In-Use Emissions and Compliance Issues

Rigorous In-Use Compliance Testing, OBD, Remote Testing

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Why in-use and production compliance is important.

Heavy duty

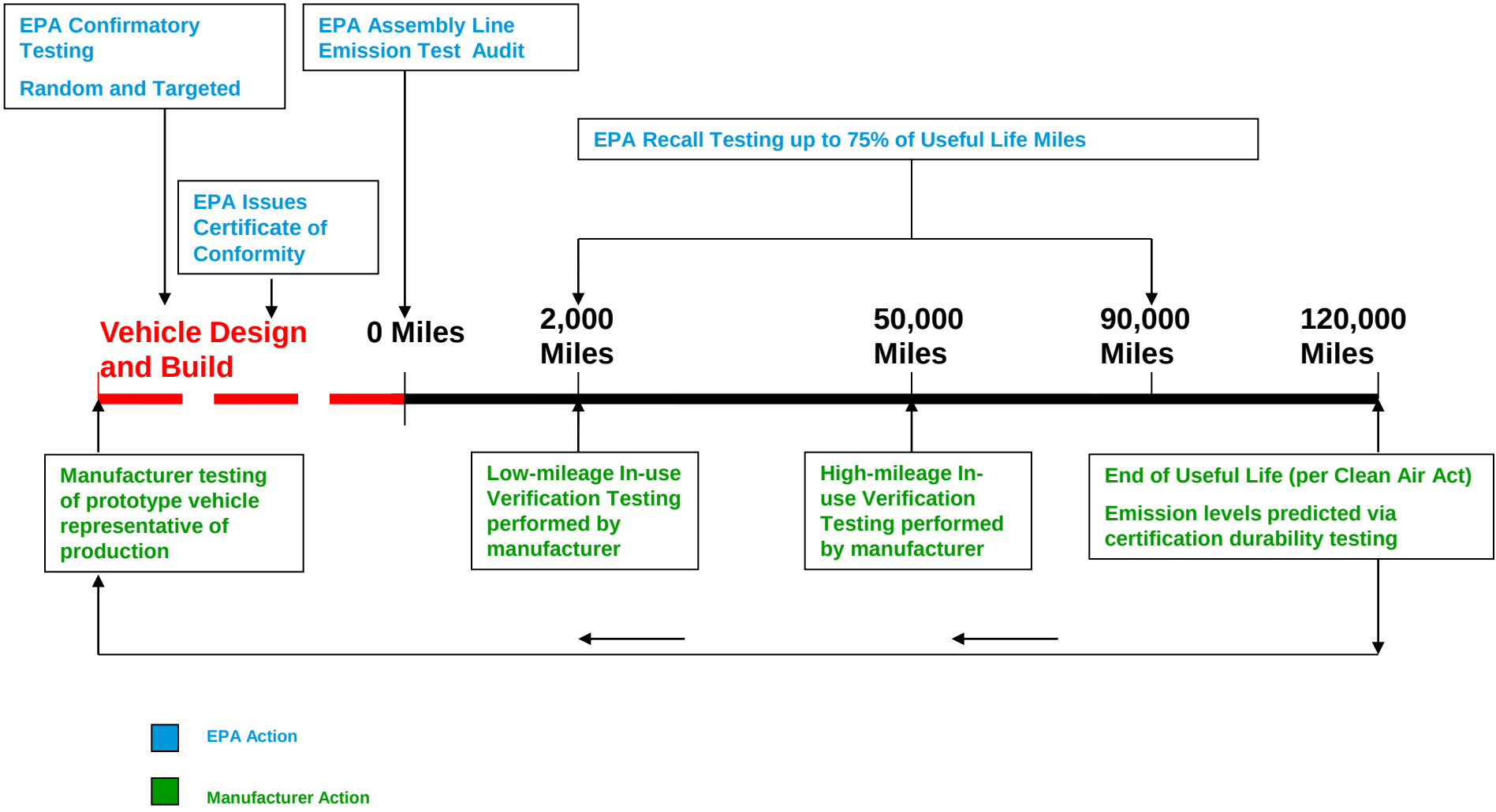
- Bharat VI SCR system disabled: NOx emissions up 10-15X.
  - One malfunctioning truck is equal to 10-15 compliant trucks.
- 5-10% non-compliance? No benefit from Bharat VI

Light duty

- No catalyst: Emissions up 40X
  - One bad car is equal to 40 compliant cars
- 2.5% non-compliant? No benefit from regulation

As emissions regulations get tighter, high-emitters have an increasing impact.

Compliance Life of a Light-duty Vehicle



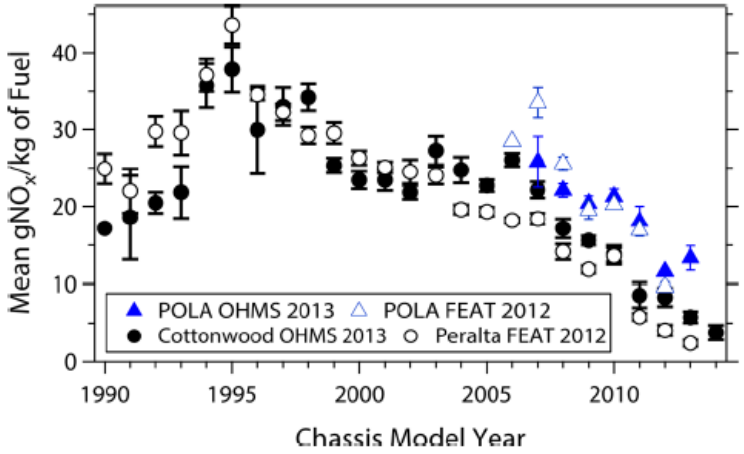
Remote OBD – Automatic reporting of OBD violation to government or manufacturer followed by an enforcement letter

- The technology has been available for >10 years.
  - Communication of the vehicle with the internet is common
- If OBD senses a problem, car sends message to the government
- Government automatically sends violation letter to owner
- Violation is tracked through remediation

- Avoids inspection and maintenance
- Resolves violations promptly
- Corrects the high-emitting problem
- Catch cheaters with remote sensing

New method for measuring on-road HD emissions and compliance: On-Road Heavy-Duty Vehicle Emissions Monitoring System (OHMS)

Trucks drive through an engineered portable tent and emissions are measured.



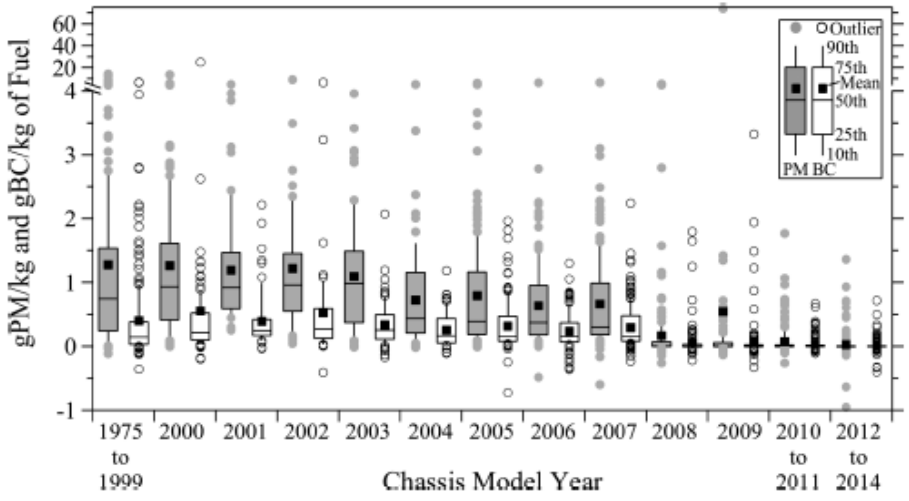
NOx emissions compared using OHMS (2013) and optical remote sensing (FEAT 2012) at same site.

location date roadway slope	HDV mean MY	gCO/kg	gHC/kg	gNO[a]/kg/ gNO$_2$/kg/ gNO$_x$[b]/kg	gPM/kg	gBC/kg	entrance/exit speed[c] acceleration[d]	IR exhaust temperature °C
Port of LA 2013 April 22–26 0°	1222 2009.1	2.3 ± 0.4	0.20 ± 0.03	12.4 ± 0.3/ 2.3 ± 0.3/ 20.7 ± 0.8	0.031 ± 0.007	0.02 ± 0.003	7.7/9.3 0.4/0.5	172° ± 2
Cottonwood 2013 May 6–10 −0.5°	1866 2005.6	5.1 ± 0.2	0.25 ± 0.04	10.6 ± 0.4/ 3.5 ± 0.1/ 20.3 ± 0.7	0.65 ± 0.11	0.23 ± 0.03	15.7/16.8 1.1/0.9	210° ± 10

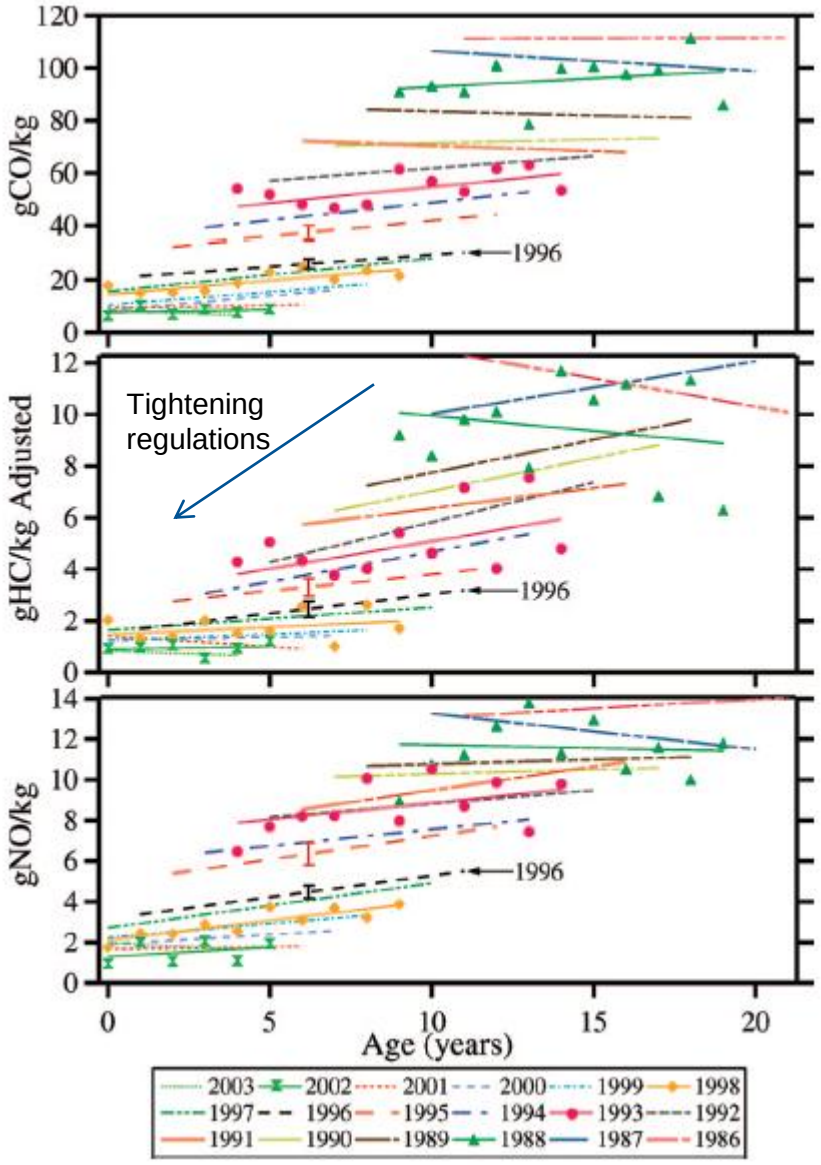
[a]Grams of NO. [b]Grams of NO$_2$. [c]Kilometers per hour. [d]Kilometers per hour/sec.

Denver Univ,
DOI: 10.1021/es505534e
Environ. Sci. Technol. 2015, 49, 1639−1645

PM measurements show the effect of DPF (2007-08).



Infra Red (IR) remote sensing shows the progression of tailpipe regulations and durability from 1986 to 2003



- IR remote sensing uses an optical beam across the road to measure the ratios of pollutants to CO_2 or fuel.
- Cars are photographed so registration data can be retrieved

- Results show a major separation at 1996 due to OBDII and enhanced warranty requirements
  - Range of emissions are shown for 1995 and 1996
- Emissions go down due to tightening regulations
- OBD resulted in a step change and more durability (decreasing slopes for later years) in 1996
- In 2008 , 1/3 of emissions were due to 1% of cars in Sherman Way, CA. (Journal of the Air & Waste Management Association, 62(10):1127–1133, 2012.)

Univ Denver, Environ. Sci. Technol. 2008, 42, 1651–1656