

March 30, 2018

California Air Resources Board Research Seminar

# Investigate the Durability of Diesel Engine Emission Controls

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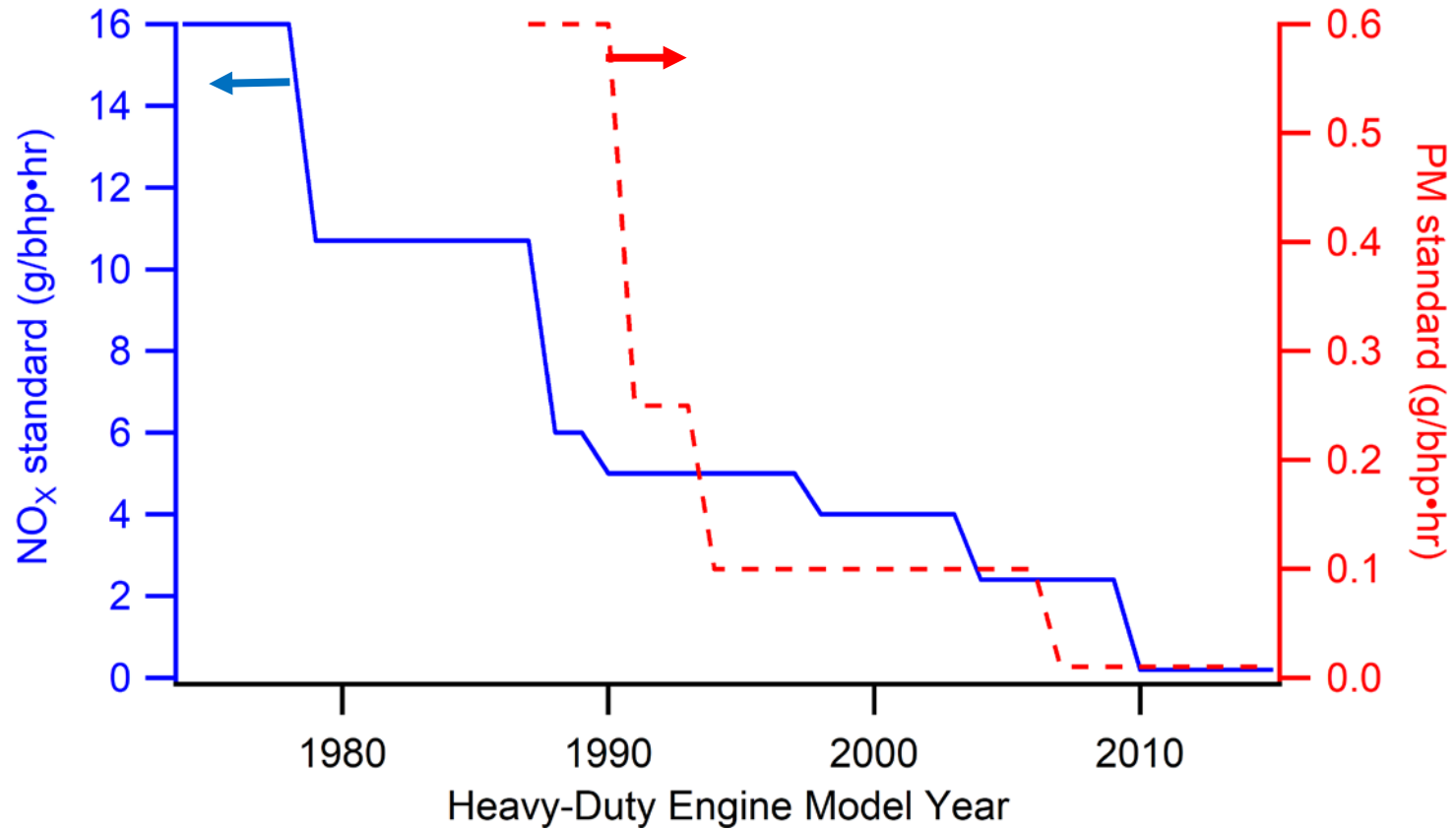
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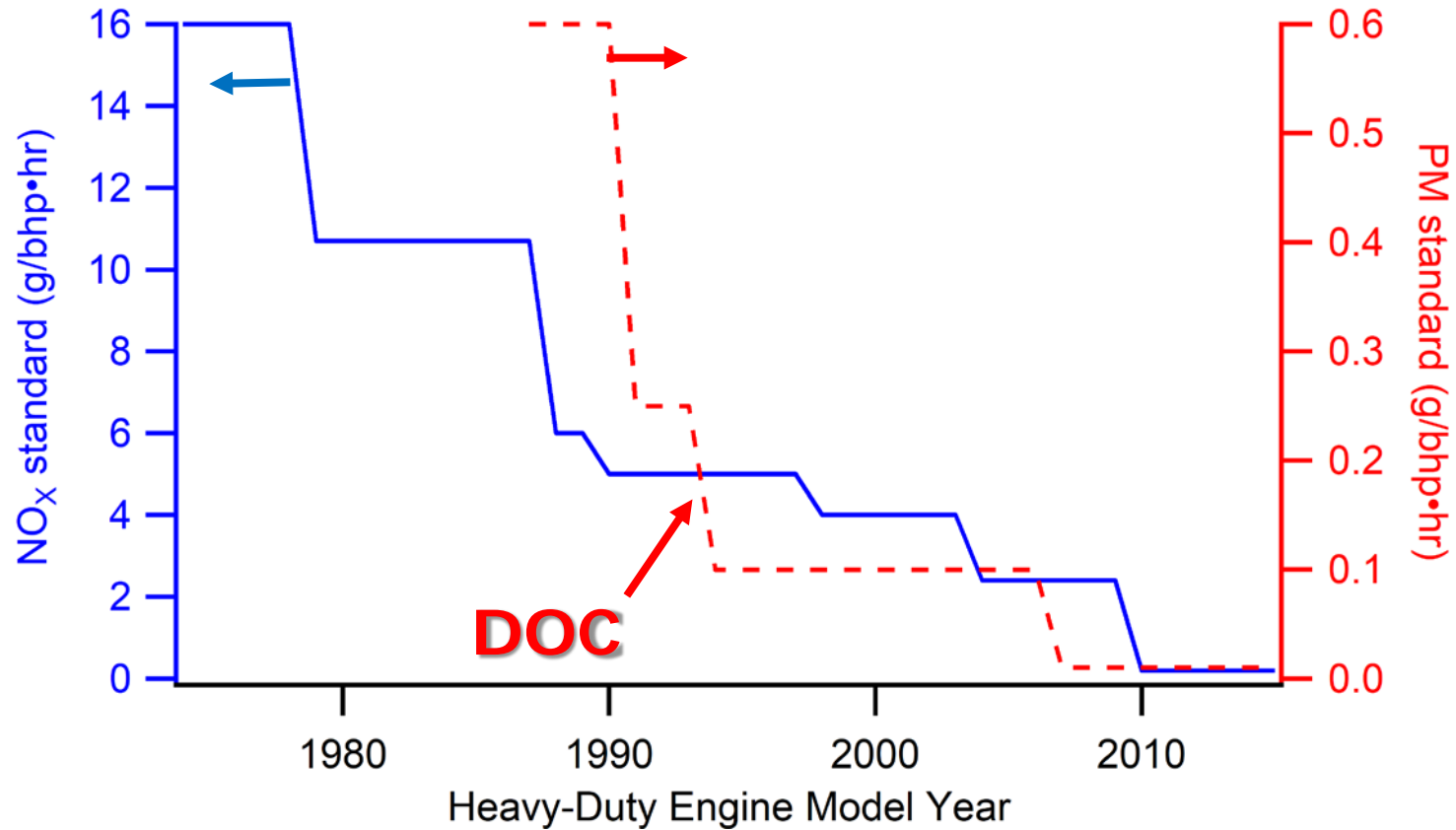


UNIVERSITY *of*  
DENVER

# Heavy-Duty Engine Emission Standards

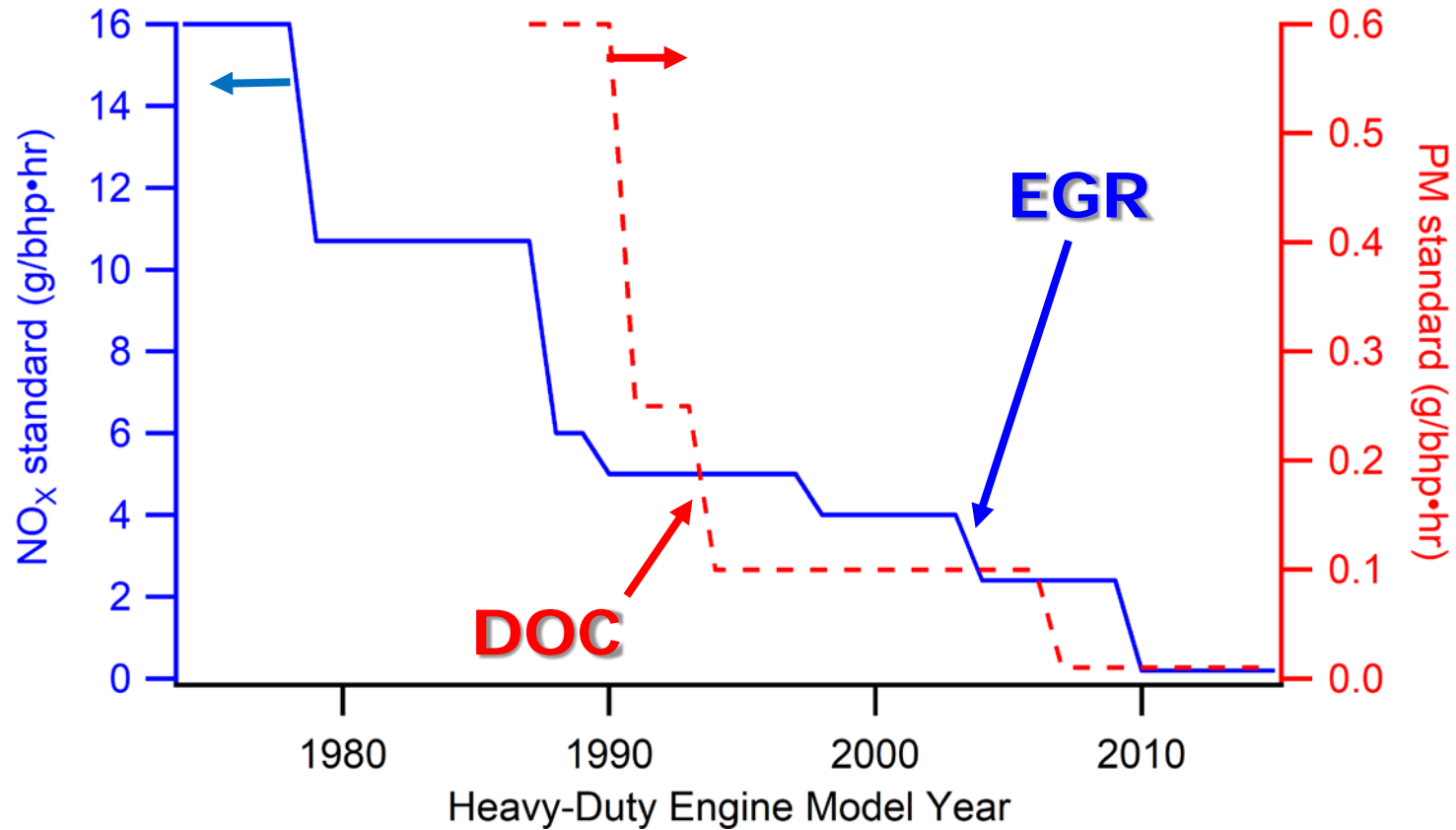


# Heavy-Duty Engine Emission Standards



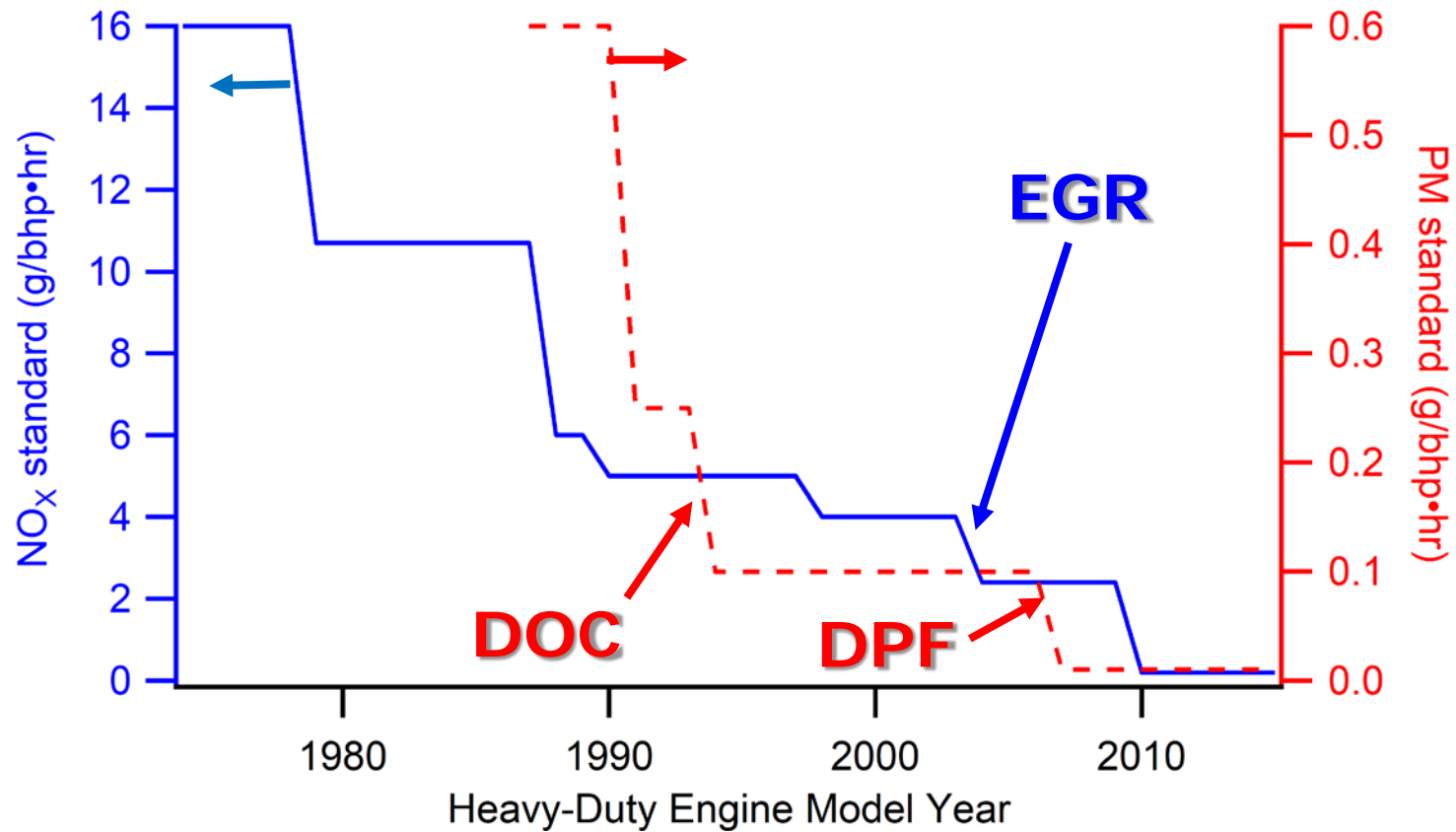
**1994: Diesel Oxidation Catalyst (DOC)**

# Heavy-Duty Engine Emission Standards



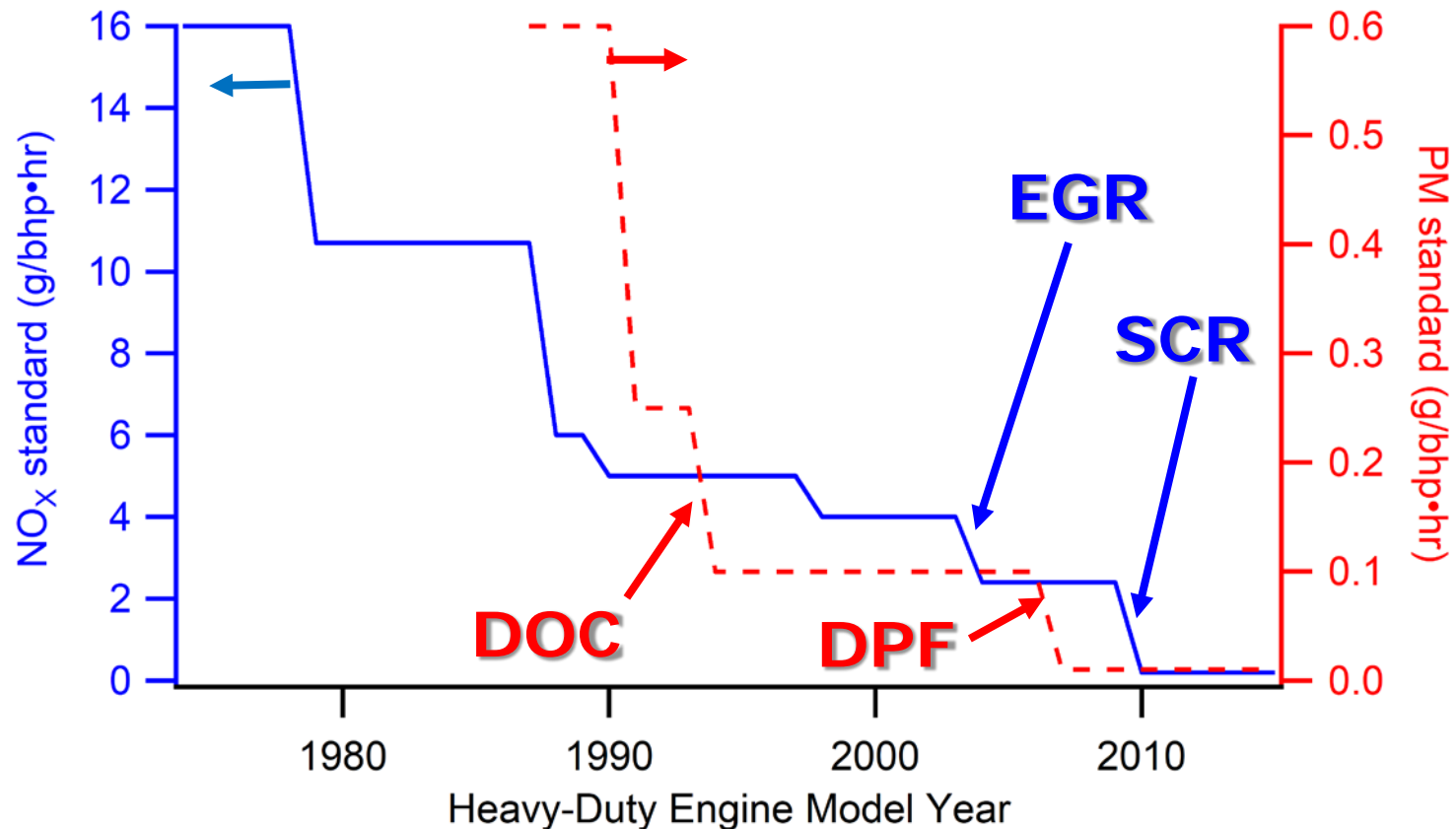
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# Heavy-Duty Engine Emission Standards



- 1994: Diesel Oxidation Catalyst (DOC)**
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- 2007: Diesel Particulate Filter (DPF)**

# Heavy-Duty Engine Emission Standards



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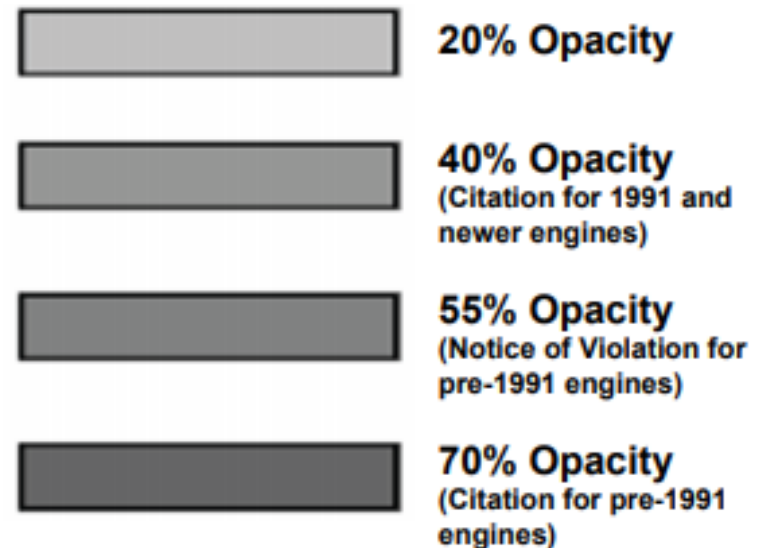
**2010: Selective Catalytic Reduction (SCR)**

# Improvements to on-road HDDVs

- California Diesel Risk Reduction Plan (DRRP, 2000)
  - Goal: 85% reduction in DPM emissions by 2020
  - Requires reduction in emissions from existing heavy-duty diesel vehicles (HDDVs) as well as new HDDVs
- Drayage Truck Regulation – all HDDVs in CA ports required to meet 2007 standards by end of 2012 (typically via DPF retrofit)

- Truck and Bus Rule – same for all HDDVs (not just those at ports) by end of 2015

- Field opacity testing (Enforcement)



<http://www.feat.biochem.du.edu>

## Heavy Duty

- Orange County, California
  - [\[1997, 0.2 mb\]](#) [\[Report\]](#) [\[ES&T\]](#)
  - [\[2008, 0.3 mb\]](#) [\[Report\]](#) [\[ES&T\]](#)
  - [\[2009, 0.3 mb\]](#) [\[Report\]](#) [\[ES&T\]](#)
  - [\[2010, 0.3 mb\]](#) [\[Report\]](#) [\[ES&T\]](#)
  - [\[2012, 0.3 mb\]](#) [\[Report\]](#) [\[ES&T\]](#)
- Port of LA, California
  - [\[2008, 0.2 mb\]](#) [\[Report\]](#) [\[ES&T\]](#)
  - [\[2009, 0.2 mb\]](#) [\[Report\]](#) [\[ES&T\]](#)
  - [\[2010, 0.3 mb\]](#) [\[Report\]](#) [\[ES&T\]](#)
  - [\[2012, 0.3 mb\]](#) [\[Report\]](#) [\[ES&T\]](#)
- Port of Houston, Texas
  - [\[2009, 0.2 mb\]](#) [\[Thesis\]](#)
- Uri, Switzerland
  - [\[1998, 0.1 mb\]](#) [\[German Report\]](#) [\[ES&T\]](#)
- San Marcos, Texas
  - [\[1998, 0.1 mb\]](#) [\[Report\]](#) [\[ES&T\]](#)
- Golden, Colorado
  - [\[1999, 0.1 mb\]](#) [\[Thesis\]](#) [\[ES&T\]](#)
  - [\[2005, 0.1 mb\]](#) [\[Thesis\]](#) [\[ES&T\]](#)
- Dumont, Colorado
  - [\[1999, 0.1 mb\]](#) [\[Thesis\]](#) [\[ES&T\]](#)
  - [\[2005, 0.1 mb\]](#) [\[Thesis\]](#) [\[ES&T\]](#)

## Light Duty

Data from:

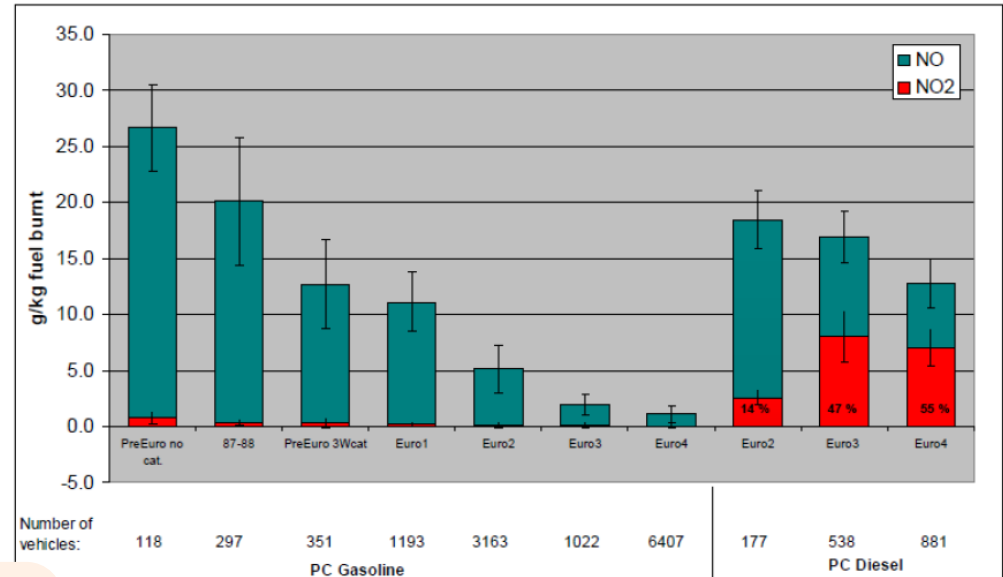
- 4 continents
- >21 countries
- >30 US locations
- Bishop & Stedman technology has been used by many others



# Use of Stedman & Bishop technology in Europe

- Several groups observed high NO and NO<sub>2</sub> emissions from light-duty diesel vehicles

Gasoline and diesel passenger cars –  
NO<sub>x</sub> and NO<sub>2</sub> emissions vs Euro class in 2007



*Jerksjö & Sjödin 2008 (CRC workshop)*

In late 2012, John German, a senior fellow at the International Council on Clean Transportation, a non-profit organisation, thought he had the answer. Having spent 13 years working for the Washington-based Environmental Protection Agency, Mr German knew how strict the regulator's compliance and enforcement programmes were. He figured that meant carmakers had been forced to make diesel cars "clean".

"Our goal was to test the diesels in the US, prove that diesels could be clean, take the data back to Europe and say, 'Hey, they can do this in the US, why can't you do this in Europe?'" he told the Financial Times after VW said late on Tuesday that it was in "advanced talks" to finalise a settlement with the DoJ.

But problems with Mr German's theory became apparent as soon as the ICCT began scrutinising VW's US diesel cars in 2013.

*Financial Times 2017 (www.ft.com)*

- This motivated the ICCT to examine light-duty diesel in the USA...

# For More Information:

- Research Division Vehicle Emissions Program

<https://www.arb.ca.gov/research/veh-emissions/>

NEW WEBSITE COMING SOON!

- Seminar and Project Links

<https://www.arb.ca.gov/research/seminars/bishop/bishop2.htm>

[https://www.arb.ca.gov/research/single-project.php?row\\_id=65094](https://www.arb.ca.gov/research/single-project.php?row_id=65094)

- Heavy-Duty Vehicle Rulemaking Portal

HD MY2007+ standards:	<a href="https://www.arb.ca.gov/msprog/onroadhd/reducstd.htm">https://www.arb.ca.gov/msprog/onroadhd/reducstd.htm</a>
Low NO <sub>x</sub> :	<a href="https://www.arb.ca.gov/msprog/hdlownox/hdlownox.htm">https://www.arb.ca.gov/msprog/hdlownox/hdlownox.htm</a>
Diesel Risk Reduction:	<a href="https://www.arb.ca.gov/diesel/dieselrrp.htm">https://www.arb.ca.gov/diesel/dieselrrp.htm</a>
HD in-use Compliance:	<a href="https://www.arb.ca.gov/diesel/dieselrrp.htm">https://www.arb.ca.gov/diesel/dieselrrp.htm</a>
Opacity & HD I/M:	<a href="https://www.arb.ca.gov/msprog/hdim/hdim.htm">https://www.arb.ca.gov/msprog/hdim/hdim.htm</a>