

# Roads, Pollution and Housing: Setting Some Boundaries

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## **Presented to**

11<sup>th</sup> Annual New Partners for Smart Growth Conference  
Session: “Housing and Freeways: How Close Is Too Close?”  
San Diego, California

## **Presented by**

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# Outline

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## Near-Road Pollution

1. News ([from Los Angeles](#))
2. Near-road pollution, why we care ([health](#))
3. Problem sources ([cars and trucks](#))
4. Problem scale ([distance from road](#))
5. The future ([fleet turnover](#))

## Smart Growth

6. Enter smart growth ([Los Angeles](#))
7. Benefits vs. risks ([health](#))
8. Solutions ([mitigation](#))



# Los Angeles Times

Freeway air pollution linked to brain damage in mice



“Our data... suggest that freeway pollution could have a profound effect on... health in children and young kids, **especially those who attend schools built alongside freeways.**”

*Todd Morgan, USC  
research professor*

Source: **April 7, 2011**, *Los Angeles Times*

# Near-Road Pollution: Why We Care

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“...near major roads [people] have an increased incidence and severity of health problems...”



Source: U.S. EPA Highway Clean Air Research Program  
<http://www.epa.gov/ord/ca/quick-finder/roadway.htm>

# Problem Sources: Cars and Trucks

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- Light-duty
  - CO, NO<sub>x</sub>, PM
  - Toxics
    - Benzene
    - 1,3-butadiene



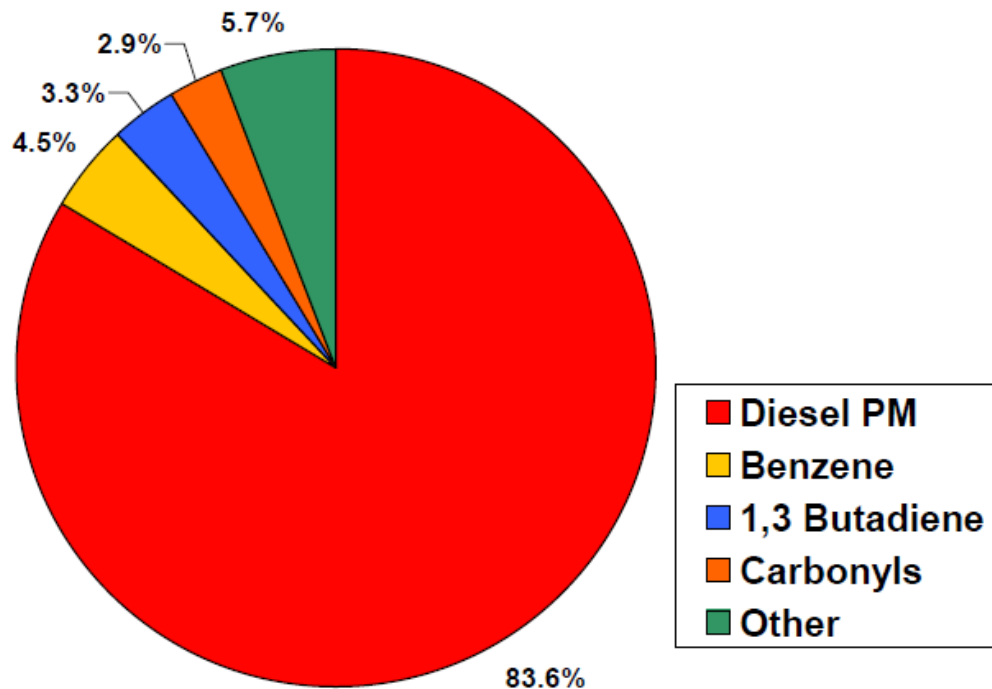
- Trucks
  - NO<sub>x</sub>, PM
  - Toxics
    - Diesel PM



# Problem Sources: Truck Focus

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Diesel particulate matter (DPM) emissions are most important “air toxic”



**Basinwide Risk: 1194 Per Million**

Los Angeles  
“MATES” study:  
DPM produced  
**over 80%** of air  
pollution-related  
cancers.

(SCAQMD, 2008)

# Problem Sources: Congestion

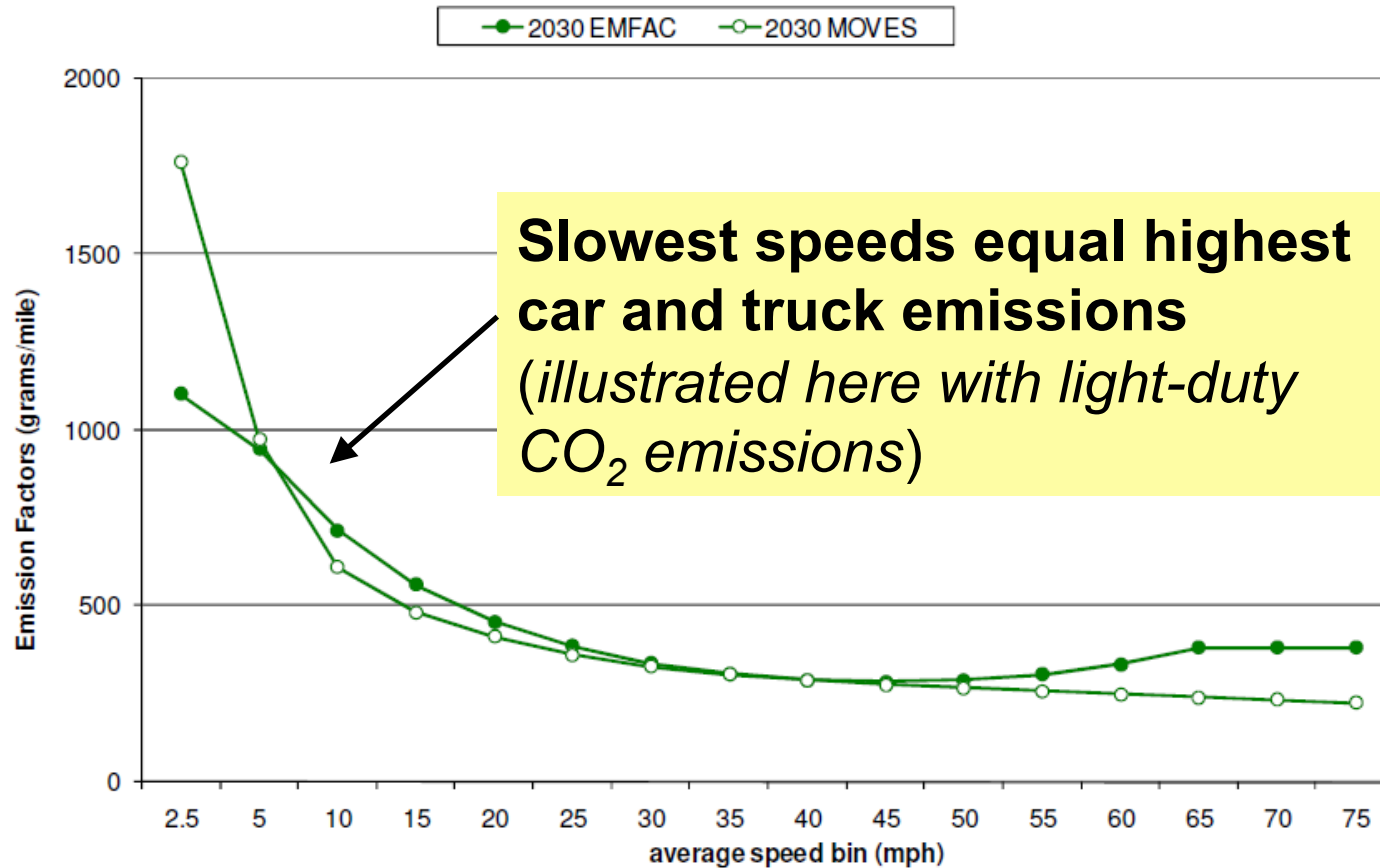
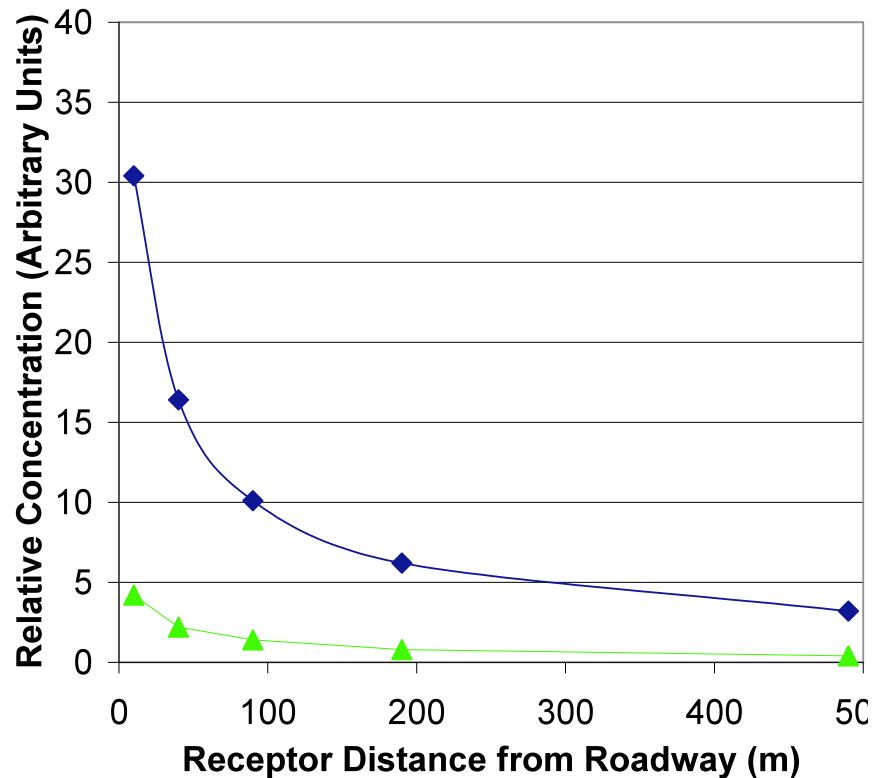


Image source: Bai, Eisinger, and Niemeier (2009)  
TRB Paper, *MOVES vs. EMFAC*

# Problem Scale: Key Concepts



Wind Speed  
**Slow: 1 m/sec**  
**Faster: 10 m/sec**

**Modeled concentrations vary with winds and distance**

Source: Tamura and Eisinger, 2003 (US 95 Case Study)

[http://www.fhwa.dot.gov/environment/air\\_quality/air\\_toxics/research\\_and\\_analysis/](http://www.fhwa.dot.gov/environment/air_quality/air_toxics/research_and_analysis/)



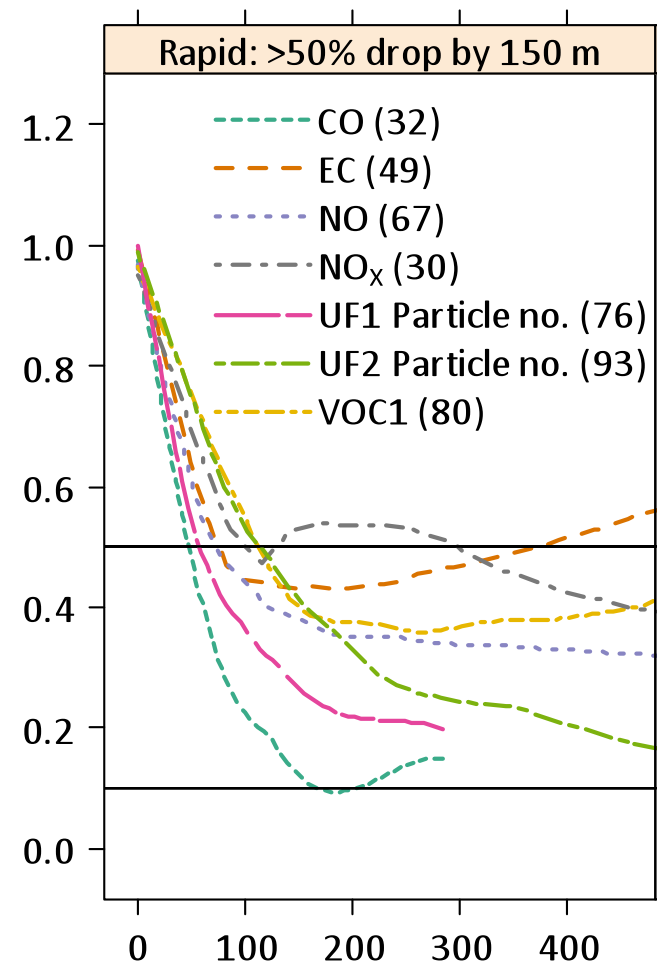
# Problem Scale: Worldwide Data

**Measured concentrations**  
41 studies, 13 countries, 30 years

Key findings, by distance from road:

- 150 m – rapid (50%) decline
- 400 m – most at background
- 600 m – nearly all at background

(nighttime exceptions)



Source: Karner, Eisinger, Niemeier; *ES&T* 2010, vol. 44, 5334-5344

# Future, Part 1: Standards

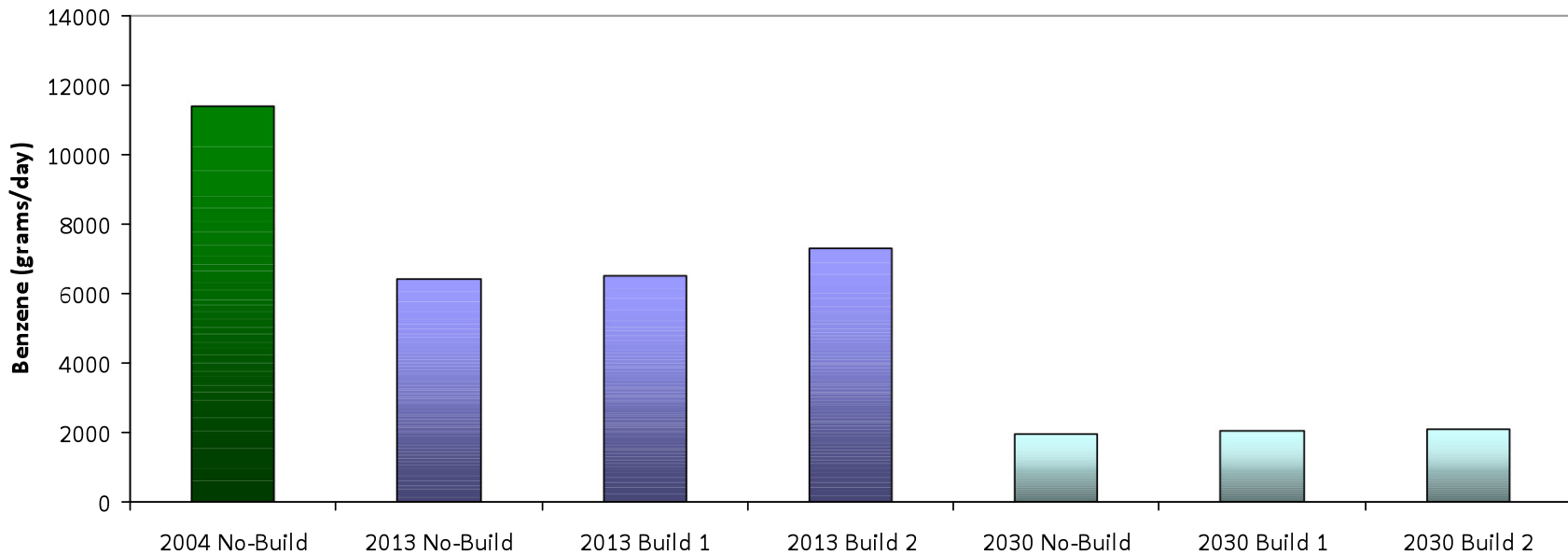
From 1980 to 2010, new-car HC emissions were cut >90%. *New-truck emissions were also reduced.*

| Model Year | HC    | CO   | NO <sub>x</sub> |
|------------|-------|------|-----------------|
| 1966       | 6.30  | 51.0 |                 |
| 1971       |       |      | 4.0             |
| 1980       | 0.39  |      | 1.0             |
| 1981       |       | 7.0  | 0.7             |
| 1993       | 0.25  | 3.4  |                 |
| 2010       | 0.035 | ~1.7 | ~0.05           |

Sample California standards for new light-duty vehicles (units are g/mi)



# Future, Part 2: Implications



Hypothetical freeway project (chart above): benzene emissions drop ~80% (2004–2030)

Source: STI analyses

Sacramento MPO modeled near-road  $PM_{2.5}$ :  $PM_{2.5}$  emissions drop ~80% (2008–2035)

Source: 2035 SACOG draft plan

# Enter Smart Growth: Reduced Travel and Emissions

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Regionally, can reduce  
VMT, energy use, and  
CO<sub>2</sub> emissions **about  
1 to 11% by 2050**



Source: U.S. National Research Council, 2009

# Los Angeles Plan: >50% of New Growth in “High-Quality Transit Areas” (HQTAs)

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2035 Plan



**Blue:** HQTAs

**Purple:** 8–11% of new growth <500 ft from freeways

Source: SCAG December 2011 Draft RTP/SCS  
Environmental Justice Supplement

# Benefits vs. Risks

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“...**initial review** of the literature suggests that **beneficial aspects** of active transportation [*walking or biking*] **outweigh any negative impacts** related to increased air pollution exposure...”



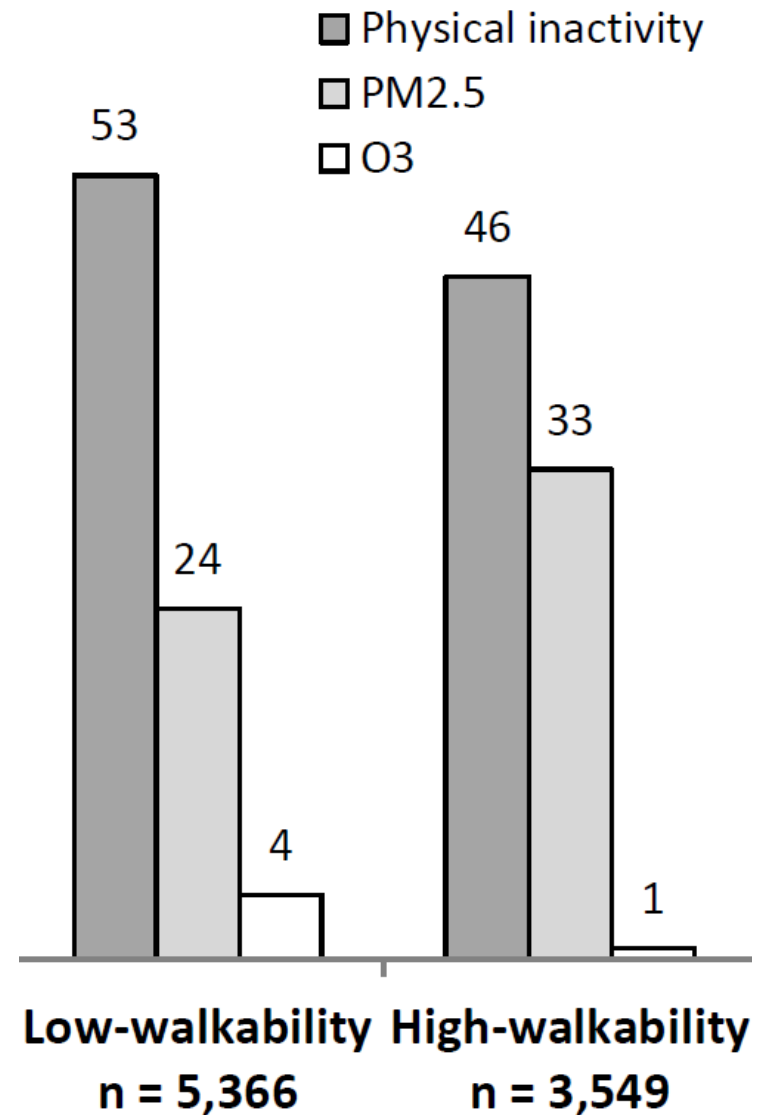


# Benefits vs. Risks: Ongoing Work

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- More people are physically active (25% vs. 13%)
- However, **increased air pollution exposure can offset activity benefits**

From: Hankey et al. (2011)  
*Health Impacts of the Built Environment*



Deaths per 100,000 people/year  
from ischemic heart disease  
(using 2001 pollution data)

# Solutions: Sample Challenge

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Bay Area Upper Muni Yard Affordable Housing Site (near I-280)  
Design Considerations: Population Groups and HVAC Filters

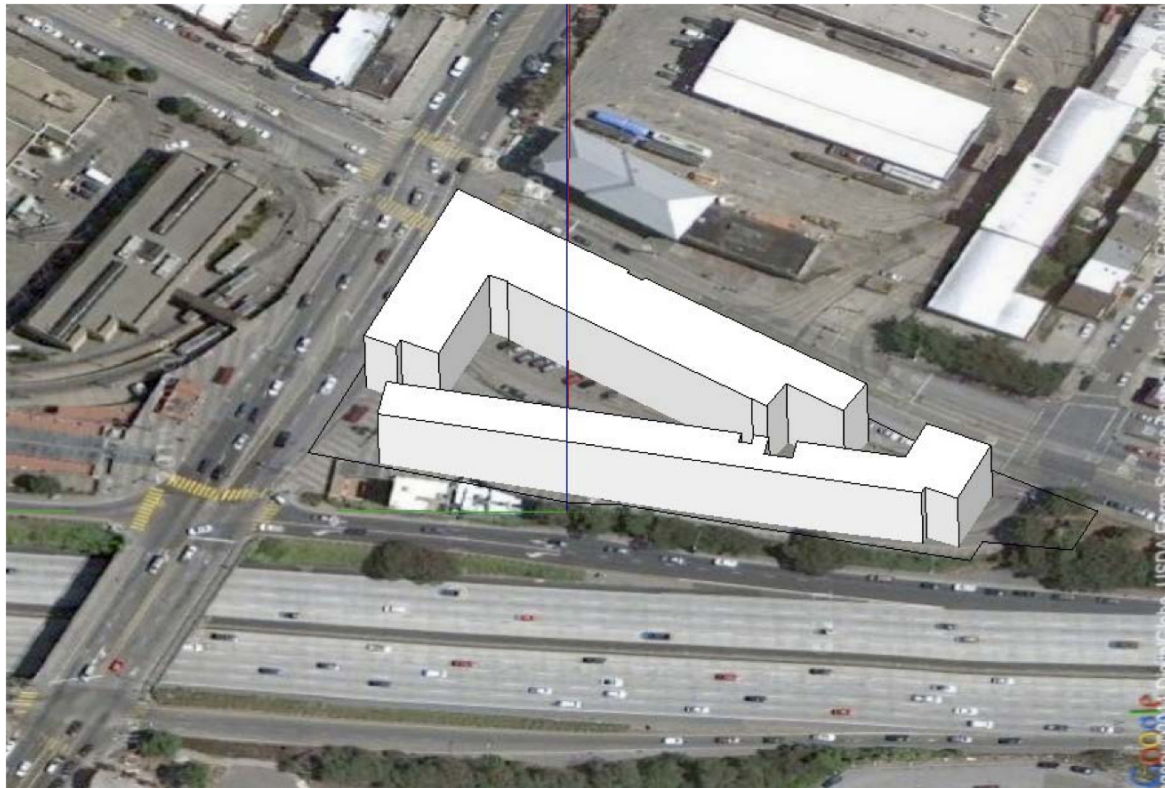


Image courtesy of Tom Rivard, SF Dept. of Public Health



# Solutions: Closing Thoughts

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## Reduce Emissions

- Congestion
- Fleet turnover

## Intercept Pollutants Outdoors

- Sound walls
- Vegetation

## Increase Distance to Roads

- 150–600 m zone

## Control Land Use by Sensitive Groups

- Children, seniors
- The health-impaired
- Pregnant women

## Control Vehicle Types

- Truck rerouting

## Intercept Pollutants Indoors

- HVAC air intake locations
- HVAC filters

# Contact

The screenshot shows the website for Sonoma Technology, Inc. (STI). At the top left is the STI logo and the company name. To the right is a Google Site Search box with a 'Search' button. Below the logo is a navigation menu with links for Home, Services, Projects, About Us, and Career Center. A sidebar on the left lists 'Clients We Serve' with categories: Government, Private Industry, University & Non-Profit, Legal, Tribal, and International. Below this is a 'Contact Us' section with the phone number 707.665.9900. The main content area features a large image of a child sitting on a rock overlooking a valley, with the text 'Air quality research and innovative solutions' overlaid. Below the image are three headline sections: 'Tell a Story with Web Videos', 'STI Voted One of the Best Places to Work in the North Bay', and 'STI Joins the Federation of Earth Science Information Partners'. To the right of these headlines is a 'Join us!' section with a recruitment message and a link to the Career Center. At the bottom right of the main content area is an image of stacked stones. The footer contains copyright information (© 1987-2011 Sonoma Technology, Inc.), social media links for YouTube and LinkedIn, and links for Privacy statement, Site map, and Contact.

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# Additional Material

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For question and answer period



## Pupils' health 'at risk' from London road pollution



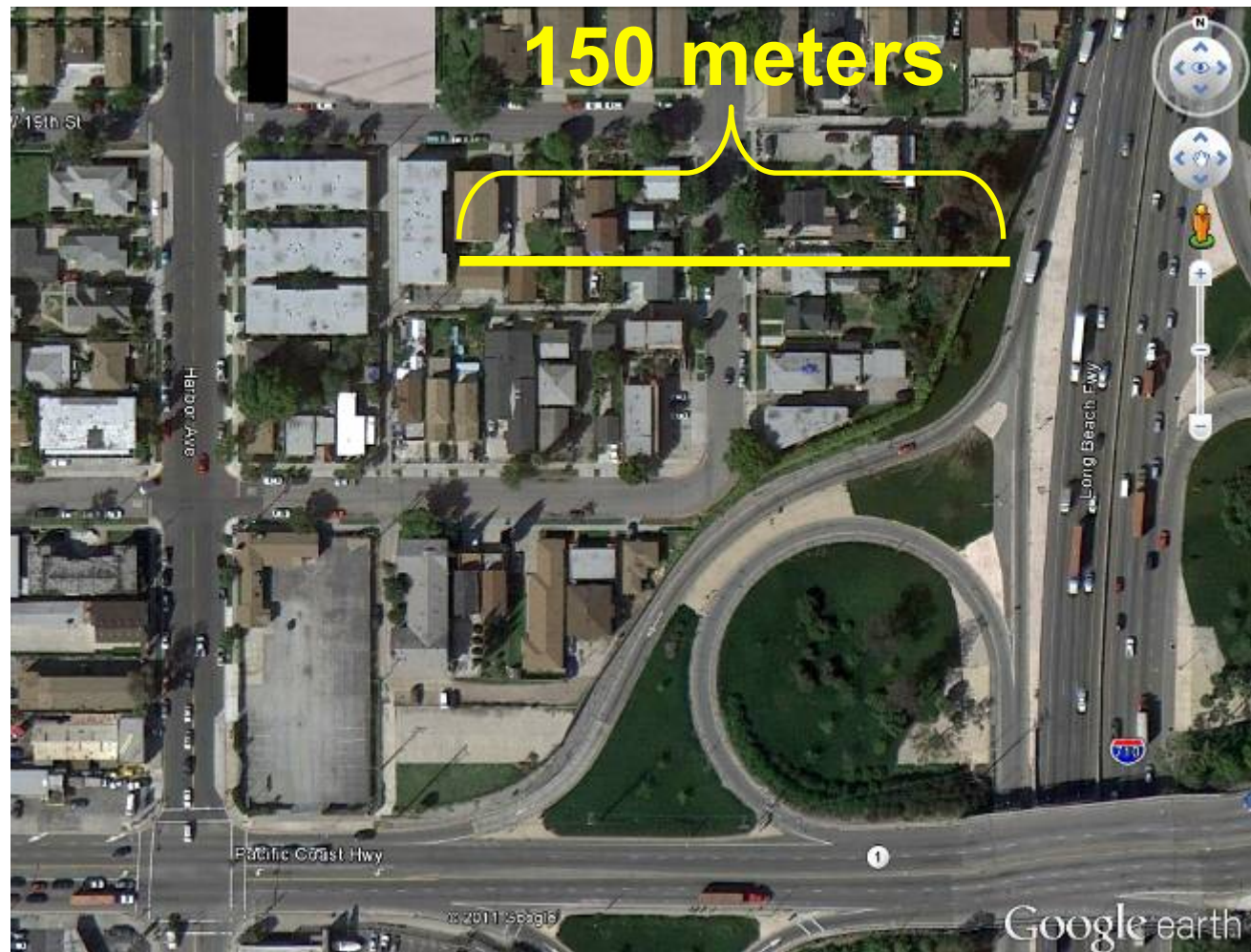
Up to 2,270 schools in London are within 400 m of busy roads

Source: **June 7, 2011**, *BBC News*

(based on research by Clean Air London and Aphekomb)

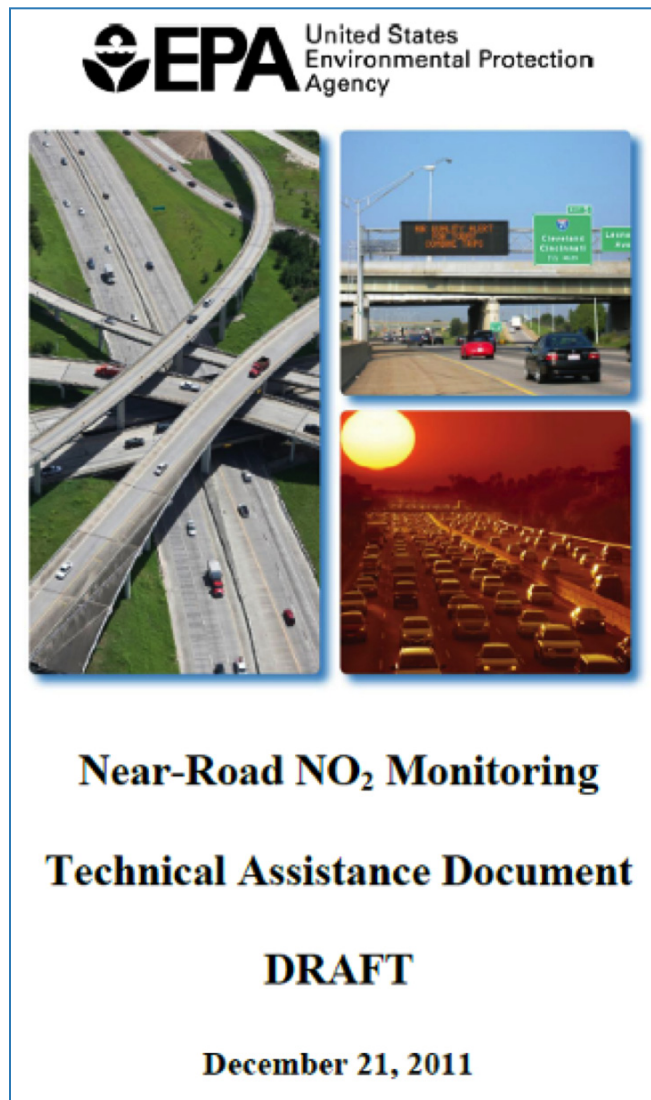
# Problem Scale: Illustration

Streets near  
710 Freeway  
and Port of  
Long Beach





# Near-Road Pollution: EPA Requirement



In recognition of the near-road issue...

EPA requires near-road pollution measurements **starting January 1, 2013**

# Required Near-Road NO<sub>2</sub> Monitoring

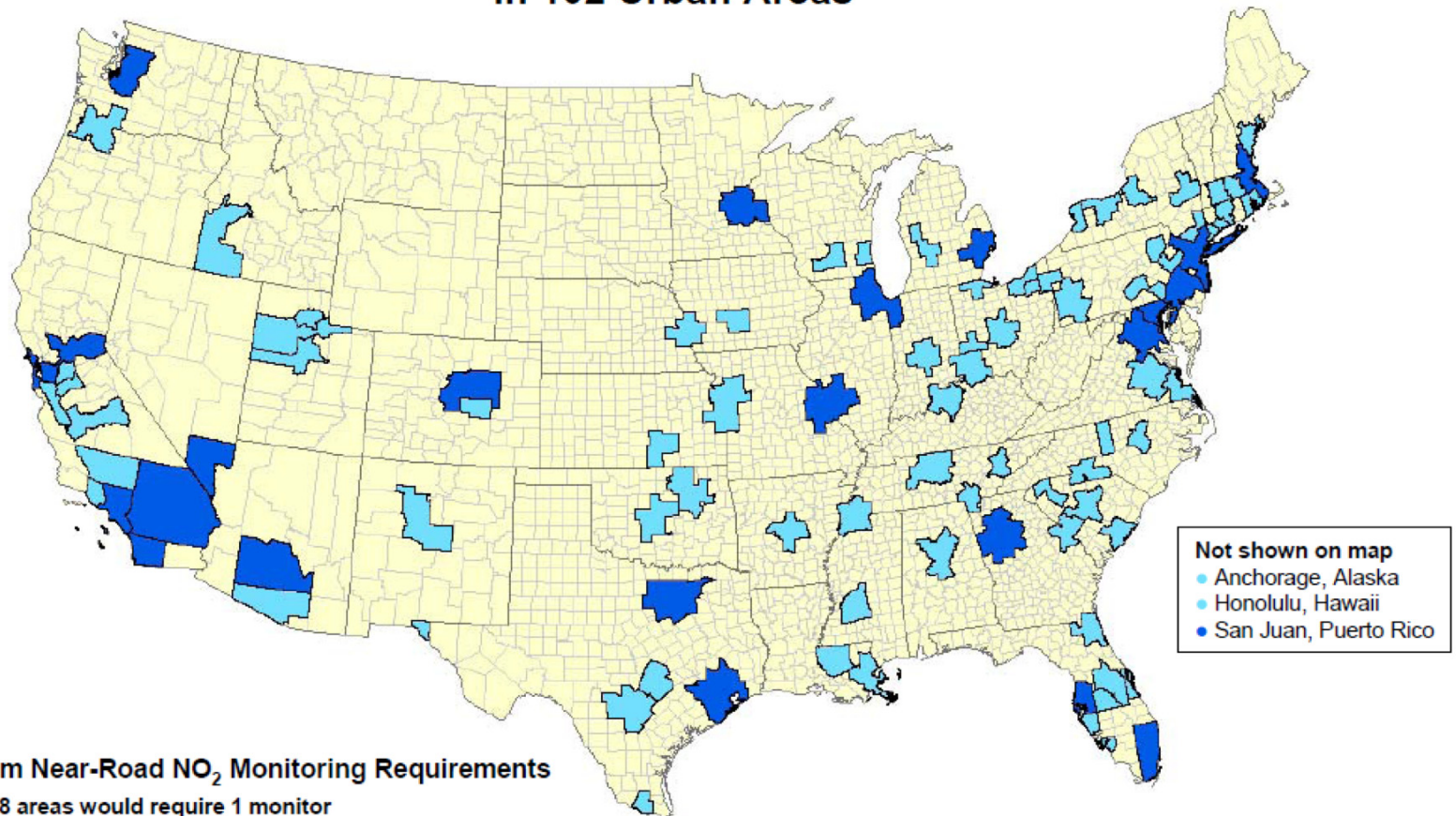
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- 1 site: areas  $\geq$  500,000 population
- 2 sites: areas  $\geq$  2.5 million population
- 2 sites: areas with roads  $\geq$  250,000 AADT
- Rank roads by AADT (weight trucks more)
- Identify possible maximum NO<sub>2</sub> sites
- Locate monitor “as near as practicable to the outside nearest edge of the traffic lanes...” **but not further than 50 meters**

# Required Near-Road NO<sub>2</sub> Monitoring



## EPA Plans to Monitor NO<sub>2</sub> Concentrations Near Roads in 102 Urban Areas





# The Future: Truck Standards Over Time

Car and truck emissions standards have become more stringent over time

(truck standards shown here)

During 2007–2010, standards tightened further:

- $\text{NO}_x$  0.20 g/(hp-hr)
- PM 0.01 g/(hp-hr)

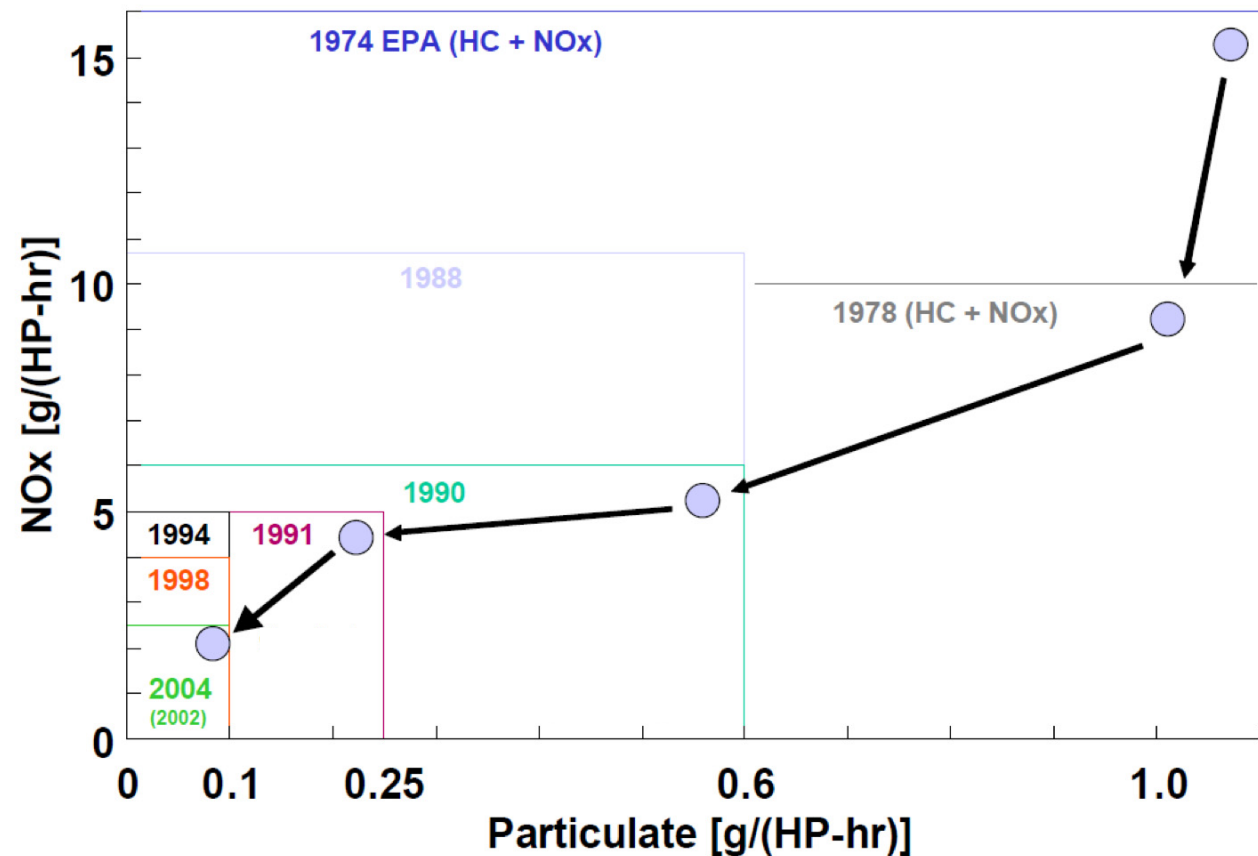
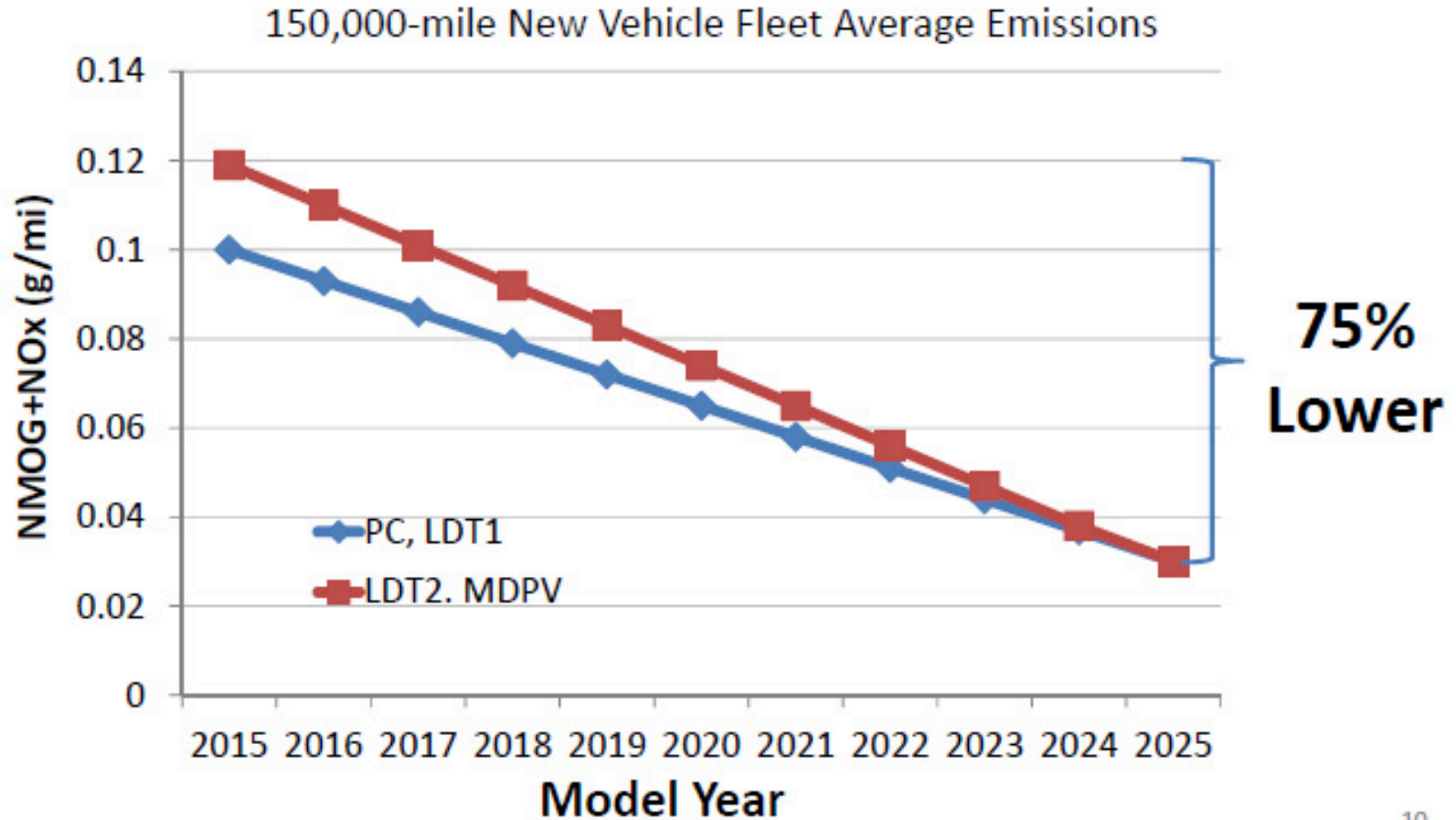


Figure source: Patrick Flynn, Cummins Engine Co.

# The Future: New ARB Clean Car Rules



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Approved by California Air Resources Board, January 27, 2012

# Solutions: Caveats

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## Caveats for impacts and mitigation

- Near-road findings are largely from studies of areas where there were no barriers between roads and receptors
- Barriers channel air and make problems more complex
- Tall buildings next to narrow streets are like “canyons” with their own meteorological and air quality conditions
- Site-specific conditions govern air quality (wind speed, wind direction, topography, traffic, and so on)
- The vehicle fleet is getting cleaner over time
- Treat these findings as “directional,” meaning they should help you grasp key concepts

# Closing Thoughts: Bullet Points

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- Pollution declines quickly within 150 to 600 m. So...
  - **Increase distance between roads and people**
  - **Consider buffers (sound walls, vegetation)**
- Vehicles pollute more when operated at slow speeds. So...
  - **Avoid congested traffic near smart growth communities**
- Diesel PM dominates air-related cancer risk (in California). So...
  - **Avoid routing truck traffic near sensitive locations**
- Some people are more susceptible, like children and elderly. So...
  - **Avoid sensitive land uses near major roads (e.g., schools)**
- People spend 90% or more of their time indoors. So...
  - **Optimize building air intake and filtering systems**
- Finally, vehicles (cars and trucks) keep getting cleaner. So...
  - **Understand that, for a given set of traffic conditions, pollution near roads will decline over time**