Roads, Pollution and Housing: Setting Some Boundaries

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Outline

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)
“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

“...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

- **Light-duty**
  - CO, NO\textsubscript{x}, PM
  - Toxics
    - Benzene
    - 1,3-butadiene

- **Trucks**
  - NO\textsubscript{x}, PM
  - Toxics
    - Diesel PM
Diesel particulate matter (DPM) emissions are most important “air toxic”

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

Slowest speeds equal highest car and truck emissions (illustrated here with light-duty CO₂ emissions)
Problem Scale: Key Concepts

Modeled concentrations vary with winds and distance

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

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

<table>
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<th>Model Year</th>
<th>HC</th>
<th>CO</th>
<th>NO_x</th>
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<td>6.30</td>
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<td>1980</td>
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<td>1993</td>
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<tr>
<td>2010</td>
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<td>~1.7</td>
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</table>

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

Regionally, can reduce VMT, energy use, and CO$_2$ 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)

2035 Plan

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

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

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

- 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

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Additional Material

For question and answer period
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 Aphekom)
Problem Scale: Illustration

Streets near 710 Freeway and Port of Long Beach
In recognition of the near-road issue...

EPA requires near-road pollution measurements starting January 1, 2013
Required Near-Road NO₂ Monitoring

• 1 site: areas ≥ 500,000 population
• 2 sites: areas ≥ 2.5 million population
• 2 sites: areas with roads ≥ 250,000 AADT

• Rank roads by AADT (weight trucks more)
• Identify possible maximum NO₂ 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$_2$ Monitoring

EPA Plans to Monitor NO$_2$ Concentrations Near Roads in 102 Urban Areas

Minimum Near-Road NO$_2$ Monitoring Requirements
- 78 areas would require 1 monitor (≥ 500,000 population)
- 24 areas would require 2 monitors (≥ 2.5 million population or road segments with annual average daily traffic counts ≥ 250,000 vehicles)
Car and truck emissions standards have become more stringent over time (truck standards shown here).

During 2007–2010, standards tightened further:

- NO\textsubscript{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

Approved by California Air Resources Board, January 27, 2012
Solutions: Caveats

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

• 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