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

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Charlotte, North Carolina

Presented by

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Petaluma, California

February 5, 2011

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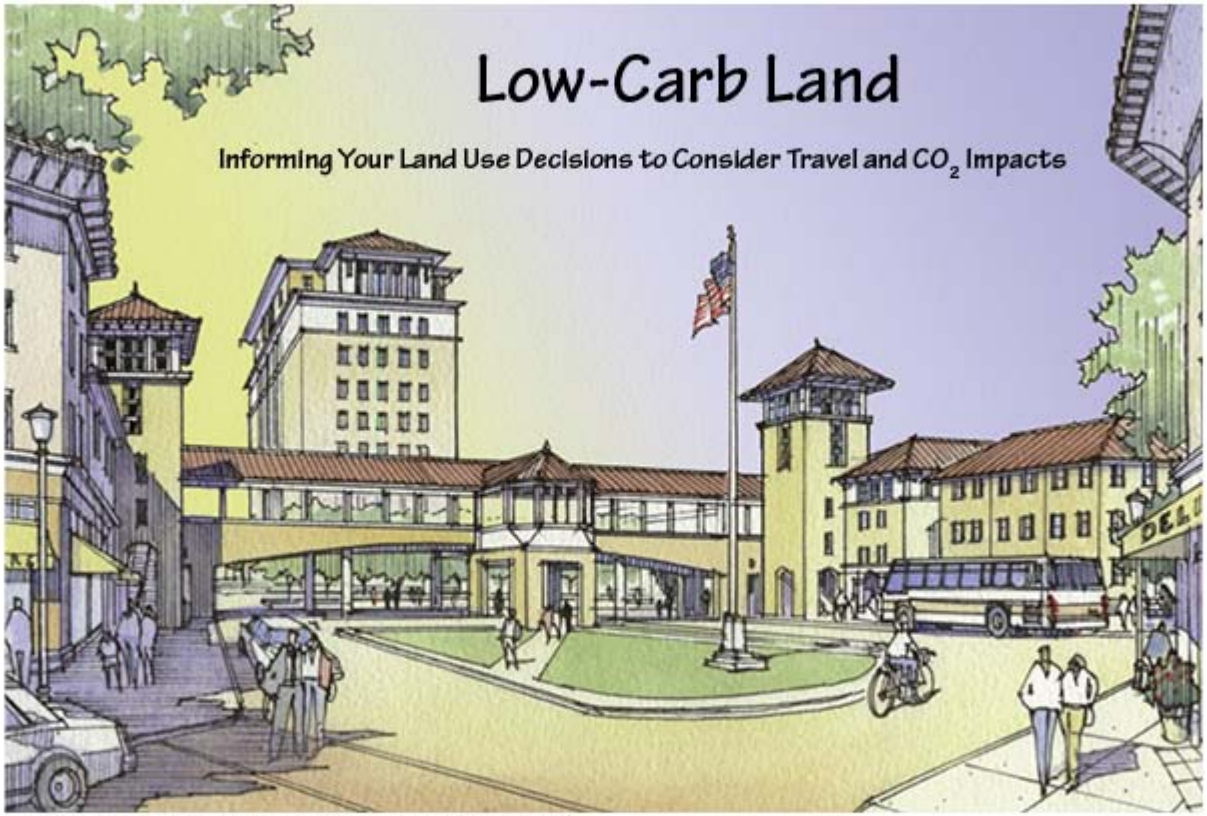

Image courtesy Contra Costa County Redevelopment Agency

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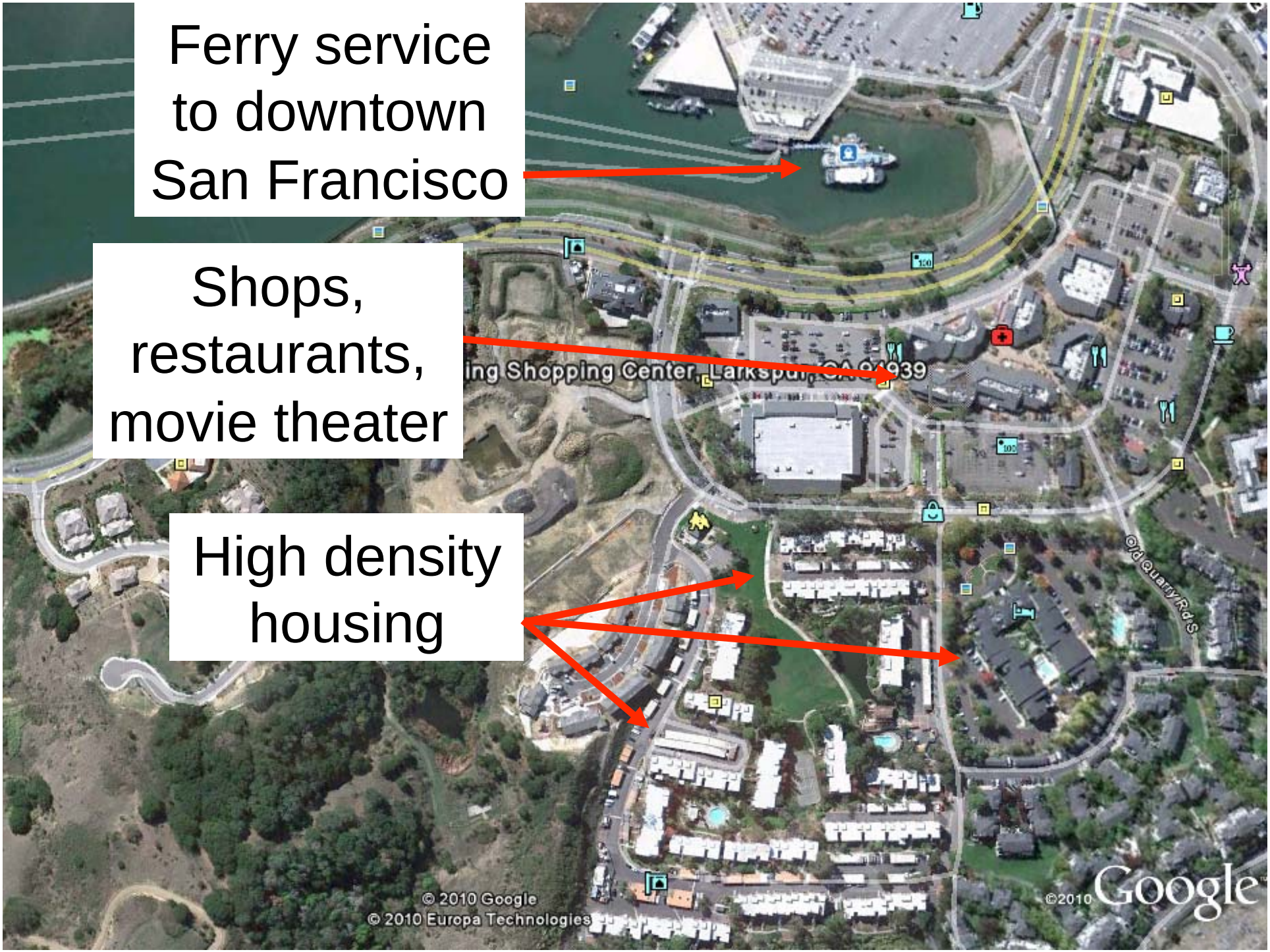
Partnership *for* Sustainable Communities

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

Source: December 2010, EPA partnership flyer


Ferry service to downtown San Francisco
Shops, restaurants, movie theater
High density housing
ing Shopping Center, Larkspur, CA 94939
Old Quarry Rd S
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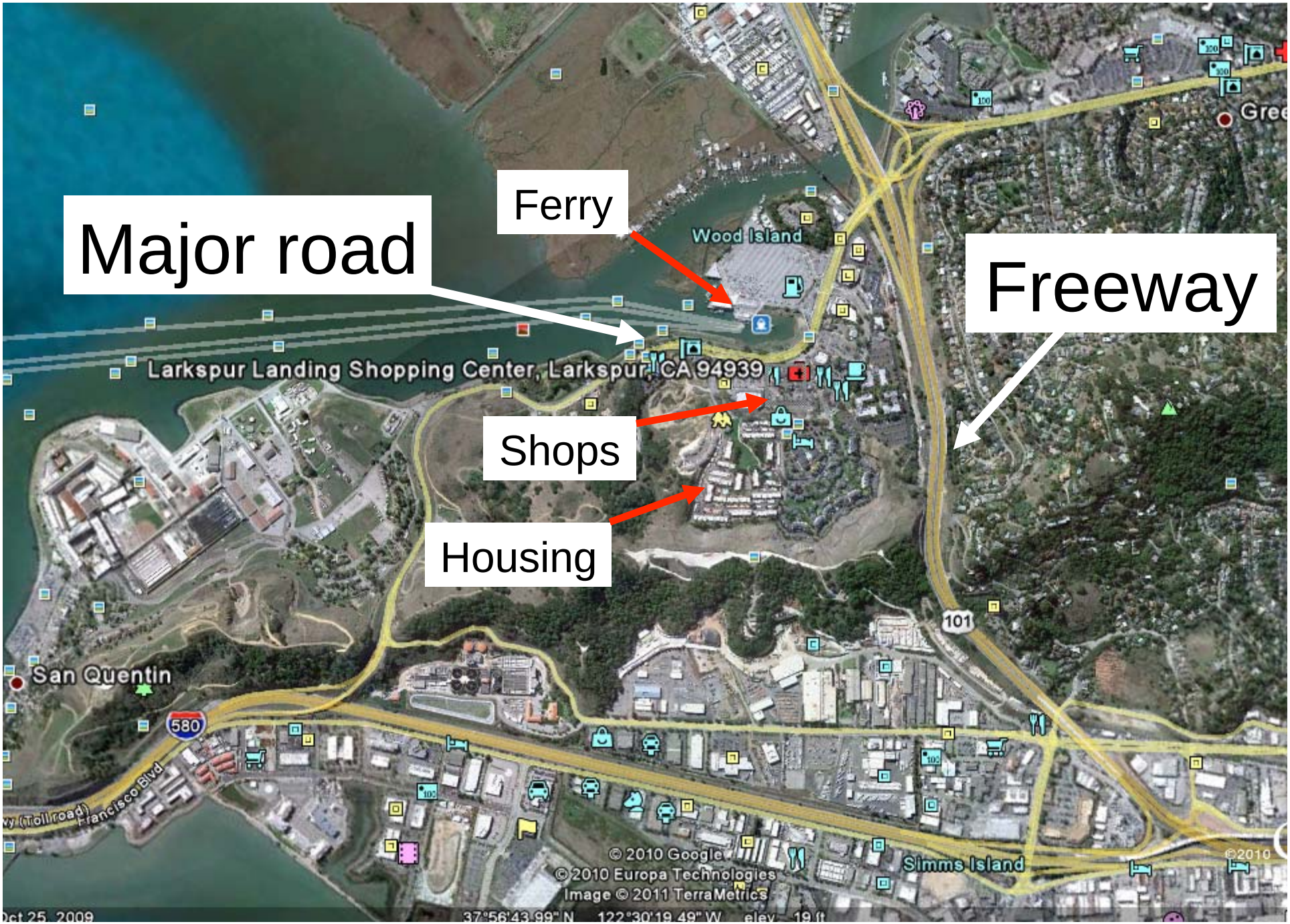
Major road
Ferry
Freeway
Shops
Housing
Wood Island
Larkspur Landing Shopping Center, Larkspur, CA 94939
San Quentin
580
101
Francisco Blvd
Simms Island
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Los Angeles Times | HEALTH

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

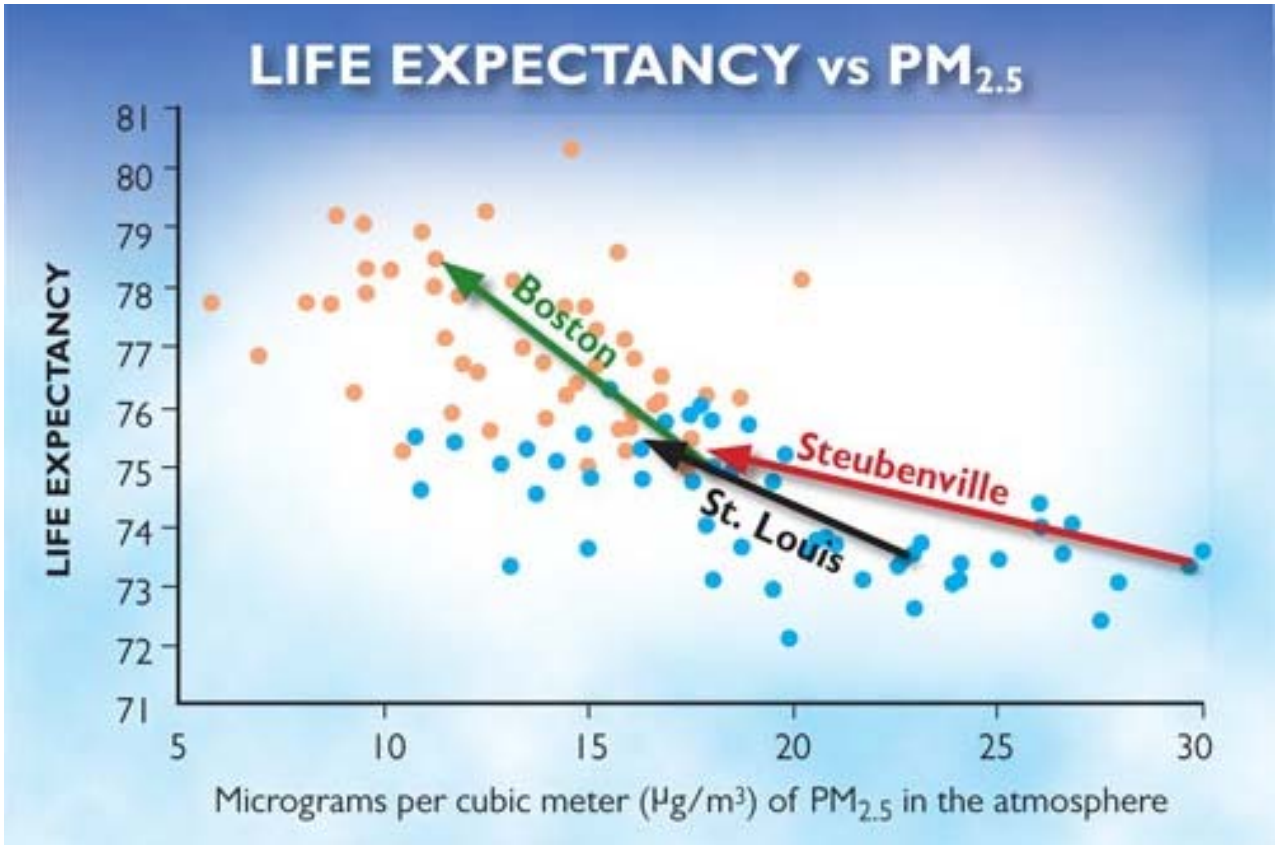

Image source:
Harvard Magazine
May-June 2009

Why Do We Care About Air Pollution?

Susceptible populations are most at risk:

Children, elderly, pregnant women, and those with pre-existing respiratory problems.

STi
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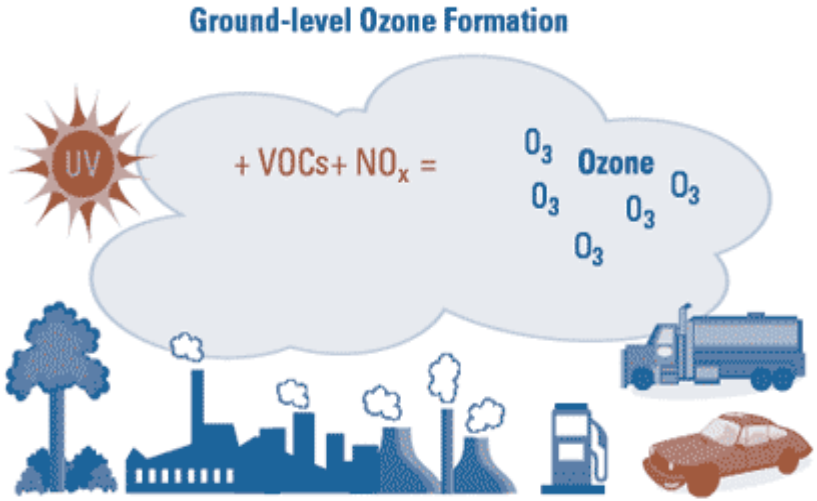
What Pollution is Key for Smart Growth?

- 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)?

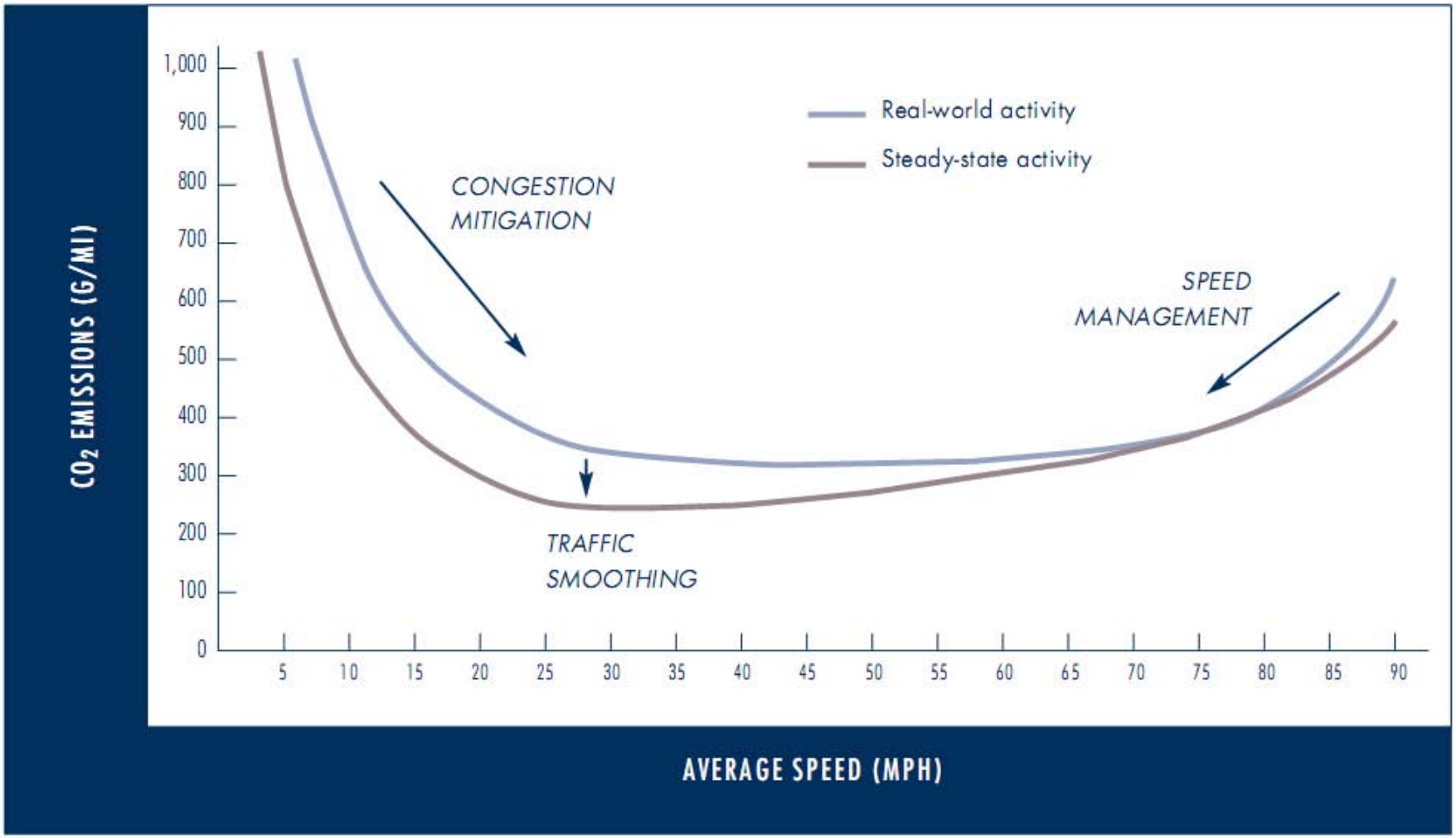
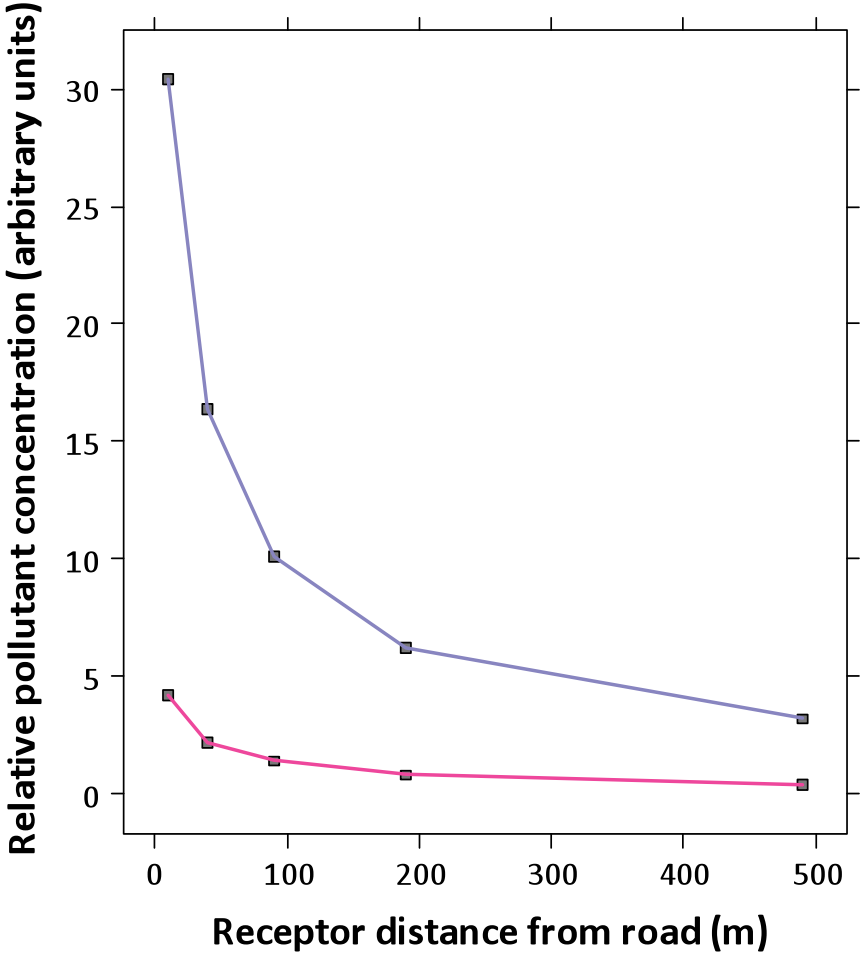


Image source: Barth and Boriboonsomsin (2009)

Where is Background? (1 of 3)



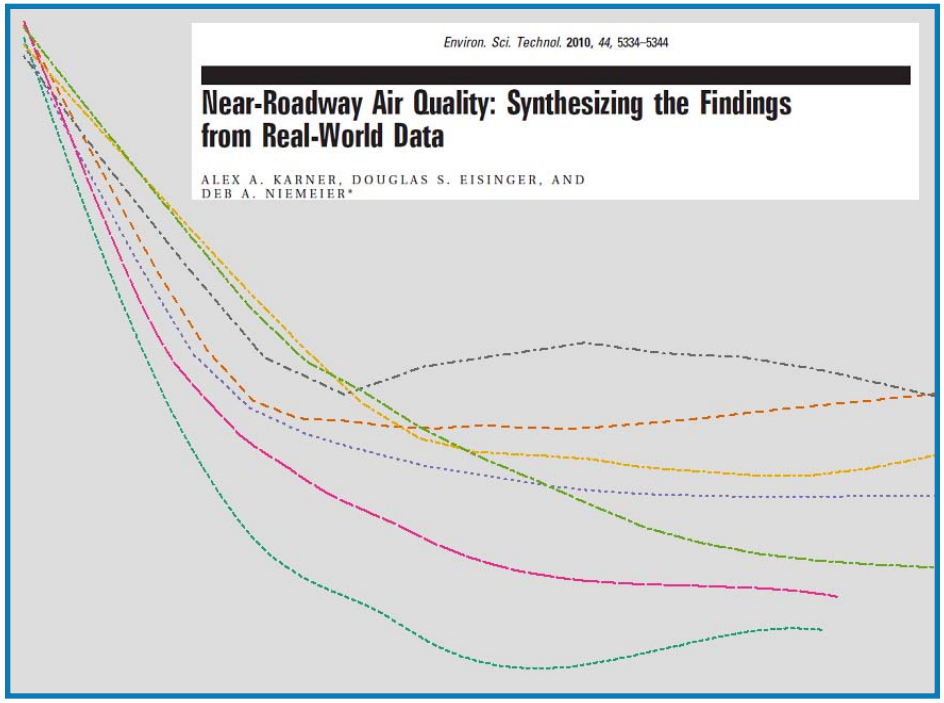
- Image for modeled "generic" pollution

- 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

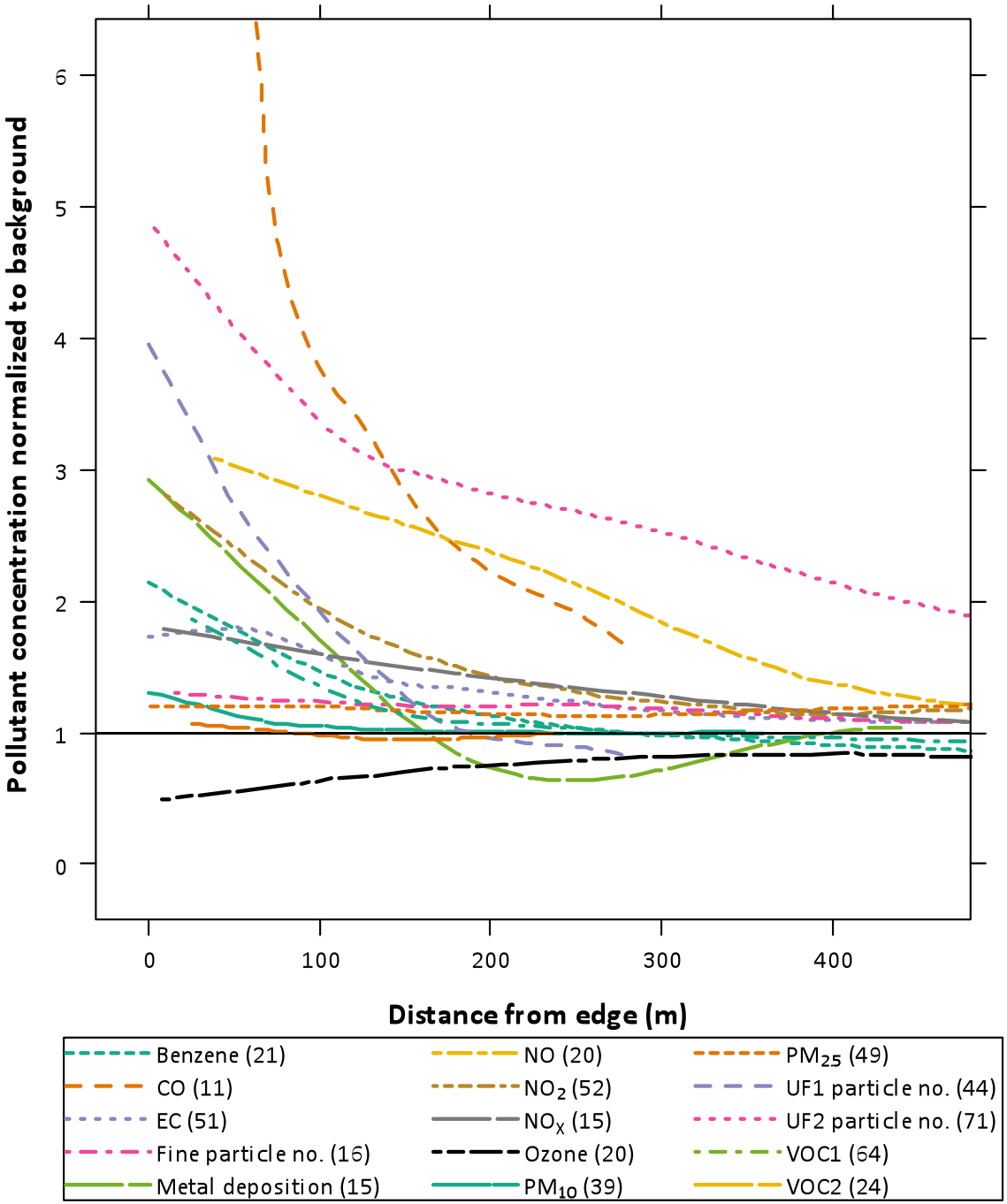
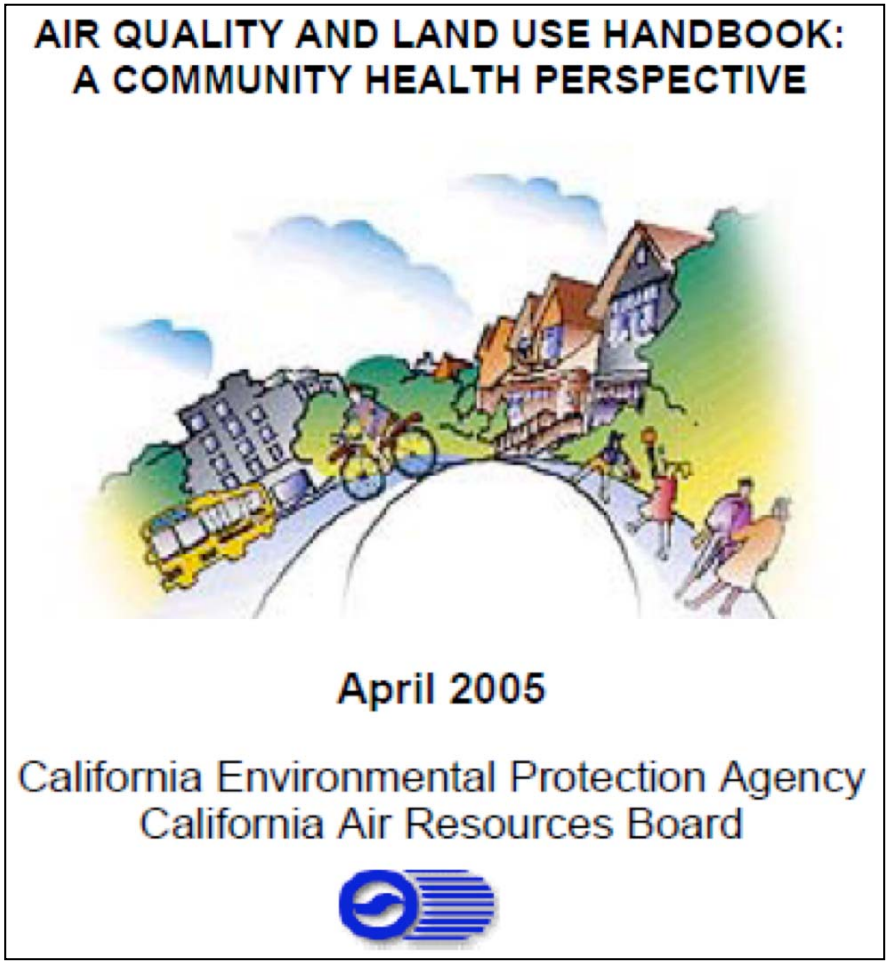


Image source:
Karner, Eisinger, Niemeier (2010)

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



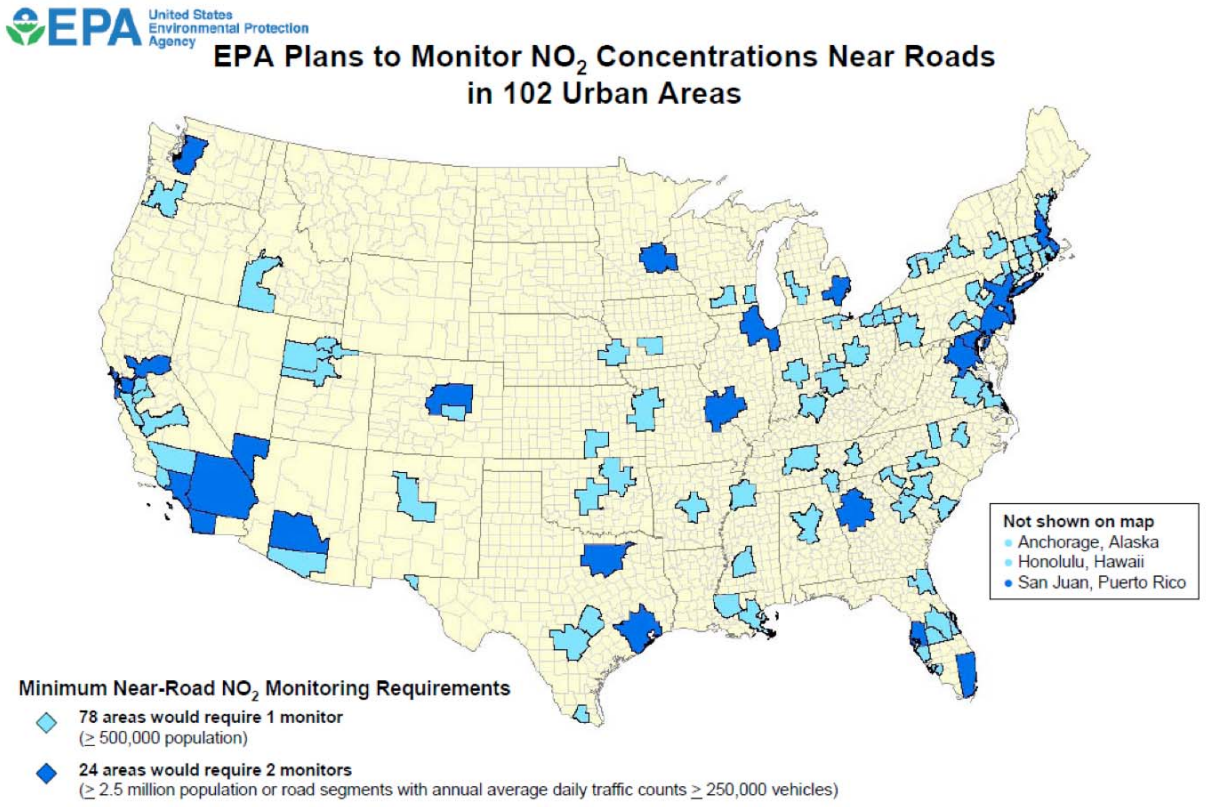
What's the Regulatory Response? (2 of 2)

- **By late 2012**

  Key traffic projects must quantify near-road PM

- **By early 2013**

  Polluted areas must monitor near-road CO and NO_2

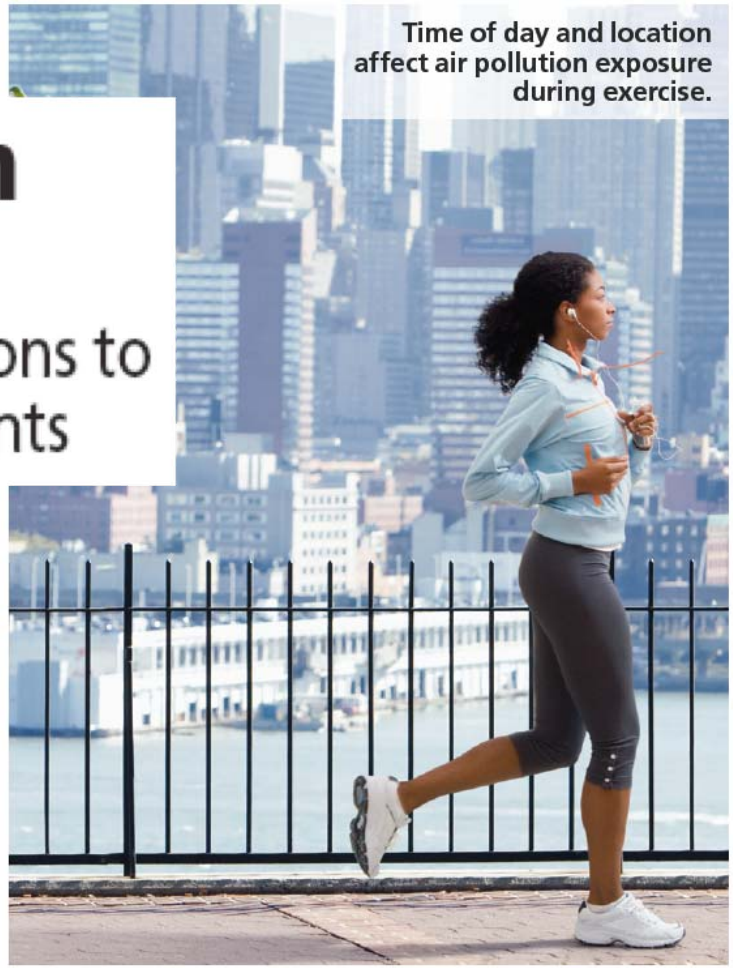


Areas that must monitor near-road NO_2

Do Benefits Outweigh Risks? (1 of 3)

Separating People from Pollution

Individual and Community Interventions to Mitigate Health Effects of Air Pollutants

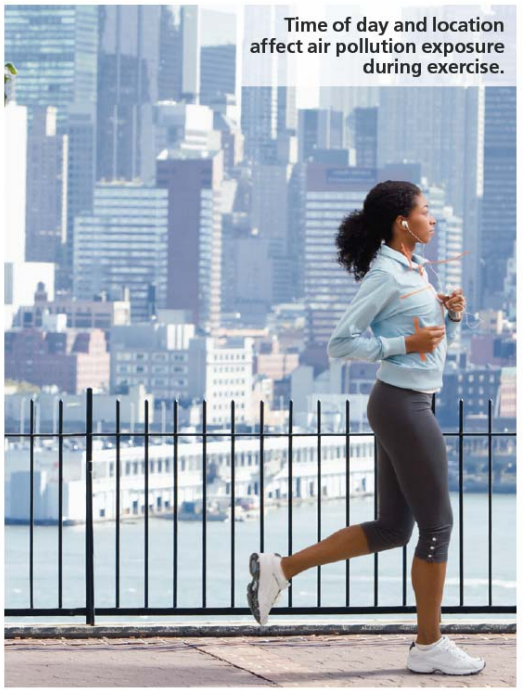


Findings from an international workshop: reducing air pollution health impacts.

March 2009, Vancouver

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.

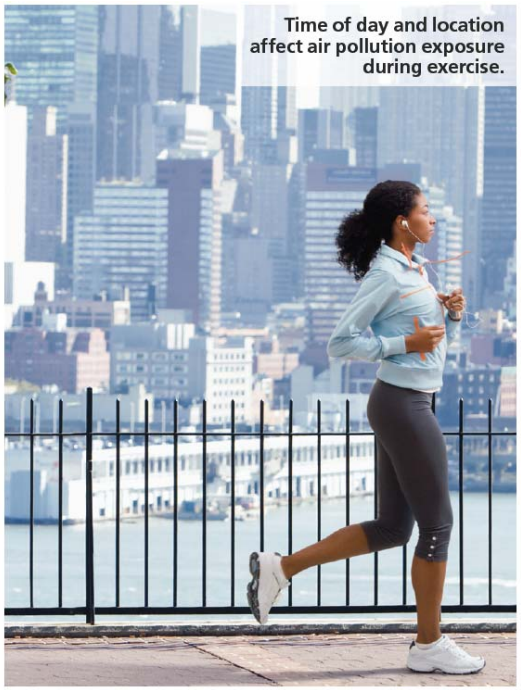
Do Benefits Outweigh Risks? (3 of 3)

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
Wood Island
Larkspur Landing Shopping Center, Larkspur
Housing
~400 m
to freeway
San Quentin
580
101
Francisco Blvd
(Toll road)
© 2010 Europa
Image © 2011 TerraMetrics

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)

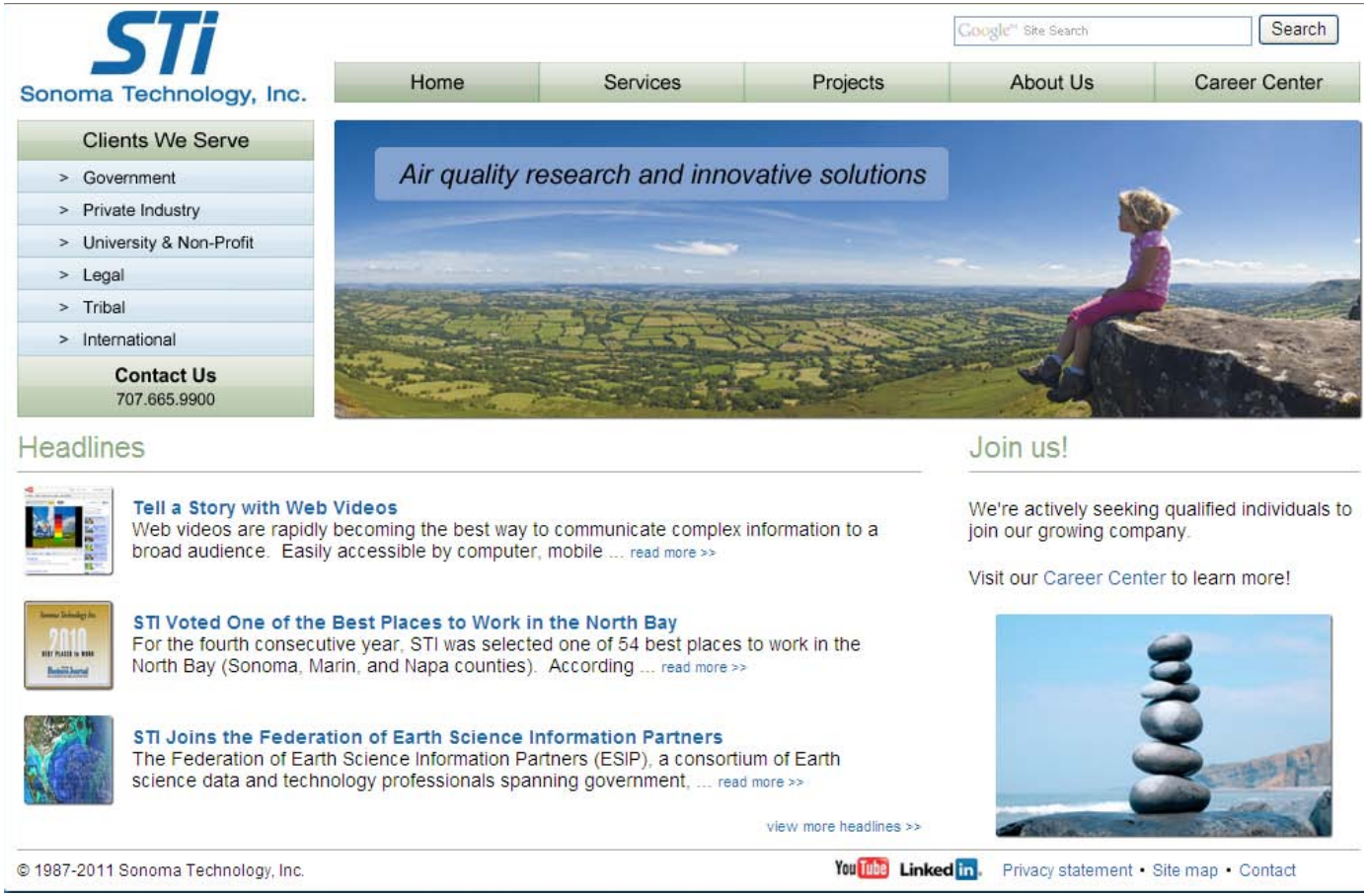
U.S. National Research Council (2010) “America’s Climate Choices” (assesses climate change science, mitigation, and adaptation)

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



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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)

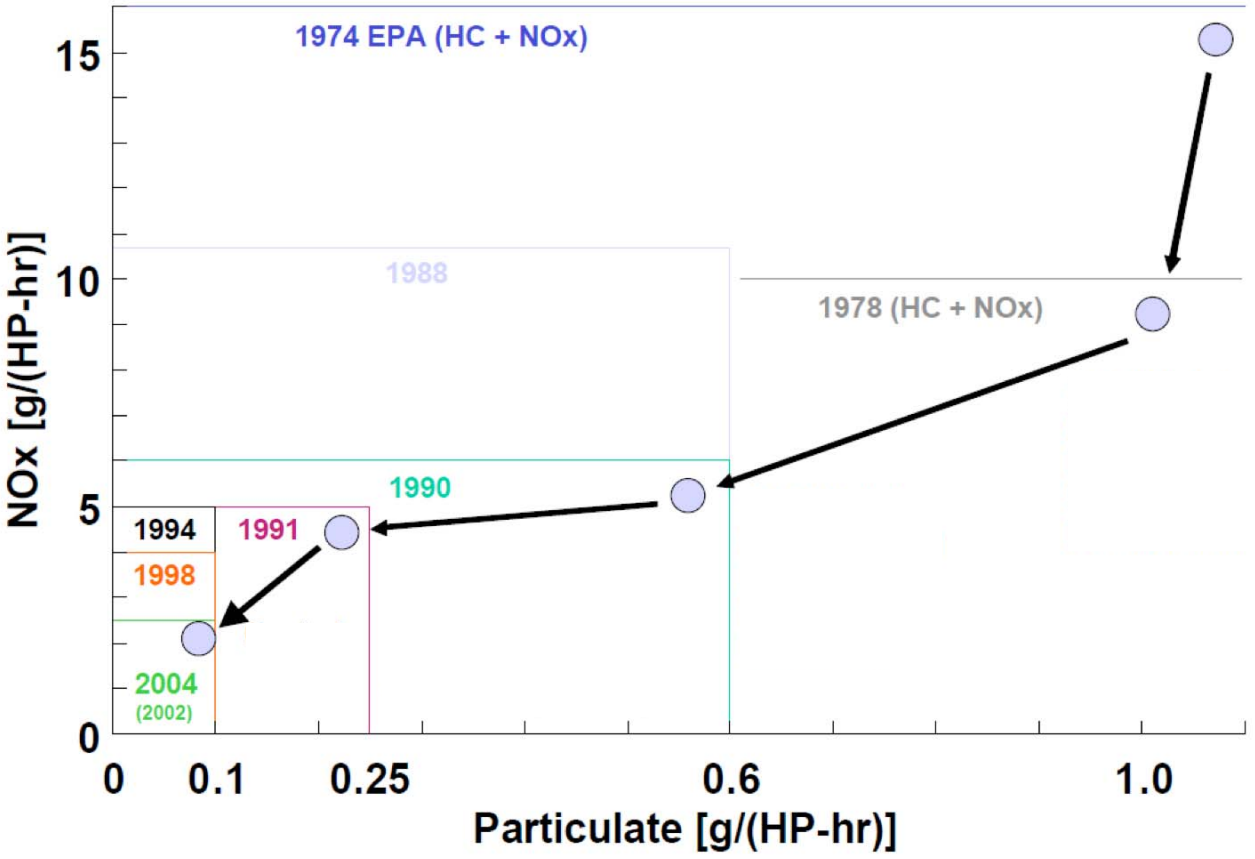

Figure source: Patrick Flynn, Cummins Engine Co.

Cars are Getting Cleaner Too

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

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)

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

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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.

ance	Design	More Info
	very low	
5 mile	low	
5 mile	medium	
ile	high	

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