Urban Planning and Transportation Policy

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Agenda

• Urban transportation, air quality, and welfare
  – Mechanisms
  – Solutions

• The Los Angeles story
  – Regional development
  – Air pollution
  – Policy responses

• The Chinese story?
The engineering perspective:
ICE-based traffic, local air pollution, & health

• Combustion
• Emissions
• Dispersion/transformation
• Concentration
• Exposure/intake
• Dose-response/impact/health end points
The system perspective: the role of human choice and its determinants

\[ I = P \times A \times T \]

- Impact
- Population
- Affluence
- Technology

ASIF
- Activity
- Mode split
- Energy intensity
- Fuel mix
Transportation activities as human choices

• Transportation demand
• Technological choice
• Behavior choices
Human choices influenced by the built environment and policies

• Locations of origins and destinations (land use)
• Infrastructure and its efficiency (LOS)
• Out-of-pocket costs
• Policy constraints (command and controls)
The human activity – land use – infrastructure system
Solutions

• Technological standards/development
• Infrastructure supply/service
• Private behavior
• Land use planning
Technological standards/development
Infrastructure supply/service

*space* required to transport *60 people*

car  bus  bicycle
Automobile traffic calming, infrastructure diet, and multimodal sharing
Private behavior

- Transit subsidies and car/van-pool assistance
- Vehicle/fuel taxes/quota
- Road/congestion/parking pricing
- Vehicle M&I/scrappage requirements
- Mandatory trip reduction (e.g. driving restrictions)
- Information/education
Relationship between Transport and Land Use

A commonly used study of 32 cities by Newman & Kenworthy in 1989 concluded that there was a strong link between urban development densities and petroleum consumption.
PUSHING THE TRANSIT MODEL INTO LOWER DENSITIES CAN LEAD TO LACKING TICKET RECEIPTS AND ACCUSATION OF FAILING TRANSIT ACCEPTANCE.
Driving-only transportation pattern

Walkable connected transportation network

(Congress for New Urbanism (https://www.cnu.org/sustainablestimulus))
Conventional Zoning
Density use, FAR (floor area ratio), setbacks, parking requirements, maximum building heights specified

Zoning Design Guidelines
Conventional zoning requirements, plus frequency of openings and surface articulation specified

Form-Based Codes
Street and building types (or mix of types), build-to lines, number of floors, and percentage of built site frontage specified.
Automobile Commuting by Type of Community
(In percent. Universe: workers 16 years and older. Data based on sample. For information on confidentiality protection, sampling error, nonsampling error, and definitions, see www.census.gov/acs/www/)

- All workers
- Lived outside any metro area
- Lived outside principal city, in metro area
- Lived in a principal city, in metro area

2006
- 87
- 90
- 90
- 80

2013
- 86
- 91
- 89
- 78

Note: Numbers are rounded. See Appendix Table 1 for estimates and margins of error.
Source: U.S. Census Bureau, 2006 and 2013 American Community Survey.
Number of Vehicles Available by Community Type: 2013

(Percentage of workers within group. Universe: workers 16 years and older in households. Data based on sample. For information on confidentiality protection, sampling error, nonsampling error, and definitions, see www.census.gov/acs/www/)

- **All workers**
  - No vehicles: 4%
  - 1 vehicle: 22%
  - 2 vehicles: 32%
  - 3 or more vehicles: 22%

- **Inside principal city, in metro area**
  - No vehicles: 9%
  - 1 vehicle: 29%
  - 2 vehicles: 24%
  - 3 or more vehicles: 24%

- **Outside principal city, inside metro area**
  - No vehicles: 2%
  - 1 vehicle: 18%
  - 2 vehicles: 36%
  - 3 or more vehicles: 36%

- **Outside any metro area**
  - No vehicles: 3%
  - 1 vehicle: 19%
  - 2 vehicles: 38%
  - 3 or more vehicles: 38%

Note: Numbers are rounded. See Appendix Table 6 for estimates and margins of error.
Source: U.S. Census Bureau, 2013 American Community Survey.
The Los Angeles Story

Regional development, air pollution, and the pursuit of blue skies
Aerial Photography of Southern California
L.A. County population
1900: <0.2 million
1920: ~1 million
1940: 2.8 million
1960: 6 million
1980: 7.5 million
2000: 9.5 million
Transportation: from streetcars to cars...

← 1930
Automobiles in L.A. County

1915: 1/8 residents (1/43 nationally)
1918: 110,000
1923: 430,000
1925: 1/2 residents (1/6 nationally)
1956: 3,000,000 (5% of US)
1940s and 50s: smog town

Vast clouds of smoke boil into the sky from the

Glendale city dump in October 1946. Burning garbage in dumps was a common practice then.
Scientific quests: measurements, impacts and sources
Public and policy responses

Early Smog Control Efforts

In the late 1940s and early 1950s, air pollution officials made significant strides in reducing smoke and fumes by regulating open burning in garbage dumps, reducing smoke from factories and cutting sulfur dioxide emissions from oil refineries.
In the 1950s, automobile exhaust became a prime suspect: The birth of modern air pollution control.

Clean up cars:
- 1959: CA Motor Vehicle Pollution Control Board
- 1963: Reduce HC emissions/evaporation
- 1975: Catalytic converter required
- Later 1970s: I/M law --> SmogCheck program

In 1955, when modern ozone monitoring began, Southland residents suffered the highest ozone level ever recorded -- 0.68 parts per million in downtown Los Angeles -- nearly three times the highest level in 1996.
Cleaning Up Fuels

In the 1960s, regulators took the first step in cleaning up motor vehicle fuels by reducing the amount of highly photochemically reactive olefins in gasoline.

Starting in 1970, the federal government also phased out the use of lead in gasoline, a toxic pollutant that in high levels can cause behavioral problems, learning disabilities and even brain damage in children. Due to the phaseout, lead levels in the Southland have not exceeded state or federal health standards since 1982.

In the early 1980s, ARCO introduced the first reformulated gasoline with fewer smog-forming and toxic ingredients. The California Air Resources Board and the U.S. Environmental Protection Agency have since required all oil companies to develop and sell even cleaner gasoline.
Starting in 1970s: energy efficiency/independence jointly pursued

During the 1970s and 1980s, California environmental agencies advocated the use of methanol and natural gas instead of gasoline, which could cut a vehicle’s smog-forming emissions in half. "Flex-fuel" vehicles could burn any combination of gasoline and methanol, so drivers never had to worry about availability of fuel.

Beyond technology

Seeking new areas for pollution reductions -- and cheaper ways to accomplish it -- air quality officials in the late 1980s and early 1990s moved beyond traditional factory smokestack and vehicle tailpipe controls to transportation and market incentive programs.

AQMD’s Governing Board adopted a landmark rideshare program in 1987. It required employers with more than 100 employees to offer tangible incentives to employees to carpool and ride public transit to work. For eight years, the program achieved marked success, reducing 272,000 trips per day. But businesses chafed at trying to change employee behavior. They also perceived the program’s cost, estimated at $110 per employee per year, as excessive and its administration as overly burdensome.
Half a century later (1980s-90s)

Targeting the Total Package: Clean Fuels and Vehicles

In 1990, CARB adopted a landmark regulation targeting both vehicles and the fuels used in them. The agency launched its Low Emission/Zero Emission Vehicle program, requiring auto manufacturers to develop incrementally cleaner cars, culminating with the mandate for an electric, zero-emission vehicle by 1998. CARB officials subsequently delayed the mandate until 2003 after oil and auto manufacturers argued that introducing electric vehicles too soon, before the technology was perfected, could alienate consumers.
1970s-90s: significant improvement

1995
Total registered vehicles reached 26 million and vehicle miles traveled is 271 billion. Cumulative California auto emissions for NOx and HC are about 1.1 million tons/year reduction compared to 1970 levels, despite a 137% increase in vehicle miles traveled from 1970 levels. Statewide averaged for NOx and HC emissions per vehicle reduced respectively by 58% and 80% from 1970 levels.

1996
The SCAQMD’s maximum one-hour ozone concentration recorded is 0.24 ppm, a 31% improvement from 1965. The area exceeded Stage 1 Smog Alerts (0.20 ppm ozone) on 7 days this year. This is an improvement of 111 days or a 94% reduction as compared to 1975.

Big seven automakers commit to manufacture and sell Zero Emission Vehicles.

CA’s Phase II Cleaner Burning Gasoline (CBG) came to market. CBG reduces lung-damaging ozone and ozone precursors by 300 tons/day, as well as reducing airborne toxic chemicals like benzene that can cause cancer. This is equivalent to taking 3.5 million cars off the road.

2000
California's population grows to 34 million with 23.4 million registered vehicles in the state. Annual vehicle miles traveled (VMT) reaches 280 billion miles. Cumulative California vehicle emissions for nitrogen oxides and hydrocarbons are about 1.2 million tons per year. This is 200,000 tons/year less than 1990 despite an increase in VMT of 40 billion miles per year.

The South Coast Air Quality Management District’s maximum one-hour ozone concentration recorded is 0.18 parts per million. The area has no Stage 1 Smog Alerts (0.20 ppm ozone) this year, down from 42 Alerts in 1990.
The never-stop sprawl

Los Angeles CSA Population Growth
2000-2010 BY SECTOR

<table>
<thead>
<tr>
<th>Sector</th>
<th>2000</th>
<th>2010</th>
<th>Change</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central Los Angeles</td>
<td>1,752,024</td>
<td>1,763,967</td>
<td>11,943</td>
<td>0.7%</td>
</tr>
<tr>
<td>Inner Ring</td>
<td>9,093,756</td>
<td>9,231,513</td>
<td>137,757</td>
<td>1.5%</td>
</tr>
<tr>
<td>Outer Suburbs</td>
<td>3,053,615</td>
<td>3,630,273</td>
<td>576,658</td>
<td>18.9%</td>
</tr>
<tr>
<td>Exurbs</td>
<td>2,173,459</td>
<td>2,822,884</td>
<td>649,425</td>
<td>29.9%</td>
</tr>
<tr>
<td>Remote</td>
<td>301,331</td>
<td>428,369</td>
<td>127,038</td>
<td>42.2%</td>
</tr>
<tr>
<td>Total</td>
<td>16,374,185</td>
<td>17,877,006</td>
<td>1,502,821</td>
<td>9.2%</td>
</tr>
</tbody>
</table>
Deal with sprawl
Controlling mobile emissions in urban regions through regional planning

- Air quality (policy) is regional
  - 1976: SCAQMD

- Transportation (policy) is regional too
  - Federal action since CAAA 1990 and ISTEA 1991
  - Regional air quality conformity
  - Air quality and metropolitan planning organization’s regional transportation plan
Transportation conformity is...

A process required by the Clean Air Act (CAA) Section 176(c) which establishes the framework for improving air quality to protect public health and the environment. The goal of transportation conformity is to ensure that Federal Highway Administration (FHWA) and Federal Transit Administration (FTA) funding and approvals are given to highway and transit activities that are consistent with air quality goals.

The CAA requires that metropolitan transportation plans, metropolitan transportation improvement programs (TIPs) and Federal projects conform to the purpose of the State Implementation Plan (SIP). Conformity to a SIP means that such activities will not cause or contribute to any new violations of the National Ambient Air Quality Standards (NAAQS); increase the frequency or severity of NAAQS violations; or delay timely attainment of the NAAQS or any required interim milestone.

Transportation Conformity:

The link between air quality and transportation planning.

Source: GAO analysis of EPA data.
What pollution does transportation conformity address?

Air pollution comes from a variety of sources. Transportation conformity only addresses air pollution from on-road mobile sources which include emissions created by cars, trucks, buses, commuter rail, and motorcycles.

Transportation conformity applies in...

All nonattainment and maintenance areas for ozone (O3), particulate matter (PM10 and PM2.5), nitrogen dioxide (NO2), and carbon monoxide (CO), and their appropriate precursors (precursor pollutants are those pollutants which contribute to the formation of other pollutants).

<table>
<thead>
<tr>
<th>Precursor Emissions*</th>
<th>Direct Emissions</th>
<th>NOx</th>
<th>VOC</th>
<th>Ammonia (NH3)</th>
<th>Sulfur Dioxide (SO2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ozone (O3)</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PM10</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PM2.5</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>NO2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO</td>
<td></td>
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</tr>
</tbody>
</table>

Precursor Emissions

* Not all precursors are required to be analyzed in every area.

What transportation activities are subject to transportation conformity?

- Metropolitan transportation plans
- Metropolitan transportation improvement programs (TIPs)
- Federal projects
  - Projects receiving FHWA/FTA funding
  - Projects receiving FHWA/FTA approval
Land use forecasting
How many households will there be, what activities will people engage in, and where will activities occur?
(generated by local and regional planners)

Travel survey data
Such as household size, trips/day, and trip method (generated by MPO or DOT)

Transportation network
Current and projected by transportation plan (generated by MPO)

Travel Demand Model

Trip generation
How many trips will be made?

Trip distribution
Where will the trips be?

Mode split
How will people travel?

Trip assignment
What routes will be used?

Outputs include
Number of trips
Trip length
Trip mode
Trip route
Vehicle miles traveled (VMT) by speed

Emission factor model (Mobile)

Emission rates (in grams of pollutant per vehicle mile traveled by speed)

VMT

Emission rates

The output from the travel demand model provides information about the performance of the transportation system and guides future plan modifications

Conformity determination
(comparison of estimated mobile source emissions to mobile source emissions budget)

Estimate of mobile source emissions

If conformity cannot be demonstrated, revisions to transportation plan are made

Source: GAO.
21st Century

June 4, 2013

Los Angeles air pollution declining, losing its sting

South Coast Air Basin. The air in the Los Angeles region has lost some of its “sting,” according to a new CIRES-led study. Regulations to reduce emissions have affected chemical processes in the atmosphere, decreasing levels of an eye irritant called peroxyacetyl nitrate. Credit: CIRES and Google Maps.

Although gasoline consumption in Los Angeles has nearly tripled since 1960, levels of vehicle-related pollutants called volatile organic compounds (VOCs) have plummeted. NOAA illustration.
2000s: GHG emissions reduction jointly pursued


AB 1811, directed the ARB to develop a joint plan with the CA Energy Commission to spend $25 million to provide incentives for the use and production of alternative fuels.

California switched to new ultra low sulfur diesel fuel.

The ports of Long Beach and Los Angeles, in cooperation with the United States Environmental Protection Agency (USEPA), the ARB, and the South Coast Air Quality Management District (AQMD), developed the most comprehensive plan in the US seaport history to reduce air pollution and associated health risks generated from port-related operations.

ARB implemented the Lower Emission School Bus Program to reduce children’s exposure to both cancer-causing and smog forming pollution.

2010: ARB makes changes to diesel regulations that protect public health, provide relief and flexibility to California business owners of on-road and off-road equipment.

ARB approves the cap-and-trade regulation, marking a significant milestone toward reducing California’s greenhouse gas emissions under AB 32. The regulation helps drive the development of green jobs and set the state on track to a clean energy future.

California regulations reduce air pollution from 11 categories of consumer products including bug sprays and a variety of household and professionally-used cleaners.

California adopts the Renewable Energy Standard. One-third of the electricity sold in the state in 2020 will come from clean, green sources of energy.

California adopts goals of SB 375 for more healthy and sustainable communities that improve the way we plan and promote transportation choices.
The right to breathe for everyone

The problems of hot spots and vulnerable population
Everyone in this family has health problems.
Ozone
Ports and freight hubs/corridors

• The San Pedro Bay ports are the largest single source of air pollution in Southern California, generating about 10% of the region's smog-forming emissions.

• Diesel emissions from the ports have the greatest health consequences for harbor area neighborhoods, where residents have higher rates of asthma and face the region's highest cancer risk from air pollution.

• The ports’ 2006 Clean Air Action Plan includes:
  – A ban on old, dirty diesel trucks
  – Docked vessels need turn off engines and plug into the electrical grid
  – Near the shore, ocean vessels are also required to burn low-sulfur fuel
L.A.’s fight for blue skies: key takeaways

• Fundamental demand for air quality
  – Crises and policy agenda
  – Policy synergies
  – Mega events

• Globalization
  – Deindustrialization
  – Freight transportation

• Technology has been the key
  – Scientific research: what technologies are needed?
  – Development: mandatory/voluntary improvements
  – Adoption: market/consumer buy-in

• Hard to change land use or lifestyle (in U.S.)
How fast can a socioeconomic-environmental system change?
Commuting by Automobile: 1960 to 2013
(Percentage of workers. Universe: workers 16 years and older. Data based on sample. For information on confidentiality protection, sampling error, nonsampling error, and definitions, see www.census.gov/acs/www/)

China’s air quality challenge
PM$_{10}$ concentration in L.A. vs. Beijing
Figure 3. Average air pollution maps. Maps of average pollutant concentration for PM$_{2.5}$, PM$_{10}$, and O$_3$ for eastern China (top row) and the Beijing to Shanghai corridor (bottom row). Concentrations are shown using color gradients and contour lines; the colors (green, yellow, etc.) represent US EPA qualitative health impacts. Pollution concentrations were computed as described in the text using hourly data and then the hourly concentration fields were averaged over the four month study duration.
Figure 4. Air pollution source maps. Maps of average pollutant flux for PM$_{2.5}$, PM$_{10}$, SO$_2$, and NO$_2$ for eastern China (top row) and the Beijing to Shanghai corridor (bottom row). Pollutant fluxes were computed as described in the text from changes in the interpolated hourly pollution fields along with contemporaneous wind and weather data. Due to sparse sampling and secondary transformations of pollutants in the atmosphere, apparent source fluxes are likely to appear more diffuse than the true emissions source.
Are we at a turning point?

PM2.5 levels: First half of 2015, change year-on-year, %
Questions to consider

• What are the systematic drivers of urban air quality in China?
• Are they changing? How fast?
To enable a socioeconomic-environmental system change

- Set expectations
- Make efforts
- Be prepared for disappointments
- Learn from others but your solution might be very different
Questions/comments?

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