

Smart Growth and Near-Road Air Pollution: Understanding the Link

Presented to

10th Annual New Partners for Smart Growth Conference
Charlotte, North Carolina

Presented by

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Petaluma, California

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Sonoma Technology, Inc.

Low-Carb Land

Informing Your Land Use Decisions to Consider Travel and CO₂ Impacts

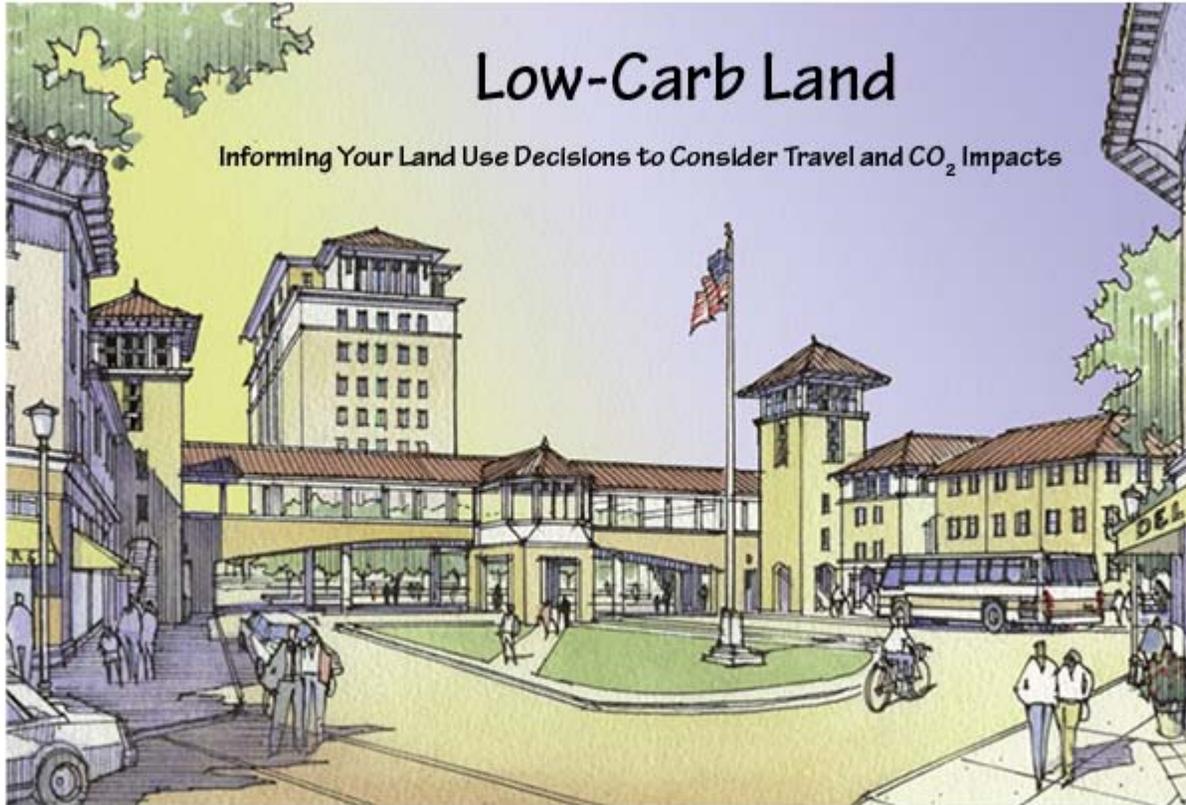


Image courtesy Contra Costa County Redevelopment Agency

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Partnership *for* Sustainable Communities



SUPPORTING ENVIRONMENTAL JUSTICE
AND EQUITABLE DEVELOPMENT

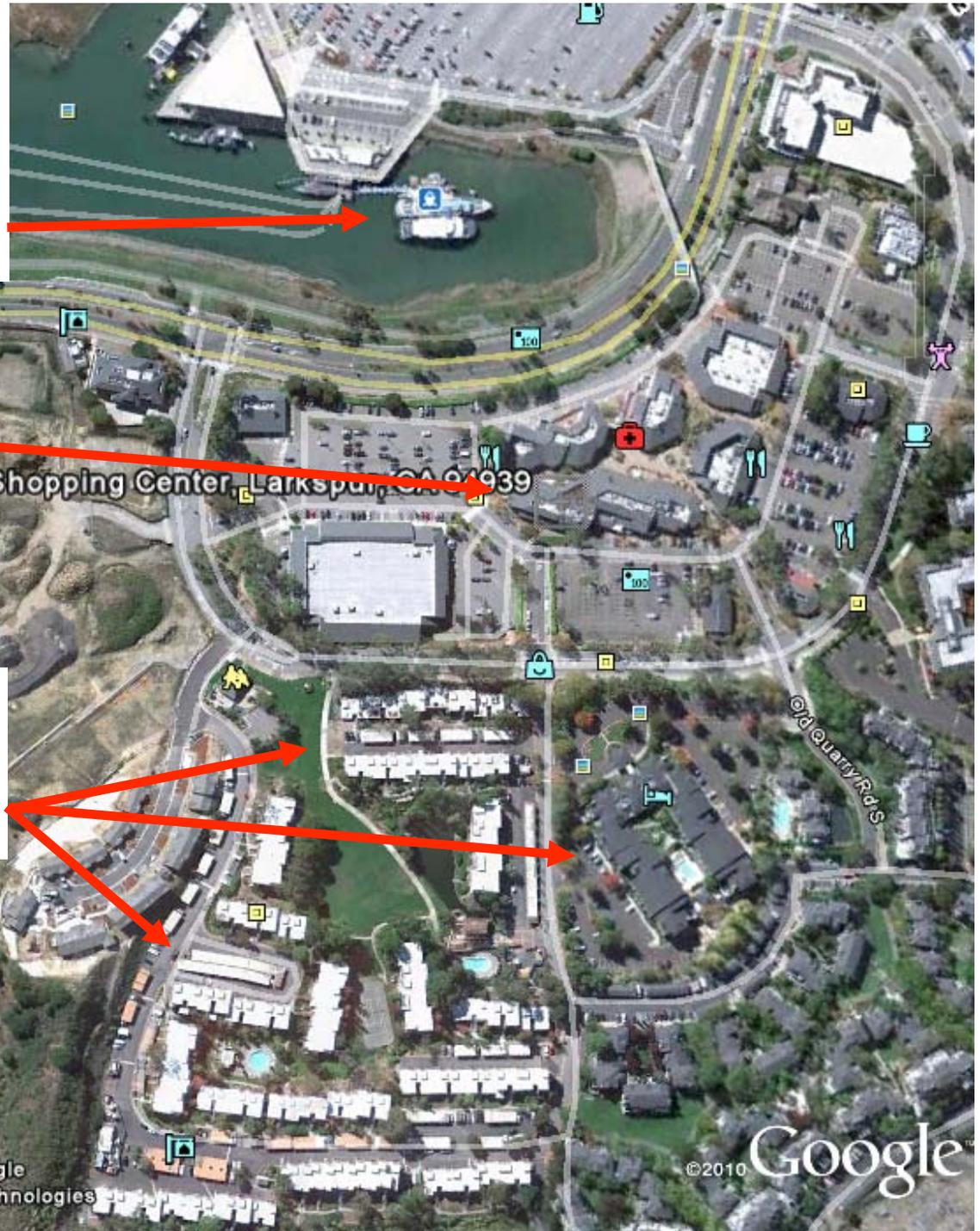
“By working together, [HUD, DOT, and EPA] can make sure that ... **affordable housing exists in close proximity** to jobs and transportation. That means encouraging shorter travel times and lower travel costs. It means safer, greener, more livable communities.”

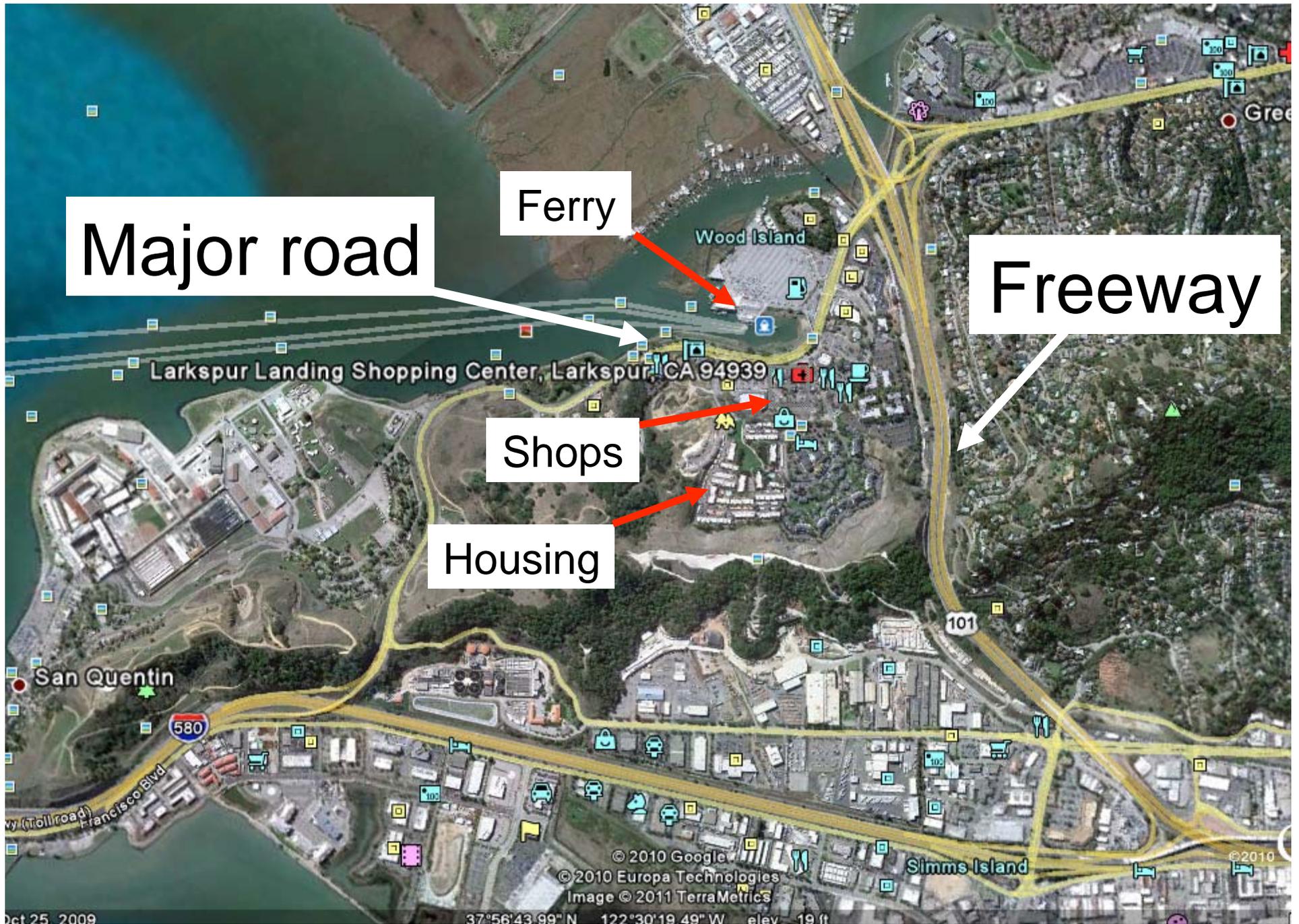
- President Barack Obama

Ferry service
to downtown
San Francisco

Shops,
restaurants,
movie theater

High density
housing





Major road

Ferry

Freeway

Shops

Housing

Larkspur Landing Shopping Center, Larkspur, CA 94939

San Quentin

101

Simms Island

© 2010 Google
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Image © 2011 TerraMetrics

Oct 25, 2009

37°56'43.99" N 122°30'19.49" W elev 19 ft

Los Angeles Times | HEALTH

Proximity to freeways increases autism risk, study finds

More research is needed, but the report suggests air pollution could be a factor.



Source: December 16, 2010, *LA Times*

based on a peer-reviewed article by Volk et al., 2010 (USC, UC Davis, STI)

Outline: Top Ten List

1. 300-400 m and 570 m

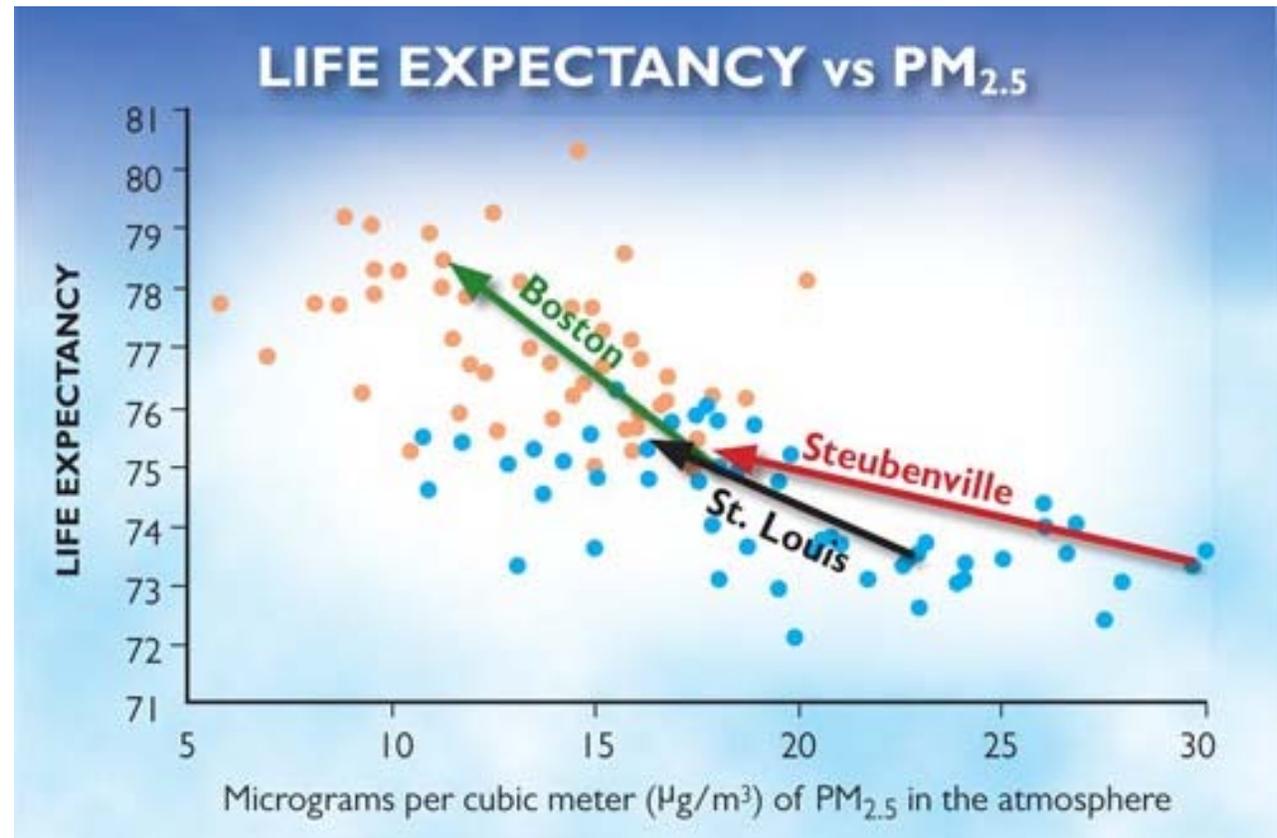
Outline: Top Ten List

1. 300-400 m and 570 m
2. Why do we care about air pollution?
3. What air pollution is key for smart growth?
4. What are the health risks near roads?
5. What traffic conditions increase emissions?
6. Where is “background”?
7. What is the regulatory response?
8. Do smart growth benefits outweigh risks?
9. How can we mitigate near-road impacts?
10. What is the long-run view? (*good news*)

Why Do We Care About Air Pollution?

- Respiratory problems
- Cancer
- Early death

Image source:
Harvard Magazine
May-June 2009



Why Do We Care About Air Pollution?

Susceptible populations are most at risk:
Children, elderly, pregnant women, and
those with pre-existing respiratory problems.

The NEW ENGLAND
JOURNAL *of* MEDICINE

ESTABLISHED IN 1812

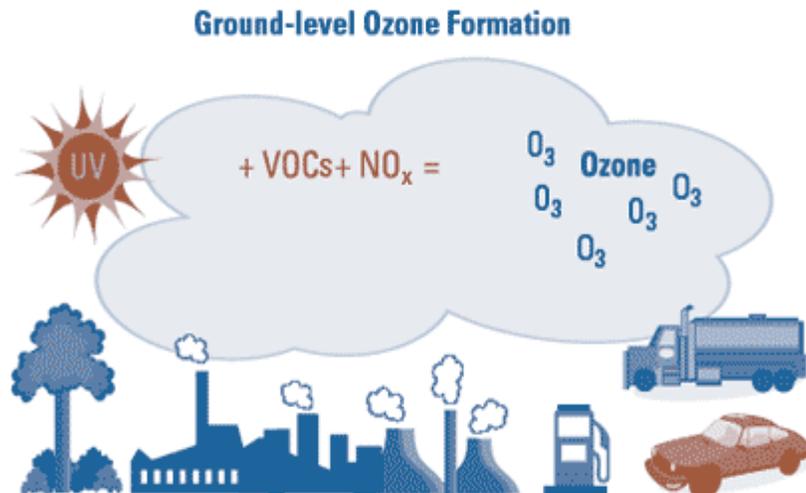
SEPTEMBER 9, 2004

VOL. 351 NO. 11

The Effect of Air Pollution on Lung Development
from 10 to 18 Years of Age

What Pollution is Key for Smart Growth?

- Primary = emitted directly
- Secondary = formed in air



Graph Source: www.cleanairachievers.ca

For smart growth, consider pollutants emitted nearby, such as

- particulate matter (PM)
- diesel exhaust
- toxics
- NO and NO_2

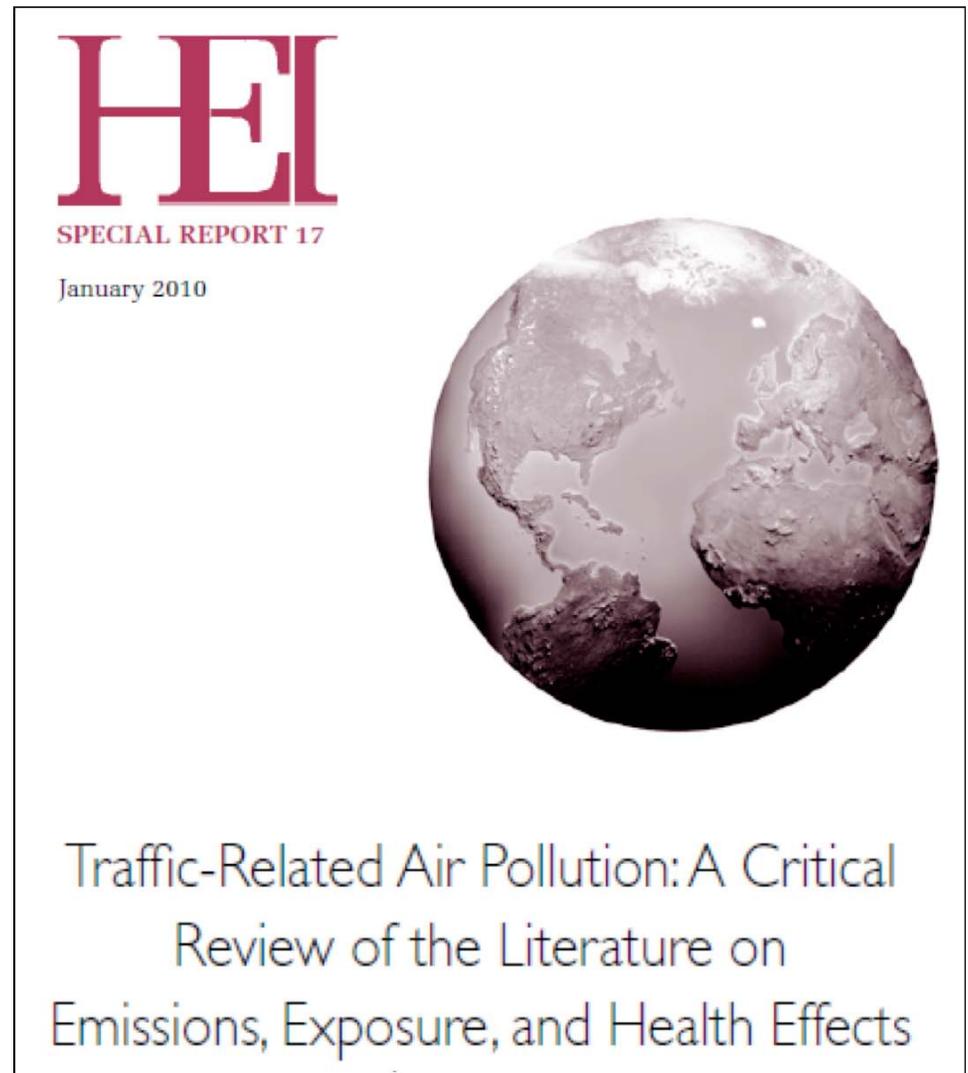
Absent nearby industry, motor vehicles are the key source.

What Are the Health Risks Near Roads?

Exposure to traffic-related air pollution **exacerbates asthma**.

There's also suggestive evidence of a causal relationship with:

- onset of childhood asthma
- other respiratory problems
- impaired lung function
- total mortality
- cardiovascular mortality
- cardiovascular morbidity



What Traffic Conditions Increase Emissions (Conventional Cars)?

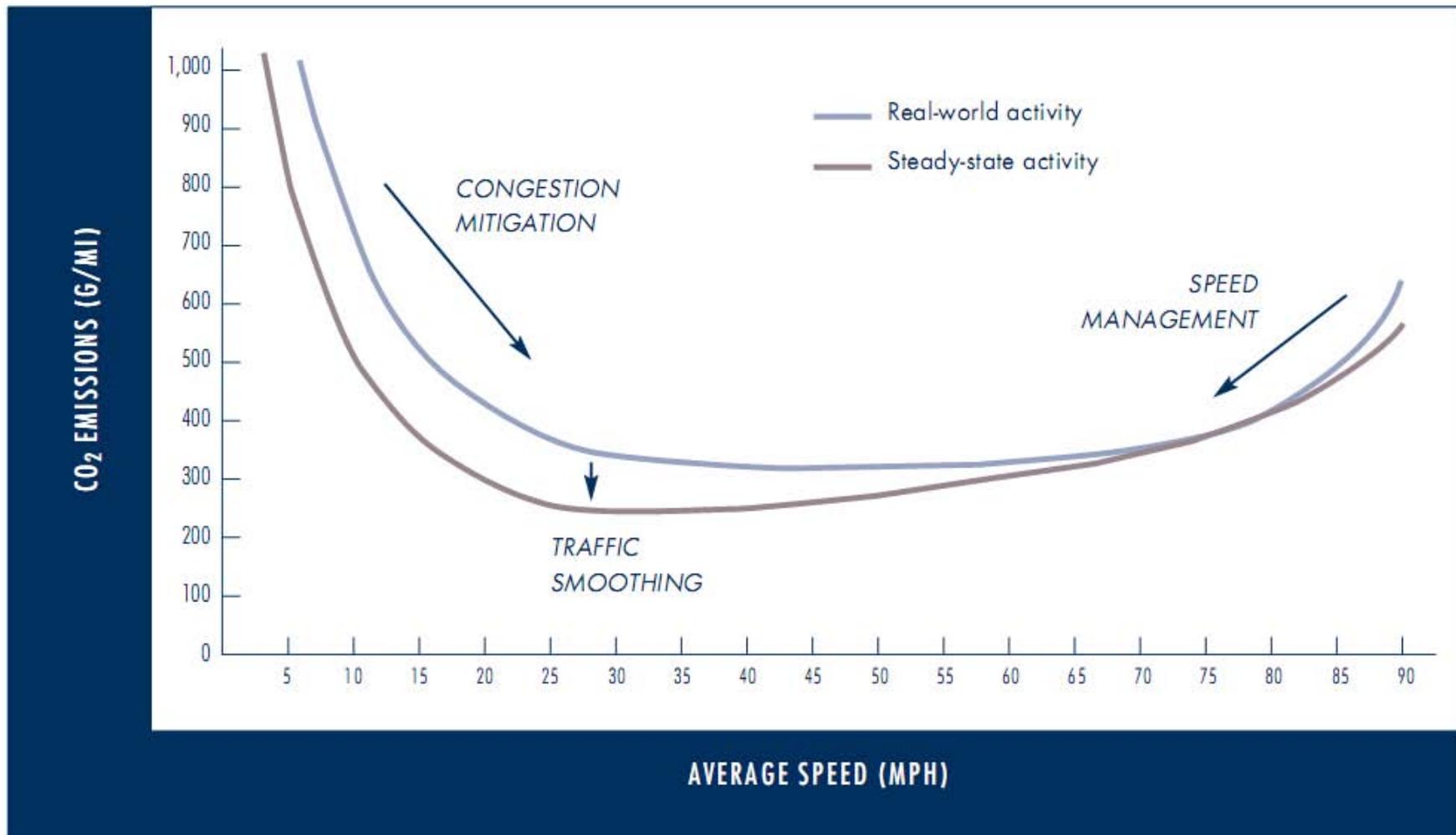
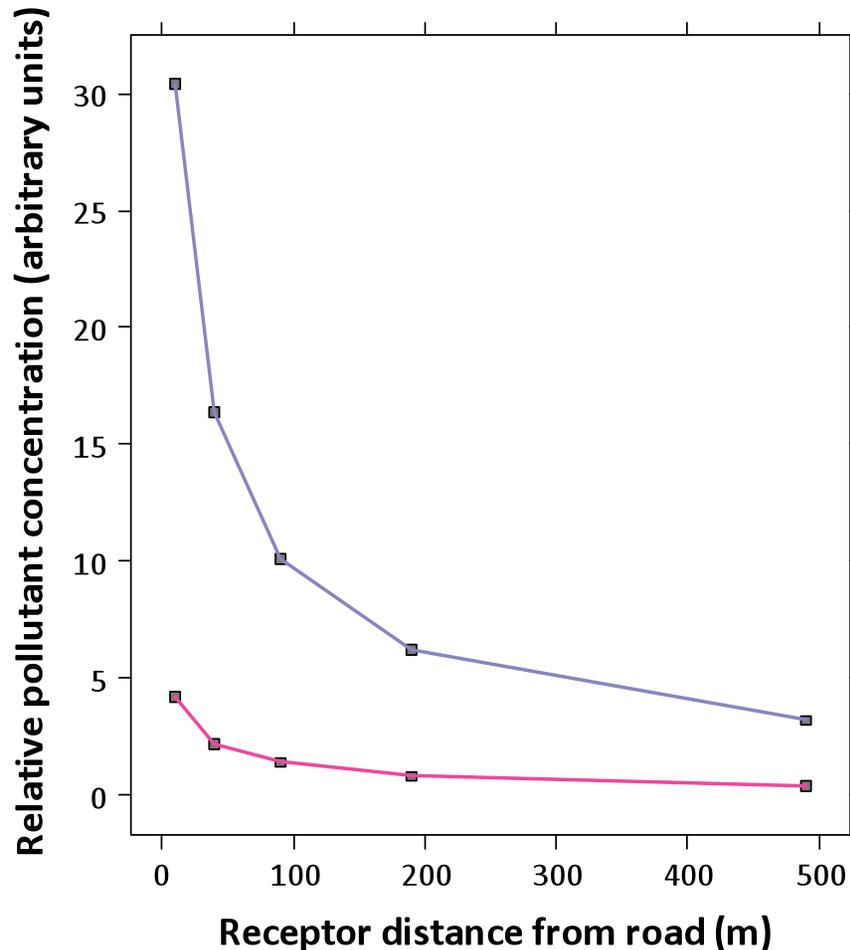


Image source: Barth and Boriboonsomsin (2009)

Where is Background? (1 of 3)

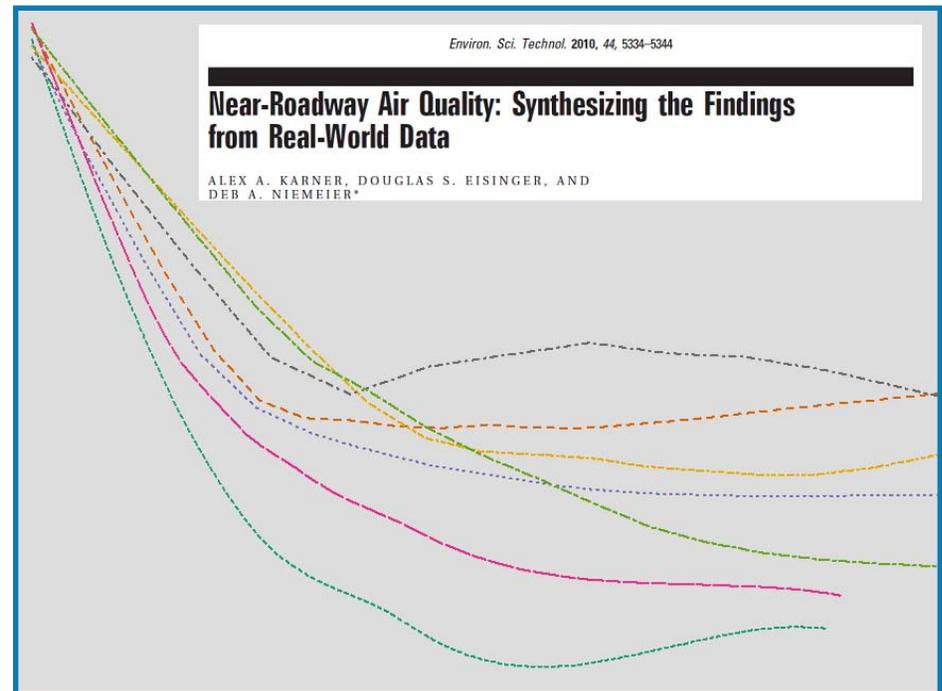


- Image for modeled “generic” pollution
- Levels decline with distance
- Higher wind speeds reduce concentrations
- Simplified example, flat terrain

Source: Tamura and Eisinger (2003)

Where is Background? (2 of 3)

- Data from:
 - 41 studies
 - 30 years
 - 13 countries
- **68% of data near freeways or highways**
- **32% of data near local roads or arterials**



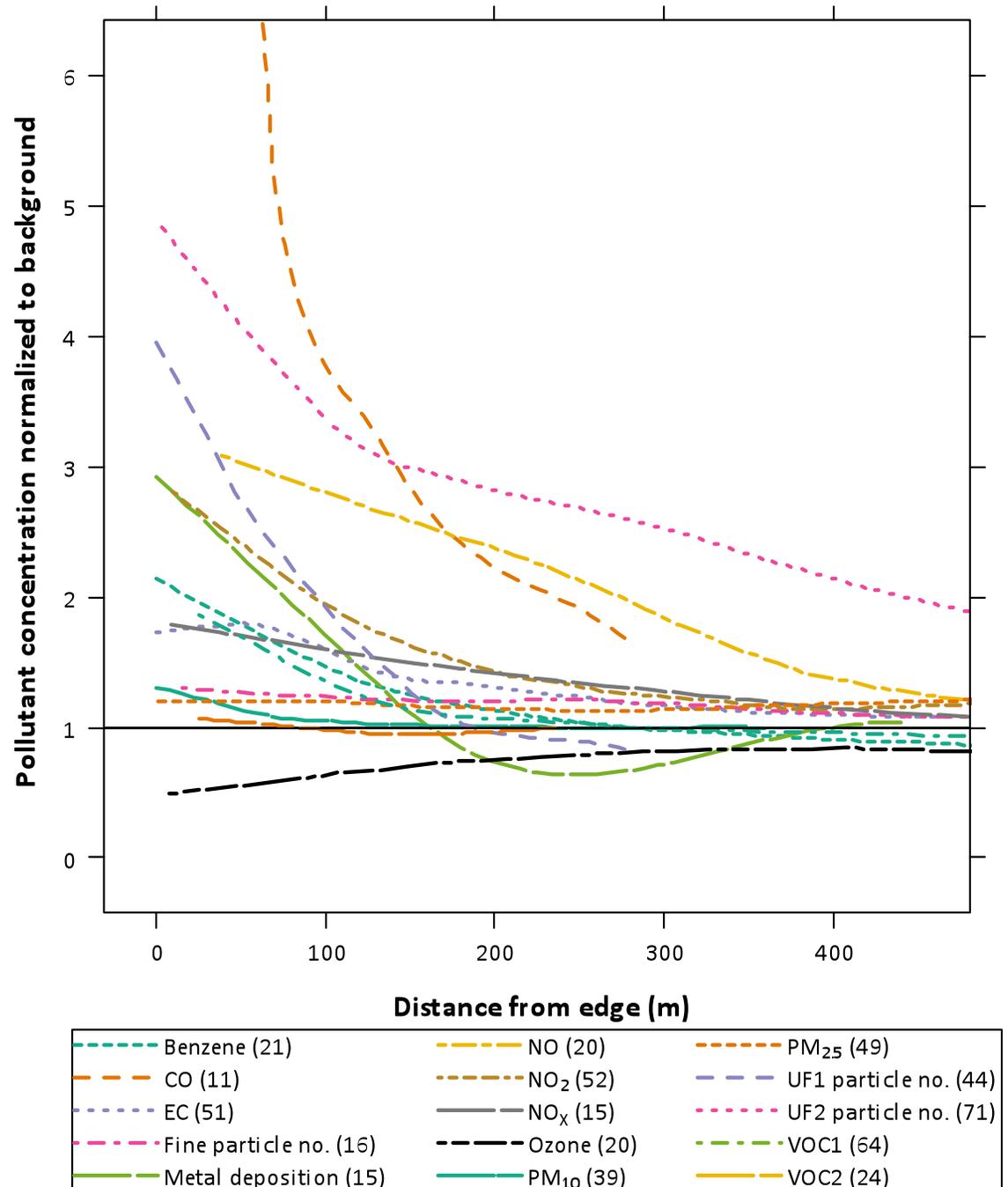
Reference: Karner, Eisinger, Niemeier (2010)

Background?

(3 of 3)

- Most reach background by 300-400 m
- Virtually all pollutants reach background by 570 m

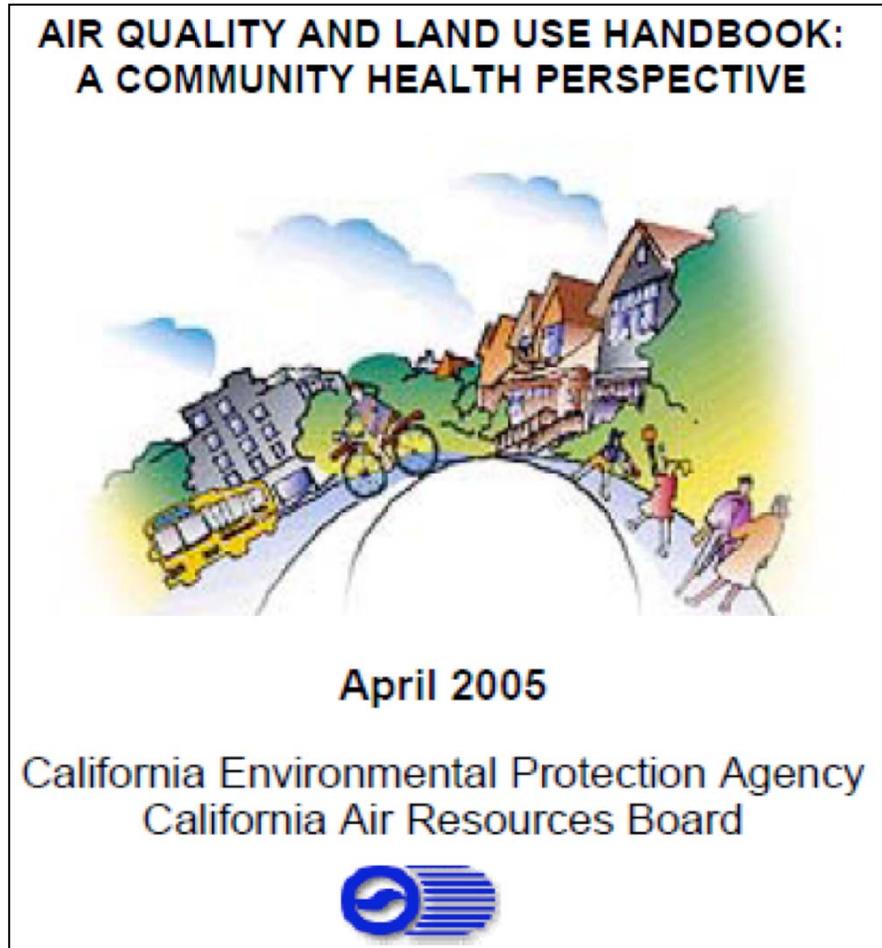
Image source:
Karner, Eisinger,
Niemeier (2010)



What's the Regulatory Response? (1 of 2)

Avoid **sensitive** land uses within 500 ft (*~150 m*) of

- Freeway
- Urban road: 100,000 vehicles daily
- Rural road: 50,000 vehicles daily

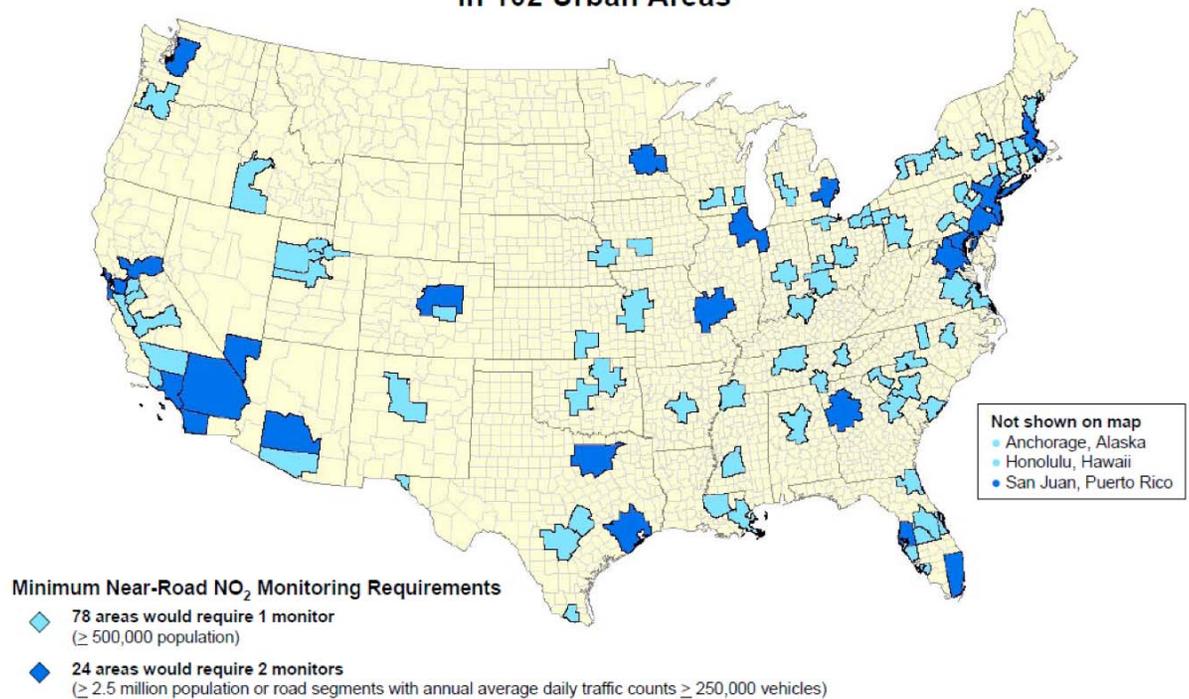


What's the Regulatory Response? (2 of 2)

- **By late 2012**
Key traffic projects must quantify near-road PM
- **By early 2013**
Polluted areas must monitor near-road CO and NO₂



EPA Plans to Monitor NO₂ Concentrations Near Roads in 102 Urban Areas



Areas that must monitor near-road NO₂

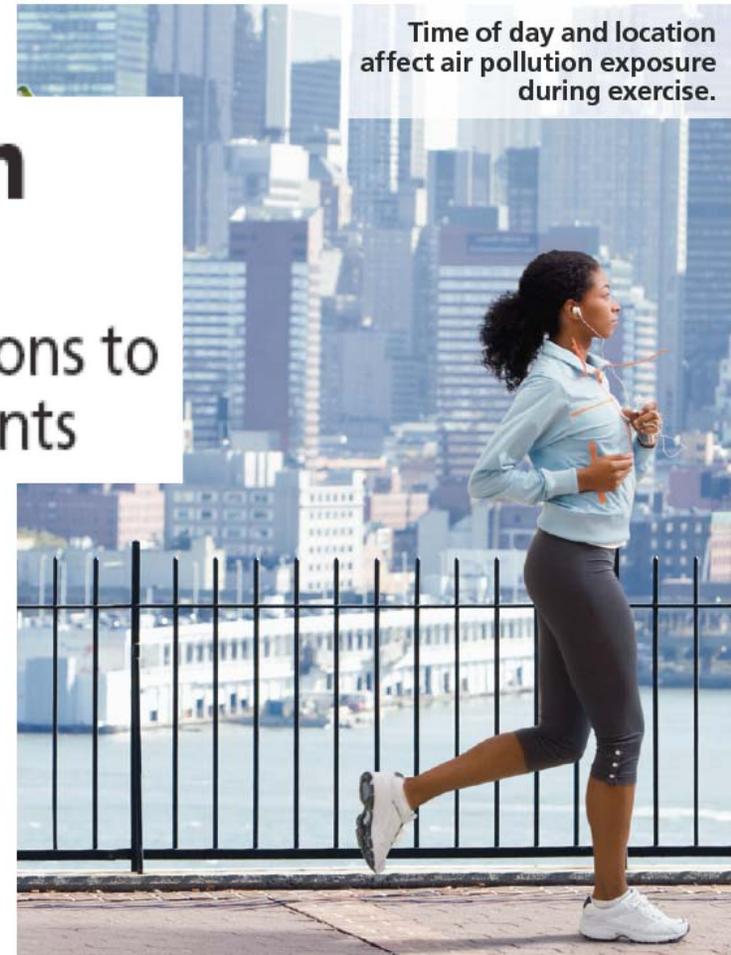
Do Benefits Outweigh Risks? (1 of 3)

Separating People from Pollution

Individual and Community Interventions to Mitigate Health Effects of Air Pollutants

Findings from an international workshop: reducing air pollution health impacts.

March 2009, Vancouver



Time of day and location affect air pollution exposure during exercise.

Do Benefits Outweigh Risks? (2 of 3)

“...**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...”



But, more research is needed... and we need to weigh sensitive individuals/subgroups, plus distance from the road.

Do Benefits Outweigh Risks? (3 of 3)

If community design

(1) separates **schools, child care centers, and hospitals** from major roads, or

(2) mitigates traffic congestion, it

“...can reduce exposure and impacts among vulnerable members of the population...”



How Can We Mitigate Impacts? (1 of 3)

1. Locate land uses (especially “sensitive” ones) ~**300-400 m** (preferably **570 m**) from major roads
2. “Major roads” has no clear definition
 - Health literature: often uses 10,000 vehicles/day
 - Regulatory tests: focus is ~100,000 vehicles/day
5. Land use targeted to **susceptible population** groups is of special concern

How Can We Mitigate Impacts? (2 of 3)

4. What mitigation options are available?

- Create buffer zones—increase distance to land use sites
- Smooth traffic flow (reduce congestion): synchronize signals
- Install HVAC filtration systems (*possibly, needs more study*)

5. Avoid mixing smart growth with high levels of diesel traffic. Reroute truck traffic away from sensitive land uses (real world examples demonstrate this works).

Diesel PM is the most significant air toxic (cancer risk).

How Can We Mitigate Impacts? (3 of 3)

6. Important caveats for impacts and mitigation

- Findings shown here are largely from studies without 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)
- Treat these findings as “directional,” meaning they should help you grasp key concepts

7. Finally, one development option is to wait...

What is the Long-Run View?

Cars, trucks, and buses are getting much cleaner over time (*good news!*)



For example, by 2010, hydrocarbon emissions from cars had been cut by more than 90% compared to cars sold 30 years earlier.

New trucks are also polluting much less.

~210 m
to major road

Housing

~400 m
to freeway



Suggested Reading

Karner, Eisinger, Niemeier (2010) “Near-roadway air quality: synthesizing the findings from real-world data” (evaluates field measurements from over 40 studies around the world)

U.S. National Research Council (2010) “America’s Climate Choices” (assesses climate change science, mitigation, and adaptation)

U.S. National Research Council (2009) “Driving and the Built Environment” (quantifies potential Smart Growth GHG reductions)

Health Effects Institute (2010) “Special Report 17” (evaluates published findings on traffic-related air pollution health effects)

Giles et al. (2011) “From Good Intentions to Proven Interventions: Effectiveness of Actions to Reduce the Health Impacts of Air Pollution” (international workshop findings relevant to smart growth)

Contact

The screenshot shows the website for Sonoma Technology, Inc. The header includes the STI logo, a Google Site Search bar, and navigation links for Home, Services, Projects, About Us, and Career Center. A main banner features a woman sitting on a cliff overlooking a valley, with the text "Air quality research and innovative solutions". Below the banner is a "Headlines" section with three articles: "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". A "Join us!" section on the right contains a recruitment message and a link to the Career Center. The footer includes copyright information, social media links for YouTube and LinkedIn, and links for Privacy statement, Site map, and Contact.

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- > Legal
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707.665.9900

Air quality research and innovative solutions

Headlines

Tell a Story with Web Videos
Web videos are rapidly becoming the best way to communicate complex information to a broad audience. Easily accessible by computer, mobile ... [read more >>](#)

STI Voted One of the Best Places to Work in the North Bay
For the fourth consecutive year, STI was selected one of 54 best places to work in the North Bay (Sonoma, Marin, and Napa counties). According ... [read more >>](#)

STI Joins the Federation of Earth Science Information Partners
The Federation of Earth Science Information Partners (ESIP), a consortium of Earth science data and technology professionals spanning government, ... [read more >>](#)

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We're actively seeking qualified individuals to join our growing company.

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Discussion



Diesel Truck Emissions Over Time

Emissions standards have become more stringent over time

During 2007-2010, standards dropped further:

- NO_x 0.20 g/(hp-hr)
- PM 0.01 g/(hp-hr)

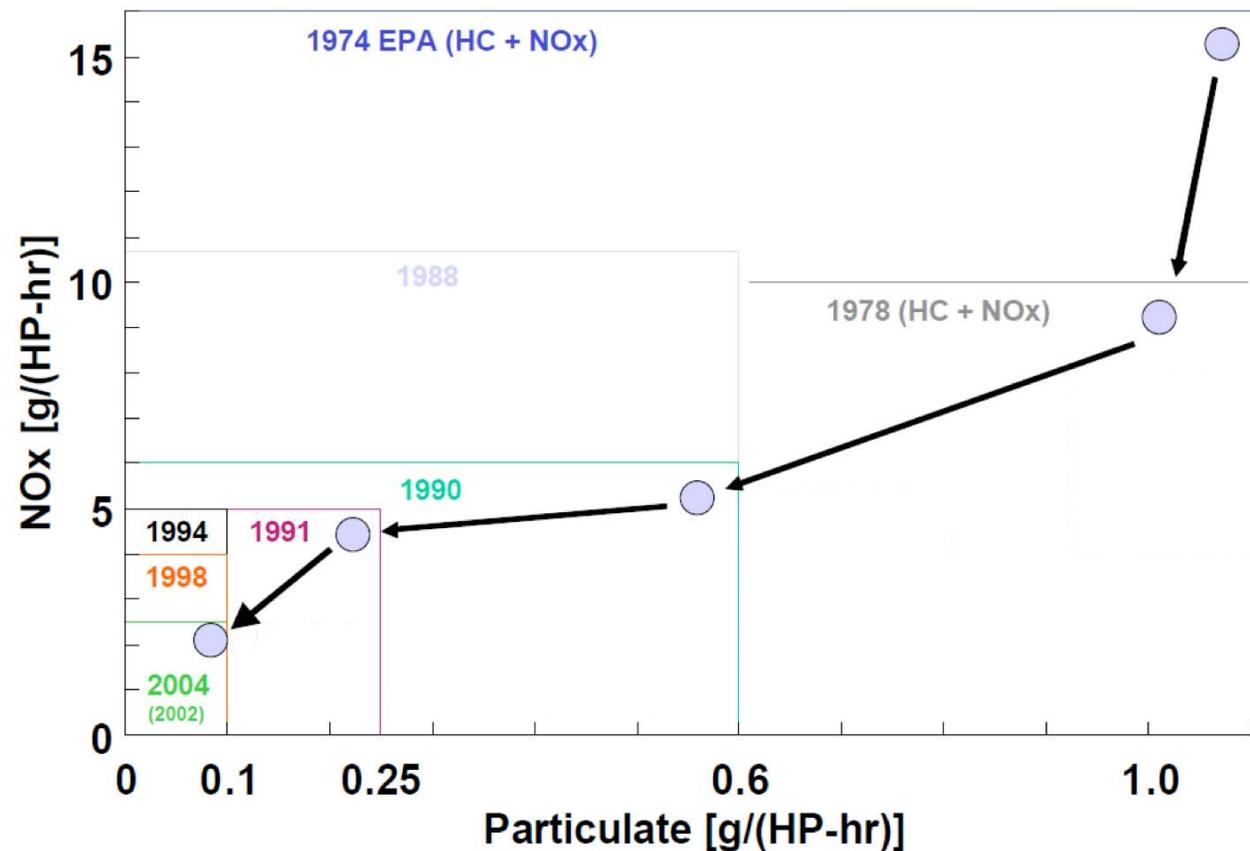


Figure source: Patrick Flynn, Cummins Engine Co.

Cars are Getting Cleaner Too

- Exhaust standards have reduced emissions of “traditional” pollutants (HC, CO, NO_x)

By 2010, HC emissions had been cut by more than 90% compared to vehicles sold 30 years earlier.

Model Year	HC	CO	NO _x
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)



Landmark Litigation Over Near-Road Issues: US 95 Road-widening (Sierra Club vs. FHWA)

Before widening



After widening



Fyfe Elementary School next to US 95 in Las Vegas.
Settlement agreement resulted in near-road
monitoring and in-school mitigation.



High Intersection Density

Medium Intersection Density

Low Intersection Density

Very Low Intersection Density

Source of images: © 2010 Alex S. MacLean / Lincoln Institute of Land Policy. For detailed image information please refer to Visualizing Density at www.alexmaclean.com and www.lincolnlpi.edu/subcenter/visualizing-density

Distance: 5 mile | Design: low | More Info

Elasticities (% change in VMT or VT given 1% change in D Vars)

	Name	VMT	VT
Edit	Density	-0.050	-0.050
Edit	Diversity	-0.060	-0.030
Edit	Design	-0.060	-0.050
Edit	Destination	-0.150	0.000
Edit	Distance	-0.080	0.000

Vehicle Miles Traveled (VMT) and Vehicle Trips (VT) per household (hh) per day

	Subregion ID #	Area Type	VMT/hh	VT/hh
Edit	491	Rural	65.6	6.2
Edit	492	Suburban	55.9	6.3
Edit	493	Town	48.1	5.2
Edit	494	Urban	42.1	5.5