

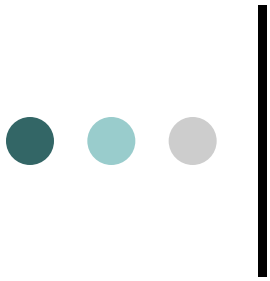
US EPA ARCHIVE DOCUMENT



# *Transportation, Cumulative Health Effects, and Environmental Justice*

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## *Transportation Infrastructure*

- Highways / roadways
- Rail lines
- Marine ports / air ports
- Distribution centers
- Bike and Pedestrian facilities
- Safety and control hardware





## *Criteria for environmental justice impacts*

- Significant disproportionately adverse health or environmental effect on a vulnerable population
  - Relatively higher effect intensity on a vulnerable population
  - Cumulative contribution to a pre-existing adverse condition or exposure
  - Population vulnerability factors mediate or exacerbate an adverse health effects
- Mitigations or alternatives exist to prevent or reduce disproportionate impacts



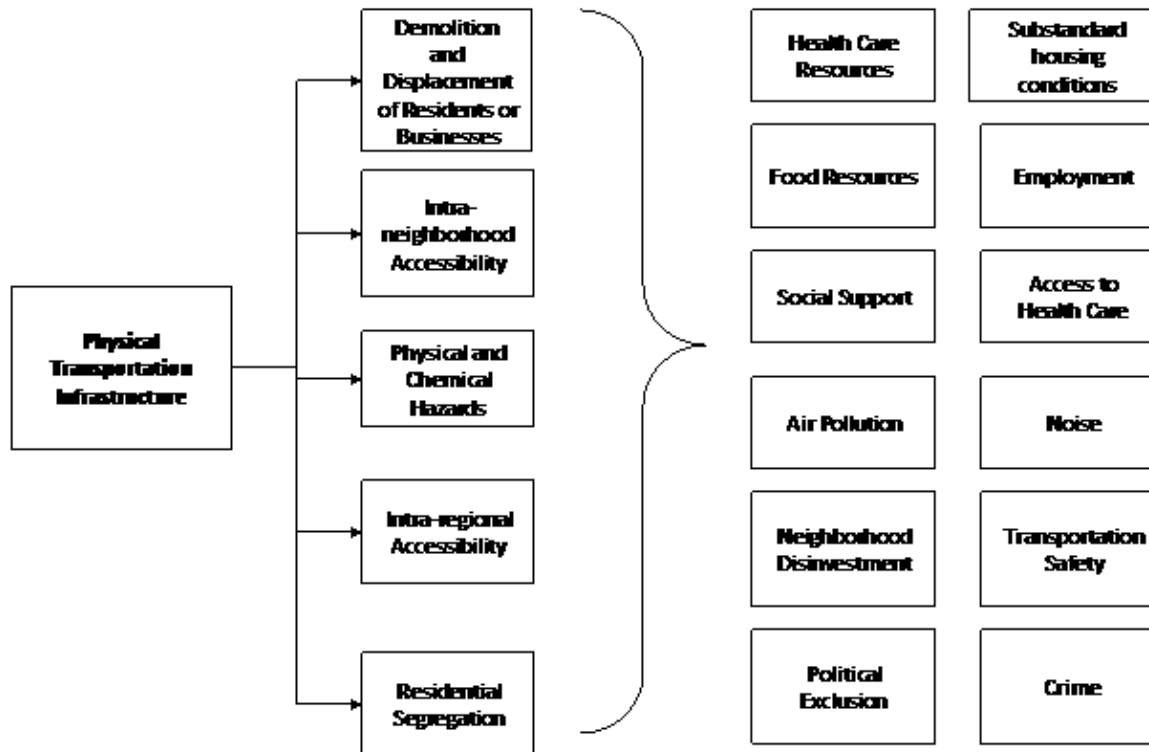


## *Cumulative Effects*

- Combined and incremental effects of human activities on environmental resources, human communities, or ecosystems (40 CFR §1508.7.; USEPA 1999).
- Cumulative effects on human communities may be combined
  - Two or more sources of the same physical exposure
  - Incremental additions to exposure over time
  - Two or more hazards with common mechanisms
  - Two or more effects on the same biological endpoint
  - Multiple effects on human health of multiple exposures occurring over time
  - Effects on community well being



# Transportation Infrastructure & Potential Cumulative / Disproportionate Effects



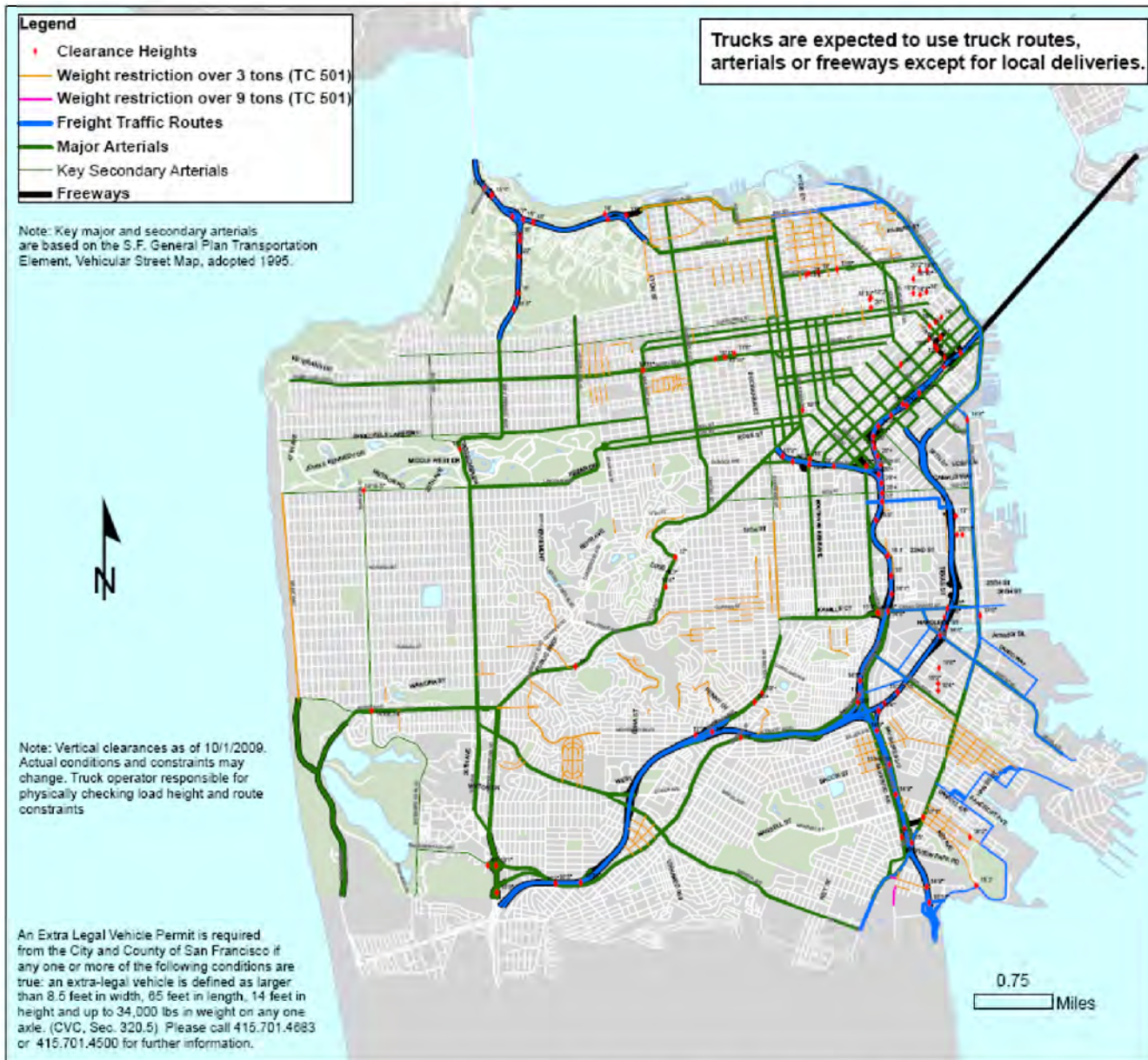
# *Long term inequities from transportation facility development*

- Following the 1956 Highway Act, freeways were built within central cities and alignments targeted low income and minority areas
- Demolished neighborhood infrastructure and displaced residents.
- Enabled suburban sprawl
- Precipitated urban flight & disinvestment
- Long term consequences
  - Social & physical fragmentation
  - Natural resource degradation
  - Blight
  - Segregation
  - Concentrated environmental hazards



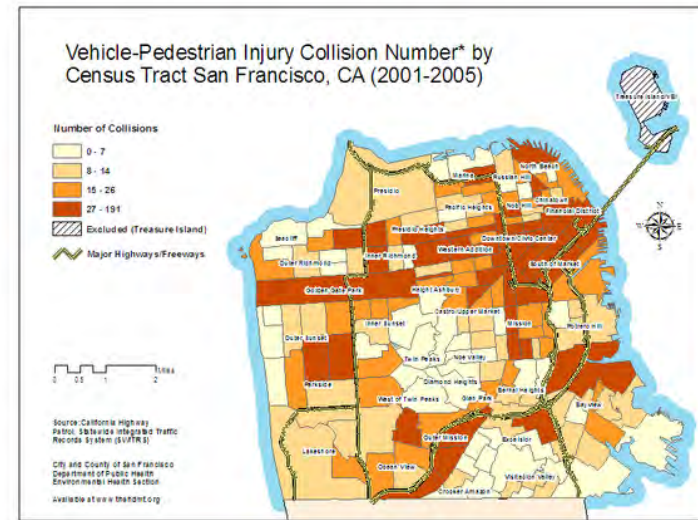
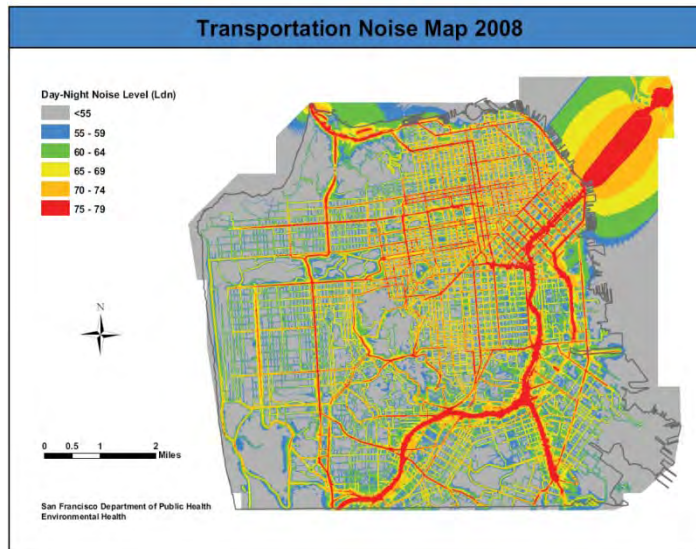
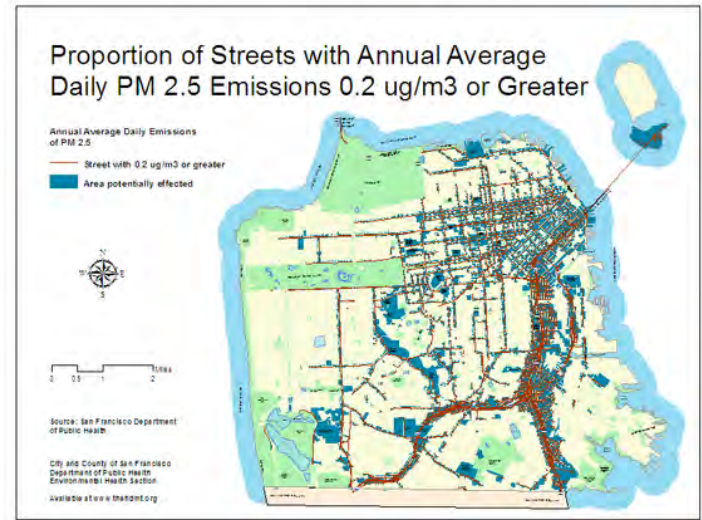


# San Francisco Truck Traffic Routes

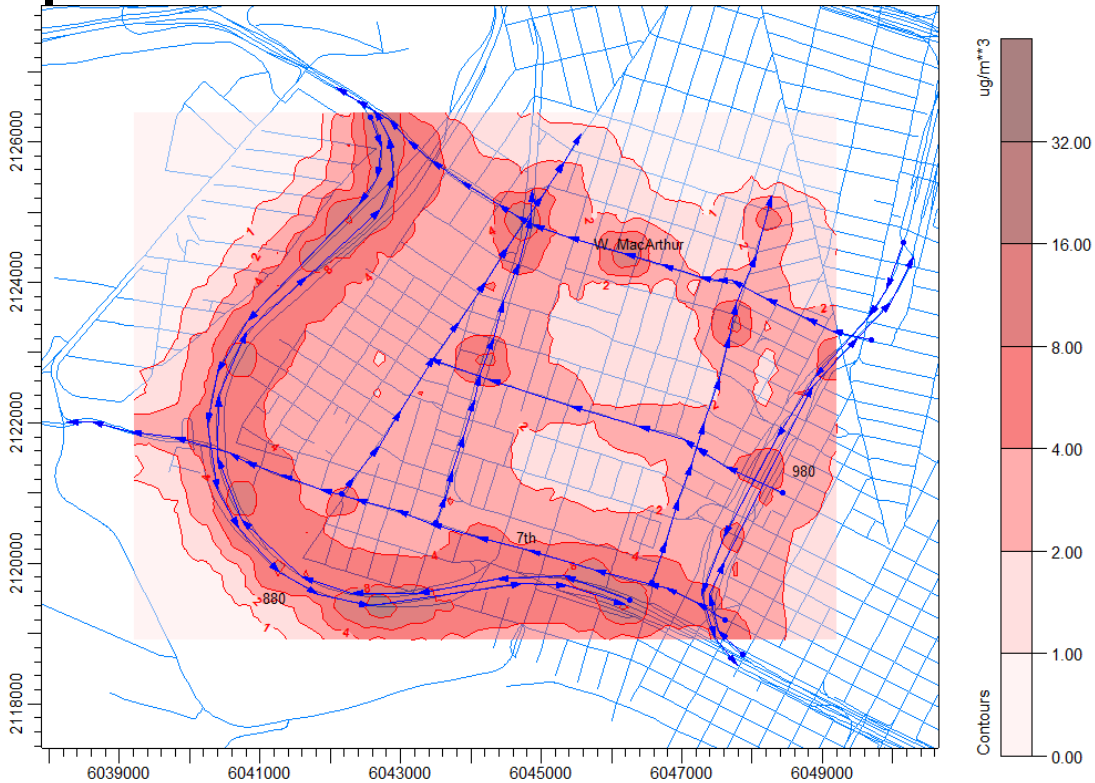


# High volume roadways as cumulative environmental hazards

Cumulative environmental hazards of high volume roadway proximity include respiratory disease, lung development, sleep disturbance, stress, hypertension, and fatal traffic injuries.



# Estimated $PM_{2.5}$ Exposure and Mortality Impacts in West Oakland



**Estimated deaths from PM 2.5 exposure**

Including contributions from local traffic and surrounding freeways:

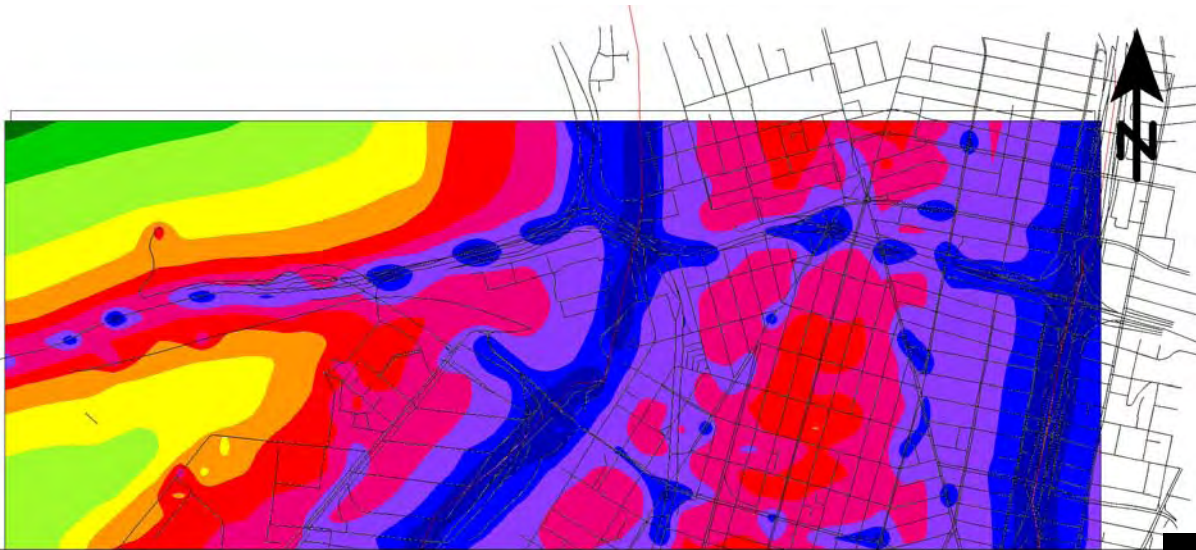
**Approximately 4 deaths/year**

$$\Delta y = y_0 (e^{\beta \Delta PM} - 1) \cdot pop$$

where:

- $\Delta y$  = changes in the incidence of a health endpoint corresponding to a particular change in PM
- $y_0$  = baseline incidence rate per person
- $\beta$  = coefficient
- $\Delta PM$  = change in PM concentration
- $pop$  = population of a particular group that a study considered

# *Estimated noise levels and health impacts in West Oakland*



**Sleep disturbed:** 29%

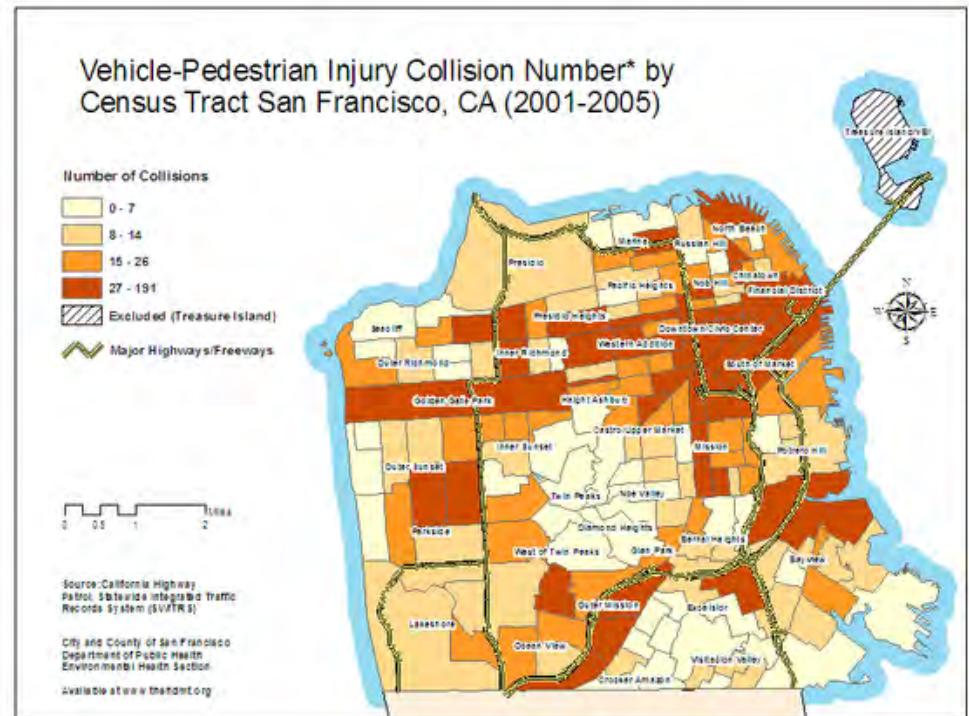
**High annoyance:** 37%

**Cognitive impairment:**  
(reading + recall) 29%

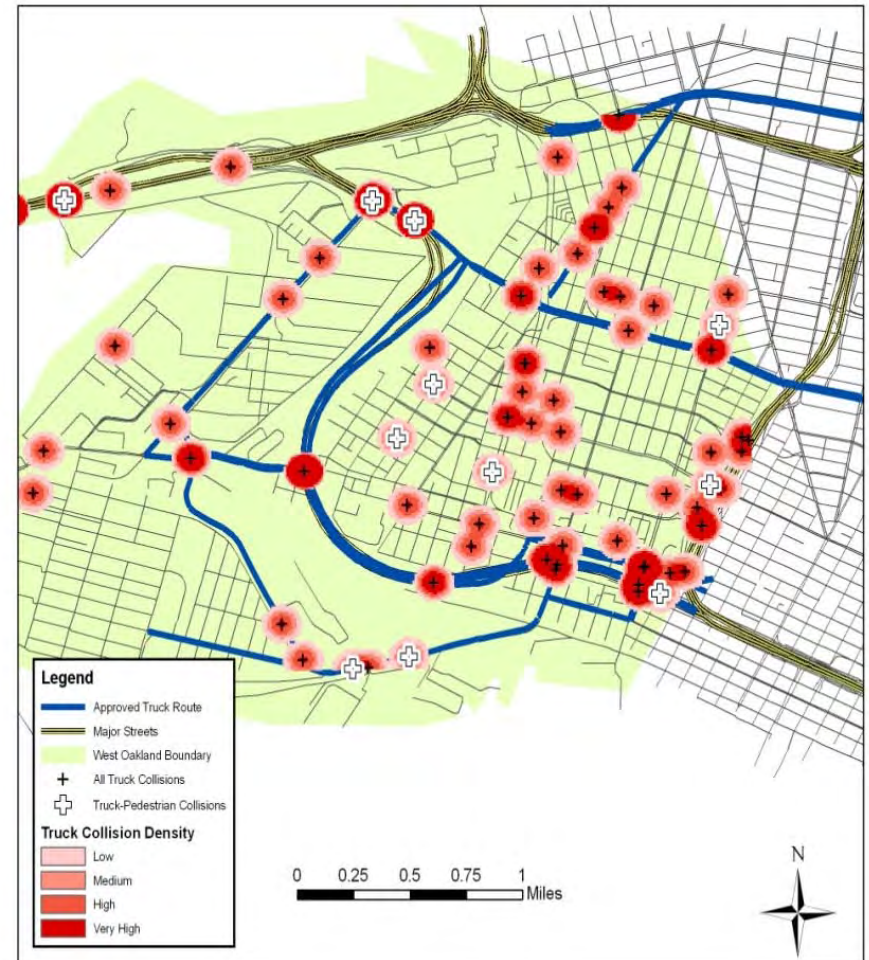
**Myocardial infarction:**  
8 deaths/year

# Area Level Regression Model of San Francisco Vehicle-Pedestrian Collision Injuries

- Traffic volume (+)
- Arterial streets (+)
  - w/o surface transit
- Commercial zoning (+)
- Employees (+)
- Residents (+)
- Land area (-)
- Below poverty level (+)
- Age 65 and over (-)



# Freight Routes and Truck-related Collisions in West Oakland



Truck-pedestrian/bicyclist collision rates five-fold higher than City

Many truck collisions occur not on the truck routes.





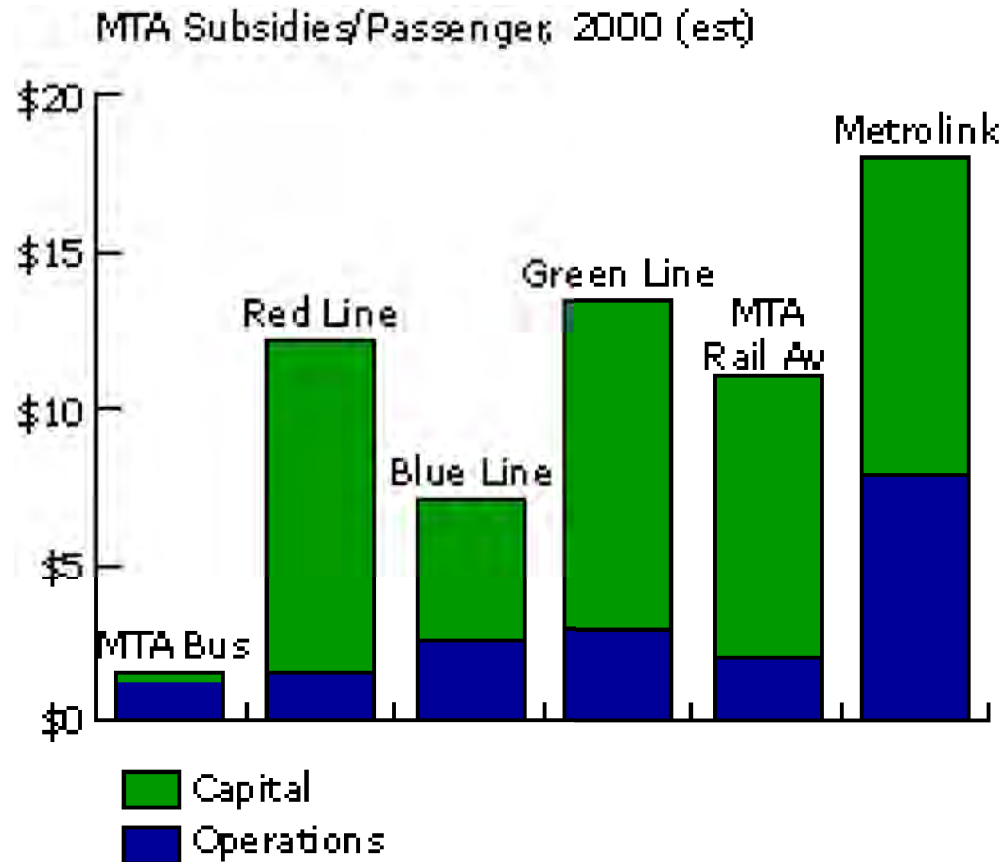
# *Lower-income households not well served by transportation systems*

## **Investments**

- Relatively fewer lower income cars owners
- 1956-2003 ratio of \$\$ to highway to transit \$\$ = 9:1
- Few public resources for urban bus systems
- Pedestrian / bike infrastructure funding disproportionately targeted to wealthier neighborhoods
  
- **Disparities for lower income households**
- Fewer trips
- Less access to employment
- Transportation barriers to health care



# Disproportionate public subsidies: Bus versus rail







# *Transportation Infrastructure Contributions to Segregation*

- Demolition and displacement
- Out migration of middle class
- Decreasing property values proximate to freeways?
- Segregations enables environmental injustice
- Residence in segregated high-poverty communities associated with 10+ years of life lost





# *Transportation Impacted Communities and Vulnerability*

- Sensitivity to stressors
  - Employment and poverty?
  - Lower physical activity?
- Higher physical exposures
- Ability to respond to stressors
  - Disaster response
  - Health care access
  - Food access?





## *Conclusions: Transport Infrastructure is the source of cumulative environmental impacts*

- Transport infrastructure → multiple harms
  - Harms act cumulatively on the human organism and community
  - Direct and indirect, social and environmental
  - Harms are intuitive and apparent
- “Risk assessment” relevant to a fraction of transportation infrastructure impacts
- Existing risk management strategies (noise, air pollutants) do not prevent cumulative hazards
- Impacted communities receive fewer infrastructure benefits





## *Research gaps*

- Research focused on infrastructure, neighborhoods, and systems (vs. molecules and exposures)
- Transportation and access to basic needs and services ( food, schools)
- Tools for “hot spot” analysis
- Synergistic effects of traffic intensity
- Effectiveness of interventions (e.g. lane reductions)
- Emerging disparities in sustainable and active transportation investments





## *Policy gaps*

- Regulation of transportation facilities as sources of multiple, cumulative hazards (versus vehicles) (maximum roadway emissions, minimum design features)
- Hazards and mitigations addressed in project design
- Health effects analyzed through NEPA documentation & USEPA Section 309 reviews
- Vulnerability incorporated into regulatory standards
- Funding for the Noise Control Act
- Ethical decision-making

