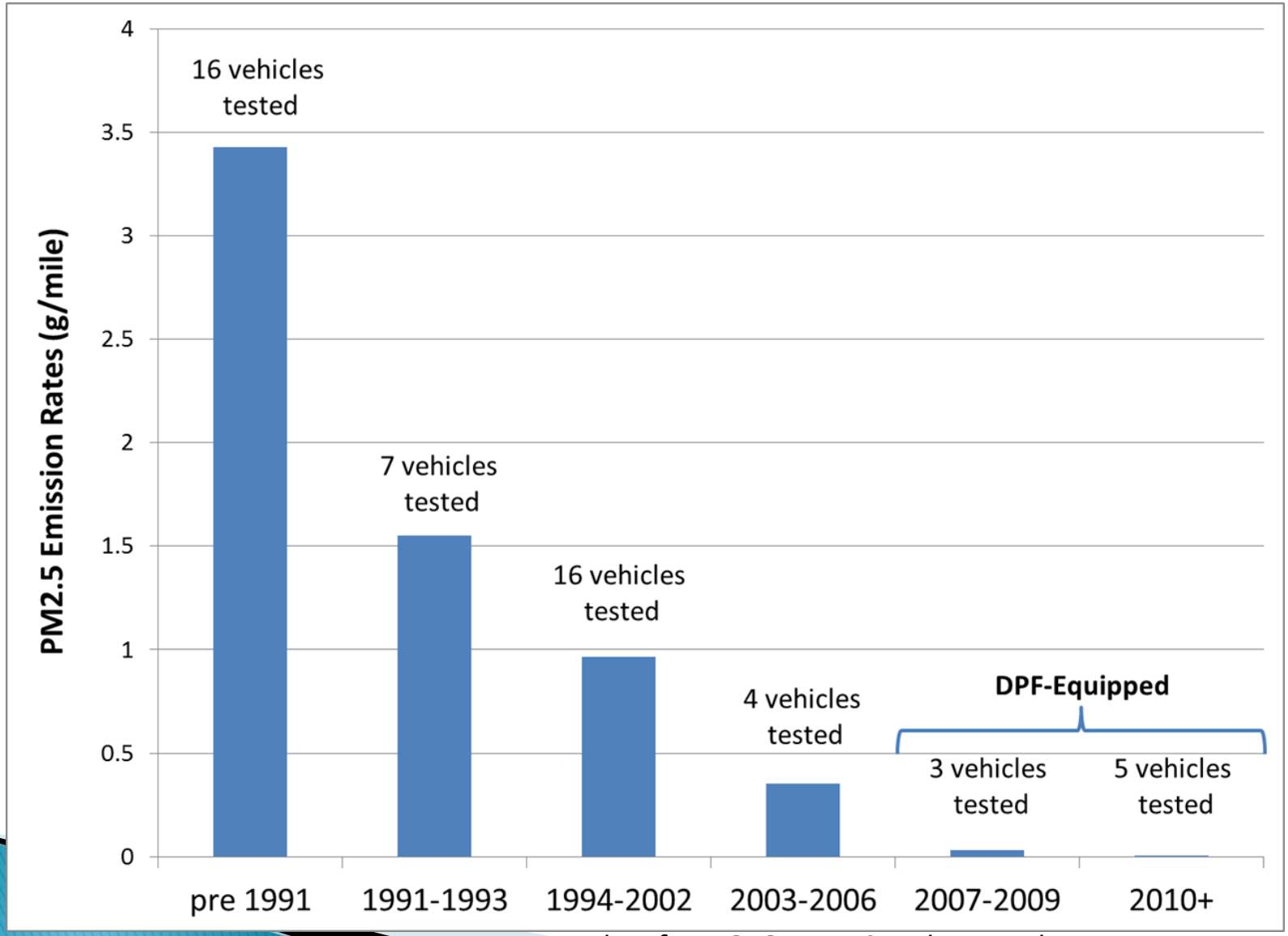
# Truck Sector In-Use Emissions
## Technology Assessment

September 2, 2014
Sacramento, California

California Environmental Protection Agency
Air Resources Board

# Diesel PM Filters are Highly Effective

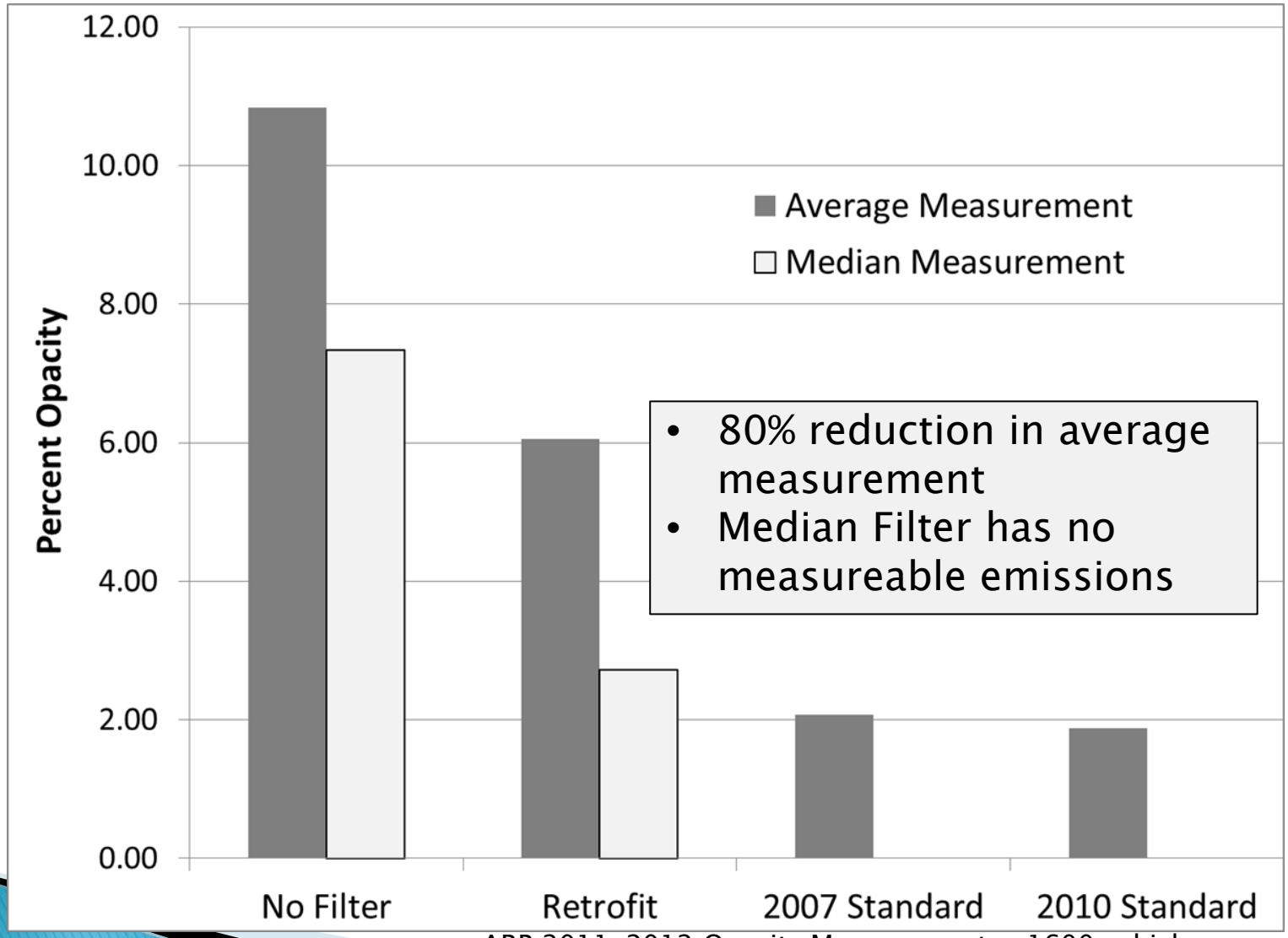



Data taken from CRC E55/59 and ARB in-house testing

# The High Emitter Issue

- California is rapidly transitioning to a 2010 compliant, after-treatment controlled fleet
- A small number of vehicles with malfunctioning after-treatment could have a significant impact on emissions
  - Remote sensing data suggests this might be happening
  - Observed NOx and PM control efficiencies across vehicle populations in the field appear lower than observed in the lab on properly functioning vehicles
  - Increasing skewness of emissions distributions across vehicle fleets in 2010 standard trucks

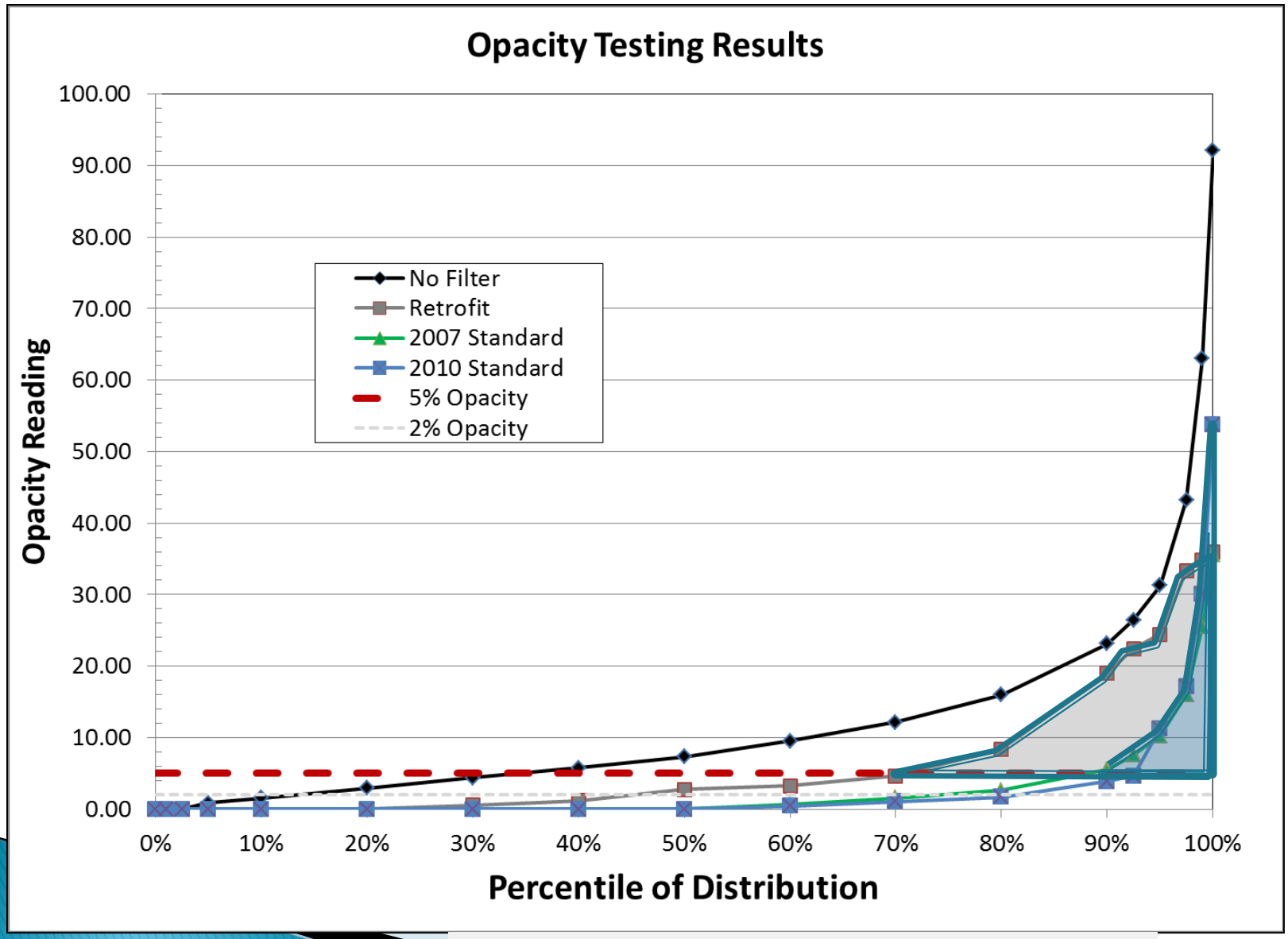
# High Emitters Impact PM Emissions




- 80% reduction in average measurement
- Median Filter has no measureable emissions

ARB 2011-2012 Opacity Measurements: 1600 vehicles

# Example: 2011 Opacity Data




ARB 2011-2012 Opacity Measurements: 1600 vehicles

# Why High Emitters?

- We don't know for sure
  - DPF regeneration at time of measurement
  - Temperature impacts on the SCR
  - Vehicle aging (deterioration)
  - Tampering / Malfunction / Mal-Maintenance
  - Manufacturer variability
- Engine durability may be an issue
  - 18% of engine families, representing 4% of total engines sold between 2007 and 2010, have a warranty claim rate for at least one component exceeding 50%
  - On average 2007 standard engines have more than one claim per vehicle

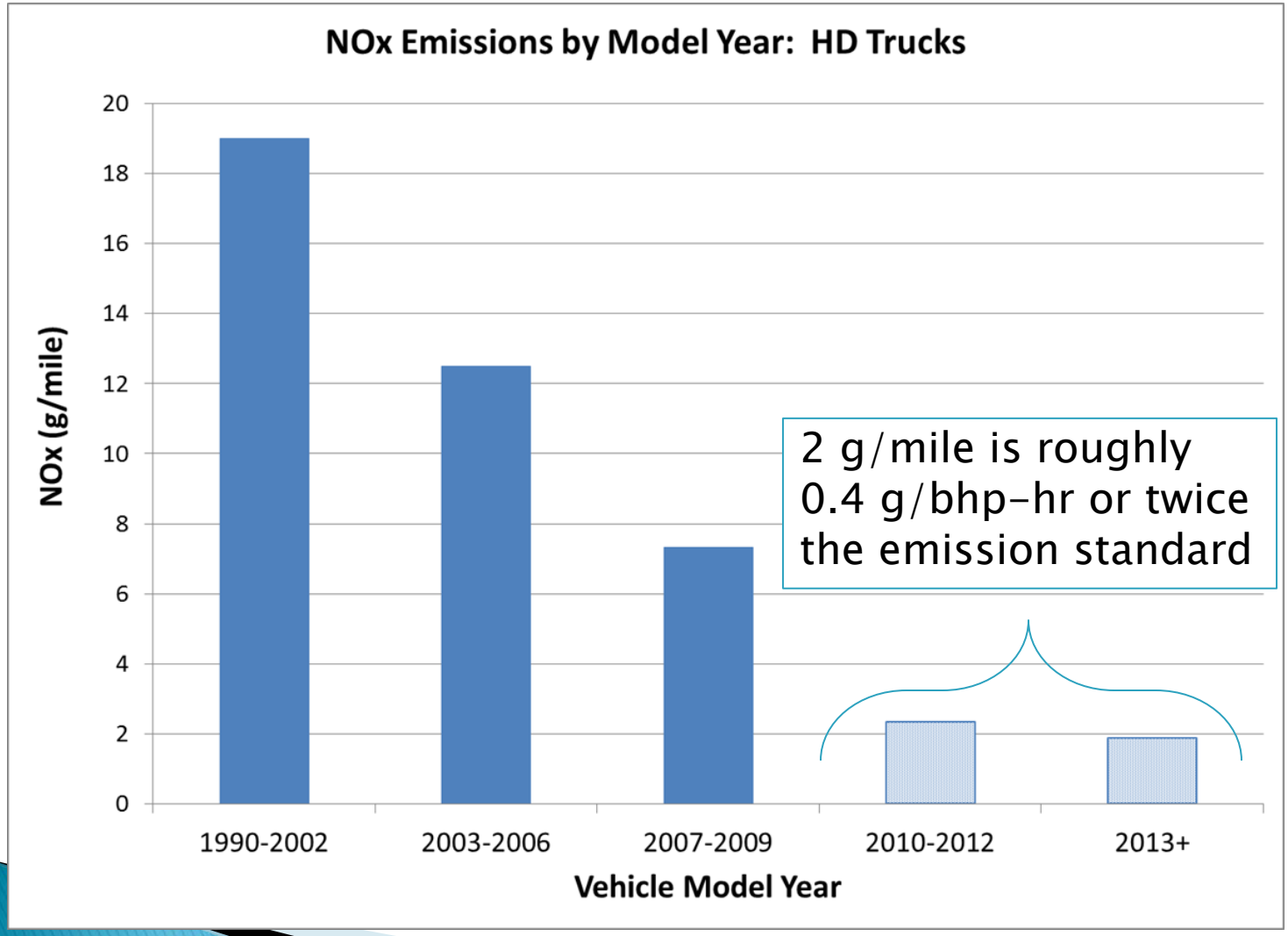
# Improving Durability Could Reduce Emissions

- Unscreened claims; averaged across engine families by MY
- Reported within 100,000 mile warranty period (claims/sales)

| MY | All Claims | EGR | Electronics | Engine | Injectors | NOx Sensors | Filter | Turbo |
|---|---|---|---|---|---|---|---|---|
| 2002 | 45% | 2% | 3% | 21% | 12% | 0% | 0% | 4% |
| 2003 | 194% | 37% | 13% | 7% | 89% | 0% | 10% | 31% |
| 2004 | 65% | 17% | 8% | 4% | 21% | 0% | 0% | 13% |
| 2005 | 77% | 24% | 8% | 6% | 21% | 0% | 0% | 17% |
| 2006 | 50% | 17% | 4% | 3% | 12% | 0% | 0% | 12% |
| 2007 | 143% | 41% | 22% | 9% | 38% | 2% | 7% | 16% |
| 2008 | 122% | 41% | 24% | 8% | 22% | 1% | 3% | 13% |
| 2009 | 104% | 30% | 14% | 6% | 31% | 0% | 2% | 12% |
| 2010 | 65% | 19% | 13% | 8% | 11% | 8% | 1% | 4% |

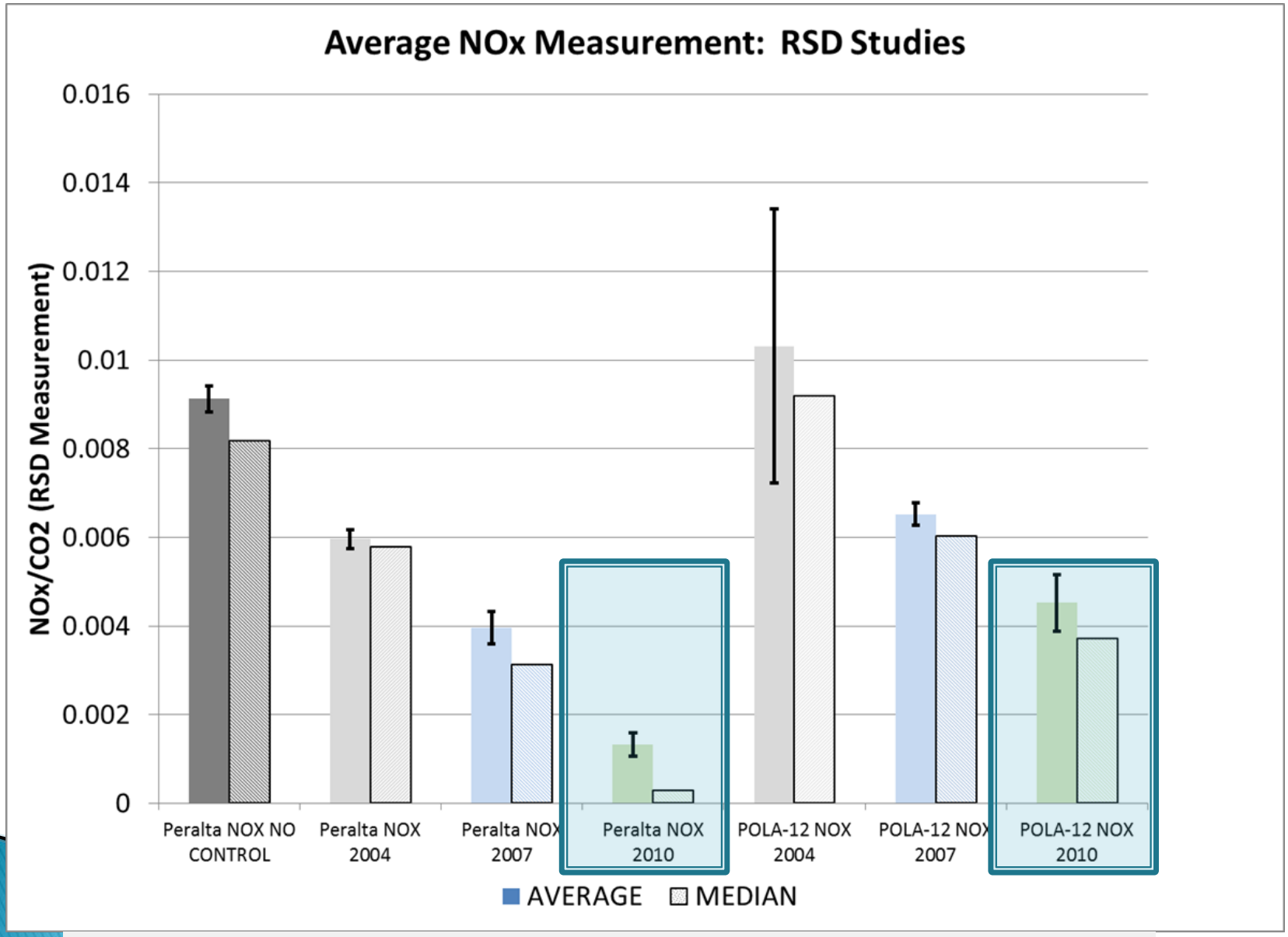
- ARB Field Study: 41 Fleets, >400 trucks
- 35% reporting having experienced engine problems
- Increasing engine durability could reduce in-use NOx emissions
- Improving in-use emissions will not provide sufficient reductions

# Progress in NOx emissions, but more needs to be done



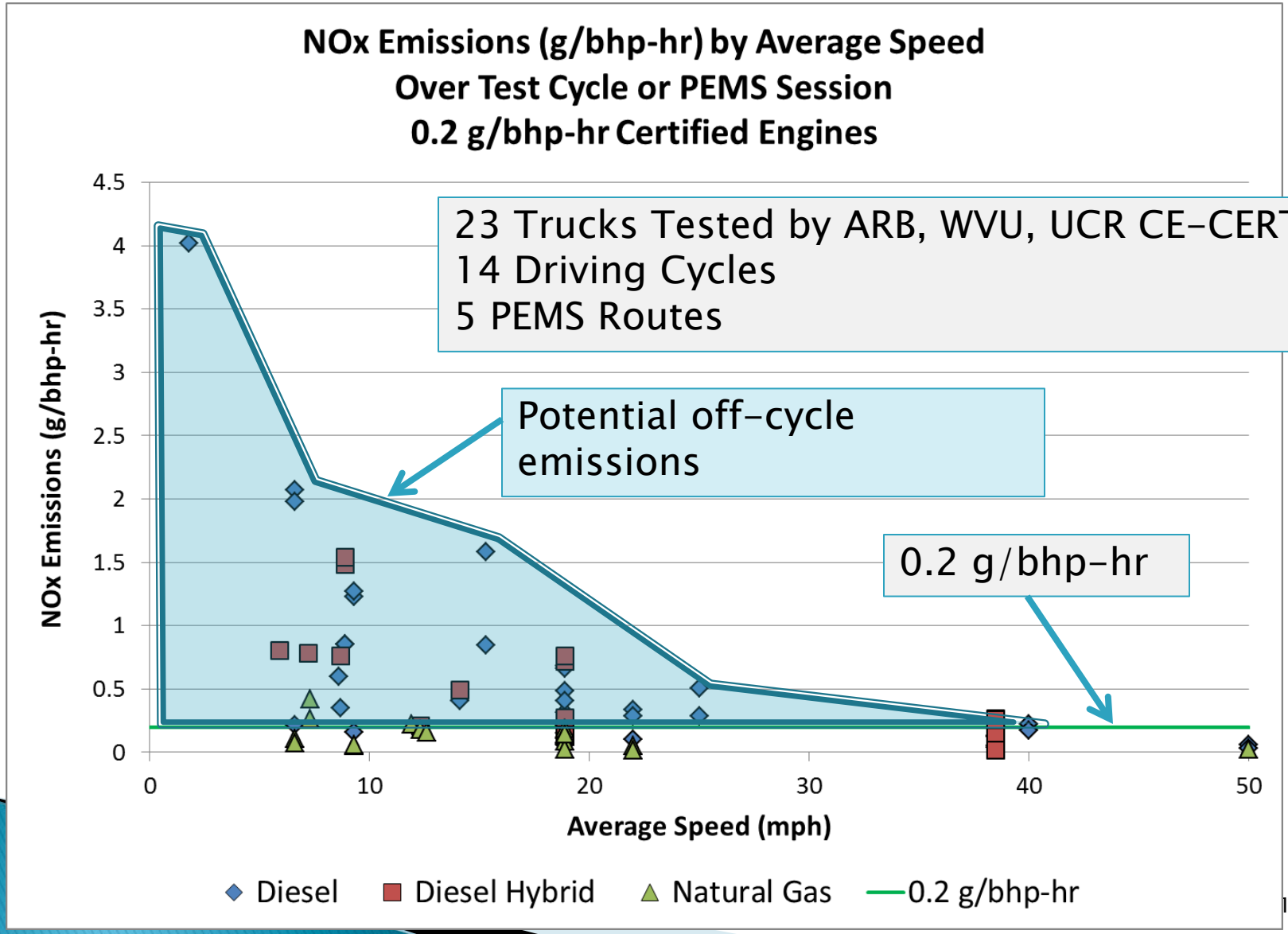

Data taken from CRC E55/59 and ARB in-house testing; UDDS cycle

# Driving Cycle Impacts NOx

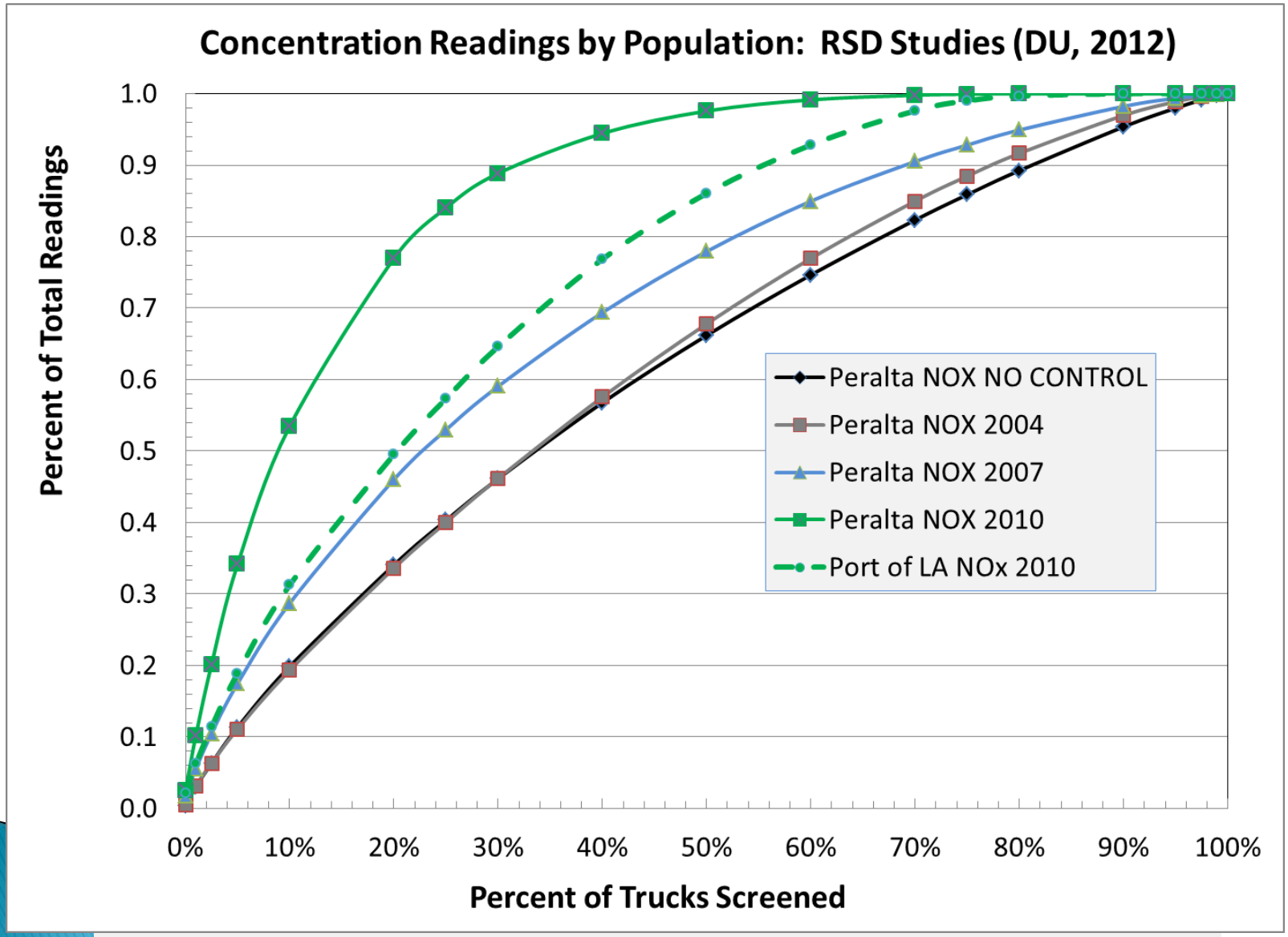



University of Denver 2012 Data: http://www.feat.biochem.du.edu/Heavy_duty_vehicles.html

# Potential Excess NOx Emissions



# NOx Emissions Distribution by Standard

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# On Board Diagnostics

- 2007-2009 MYs: engine manufacturer diagnostics (EMD) systems required
- 2010-2012 MYs: On Board Diagnostic (OBD) phase-in with reduced capability
- 2013 MY and later: OBD near final capability
  - Early OBD systems had limited diagnostic capability
- Staff working with manufacturers to ensure robust OBD systems
- OBD regulations will be updated as needed

# Redesigning Inspection and Maintenance

- Cooperative approach with industry
- Modernize requirements
  - Highlight preventative maintenance procedures
  - Update vehicle inspection and reporting
  - Update opacity testing requirements or expand remote sensing
- Use On-Board Diagnostics

# Contacts

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- Submit comments by Oct. 1 to: http://www.arb.ca.gov/msprog/tech/comments.htm