

# Lost Emissions Reductions from Monitors Not Ready: An Analysis Using Remote Sensing

## NCVECS 2010

Virginia Department of Environmental Quality

# Lost Emissions Reductions from Monitors Not Ready

## ❑ Authors:

- Rich Olin, VDEQ
- Peter McClintock, Applied Analysis

## ❑ Acknowledgements:

- Virginia Department of Environmental Quality
- Colorado Department of Public Health and Environment
- ESP

# Presentation Outline

- ☐ Northern Virginia I/M Program
- ☐ OBD Readiness Exemptions
- ☐ OBD Pass / Fail and Readiness Status
- ☐ RSD Emissions Before and After I/M
- ☐ Estimated Losses in Emissions Reductions

# Northern Virginia I/M Program

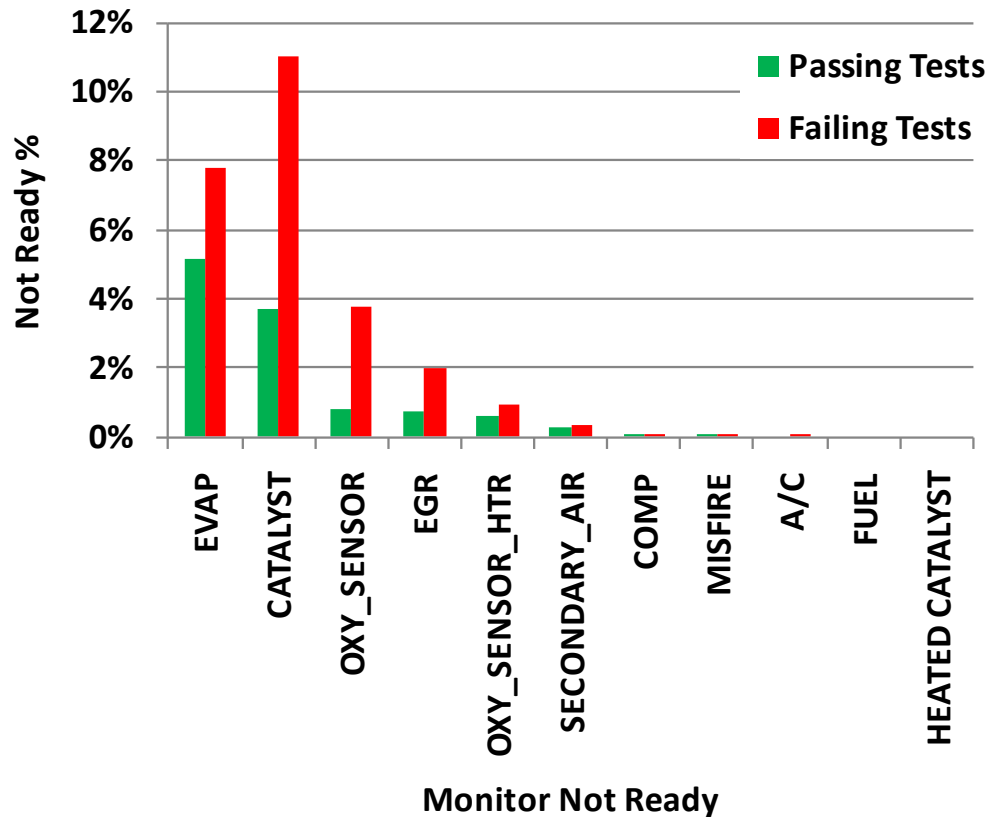
- ❑ **Northern Virginia Light Vehicles ~ 1.7M**
- ❑ **Decentralized testing:**
  - **OBD-II for equipped 1996 & newer since 2004**
  - **ASM for 1981 to 1995**
  - **TSI for pre-1981 and non-OBD > 8,500lbs**
- ❑ **RSD High Emitter and Fleet Monitoring:**
  - **Started in 2004 – HEI since 8 / 2006**
  - **Low intensity ~ 400k annual measurements.**

# **April 5, 2001 Amendments to OBD I/M Requirements**

- ☐ **Reject for OBD monitors not ready**
- ☐ **Optional Readiness exception:**
  - **MY 1996-2000 reject only if 3 or more monitors not ready**
  - **MY 2001+ reject only if 2 or more monitors not ready**
- ☐ **June 2001 EPA guidance:**
  - **Initial failures with catalyst DTC should have catalyst monitor ready on retest**
  - **Readiness exceptions for some models (EPA 420-R-01-015 Appendix D)**

# Mill On and Readiness

**% of OBD Initial Tests with Monitors Not Ready**



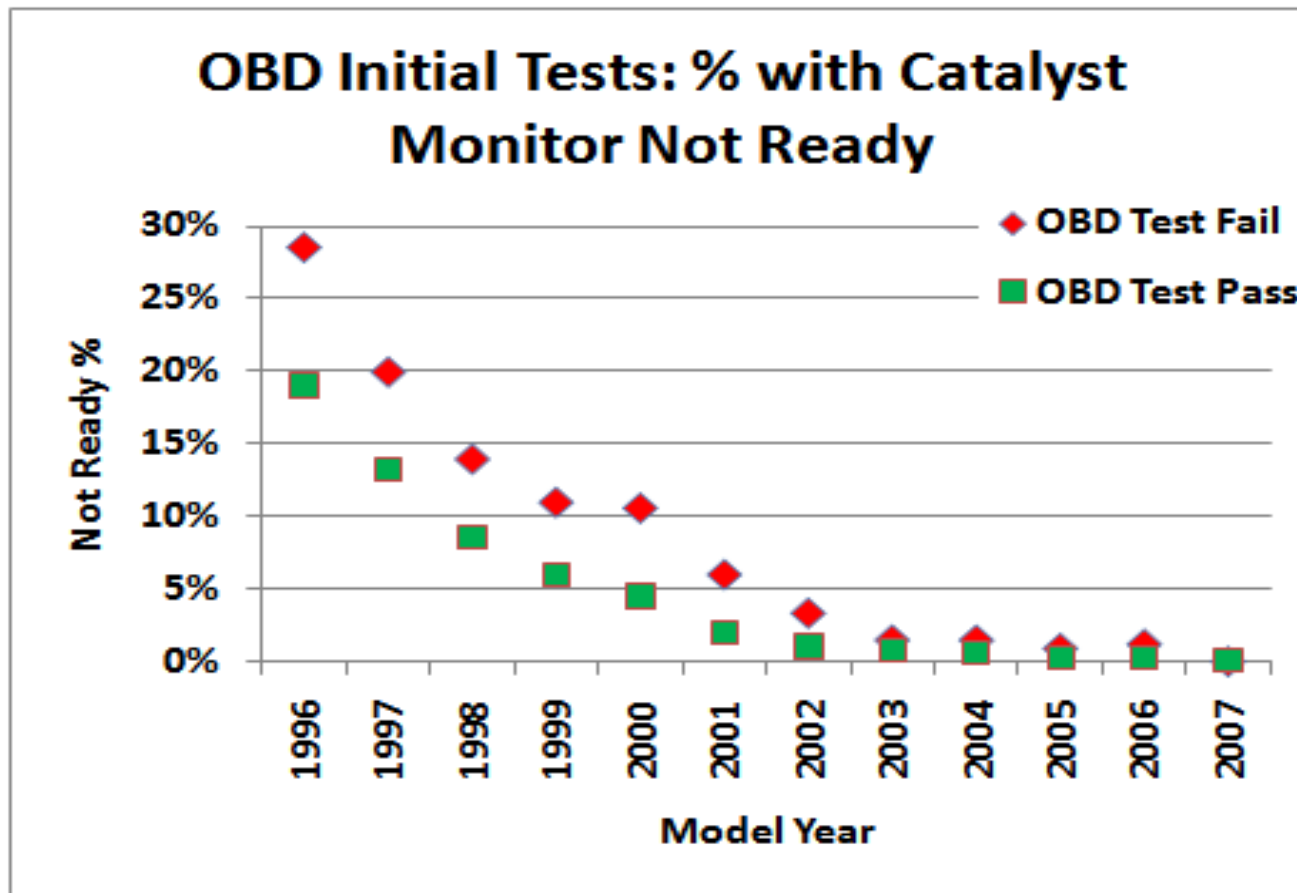
## **Monitors Not Ready on Passing Tests:**

- Evaporative monitor 5.2%;
- Catalyst monitor 3.7%;
- Oxygen sensor monitor 0.7%;
- EGR monitor 0.7%
- Oxygen sensor heater monitor 0.6%

**Almost as many vehicles passed OBD with unset monitors as failed OBD.**

# MIL On and Readiness

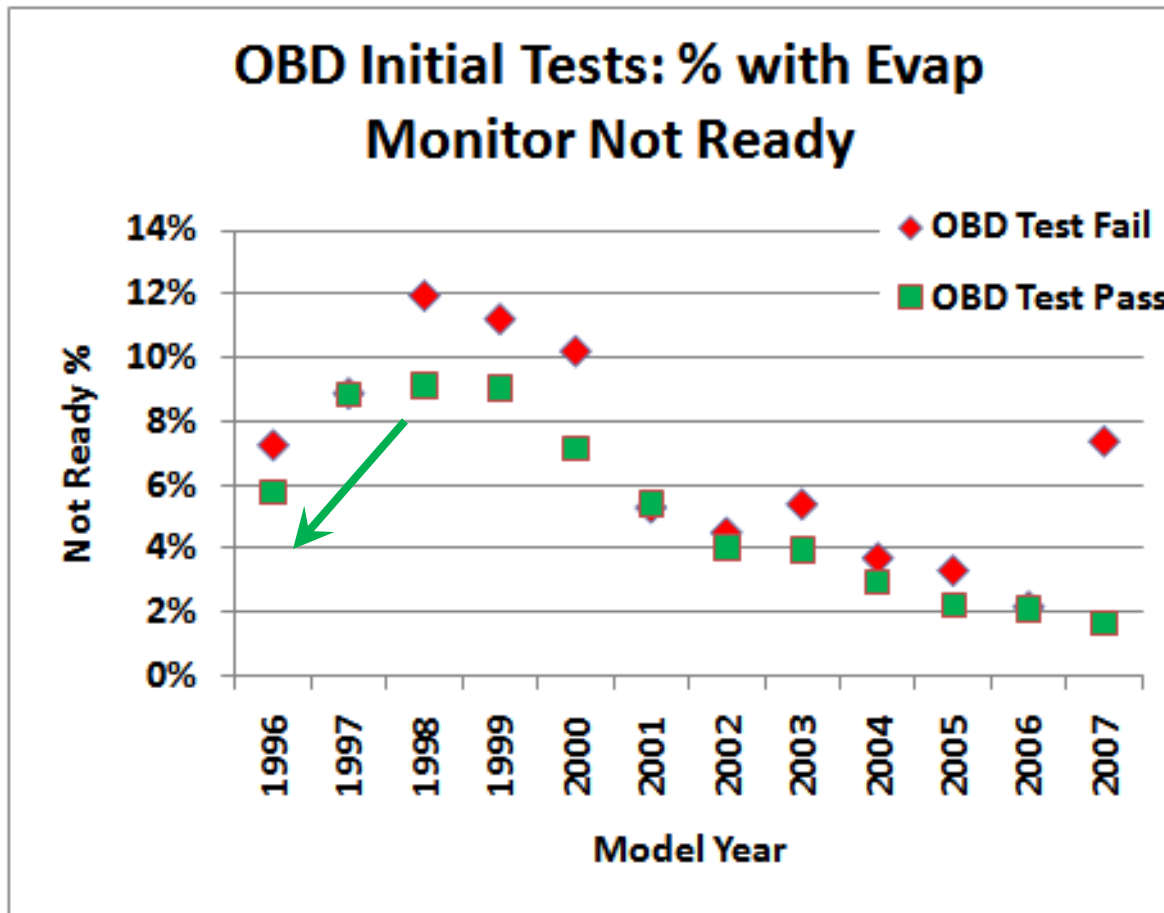
Initial **pass/fail** % with catalyst monitor not ready.



➤ Possible attempt to reset codes before initial test?

# MIL On and Readiness

Initial **pass/fail** % with evap monitor not ready.

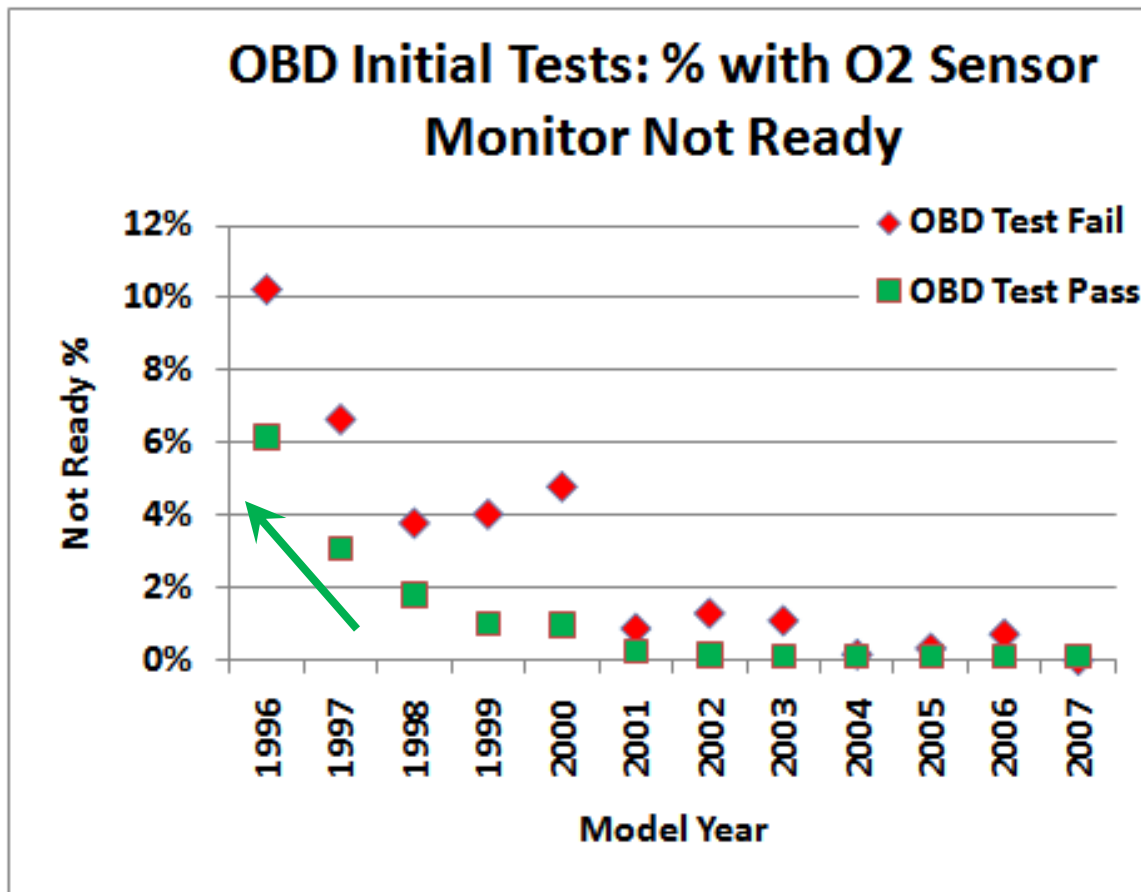


- Lower pass rates in 1996 & 1997 models due to evap monitor phase-in?
- High rate for 2007 new models from slow 'set' due to required tank fill and operating conditions.



# MIL On and Readiness

Initial **pass/fail** % with O2 sensor monitor not ready.

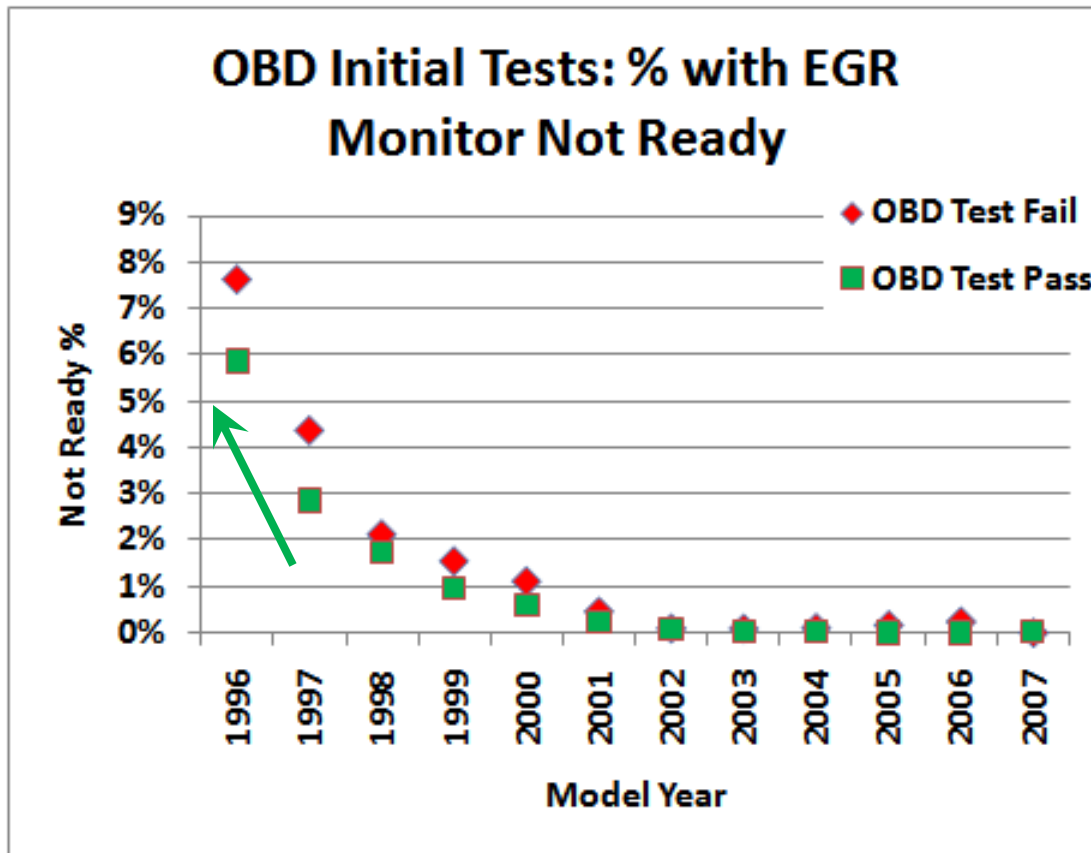


Higher pass rates with unset O2 in 1996 & 1997 related to evap. monitor phase-in?

Reject %'s are not included.

# MIL On and Readiness

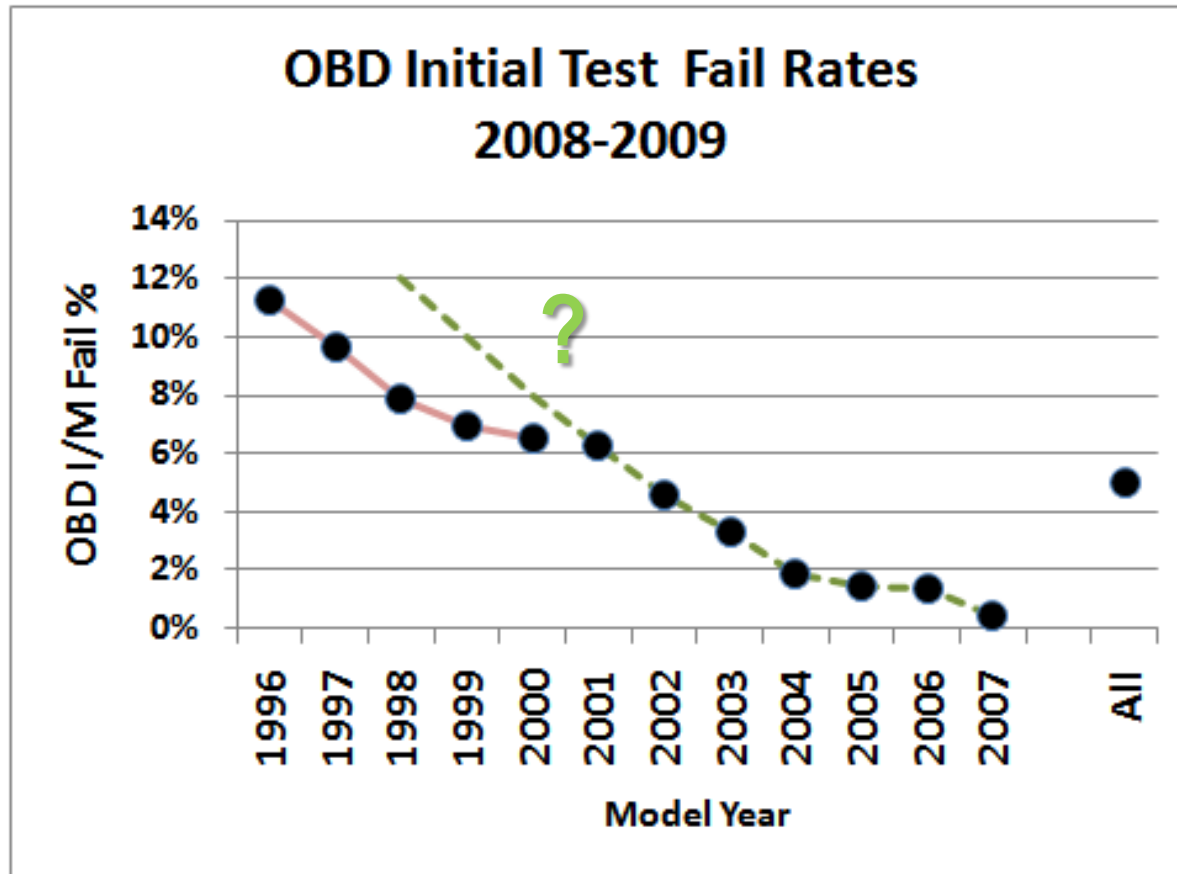
Initial **pass/fail** % with EGR monitor not ready.



Higher pass rates with unset EGR in 1996 & 1997 related to evap. monitor phase-in?

Reject %'s are not included.

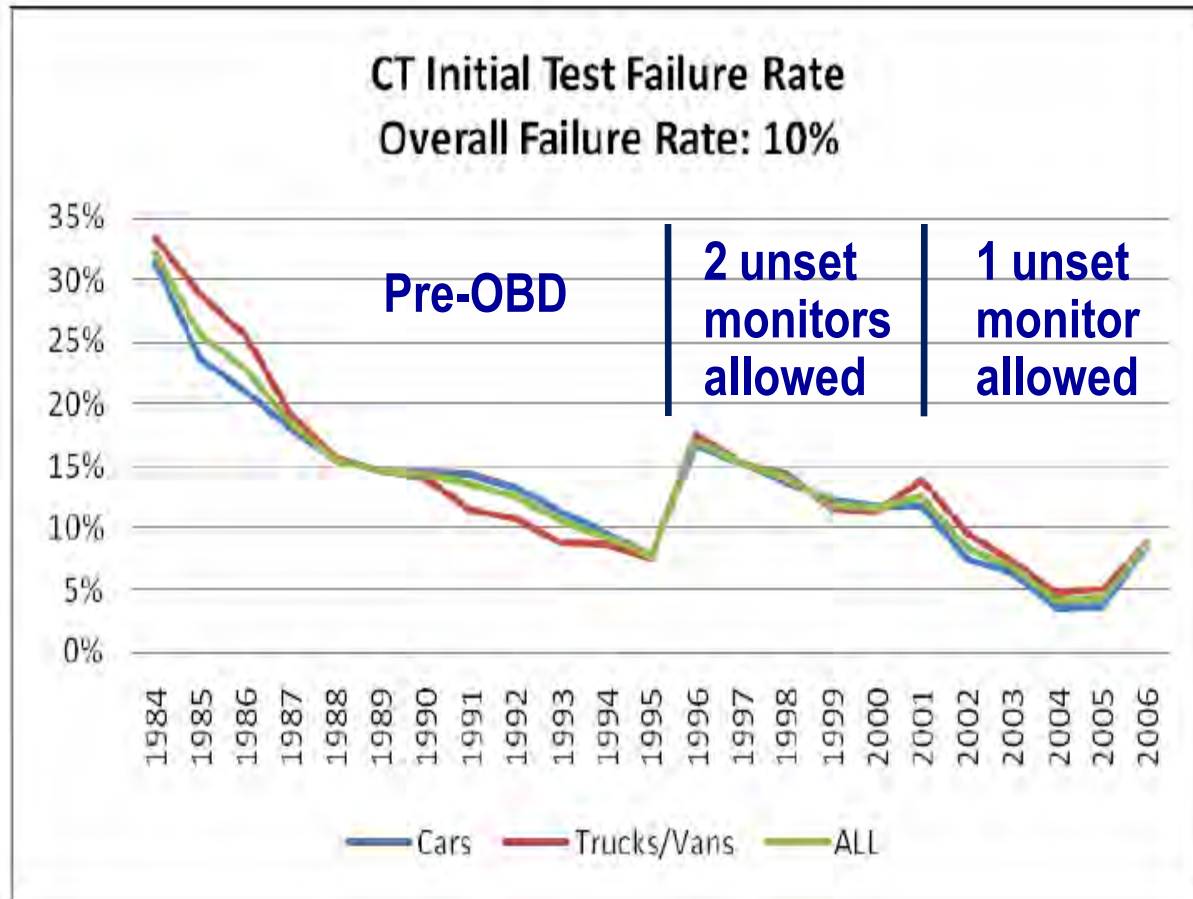
# MIL On and Readiness



Increase in fail rate  
pauses between 2001  
and 2000.

A result of allowing  
2000 and older to pass  
with two monitors not  
ready?

# MIL On and Readiness



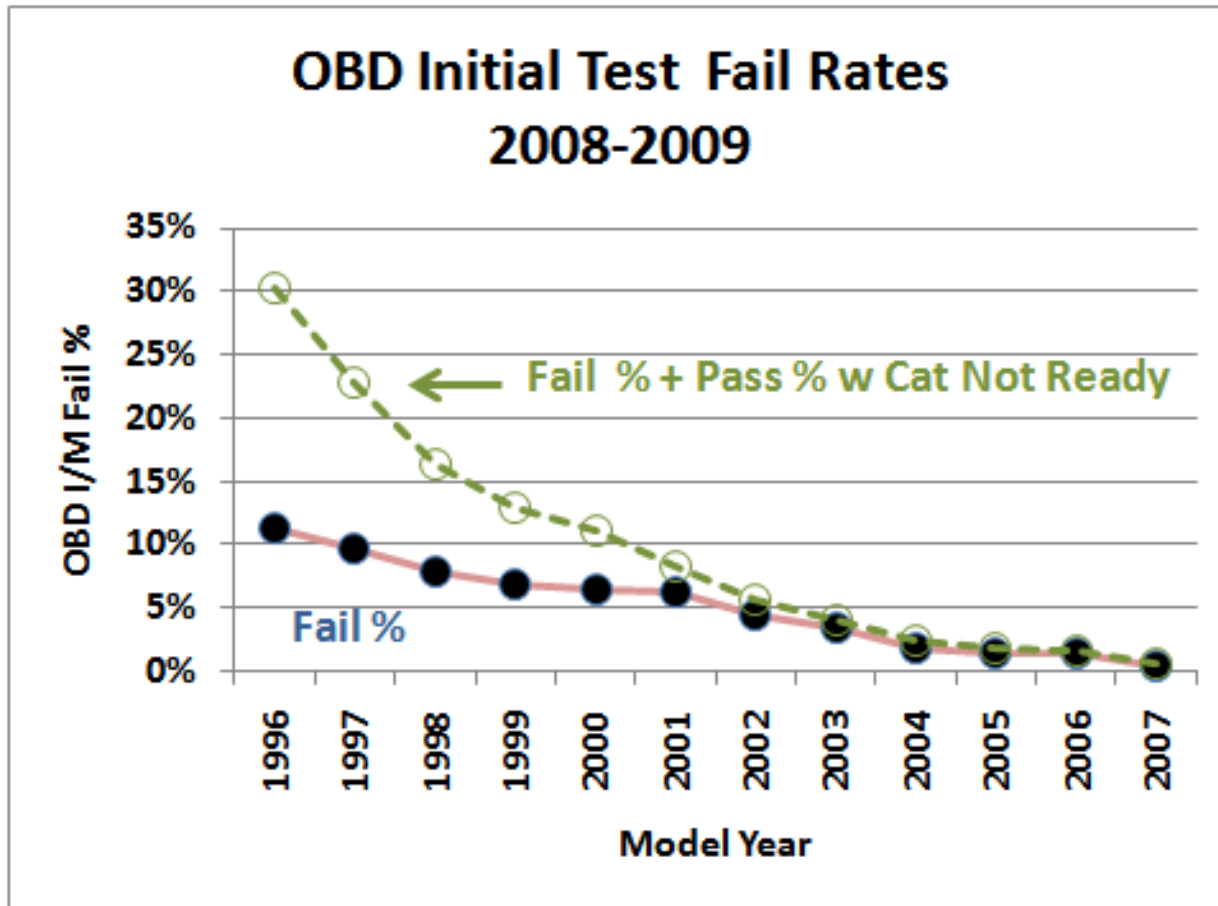
Similar pattern in Connecticut.

Does it matter?

BIENNIAL EVALUATION OF CONNECTICUT'S INSPECTION/MAINTENANCE PROGRAM 2008-2009 ,  
dKC – de la Torre Klausmeier Consulting , June 2010

# MIL On and Readiness

OBD fail % + initial pass % with catalyst monitor not ready.



Pre-inspection:

- repair, or
- reset?

# RSD Emissions Before and After I/M

- ❑ **RSD measurements:**
  - **Before: 82,672 measurements 0-180 days before initial I/M**
  - **After: 69,502 measurements 0-180 days after Initial I/M**
- ❑ **Average On-road Conditions:**
  - **Before: VSP: 12.4 kw/t, Temp: 70F, Humidity: 41**
  - **After: VSP: 12.4 kw/t, Temp: 71F, Humidity: 40**
- ❑ **OBD status = status of initial I/M inspection**
- ❑ **Not the same vehicles before and after but the same I/M status and similar RSD conditions**

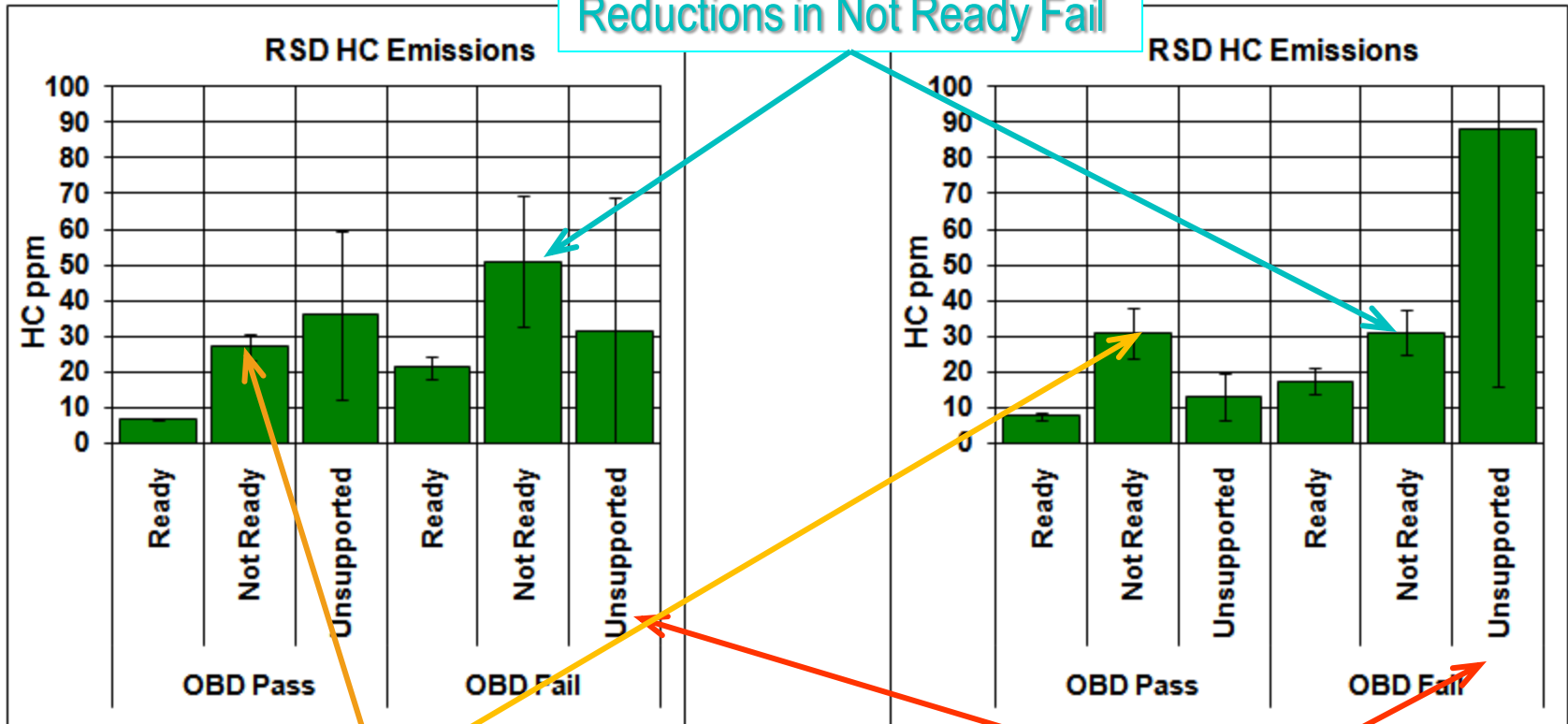
# RSD Emissions Before and After I/M - HC

Initial Test, Cat Monitor Status

Before

After

Reductions in Not Ready Fail



No change in Not Ready Pass

Unsupported cats?  
A few to be investigated!

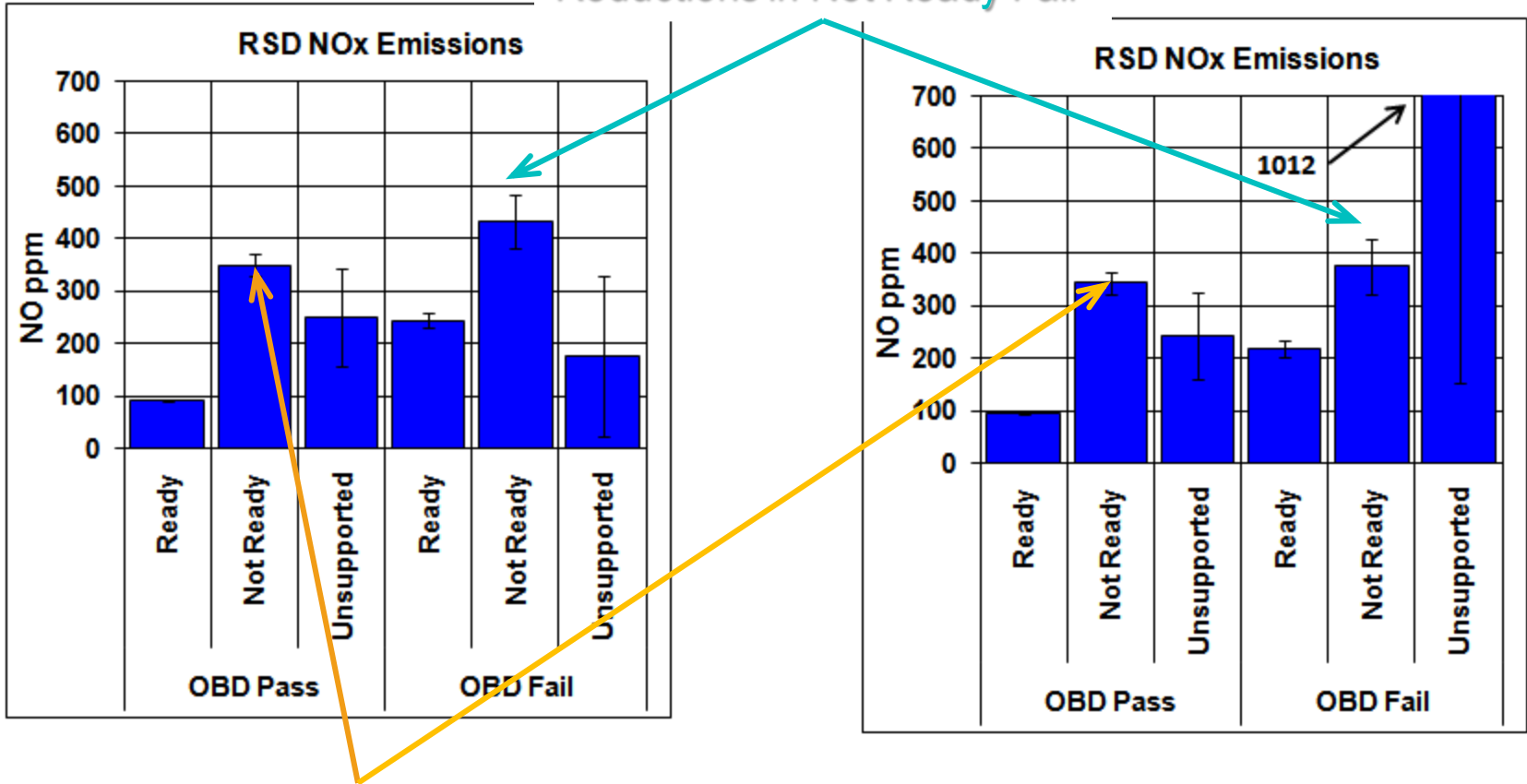
# RSD Emissions Before and After I/M - NOx

# Initial Test, Cat Monitor Status

# Before

## Reductions in Not Ready Fail

# After



## No change in Not Ready Pass



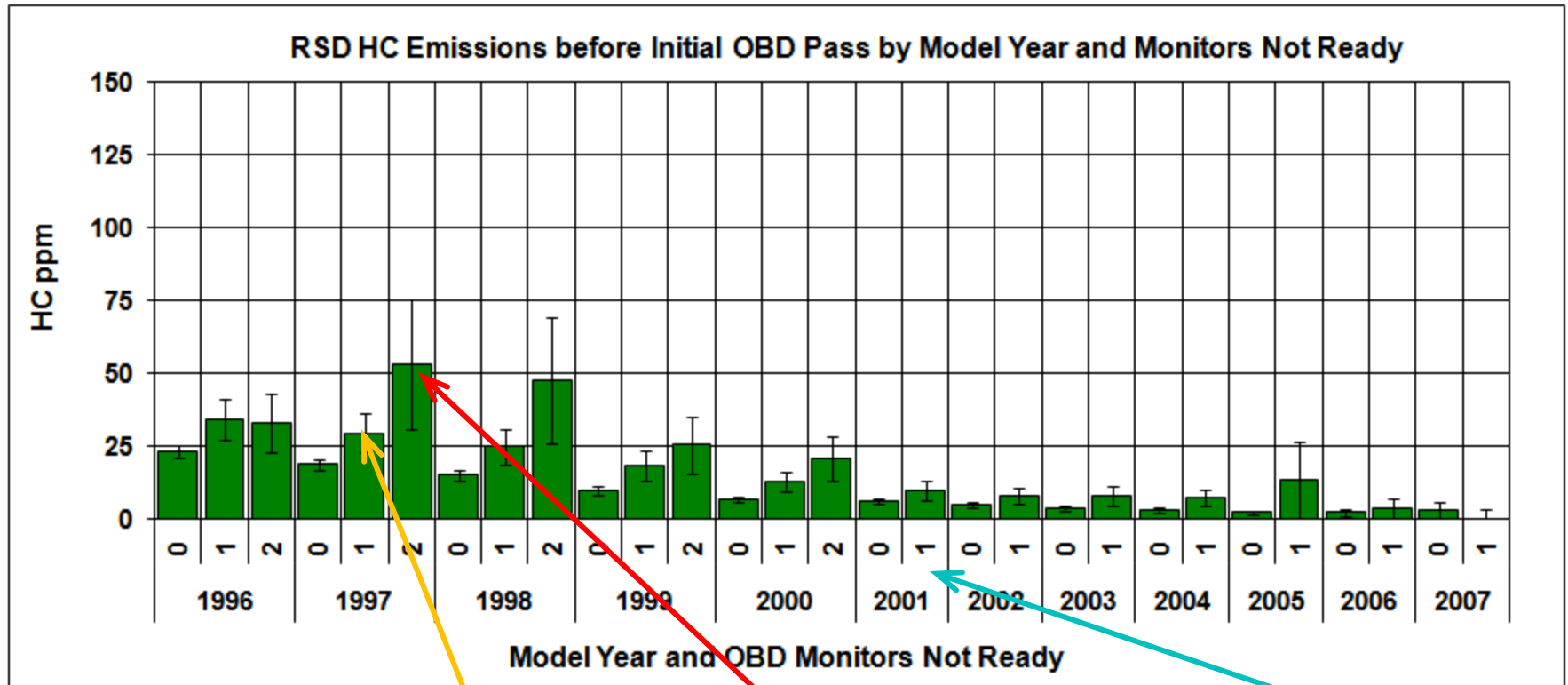
# RSD Emissions Before and After I/M

- ❑ Emissions are higher for passing vehicles with monitors not ready
- ❑ Before ->After emission reductions for vehicles that failed OBD I/M
- ❑ No emission reductions for vehicles that passed OBD I/M with monitors Not Ready
- ❑ Is unsupported CAT monitor a circumvention method?
- ❑ Perhaps the higher emissions of 'Not Ready' vehicles passing the test is because they are generally older than the Ready vehicles?

# RSD Emissions Before I/M - HC

By number of monitors Not Ready and Model Year

Before Initial OBD Pass:



One monitor unset, higher emissions

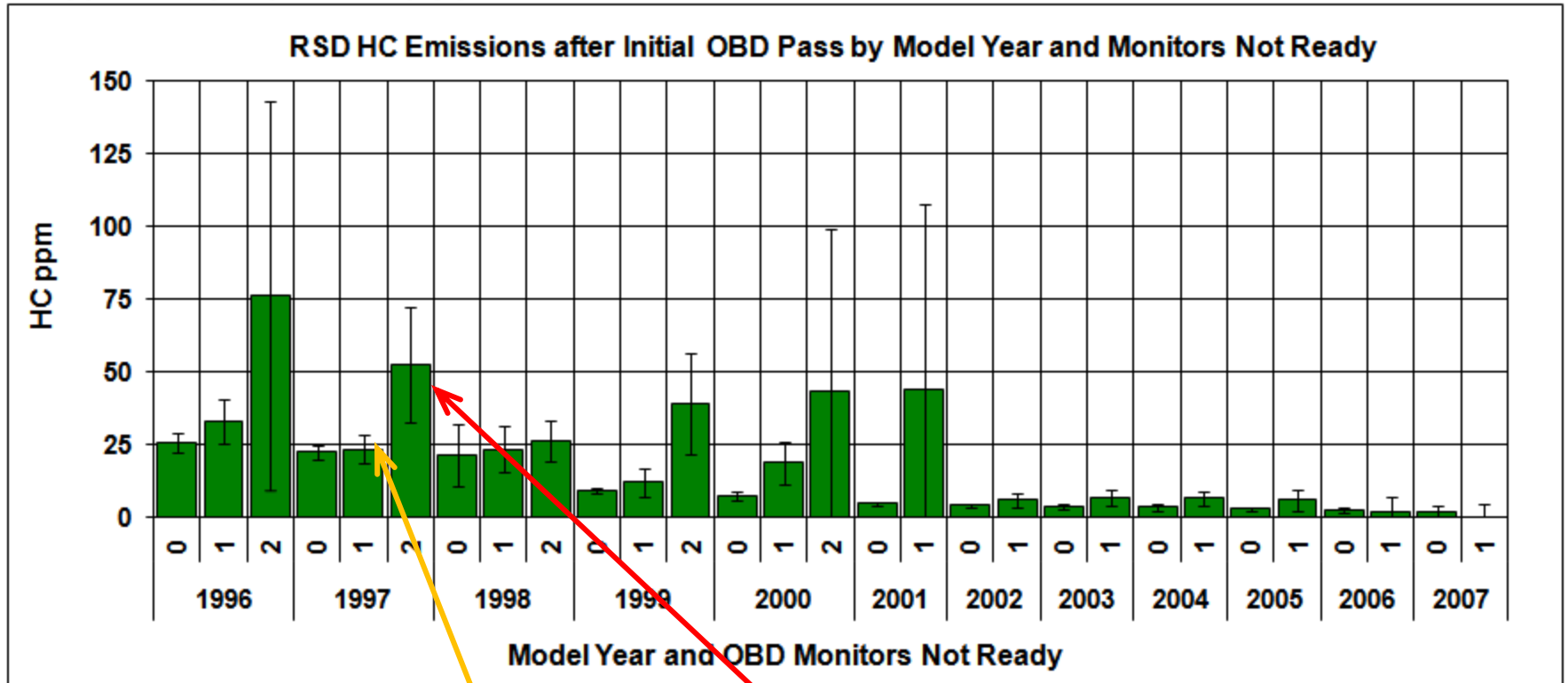
Two monitors unset, even higher emissions

2001 & newer only allowed one unset monitor

# RSD Emissions After I/M - HC

By number of monitors Not Ready and Model Year

After Initial OBD Pass:



One monitor unset, maybe better

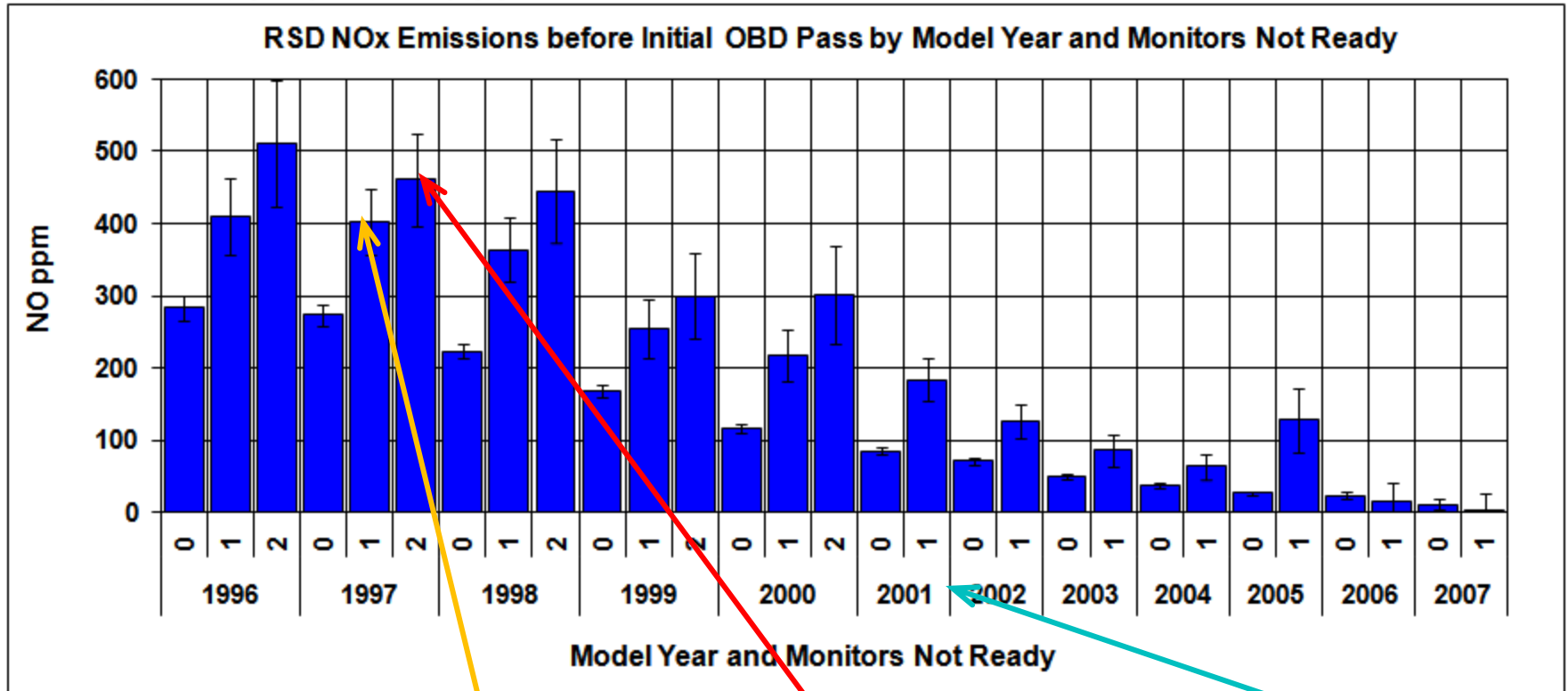
Two monitors unset, still high

More data would tighten 95% confidence ranges

# RSD Emissions Before I/M - NO

By number of monitors Not Ready and Model Year

Before Initial OBD Pass:



One monitor unset, higher emissions

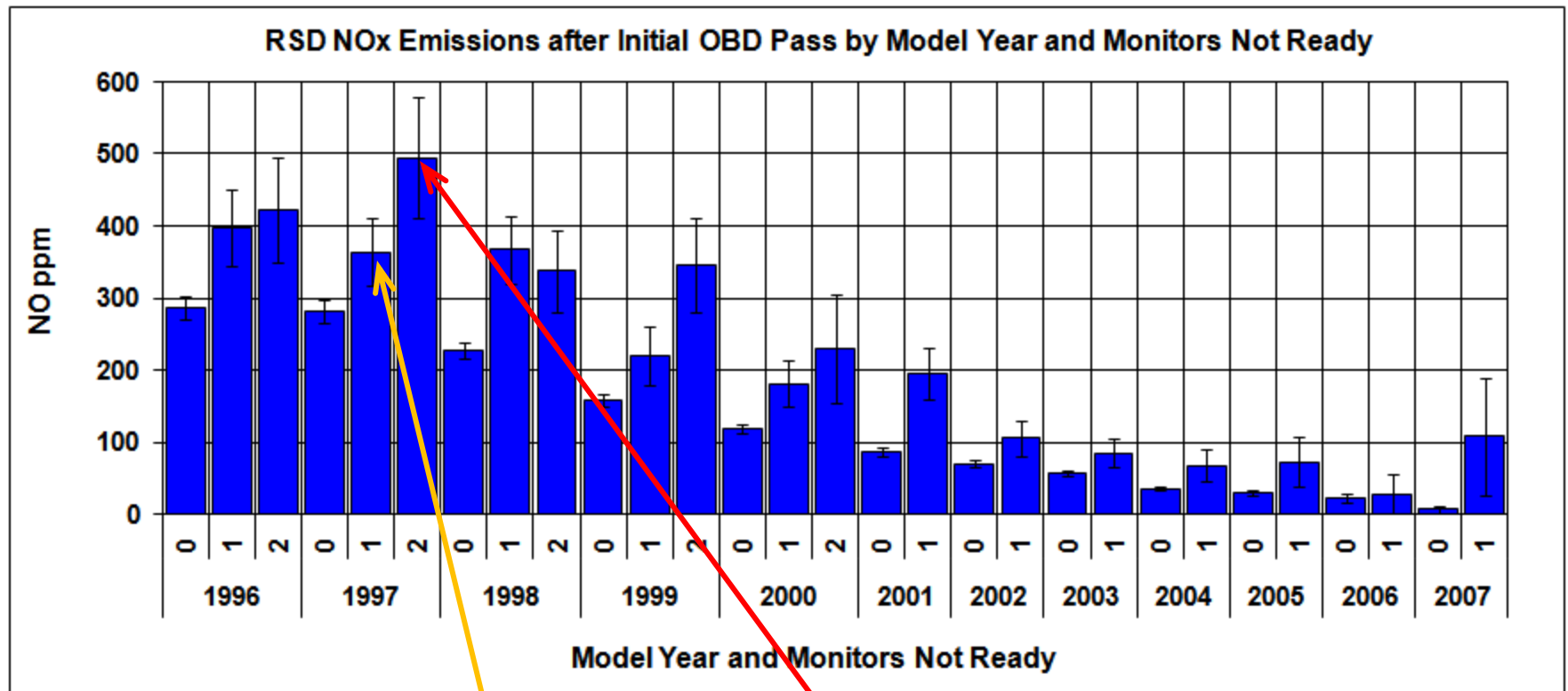
Two monitors unset, even higher emissions

2001 & newer only allowed one unset monitor

# RSD Emissions After I/M - NOx

By number of monitors Not Ready and Model Year

After Initial OBD Pass:



One monitor unset, still high

Two monitors unset, still high

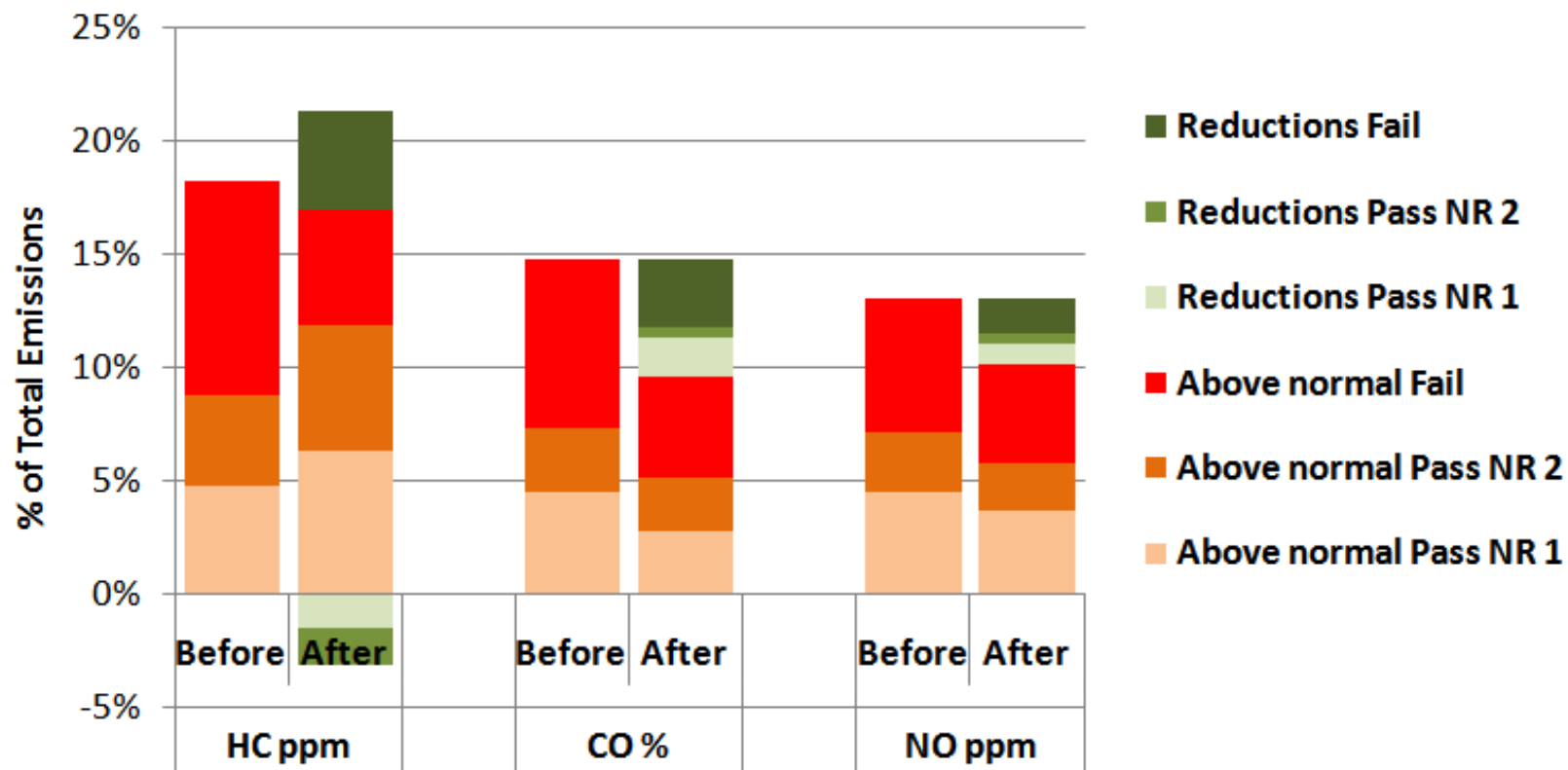
More data would tighten 95% confidence ranges

# Estimated Losses in Emissions Reductions

- ❑ **Approximate estimate of the potential scale of losses.**
- ❑ **Use model year averages for each group:**
  - **Assume 'normal' emissions are I/M Pass All Ready**
  - **Calculate 'above normal' emissions for:**
    - **OBD initial fail;**
    - **OBD initial pass: one monitor not ready**
    - **OBD initial pass: two monitors not ready**
  - **Calculate Before and After**
  - **Compare changes**
- ❑ **Caveats:**
  - **Done as sum of concentrations, not mass emissions**
  - **'Normal' does not equal emissions standards**

# Estimated Losses in Emissions Reductions

**1996-2006 Model Above Normal\* Emissions as % of Total Emissions  
from RSD Emissions 180 Days Before and After Initial Test in 2008/9**



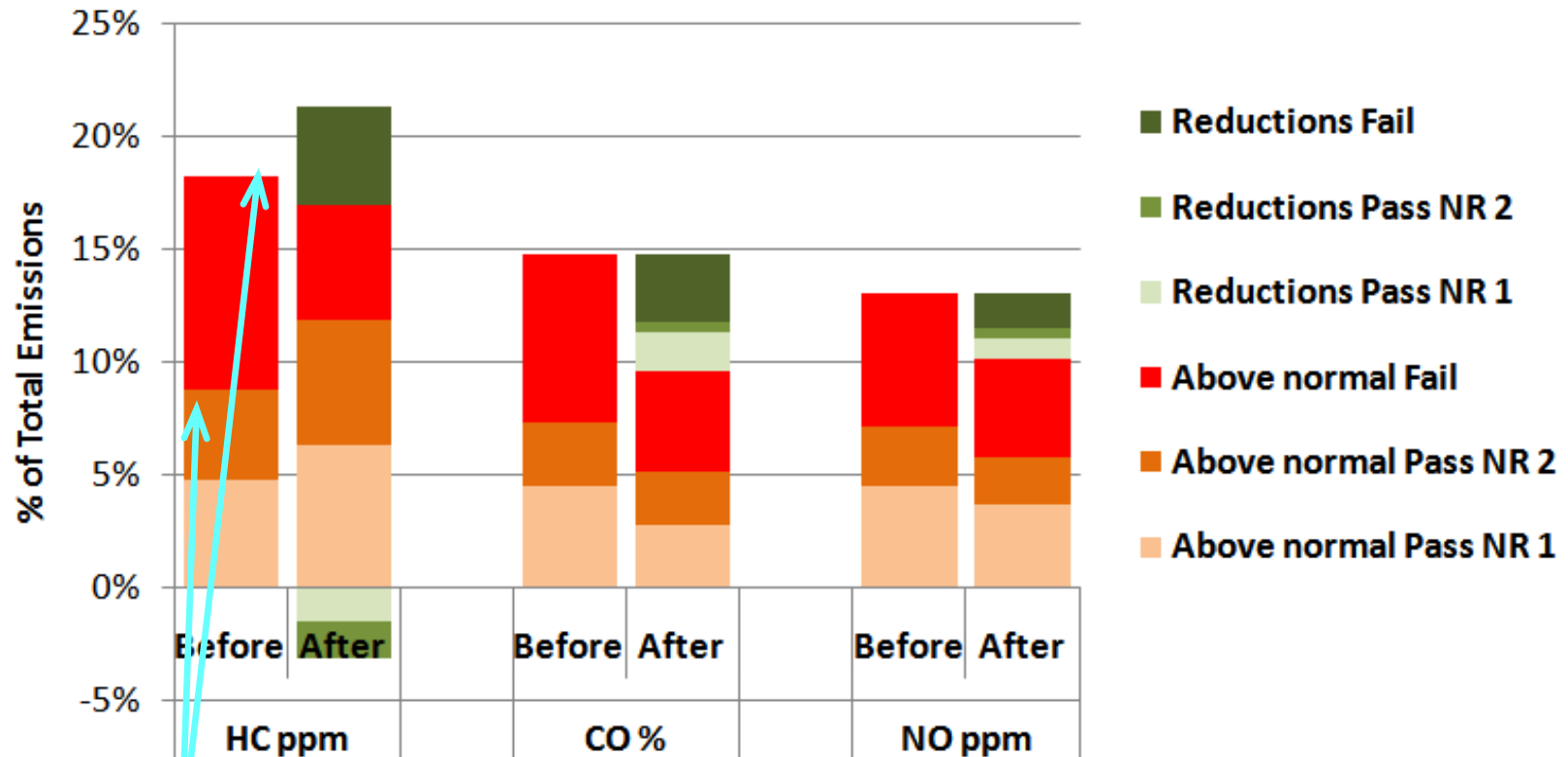
\* Normal = MY average emissions of vehicles passing with all monitors ready

Pass NR1 = pass with one monitor not ready

Pass NR2 = pass with two monitors not ready

# Estimated Losses in Emissions Reductions

1996-2006 Model Above Normal\* Emissions as % of Total Emissions  
from RSD Emissions 180 Days Before and After Initial Test in 2008/9

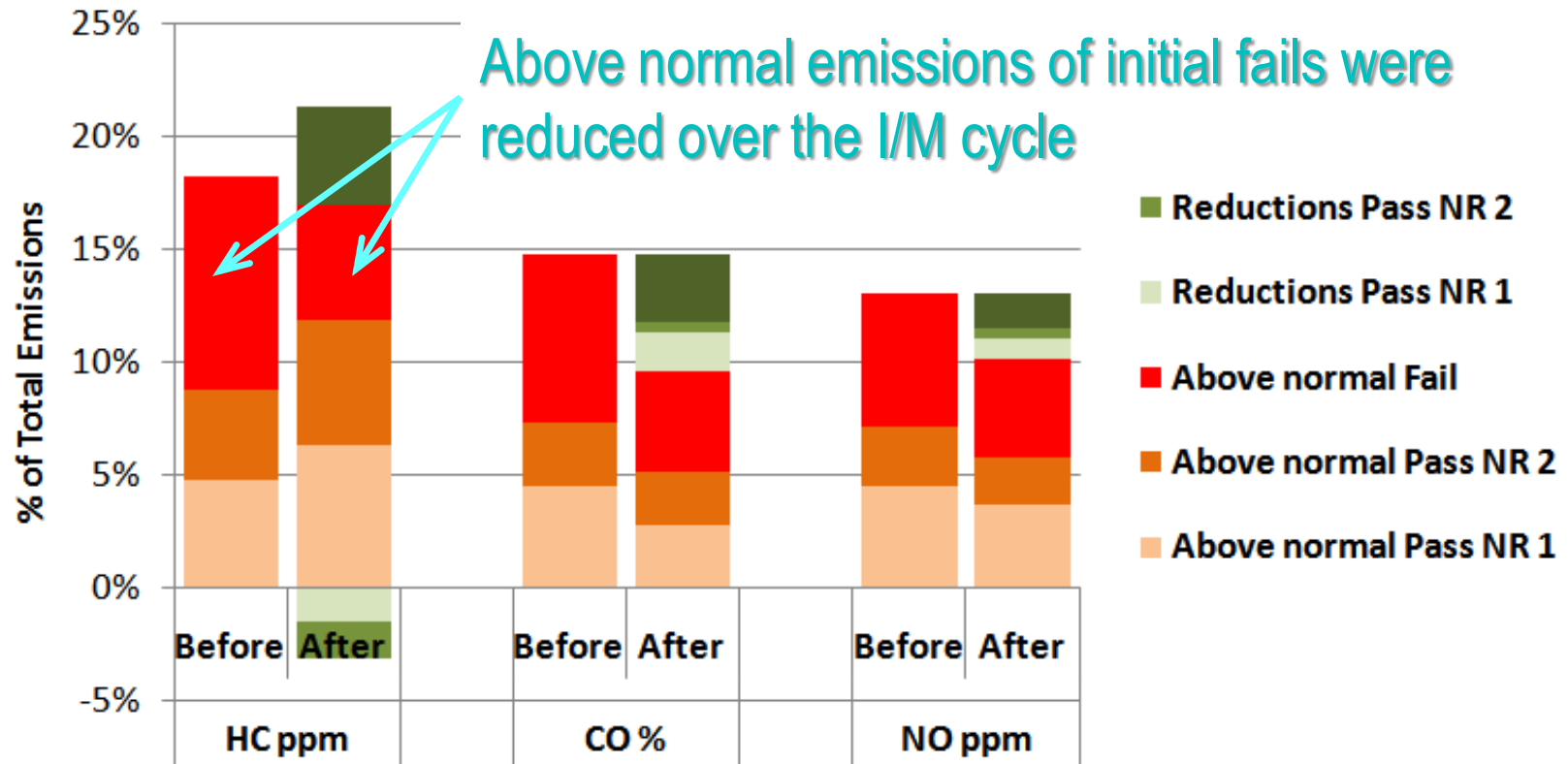


Sum of above normal emissions of NR1 & NR2 vehicles is similar in size to above normal emissions of failing vehicles.



# Estimated Losses in Emissions Reductions

1996-2006 Model Above Normal\* Emissions as % of Total Emissions  
from RSD Emissions 180 Days Before and After Initial Test in 2008/9



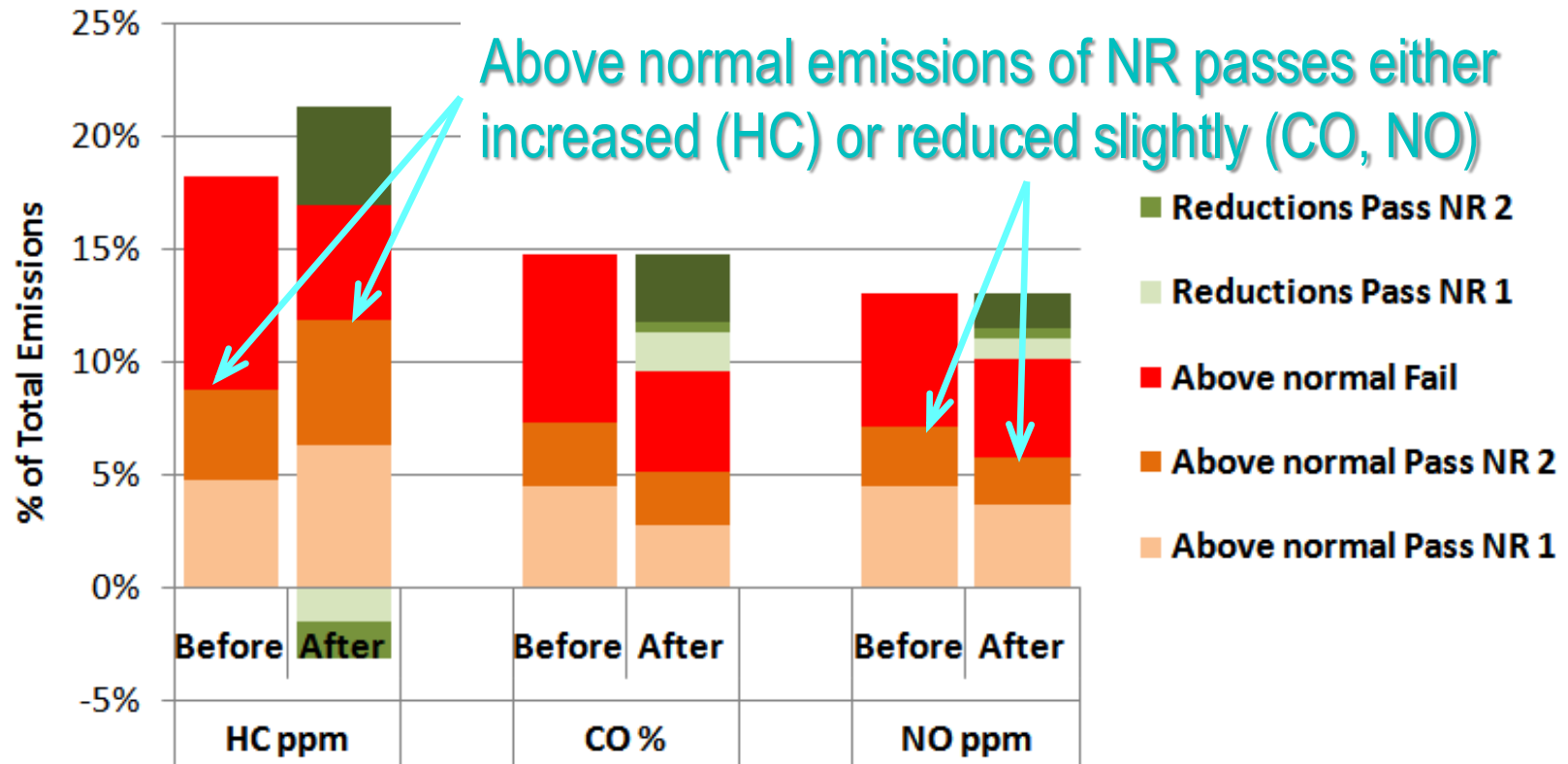
\* Normal = MY average emissions of vehicles passing with all monitors ready

Pass NR1 = pass with one monitor not ready

Pass NR2 = pass with two monitors not ready

# Estimated Losses in Emissions Reductions

1996-2006 Model Above Normal\* Emissions as % of Total Emissions  
from RSD Emissions 180 Days Before and After Initial Test in 2008/9



\* Normal = MY average emissions of vehicles passing with all monitors ready

Pass NR1 = pass with one monitor not ready

Pass NR2 = pass with two monitors not ready

# Estimated Losses in Emissions Reductions

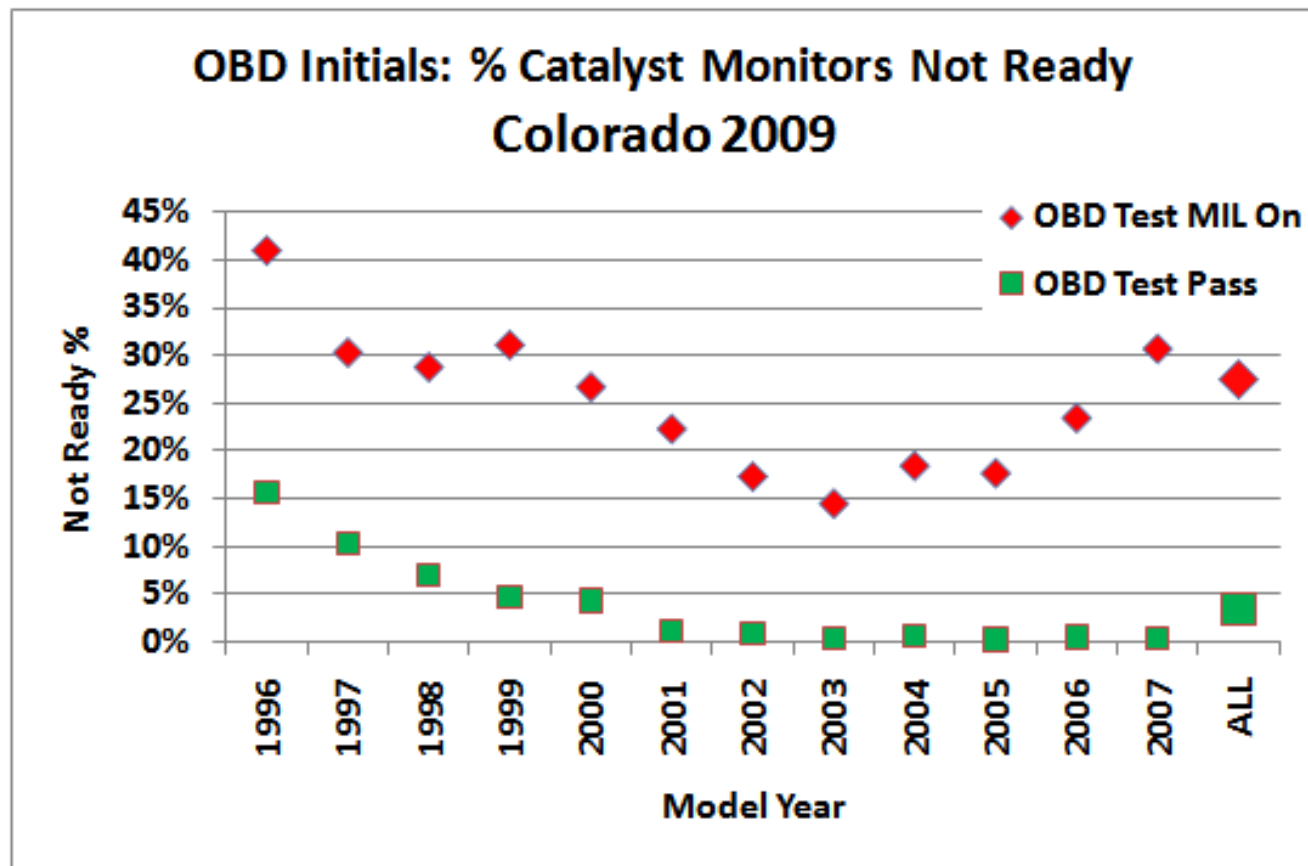
- **Conclusions from Virginia I/M and RSD data:**
  - **RSD data are useful for evaluating OBD I/M program designs;**
  - **Losses in emissions reductions from readiness exemptions are substantial;**
  - **The losses are greater for 1996-2000 models that are allowed two monitors Not Ready;**
  - **More data and more detailed analysis required to obtain a more accurate estimate.**

# Estimated Losses in Emissions Reductions

- ❑ **Colorado IM240 Program:**
  - **Does not fail for OBD - uses IM240**

# Estimated Losses in Emissions Reductions

- ❑ **Colorado IM240 Program: does not fail for OBD**
  - **Fewer OBD Pass Not Ready in Colorado**
  - **Not Ready %'s lower than OBD-I/M programs**



1996-2000  
pass w cat  
not ready:  
Colorado 7.5%  
Virginia 8.8%

# Estimated Losses in Emissions Reductions

- ❑ **Identification of 'repairable' emissions using IM240**
- **'What-if' OBD pass/fail based on MIL-On and Readiness Status**
- **IM240 values used to calculate repairable emissions:**
  1. **Identified by OBD: vehicles with Mil-On or rejected:**
    - a) **Allowing EPA readiness exemptions**
    - b) **With NO readiness exemptions**
  2. **Identified by IM240: vehicles failing IM240**
  3. **Not identified by either: vehicles > 1.5x simplified cert stds not failing OBD or IM240**
- **Repairable emissions:**
  - ❑ **OBD fail or reject: initial emissions - simplified in-use stds (assumes OBD fails below 1.5x are correct)**
  - ❑ **Others w IM240>1.5 x in-use: initial emissions - simplified in-use stds**

# Estimated Losses in Emissions Reductions

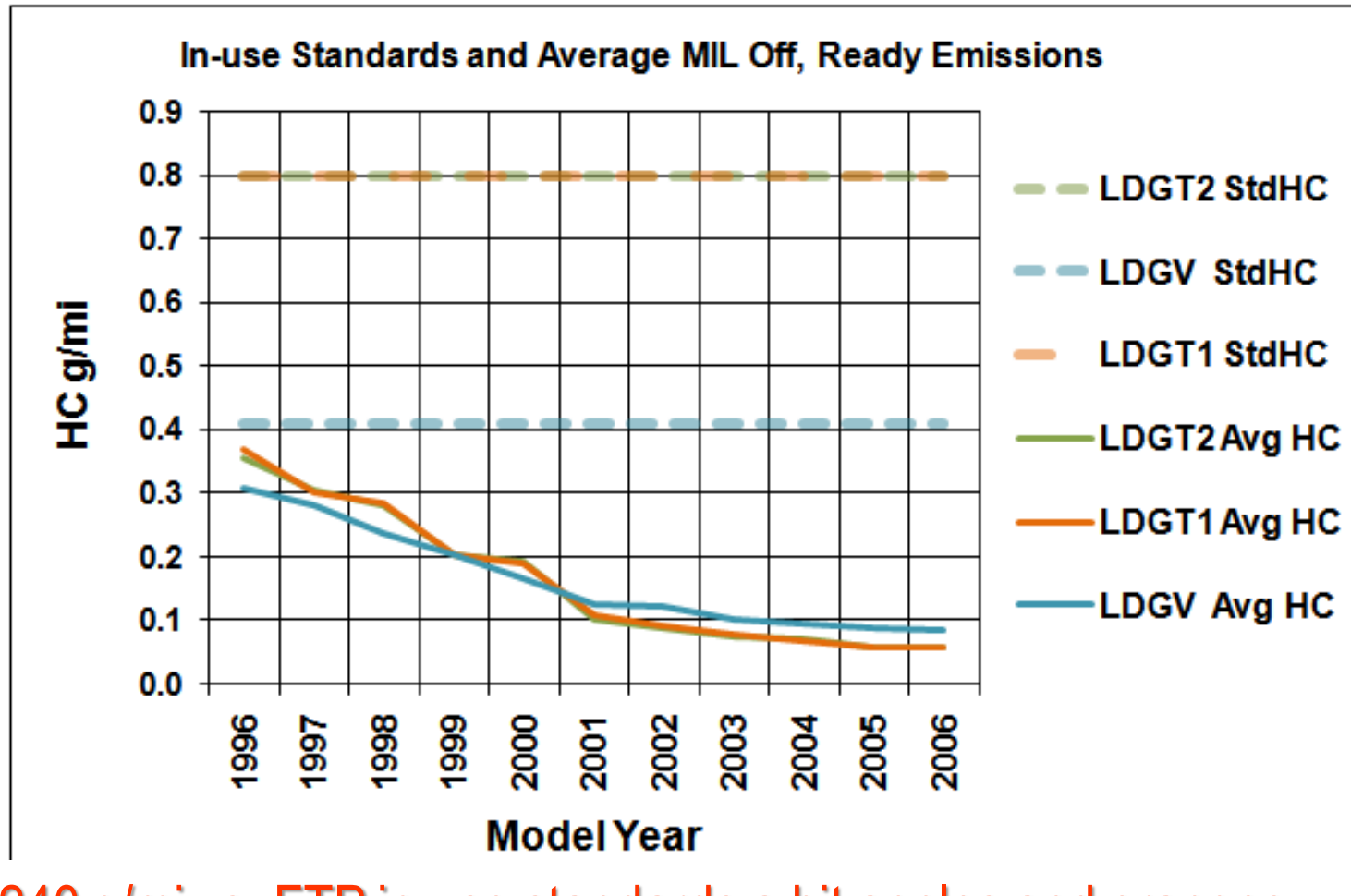
## ❑ Caveats:

- Lane IM240 used to estimate repairable emissions:
  - ❑ IM240 results include some unconditioned emissions when vehicle fast passes IM240 standards
  - ❑ Lane IM240 has some variability in drive traces, etc.
  - ❑ Simplified standards may underestimate 'repairable' emissions for ULEVs, ZLEVs, etc
- In-use standards used as the average after repair value:
  - ❑ May underestimate 'repairable' HC because average 'normal' HC may be lower than in-use standards
  - ❑ May overestimate 'repairable' NOx because average 'normal' NOx may be higher than in-use standards



# Estimated Losses in Emissions Reductions

- Simplified in-use HC standards and
- Colorado IM240 'normal' emissions (Mil Off, Ready)

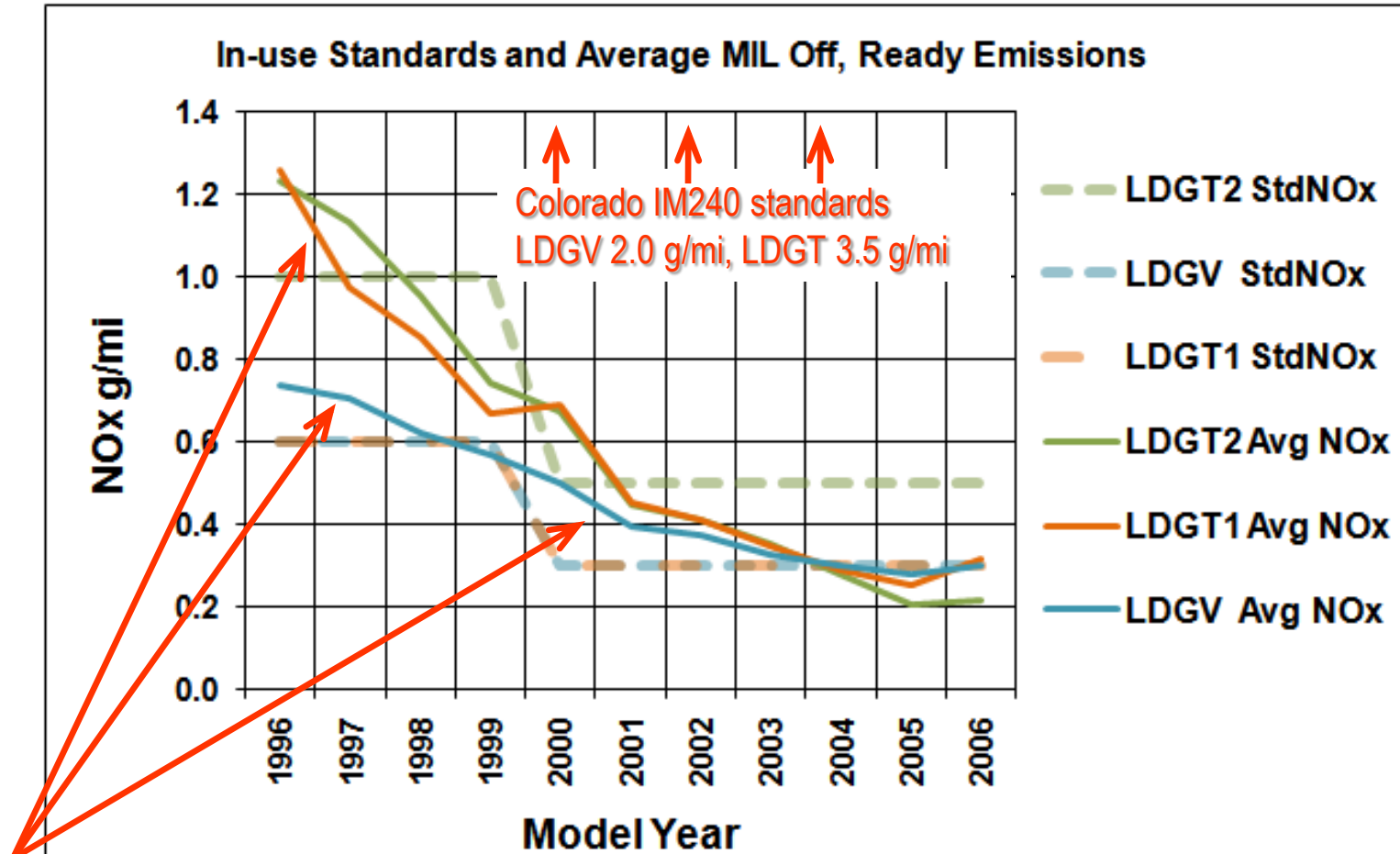


IM240 g/mi vs. FTP in-use standards a bit apples and oranges



# Estimated Losses in Emissions Reductions

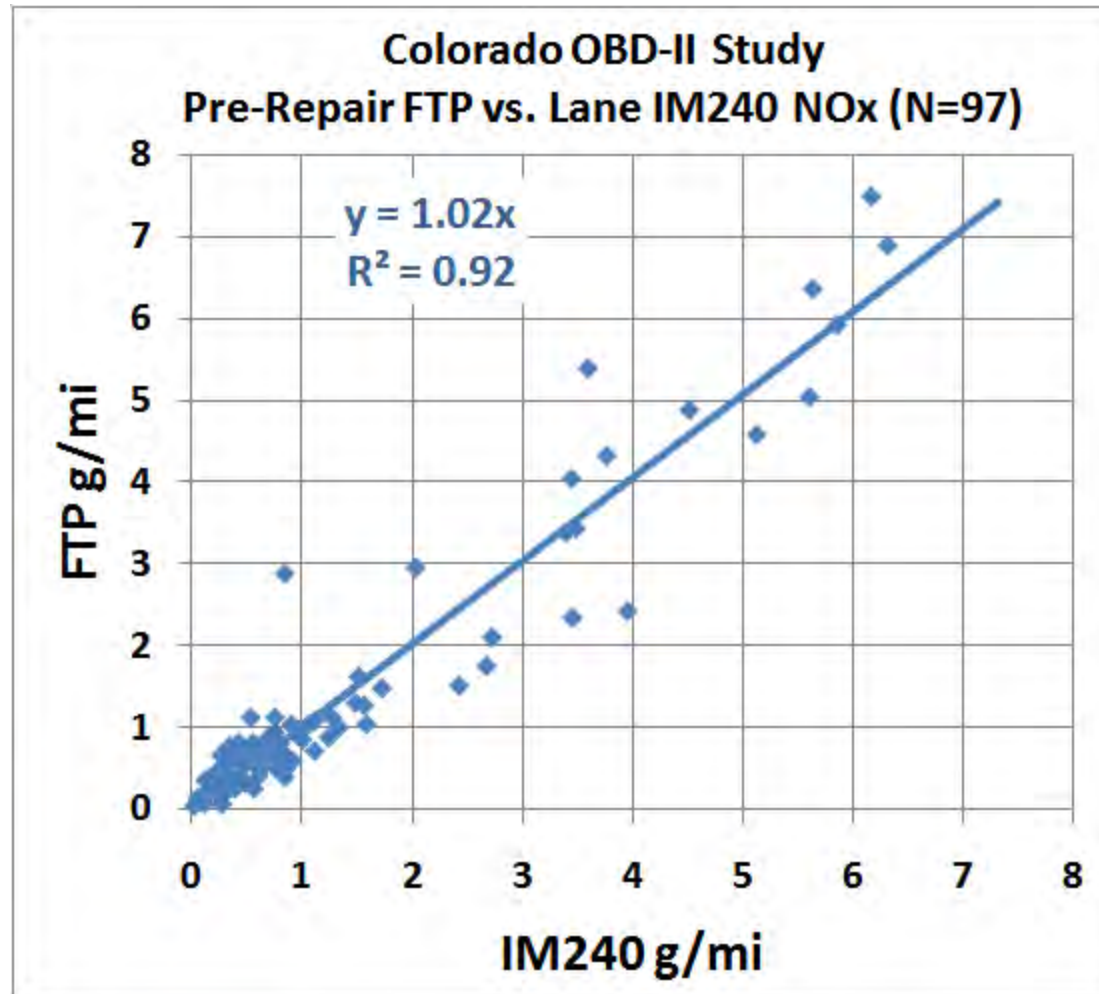
- Simplified in-use NOx standards and
- Colorado IM240 'normal' emissions (Mil Off, Ready)



Average 'normal' NOx exceeds in-use standards for many models

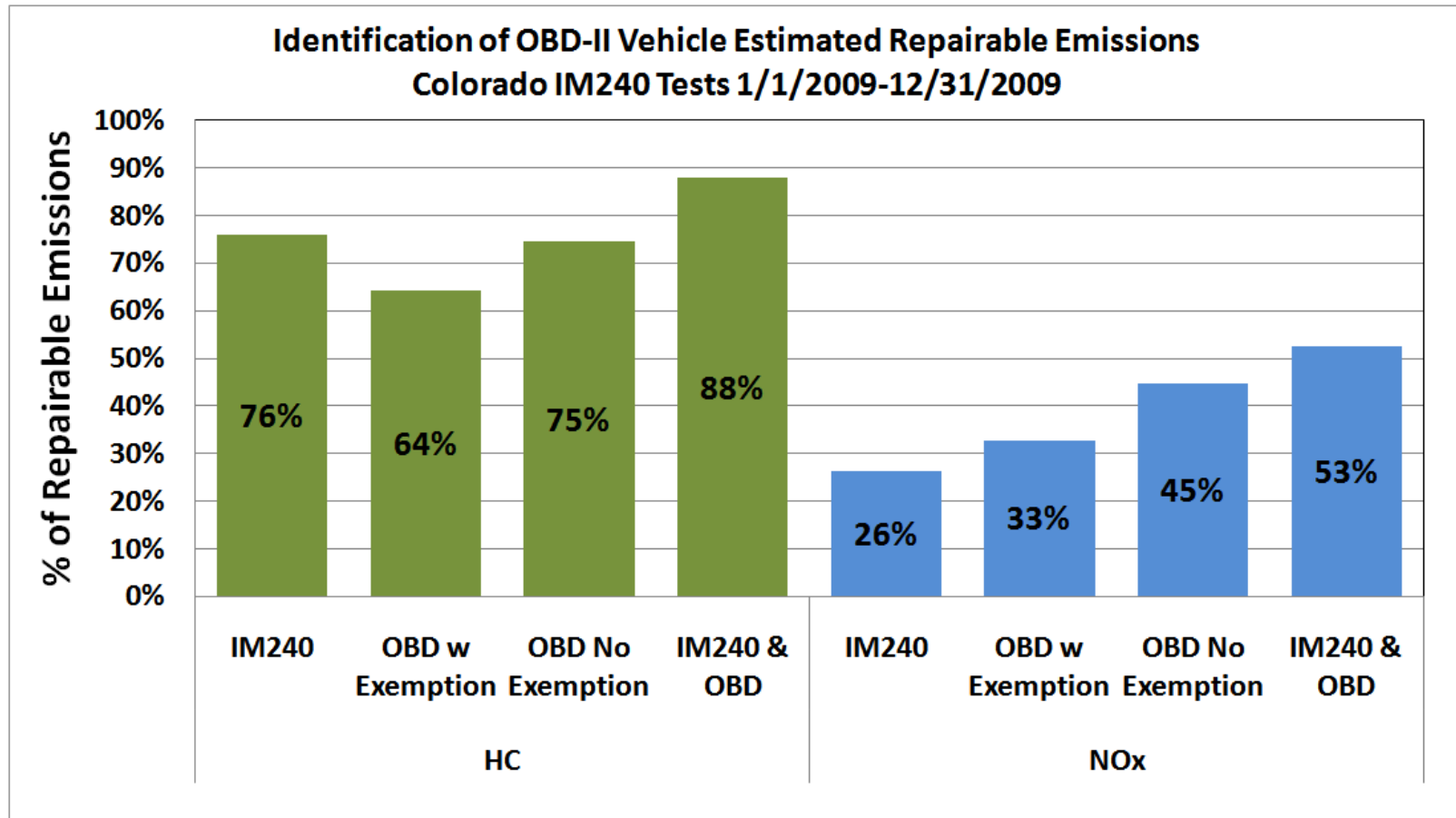
# Estimated Losses in Emissions Reductions

- IM240 NOx g/mi equivalent to FTP g/mi



# Estimated Losses in Emissions Reductions

## Program effectiveness as measured by IM240:



# Estimated Losses in Emissions Reductions

- **Colorado Results:**
  - **Removing Readiness Exemption increases 'repairable' emissions identified by:**
    - **17% for HC**
    - **38% for NOx**
  - **Improvements will be larger in OBD I/M programs**
  - **Identification of excess NOx appears to be poor:**
    - **Deliberately loose Colorado IM240 standards**
    - **OBD identification poor as well?**
  - **Combination of tailpipe and OBD identifies more**

# **OBD Readiness Exemption Solutions**

- ❑ **Suggested OBD readiness exemption solution:**
  - **Allow only evaporative monitor to be Not Ready on initial tests (maybe with tank pressure test);**
  - **Require all monitors to be ready after repair (except evap with tank pressure test);**
  - **Require tailpipe test (and OBD) if any monitors not ready (VA could do this);**
  - **Require tailpipe test (and OBD) for models with high Not Ready percentage (VA will do this);**
  - **Review impact on stations / owners before implementing.**

**The End**