Land Use and Air Quality Management

with Transportation as the Link

AWMA, Oregon Chapter
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Portland State University
Outline of talk

- Problems
- Land use solutions, in theory
- Issues
- Regulatory framework
- What’s being done
- The evidence
The problem

- Mobile sources contribute significantly to emissions inventories

2001 data from EPA’s 2002 Air Quality Trends
The problem

- Vehicles are getting cleaner, but people are driving more

1970 - 2001

- VOC emissions/mile ↓ 89%
- On-road VOC emissions ↓ 71%
- Vehicle miles traveled ↑ 151%
The problem

- VMT growth may overcome emissions reductions

Light-Duty Vehicle Emissions Under Tier II and Low Sulfur Gasoline Rule
The problem

- Growth: 1975-2000

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Person miles traveled</td>
<td>88%</td>
</tr>
<tr>
<td>Automobiles</td>
<td>67%</td>
</tr>
<tr>
<td>Income</td>
<td>64%</td>
</tr>
<tr>
<td>Workers</td>
<td>52%</td>
</tr>
<tr>
<td>Households</td>
<td>48%</td>
</tr>
<tr>
<td>Population</td>
<td>31%</td>
</tr>
</tbody>
</table>
The problem

- Change in household travel, 1977-2001
### The problem

- Metropolitan areas are spreading

<table>
<thead>
<tr>
<th>Urbanized Area</th>
<th>Population Growth 1950-90</th>
<th>Urbanized Area Growth 1950-90</th>
<th>Ratio: Area to Pop Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pittsburgh</td>
<td>9.5%</td>
<td>206.3%</td>
<td>21.72</td>
</tr>
<tr>
<td>Buffalo</td>
<td>6.6</td>
<td>132.5</td>
<td>20.08</td>
</tr>
<tr>
<td>Milwaukee</td>
<td>47.9</td>
<td>402.0</td>
<td>8.39</td>
</tr>
<tr>
<td>Cincinnati</td>
<td>49.1</td>
<td>250.7</td>
<td>5.11</td>
</tr>
<tr>
<td>New York</td>
<td>30.5</td>
<td>136.8</td>
<td>4.49</td>
</tr>
<tr>
<td>Chicago</td>
<td>38.0</td>
<td>123.9</td>
<td>3.26</td>
</tr>
<tr>
<td>Atlanta</td>
<td>325.4</td>
<td>972.6</td>
<td>2.99</td>
</tr>
<tr>
<td>Washington</td>
<td>161.3</td>
<td>430.9</td>
<td>2.67</td>
</tr>
<tr>
<td>34 Metro Areas with Pop. &gt; 1 million</td>
<td>92.4</td>
<td>245.2</td>
<td>2.65</td>
</tr>
</tbody>
</table>
What impacts emissions?

- Total activity
  - Vehicle miles traveled
  - Trips (starts and stops)

- Type of activity
  - Speed, acceleration, stop-and-go
  - Power (towing, air conditioning, etc.)

- The vehicle
  - Age
  - Maintenance
  - Fuel
VOC emissions for typical trip

- 17% of emissions relate to # of trips
- 59% relate to VMT

12% for Cold Start
50% for Running exhaust
9% for Running loss
5% for Hot soak
24% for Parking all day

grams, Year 2000, 7.5 miles
VOC emission rates by speed

- VOC grams/mile
- Speed (mph)

- 1970
- 1980
- 1990
- 2000
NOx emission rates by speed
The Land Use Solution: Theory

- Switching modes eliminates vehicle trip & VMT
  - Exception: driving to transit station
- Shortening trips reduces VMT
- Linking trips reduces VMT, maybe cold starts
The Land Use Solution: Theory

- **Increased density** ➔ shorter trips (including infill)

- **Increase congestion?** ➔ decrease speeds

  switch modes (transit, walk, bike)
The Land Use Solution: Theory

- **Mix uses** ➔ combine trips
  switch modes (transit, walk, bike)
The Land Use Solution: Theory

- Transit-oriented development ➔ switch modes
The Land Use Solution: Theory

- Jobs-Housing balance ➔ shorter trips change modes?
The Land Use Solution: Theory

- Increased street connectivity ➔ shorter trips
  change modes (walk & bike)
The Land Use Solution: Theory

- Improved urban design ➔ change modes (walk & bike)
Issues

• Our current models don’t predict impacts of land use changes well
• Research findings are mixed
• Some measures might increase emissions, depending upon speeds, congestion
• SIP credit
• Air quality agencies don’t have land use authority
Regulatory Framework

• Federal Clean Air Act
• SIP “credit” options for land use measures
  – Include in the forecast of future emissions
  – Include as a control strategy
    • Quantifiable
    • Surplus
    • Enforceable
    • Permanent
    • Adequately supported
  – Include in conformity determination
Regulatory Framework

- Federal Transportation Legislation
  - ISTEA and TEA-21
    - Increased consideration of air quality in transportation planning and funding
    - Congestion Management Air Quality (CMAQ) funds
Regulatory Framework: Oregon

- State land use planning goals
  - Requires Urban Growth Boundaries
- Transportation Planning Rule
  - Transportation Systems Plans
  - Four Metro areas: 10% reduction in vehicle miles of travel (VMT) per capita in 20 years (15% in 30 years)
  - Urban areas (25,000+ population): Regulations requiring new retail, office, & institutional buildings to provide preferential access to transit
What’s being done

- TSPs in most cities include measures to reduce auto dependence
- Metro’s 2040 Growth Concept concentrates growth in centers and along transit corridors
- Incentives for Transit Oriented Development
Evidence

- Most research focuses on changes in travel behavior, not emissions
- Most emissions estimates based on models, both travel demand and emissions factor
Evidence: LUTRAQ

- Modeling effort comparing Western Bypass to land use and pricing strategies
- Emissions compared to “no build” alternative

<table>
<thead>
<tr>
<th></th>
<th>Highways only</th>
<th>Highways &amp; parking pricing</th>
<th>LUTRAQ</th>
<th>LUTRAQ &amp; congestion pricing</th>
</tr>
</thead>
<tbody>
<tr>
<td>HC</td>
<td>-0.2%</td>
<td>-3.6%</td>
<td>-6.2%</td>
<td>-11.5%</td>
</tr>
<tr>
<td>NOx</td>
<td>6.7%</td>
<td>3.6%</td>
<td>-2.6%</td>
<td>-8.4%</td>
</tr>
<tr>
<td>CO</td>
<td>-0.6%</td>
<td>-4.0%</td>
<td>-6.7%</td>
<td>-12.0%</td>
</tr>
</tbody>
</table>
Evidence: Puget Sound

- Estimates based on household travel survey data and existing land uses
- Emissions declined as
  - household density increased
  - employment density increased
  - block density increased (NOx only)
  - Distance to work decreased

# Evidence: Sacramento

- Model scenarios, difference from base

<table>
<thead>
<tr>
<th>Scenario</th>
<th>TOG</th>
<th>CO</th>
<th>NOx</th>
<th>PM</th>
</tr>
</thead>
<tbody>
<tr>
<td>HOV lanes</td>
<td>2.1%</td>
<td>1.4%</td>
<td>0.9%</td>
<td>0.3%</td>
</tr>
<tr>
<td>Beltway</td>
<td>5.9%</td>
<td>8.3%</td>
<td>8.2%</td>
<td>2.5%</td>
</tr>
<tr>
<td>Pricing</td>
<td>-27.0%</td>
<td>-22.9%</td>
<td>-19.6%</td>
<td>-28.5%</td>
</tr>
<tr>
<td>Urban reserve + infill + light rail transit</td>
<td>-12.6%</td>
<td>-9.4%</td>
<td>-6.8%</td>
<td>-13.3%</td>
</tr>
<tr>
<td>Urban growth boundary + light rail transit</td>
<td>-32.6%</td>
<td>-13.2%</td>
<td>-8.6%</td>
<td>-18.6%</td>
</tr>
<tr>
<td>Urban growth boundary + light rail transit + pricing</td>
<td>-38.1%</td>
<td>-33.1%</td>
<td>-28.8%</td>
<td>-39.0%</td>
</tr>
</tbody>
</table>

### Evidence: Infill vs. Greenfield

- **Model simulations**

<table>
<thead>
<tr>
<th>Case Study</th>
<th>Infill as % of Greenfield</th>
<th>Per capita daily VMT</th>
<th>Emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Diego, CA</td>
<td></td>
<td>52%</td>
<td>CO: 88% NOx: 58%</td>
</tr>
<tr>
<td>Montgomery County, MD</td>
<td></td>
<td>42%</td>
<td>CO: 52% NOx: 69%</td>
</tr>
<tr>
<td>West Palm Beach, FL</td>
<td></td>
<td>39%</td>
<td>CO: 75% NOx: 72%</td>
</tr>
<tr>
<td>Atlantic Steel, GA</td>
<td>48-85%</td>
<td></td>
<td>NOx: 19-63%</td>
</tr>
</tbody>
</table>

Source: EPA, Our Built and Environment Environments, A Technical review of the interactions between land use, transportation, and environmental quality, page 46-47
Evidence: Portland

- Portland appears to be getting denser
Evidence: Portland

- Commuting by bicycle (2000 Census)
Evidence: Portland

- Commuting by walking (2000 Census)
Evidence: Portland

- Commuting by transit (2000 Census)
Evidence: Portland

- Total transit trips per capita (2000)
Evidence: Portland

- Daily VMT per capita, 1993-2000
My thoughts

- Land use measures can influence travel decisions and, therefore, emissions
- Lots of uncertainty over net impacts
- Reductions from new technology are likely to have much larger impacts on emissions in the near term
- Pricing strategies are likely to have larger impacts on travel and congestion
- But, land use strategies have many other benefits (health, livability, etc.)
More thoughts

- Greenhouse gases
- Hazardous air pollutants
More thoughts

• Less-regulated mobile sources are becoming more significant. These sources are not as closely related to land use.

Percent of Change in Emissions (1970-99)
More info

- Weekly transportation seminar
  - Fridays @ noon at PSU
  - Webcast live and archived
- New Graduate Certificate in Transportation
- Anyone can take PSU classes via “quick entry”
- jdill@pdx.edu
- web.pdx.edu/~jdill
The end

jdill@pdx.edu
web.pdx.edu/~jdill