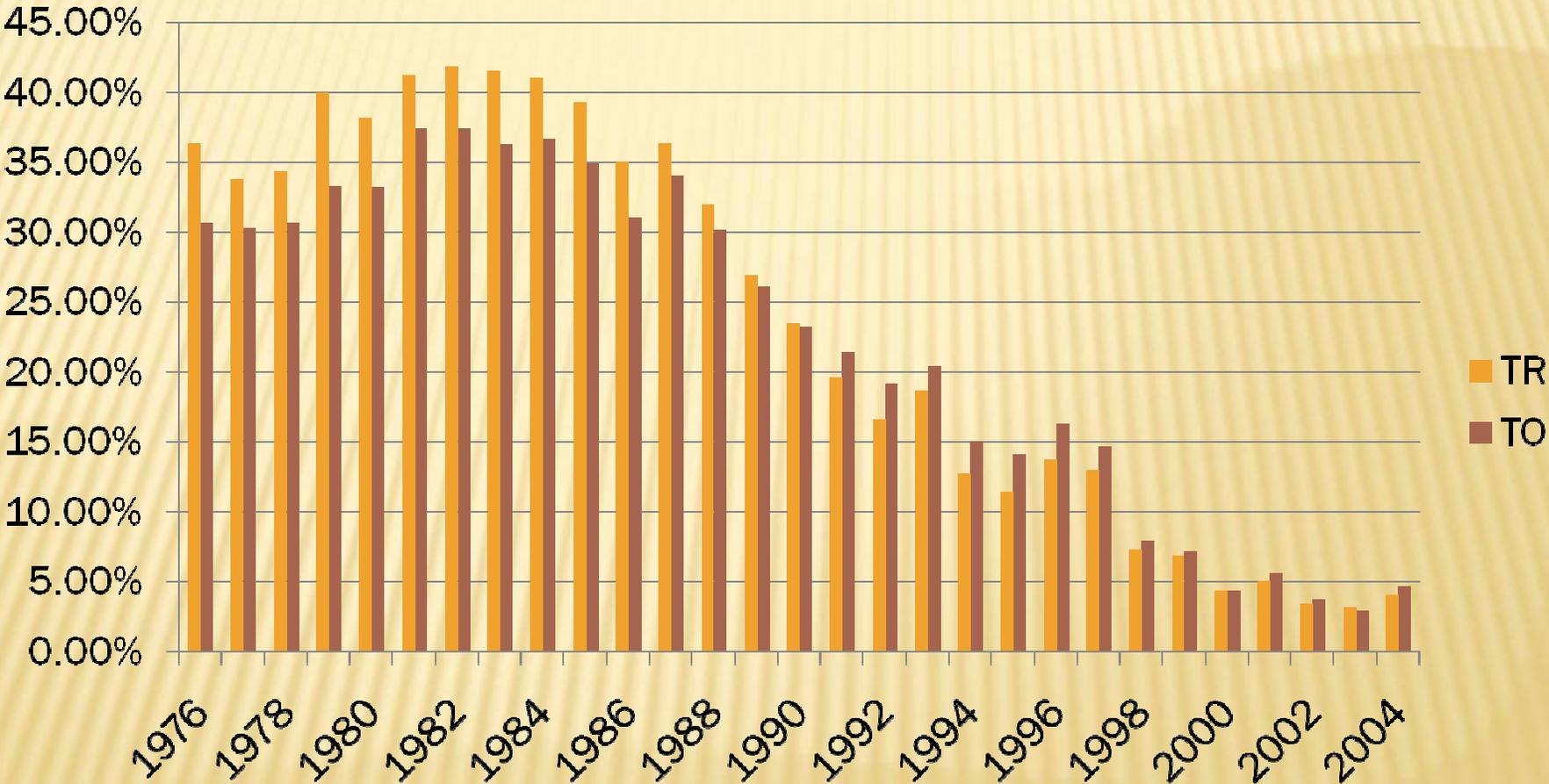
CUMULATIVE FAILURE RATE



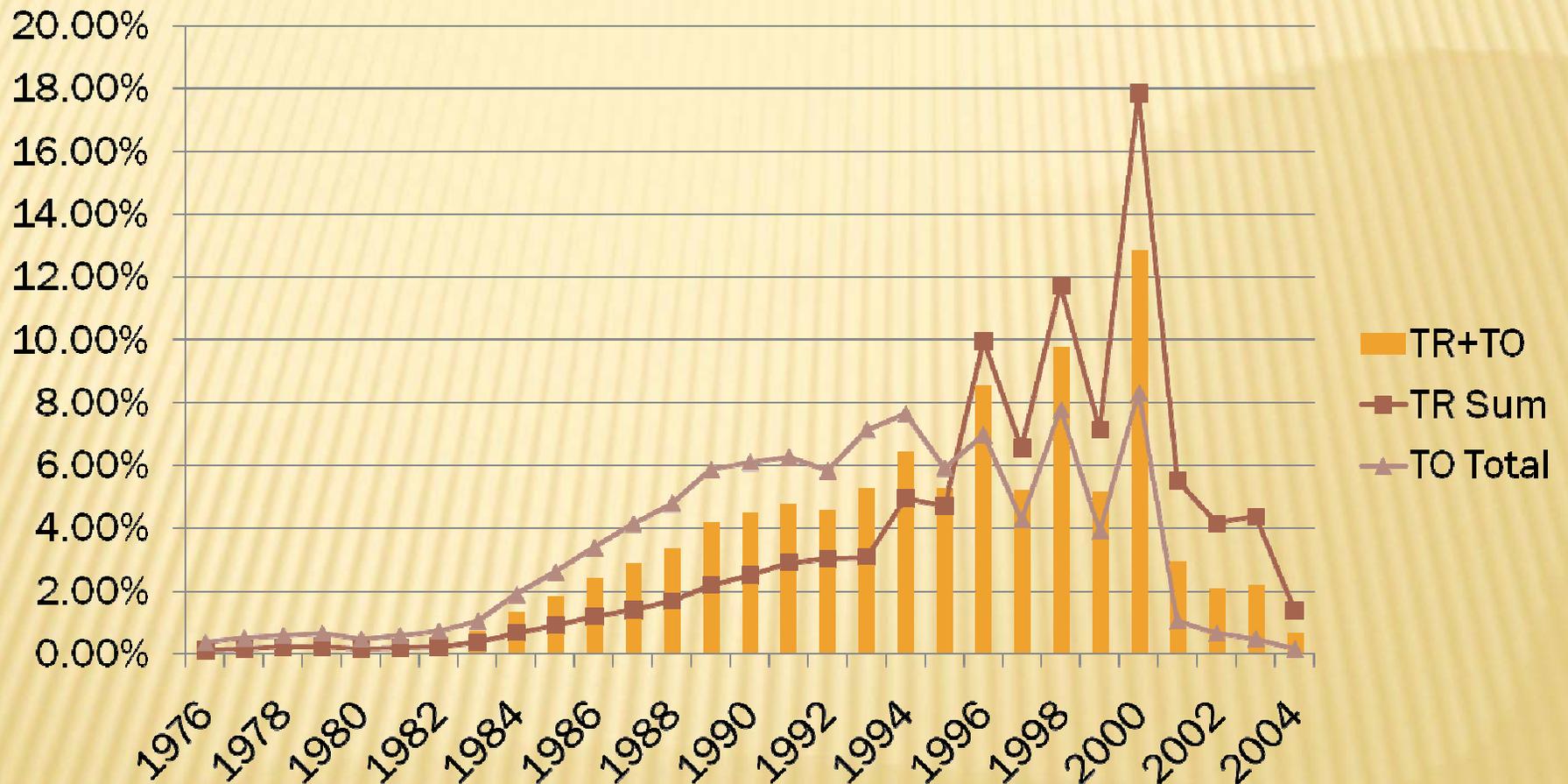
I/M FAILURE RATE BY PROGRAM TYPE



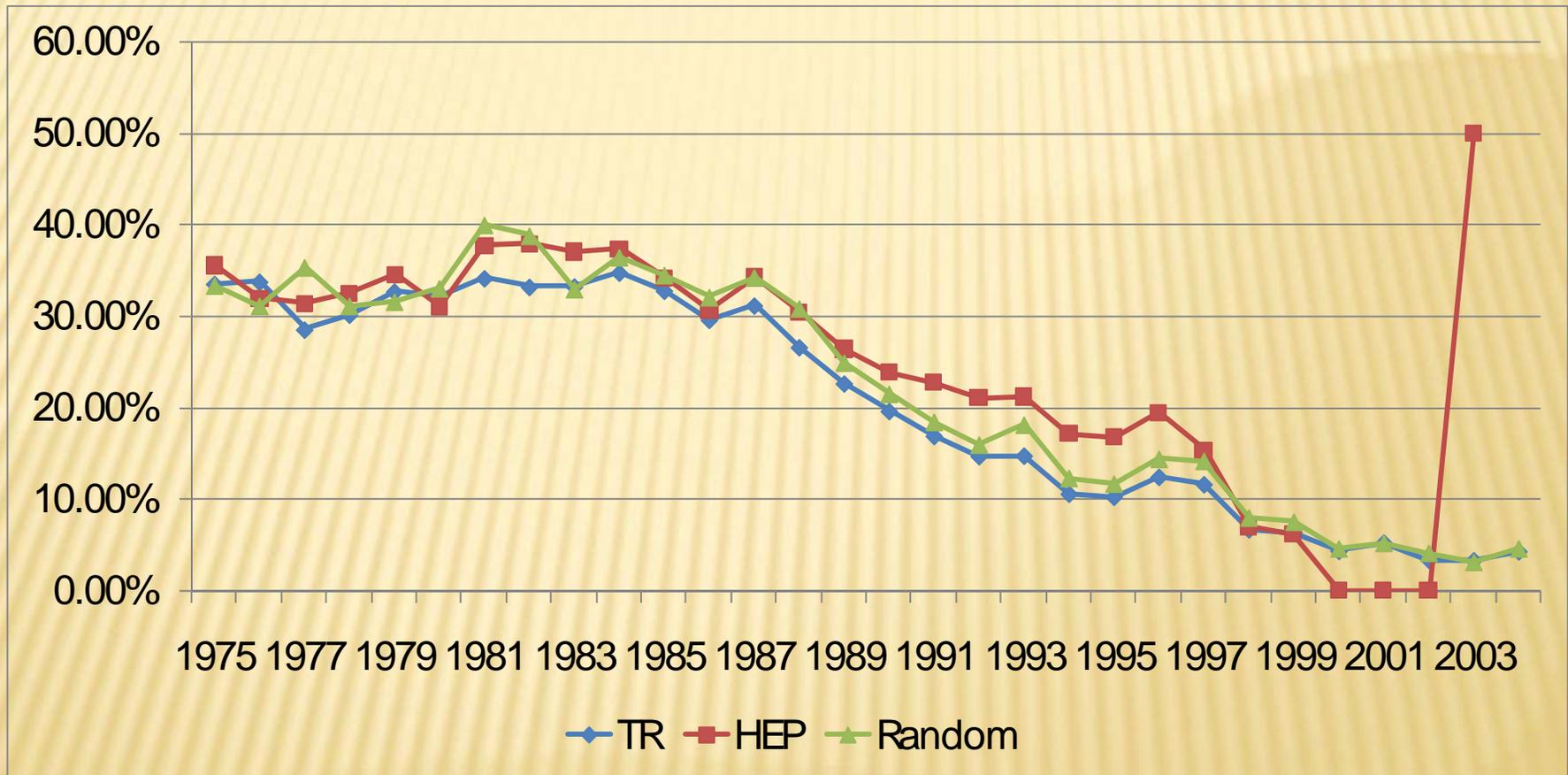
ASM FAILURE RATE BY MODEL YEAR



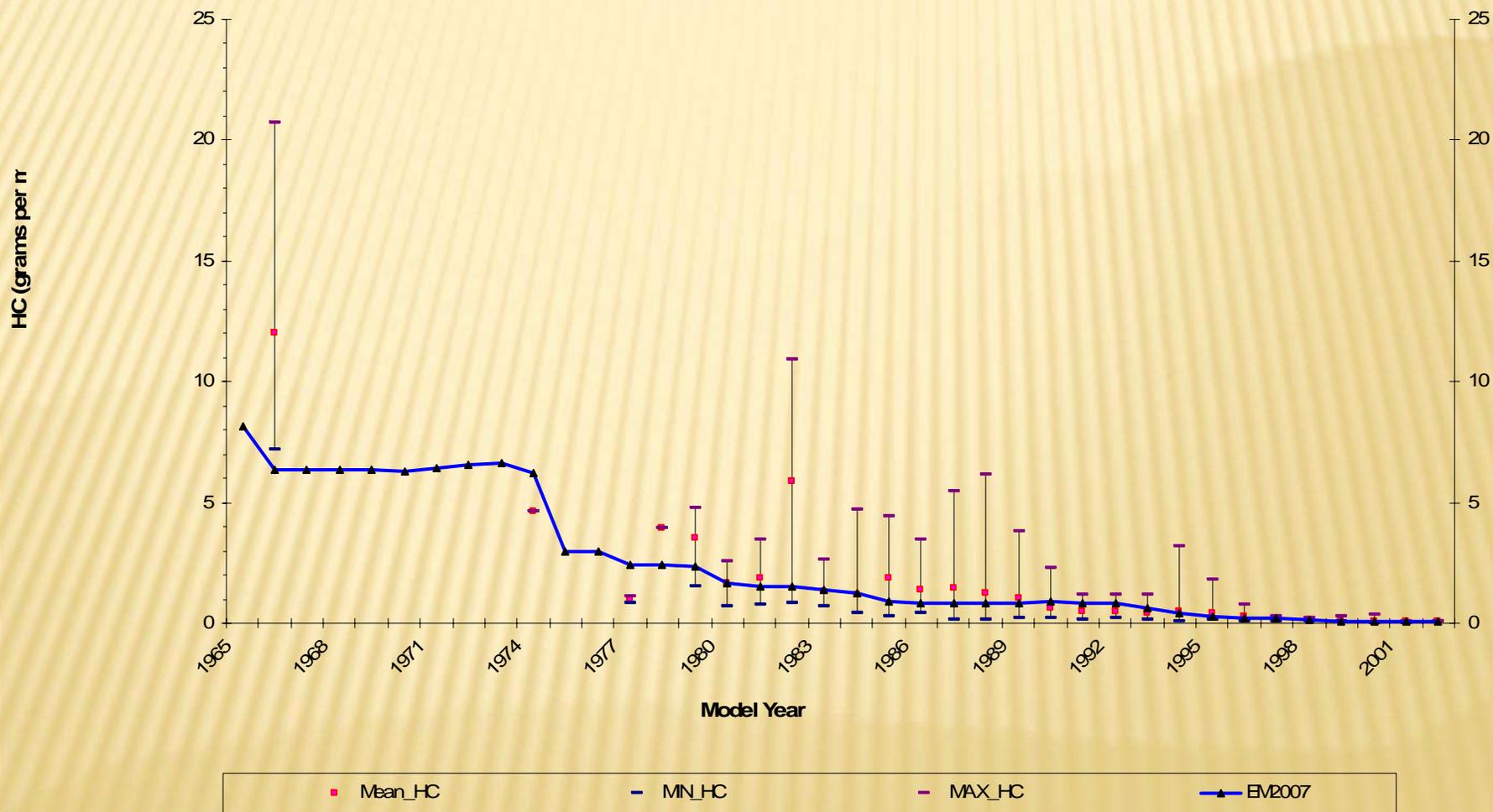
MODEL YEAR DISTRIBUTION BY PROGRAM TYPE



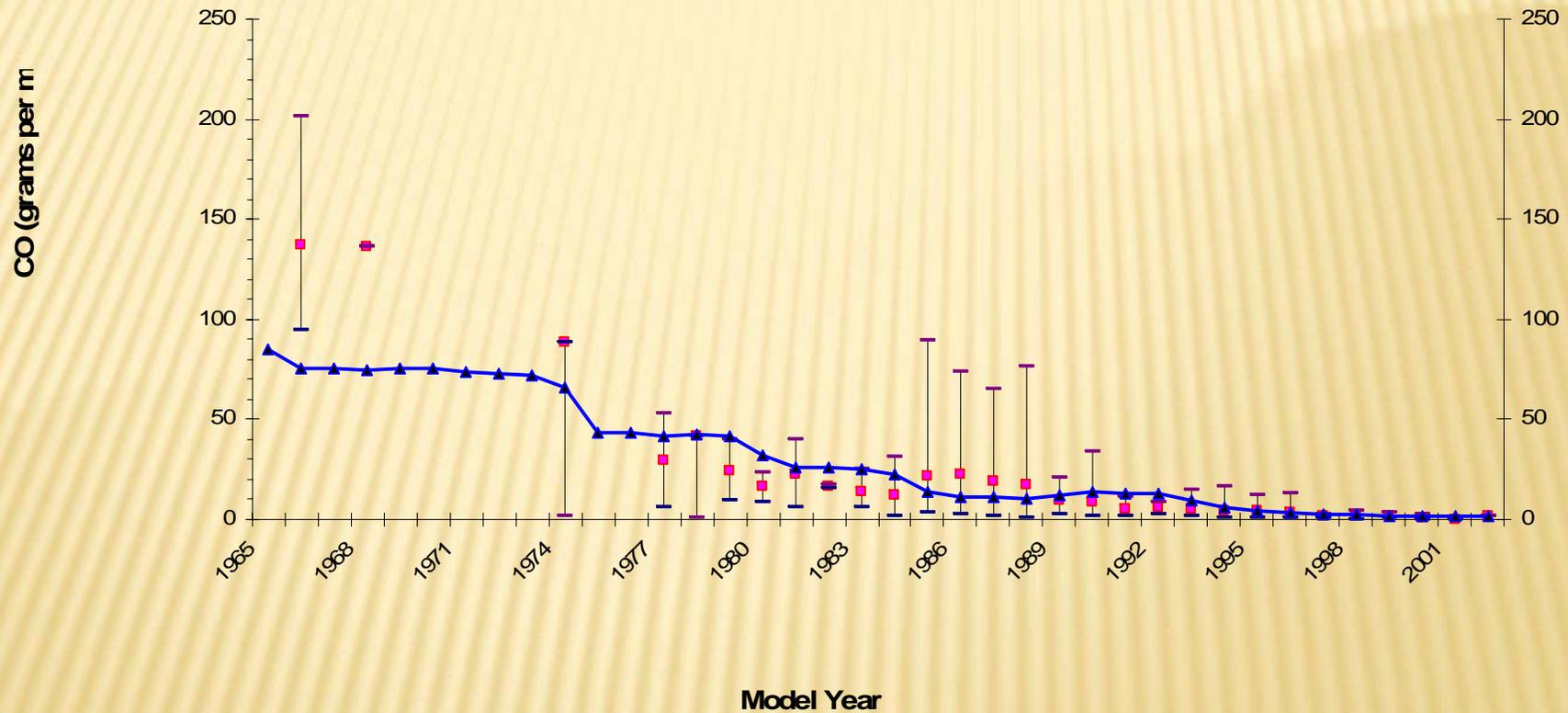
FAILURE RATE BY PROGRAM TYPE



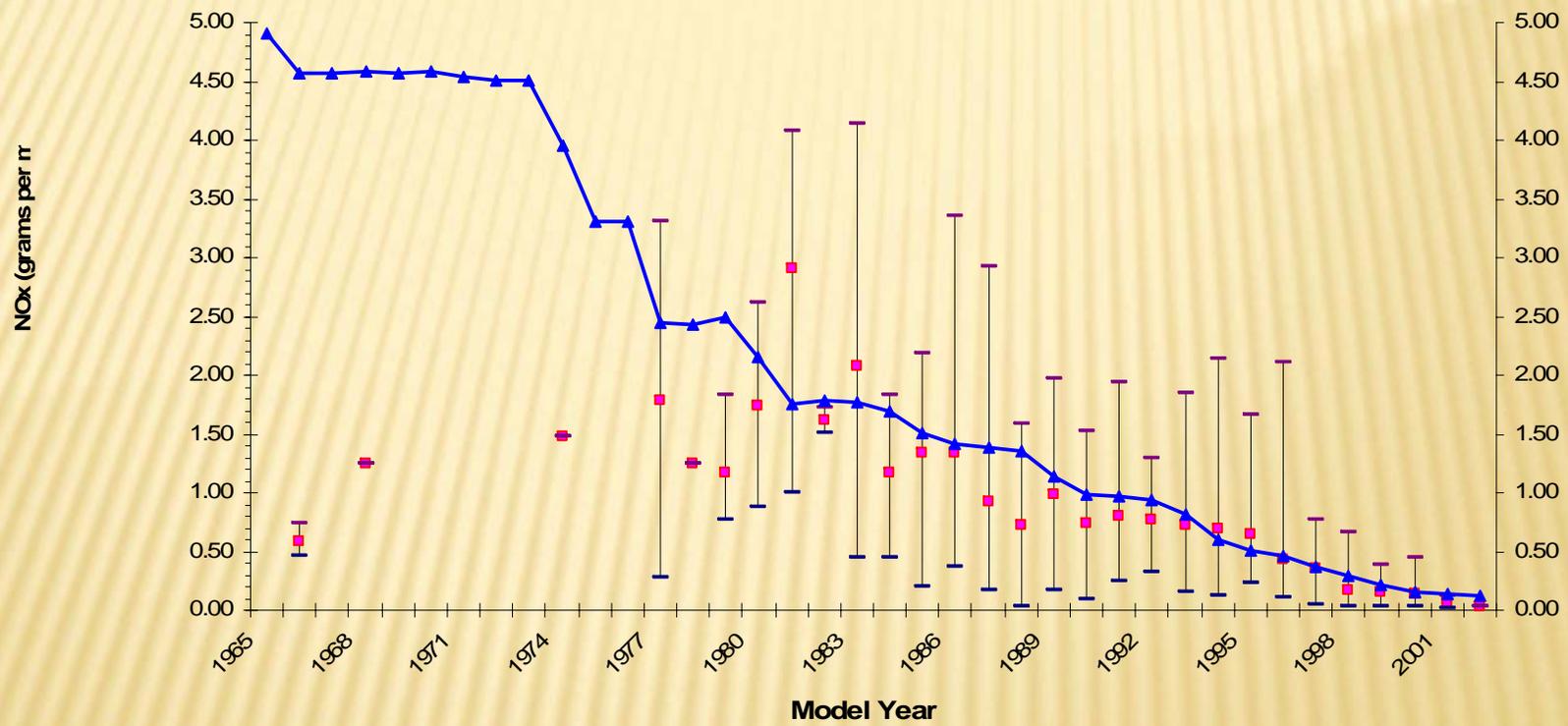
MEASURED VS MODELED EMISSIONS (HC)



MEASURED VS MODELED EMISSIONS (CO)



MEASURED VS MODELED EMISSIONS (NOx)



CONCLUSIONS



Don't Know Much About History...

- + Little information on the behavior of older vehicles



× The Future's Not Ours to See...

- + The behavior of newer vehicles is based on our knowledge of older vehicles



× I Love LA...

- + The majority of emissions data in EMFAC is from SCAB

CONCLUSIONS (CONTINUED)

 What Have You Done For Me Lately?

+ I/M Evaluation programs are few and far between



× I'm In With the In-Crowd...



+ EMFAC can not model contiguous programs

× What Difference Could It Make?

+ EMFAC doesn't know the difference between test only and test and repair stations



× Same Time Next Year...

+ Little longevity of repair is assumed in the model