What you see in this picture is the least of it!

I93 has 150,000 vehicles per day overhead

New housing proposed with retail to the right

MBTA diesel commuter rail lines (3) under

Transportation & Community Desig

Regional Pollution – Local Receptors

Wig Zamore STEP - NPSG Denver 2014

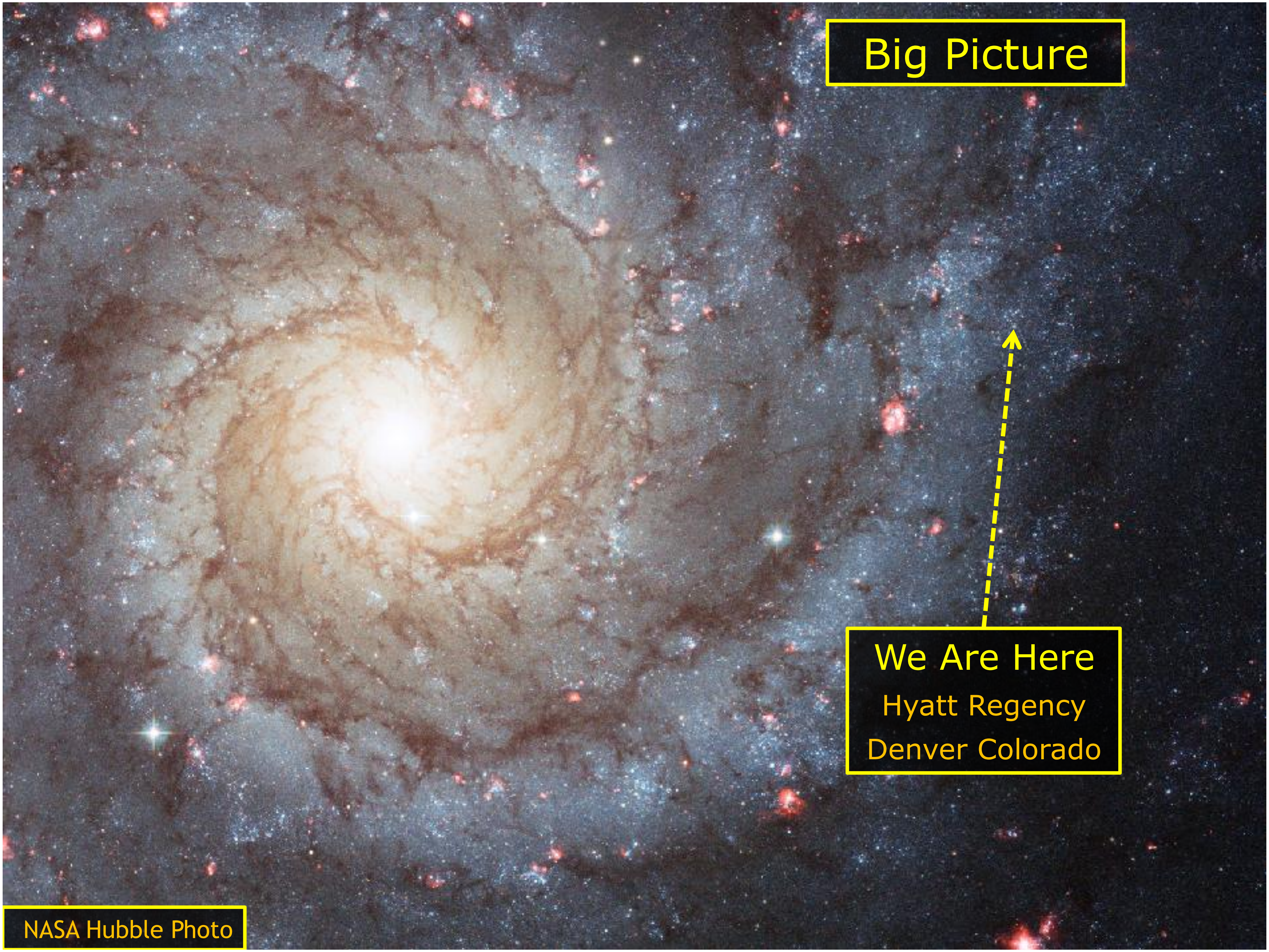

Is this a healthy place and time for a
young mother and daughter to exercise?

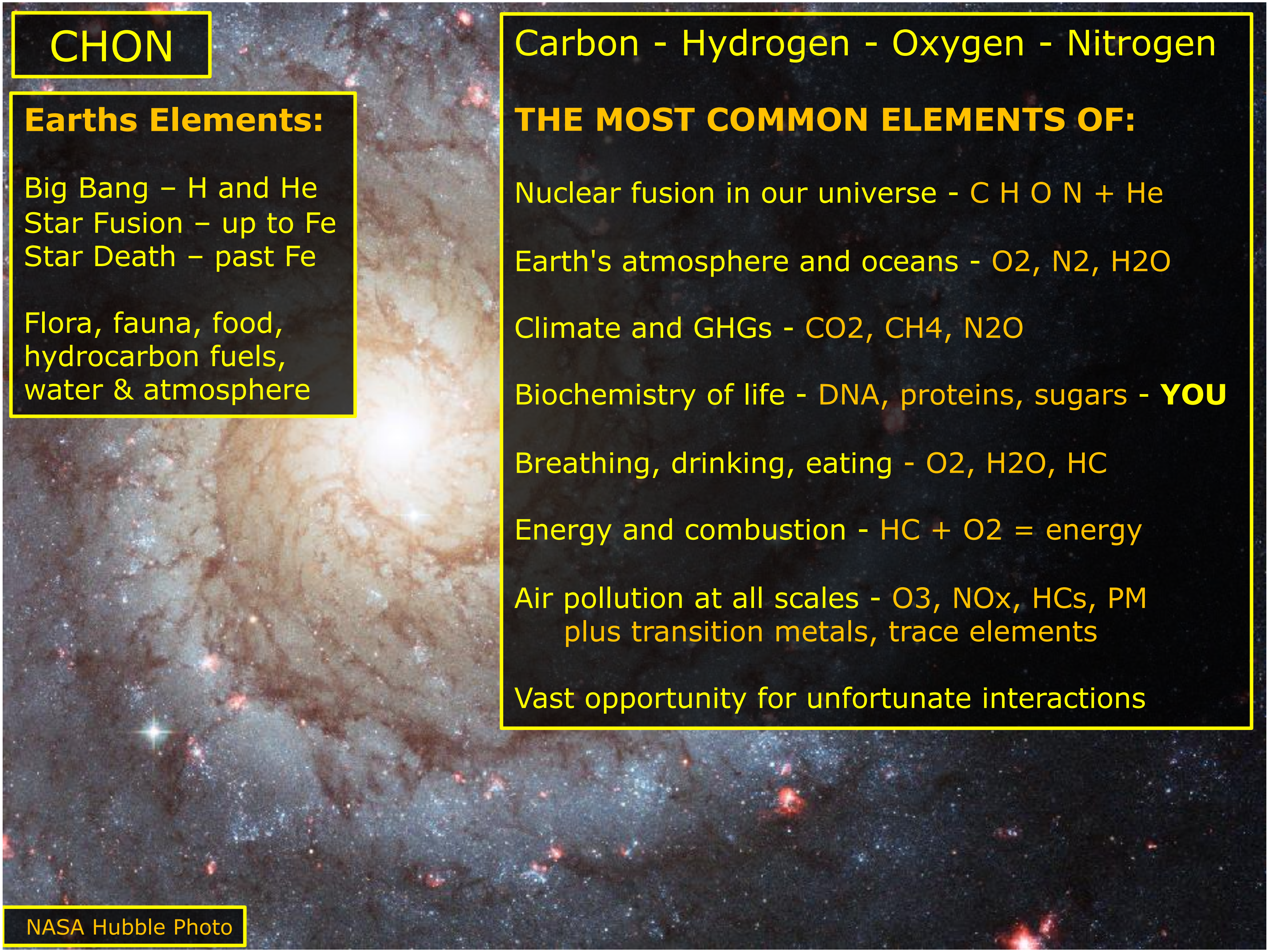

Are these healthy places for housing?
Are HEPA filter interventions possible?

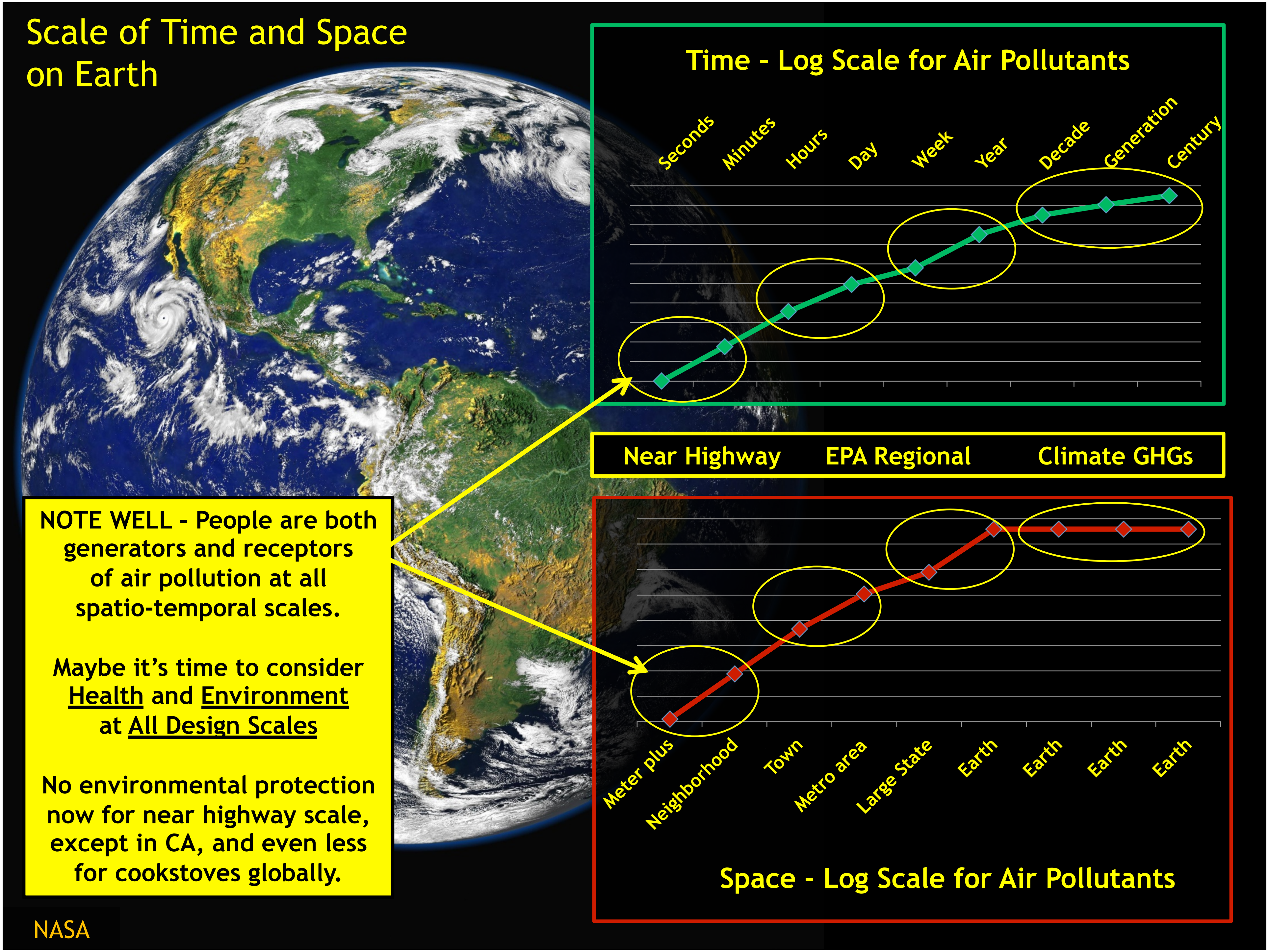

Is Route 28 a good place for a bicycle
commuter in morning rush hour?


Can alternatives
can provide respite
NO
MOTOR
VEHICLES
Somerville
Community Path
near Davis Square


Many People on Earth are Moving to Cities.
What Scale Defines Neighborhood?
TOP SPEED PIZZERIA

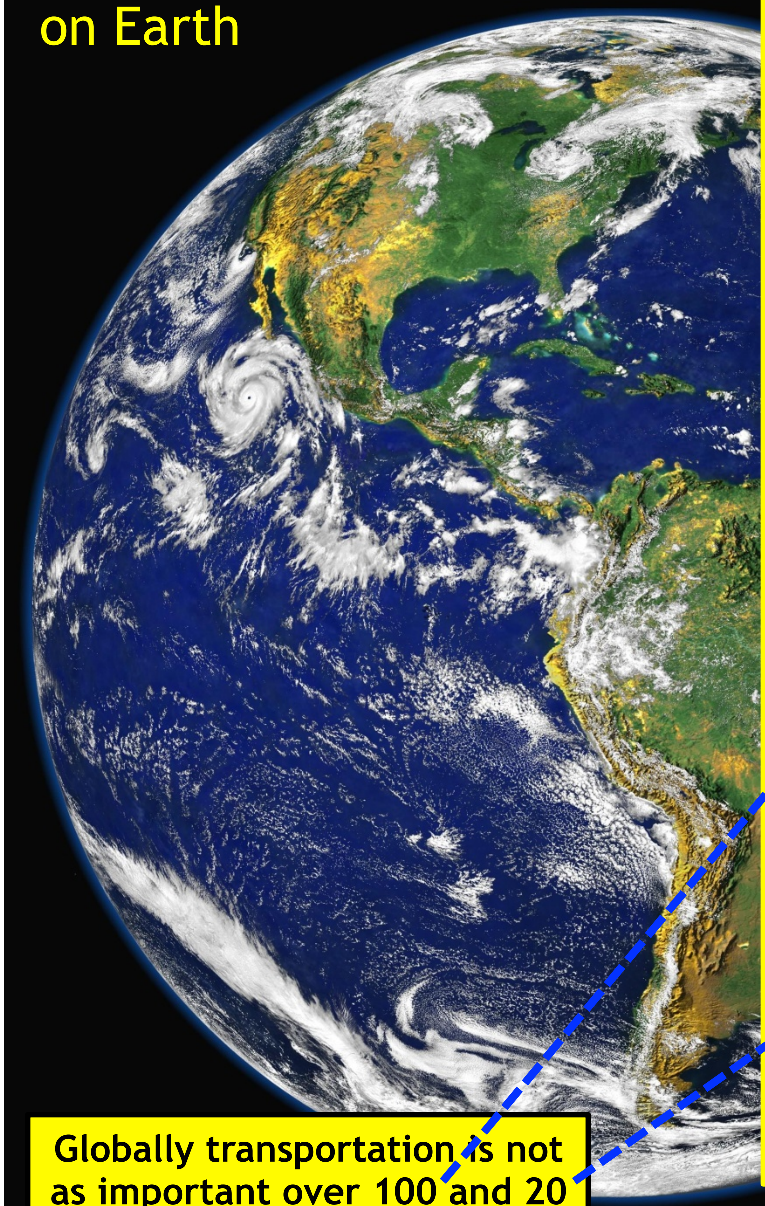

Big Picture
We Are Here
Hyatt Regency
Denver Colorado
NASA Hubble Photo


CHON
Earths Elements:
Big Bang – H and He
Star Fusion – up to Fe
Star Death – past Fe
Flora, fauna, food,
hydrocarbon fuels,
water & atmosphere
Carbon - Hydrogen - Oxygen - Nitrogen
THE MOST COMMON ELEMENTS OF:
Nuclear fusion in our universe - C H O N + He
Earth's atmosphere and oceans - O2, N2, H2O
Climate and GHGs - CO2, CH4, N2O
Biochemistry of life - DNA, proteins, sugars - YOU
Breathing, drinking, eating - O2, H2O, HC
Energy and combustion - HC + O2 = energy
Air pollution at all scales - O3, NOx, HCs, PM
plus transition metals, trace elements
Vast opportunity for unfortunate interactions
NASA Hubble Photo



Scale of Time and Space on Earth
Time - Log Scale for Air Pollutants
Seconds
Minutes
Hours
Day
Week
Year
Decade
Generation
Century
Near Highway
EPA Regional
Climate GHGs
NOTE WELL - People are both generators and receptors of air pollution at all spatio-temporal scales.
Maybe it's time to consider Health and Environment at All Design Scales
No environmental protection now for near highway scale, except in CA, and even less for cookstoves globally.
Meter plus
Neighborhood
Town
Metro area
Large State
Earth
Earth
Earth
Earth
Space - Log Scale for Air Pollutants
NASA

Scale of Time and Space on Earth



Final Draft (7 June 2013) Chapter 8 IPCC WGI Fifth Assessment Report

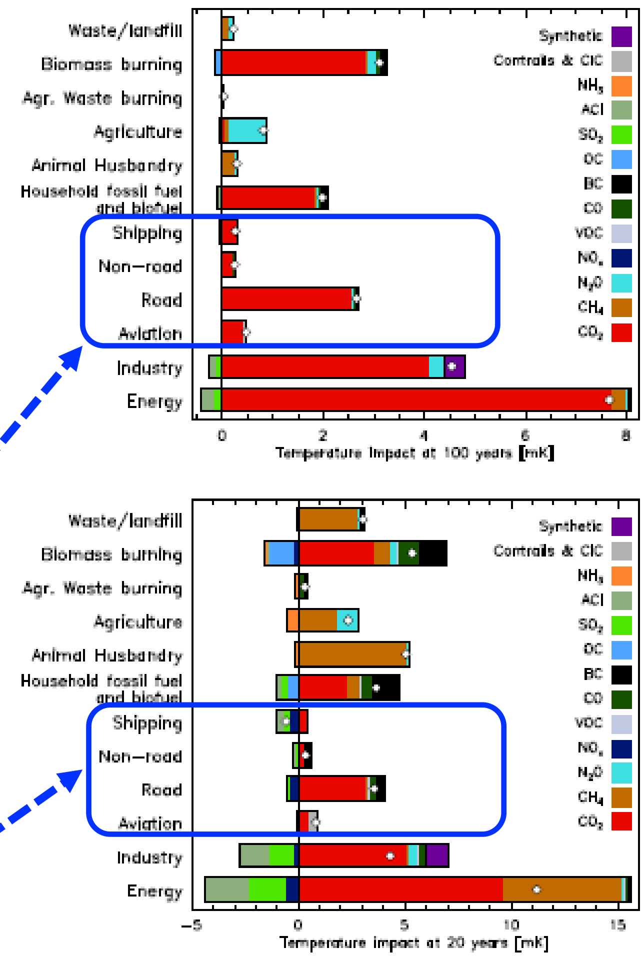


Figure 8.34: Net global mean temperature change by source sector after (a) 100 and (b) 20 years (for one year pulse emissions). Emission data for 2008 are taken from the EDGAR database. For BC and OC anthropogenic emissions are from Shindell et al. (2012a) and biomass burning emissions are from Lamarque et al. (2010), see Supplementary Material Section 8.SM.17. There are large uncertainties related to the AGTP values and consequentially also to the calculated temperature responses (see text).

Globally transportation is not as important over 100 and 20 years as some other sectors

NASA

Quantifying Carbon Footprint Reduction Opportunities for U.S. Households and Communities

Christopher M. Jones* and Daniel M. Kammen*

Energy and Resources Group, University of California, Berkeley, 310 Barrows Hall, Berkeley, California 94720-3050, United States

Environmental Science & Technology ARTICLE

Note transportation CO2e prominence and direct (blue) versus indirect (green) energy

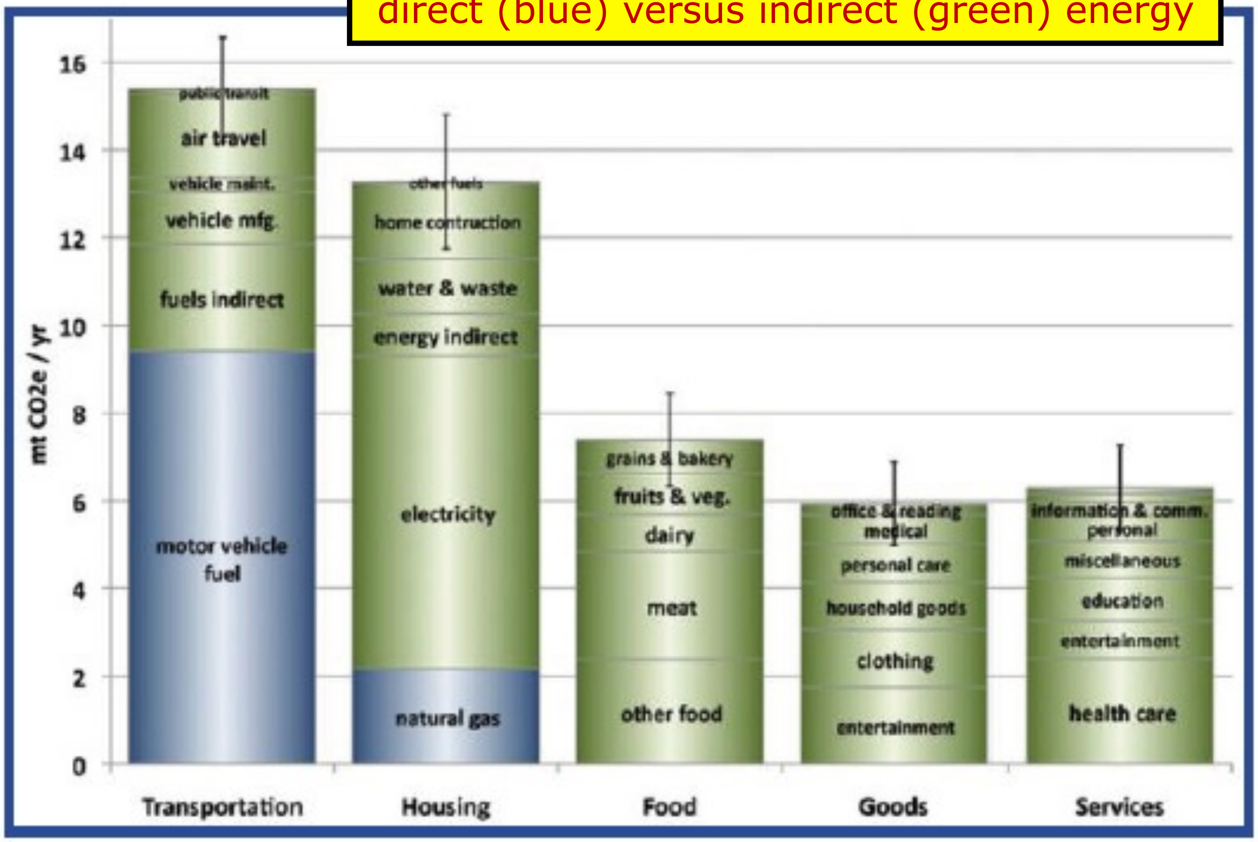


Figure 1. Total carbon footprint of the typical U.S. household: 48 t CO2e/yr. Blue indicates direct emissions; green indicates indirect emissions.

Quantifying Carbon Footprint Reduction Opportunities for U.S. Households and Communities

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Variation in households and cities – Lower income and Compactness = Less transportation share

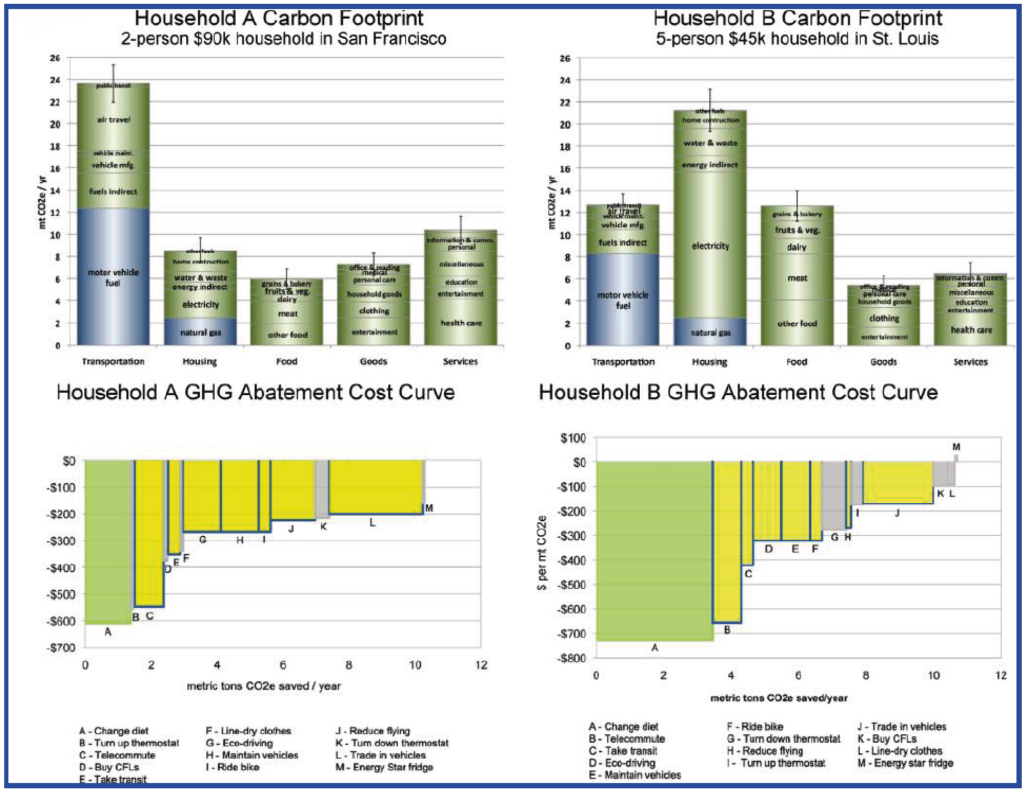
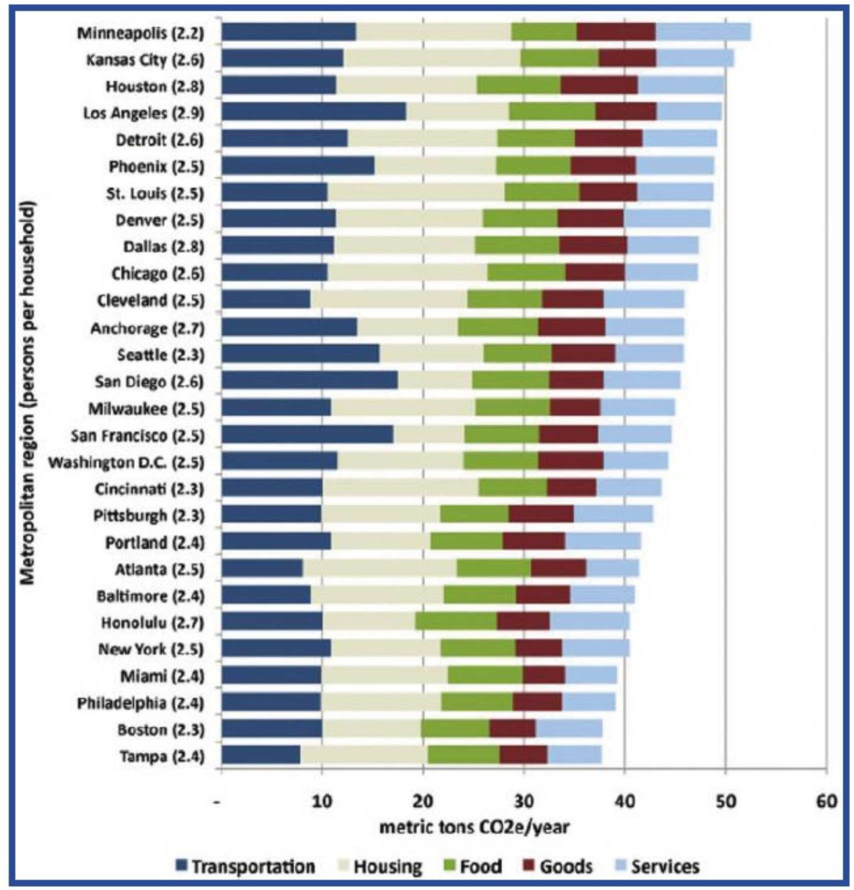
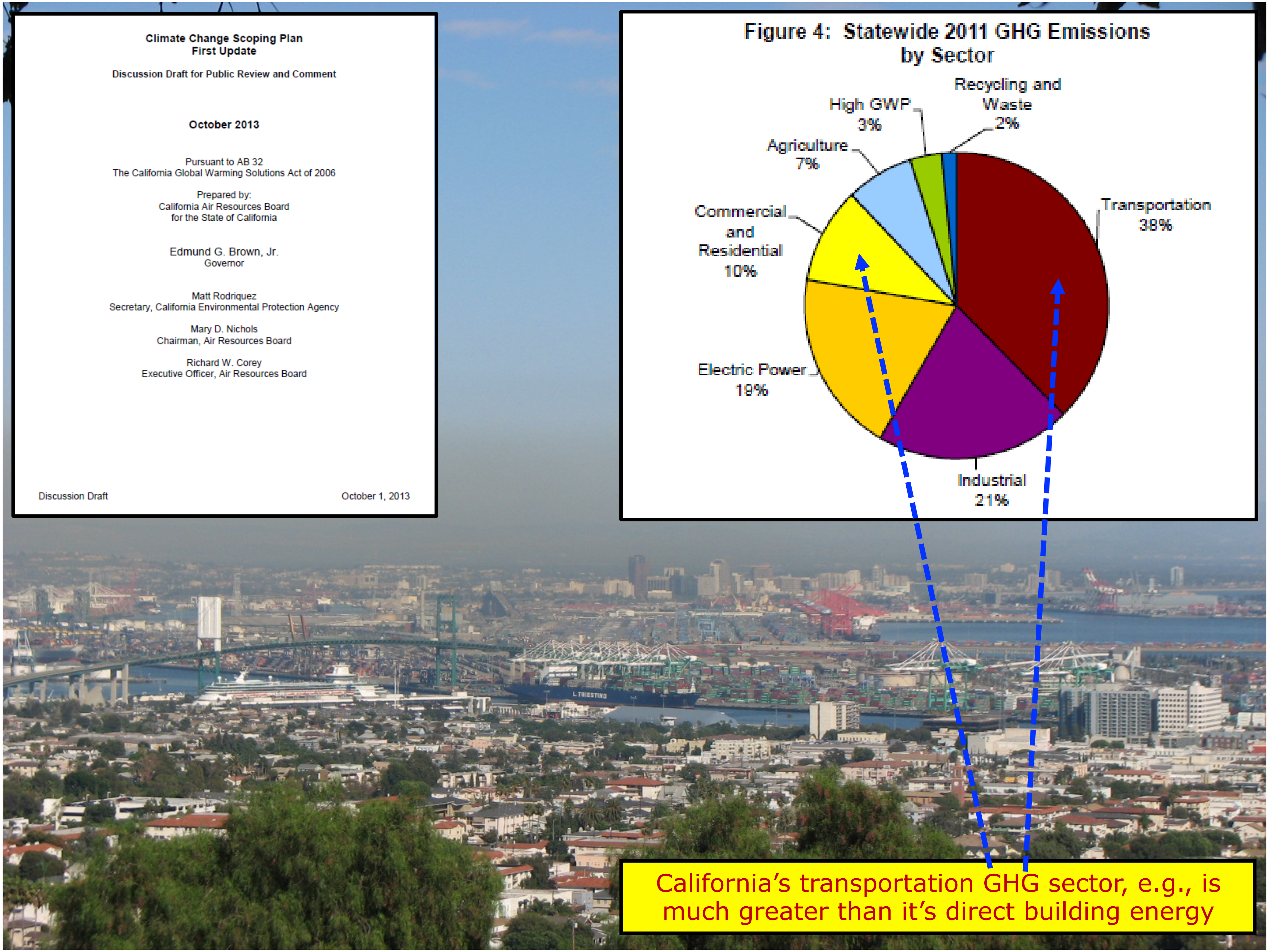
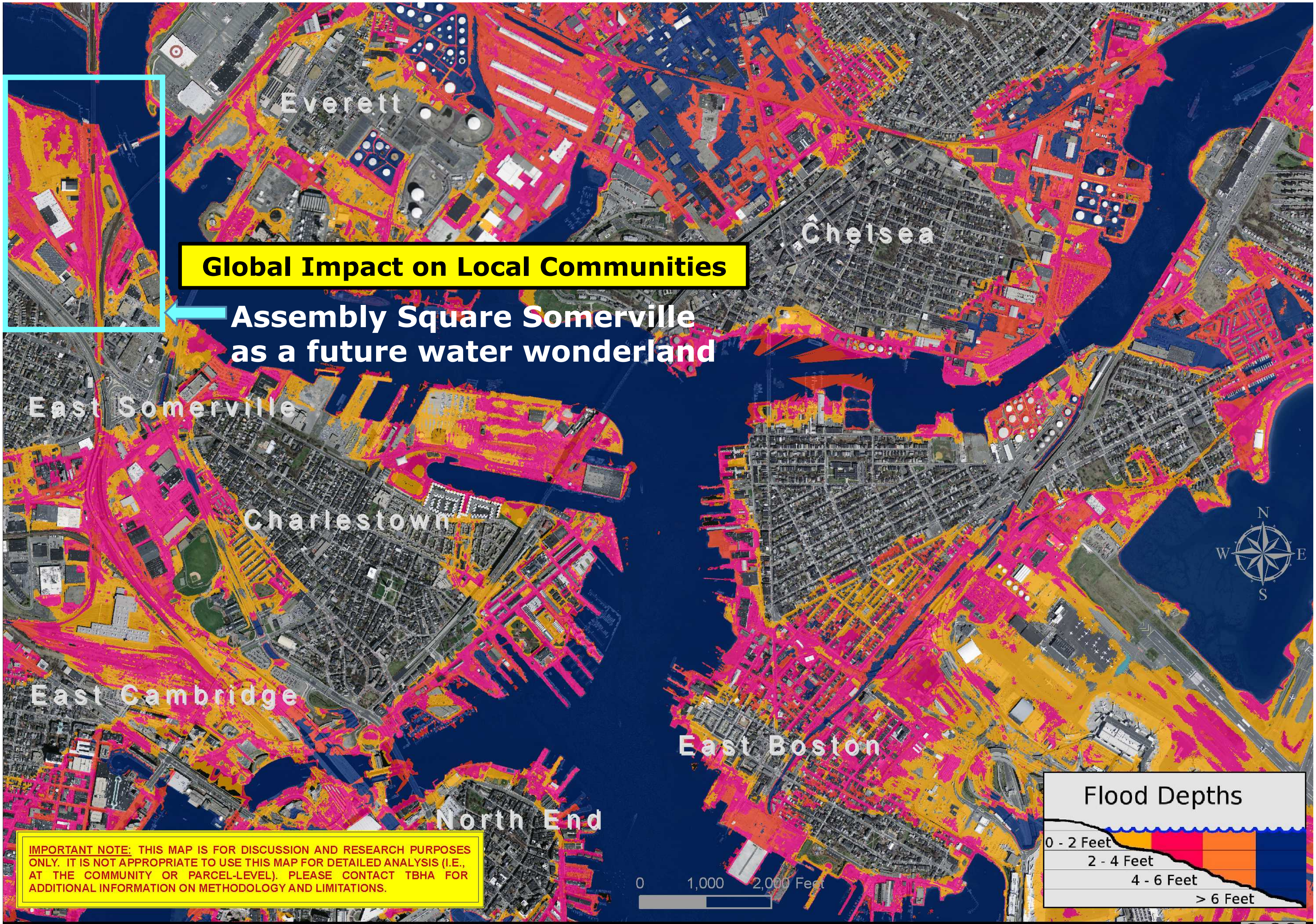


Figure 6. Carbon footprints and GHG abatement cost curves for example households. Household A is an upper income two-person household in the San Francisco Bay Area. Household B is a middle-income five-person household in St. Louis. In the upper figures, carbon footprints are shown for the major categories of emissions, with annual CO_2e emissions on the *y*-axis. In the lower figures, *X*-axis is annual GHG savings; *y*-axis is levelized annual cost of mitigation measures per metric ton of CO_2e conserved. Green bars are for changing diets; yellow bars with blue outline are transportation; solid gray bars are household energy.




Climate Change Scoping Plan
First Update
Discussion Draft for Public Review and Comment
October 2013
Pursuant to AB 32
The California Global Warming Solutions Act of 2006
Prepared by:
California Air Resources Board
for the State of California
Edmund G. Brown, Jr.
Governor
Matt Rodriquez
Secretary, California Environmental Protection Agency
Mary D. Nichols
Chairman, Air Resources Board
Richard W. Corey
Executive Officer, Air Resources Board
Discussion Draft
October 1, 2013
Figure 4: Statewide 2011 GHG Emissions by Sector
Recycling and Waste 2%
High GWP 3%
Agriculture 7%
Commercial and Residential 10%
Transportation 38%
Electric Power 19%
Industrial 21%
California's transportation GHG sector, e.g., is much greater than it's direct building energy



Chelsea, Everett, EastBoston
Mean Higher High Water Plus 7.5 Feet
Sources: MassGIS, NOAA, USGS

Map Development:
Chris Watson,Ellen Douglas - UMass Boston
Paul Kirshen - Battelle

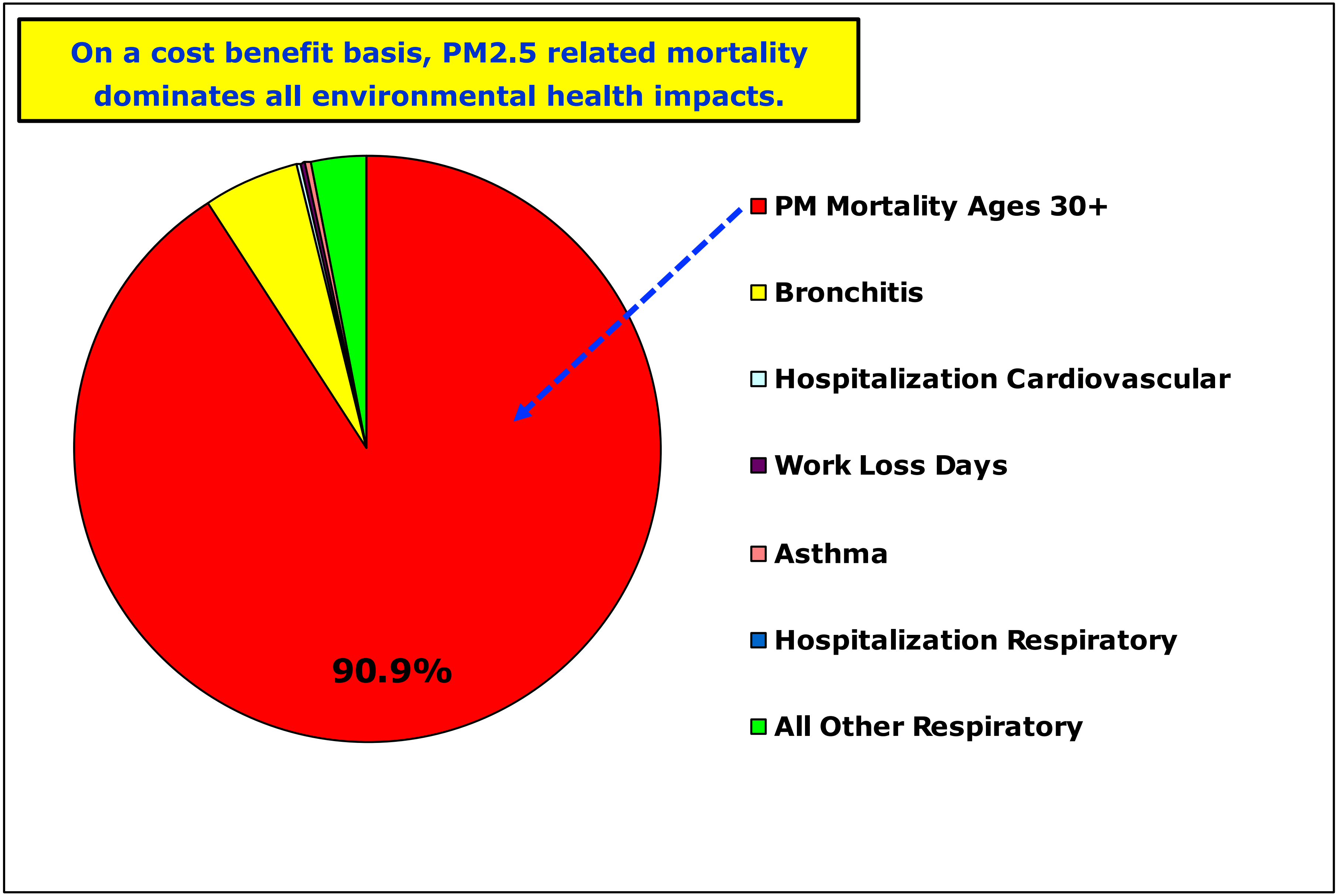
National Ambient Air Quality Standards (NAAQS)

The Clean Air Act, which was last amended in 1990, requires EPA to set National Ambient Air Quality Standards (40 CFR part 50) for pollutants considered harmful to public health and the environment. The Clean Air Act identifies two types of national ambient air quality standards. ***Primary standards*** provide public health protection, including protecting the health of "sensitive" populations such as asthmatics, children, and the elderly. ***Secondary standards*** provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings. EPA has set National Ambient Air Quality Standards for six principal pollutants, which are called "criteria" pollutants. They are listed below. Units of measure for the standards are parts per million (ppm) by volume, parts per billion (ppb) by volume, and micrograms per cubic meter of air ($\mu g/m^3$)

Pollutant [final rule cite]		Primary/ Secondary	Averaging Time	Level	Form
Carbon Monoxide [76 FR 54294, Aug 31, 2011]		primary	8-hour	9 ppm	Not to be exceeded more than once per year
			1-hour	35 ppm	
Lead [73 FR 66964, Nov 12, 2008]		primary and secondary	Rolling 3 month average	$0.15\ \mu g/m^3$ (1)	Not to be exceeded
Nitrogen Dioxide [75 FR 6474, Feb 9, 2010] [61 FR 52852, Oct 8, 1996]		primary	1-hour	100 ppb	98th percentile, averaged over 3 years
		primary and secondary	Annual	53 ppb (2)	Annual Mean
Ozone [73 FR 16436, Mar 27, 2008]		primary and secondary	8-hour	0.075 ppm (3)	Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years
Particle Pollution Dec 14, 2012	$PM_{2.5}$	primary	Annual	$12\ \mu g/m^3$	annual mean, averaged over 3 years
		secondary	Annual	$15\ \mu g/m^3$	annual mean, averaged over 3 years
		primary and secondary	24-hour	$35\ \mu g/m^3$	98th percentile, averaged over 3 years
	PM_{10}	primary and secondary	24-hour	$150\ \mu g/m^3$	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide [75 FR 35520, Jun 22, 2010] [38 FR 25678, Sept 14, 1973]		primary	1-hour	75 ppb (4)	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		secondary	3-hour	0.5 ppm	Not to be exceeded more than once per year

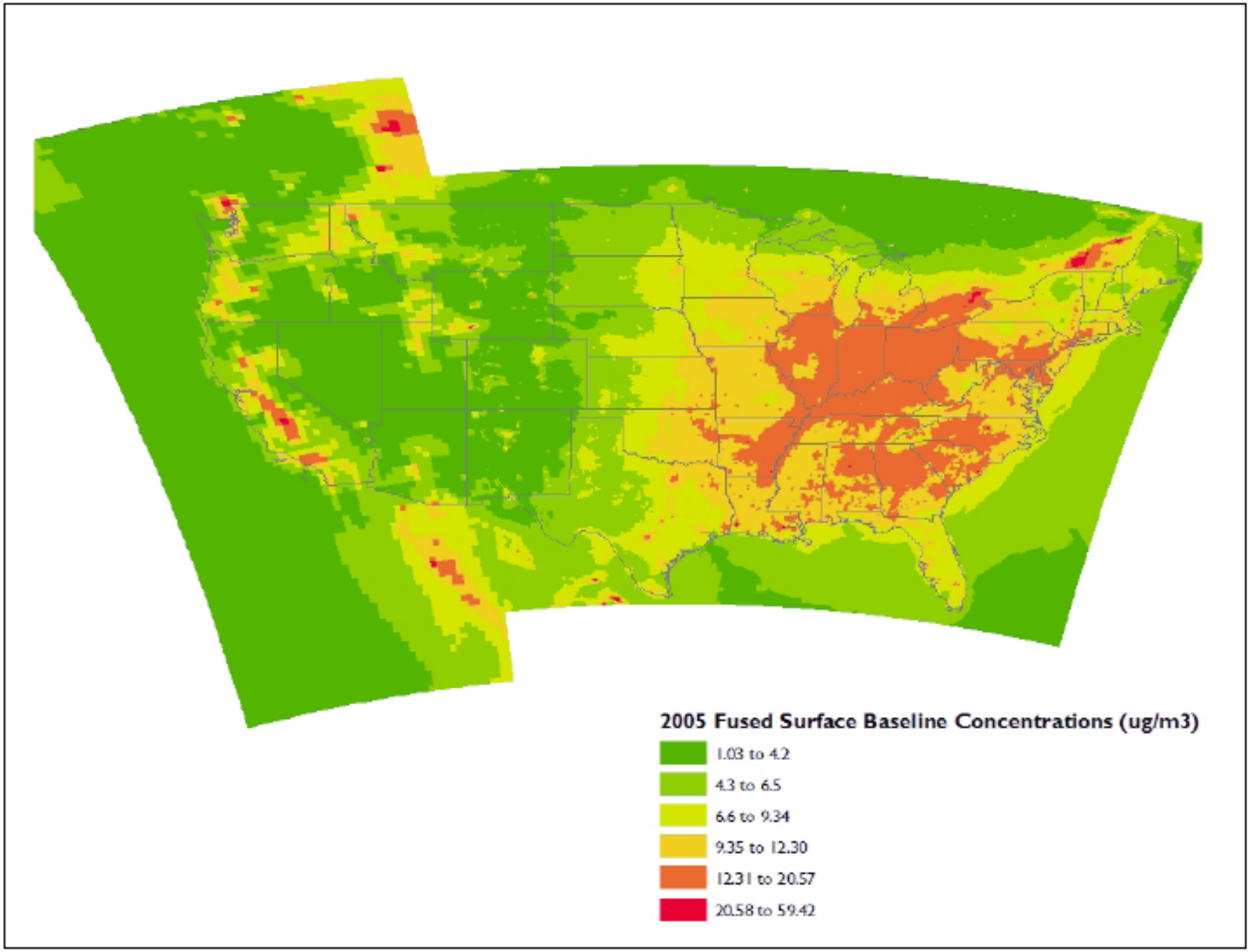
Main concerns for EPA are PM2.5 and Ozone

Benefits and Costs of the CAA 1990 – 2010 EPA Report to Congress
PM2.5 also dominates the benefit to cost ratio of all Federal regulations



EPA PM NAAQS Second Draft Risk Assessment - Feb 2010

Figure 5-2 2005 fused surface baseline $PM_{2.5}$ concentrations



Utah clean air rally draws thousands to Capitol

Rally » More than 4,000 protesters swarm the Hill, call for government action in fight against pollution.

By Jennifer Napier-Pearce | The Salt Lake Tribune

First Published Jan 25 2014 03:11 pm • Last Updated Jan 27 2014 09:38 am

In what organizers called the largest demonstration for clean air yet, more than 4,000 Utahns stood on the steps of the Capitol Saturday to push for government intervention in the fight against air pollution.

Protesters, dozens of whom wore surgical or gas masks, swarmed Capitol Hill. Parents brought children in strollers, leashed dogs roamed on the grass and scores waved hand-written signs while musicians played protest songs and advocates addressed the crowd.

View photo gallery (22 photos)

Related Stories

- **Utahns take to social media as thousands rally for clean air**
  Published January 25, 2014
- **Editor column: Will Utah Legislature heed the public?**
  Published January 25, 2014
- **How does Utah's bad air hurt our health?**
  Published January 29, 2014
- **Trib Talk: Pollution and your health**
  Published January 27, 2014
- **My bad air day: Utah doc: More illness, depression in inversions**
  Published January 27, 2014
- **Clean-air activists give most Utah lawmakers bad grades**
  Published January 28, 2014

Note that inversions drive up both PM2.5 and local transportation pollution levels


IN CLEAN AIR
CLEAN AIR


I WANT TO PLAY OUTSIDE!


PEOPLE OVER PROFITS
AND SMELL THE POLLUTION

(Steve Griffin | The Salt Lake Tribune) The sunrise illuminates the peaks of the Oquirrh Mountains as a the inversion blankets the Salt Lake Valley in Salt Lake City, Utah Monday, December 16, 2013. A Salt Lake Tribune poll has found that a majority of Utahns want stricter air quality standards.

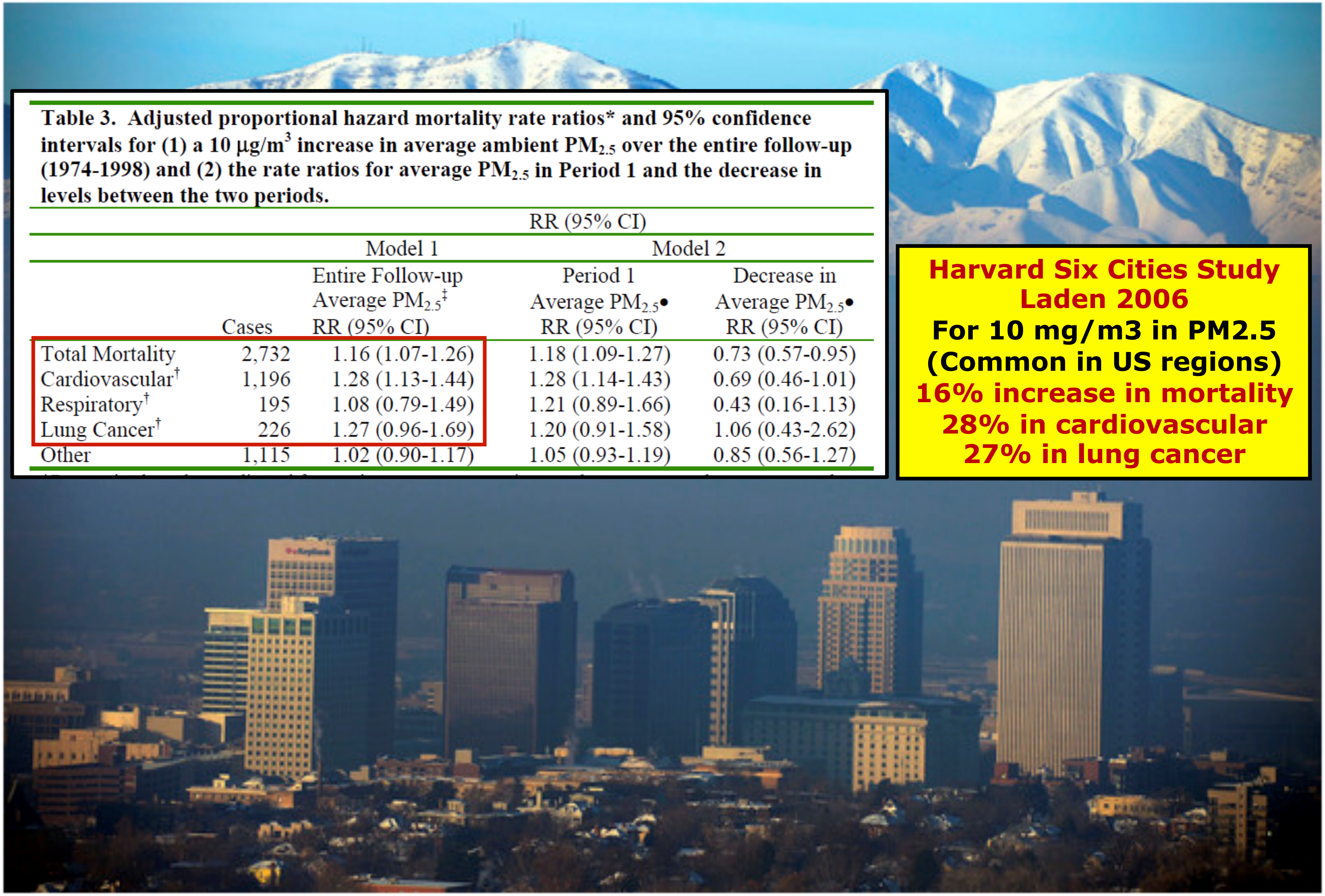


Table 3. Adjusted proportional hazard mortality rate ratios* and 95% confidence intervals for (1) a 10 μg/m^3 increase in average ambient $PM_{2.5}$ over the entire follow-up (1974-1998) and (2) the rate ratios for average $PM_{2.5}$ in Period 1 and the decrease in levels between the two periods.

		RR (95% CI)		
		Model 1	Model 2	
	Cases	Entire Follow-up Average $PM_{2.5}$‡ RR (95% CI)	Period 1 Average $PM_{2.5}$• RR (95% CI)	Decrease in Average $PM_{2.5}$• RR (95% CI)
Total Mortality	2,732	1.16 (1.07-1.26)	1.18 (1.09-1.27)	0.73 (0.57-0.95)
Cardiovascular†	1,196	1.28 (1.13-1.44)	1.28 (1.14-1.43)	0.69 (0.46-1.01)
Respiratory†	195	1.08 (0.79-1.49)	1.21 (0.89-1.66)	0.43 (0.16-1.13)
Lung Cancer†	226	1.27 (0.96-1.69)	1.20 (0.91-1.58)	1.06 (0.43-2.62)
Other	1,115	1.02 (0.90-1.17)	1.05 (0.93-1.19)	0.85 (0.56-1.27)

Harvard Six Cities Study
Laden 2006
For 10 mg/m3 in PM2.5
(Common in US regions)
16% increase in mortality
28% in cardiovascular
27% in lung cancer

(Steve Griffin | The Salt Lake Tribune) The sunrise illuminates the peaks of the Oquirrh Mountains as a the inversion blankets the Salt Lake Valley in Salt Lake City, Utah Monday, December 16, 2013. A Salt Lake Tribune poll has found that a majority of Utahns want stricter air quality standards.

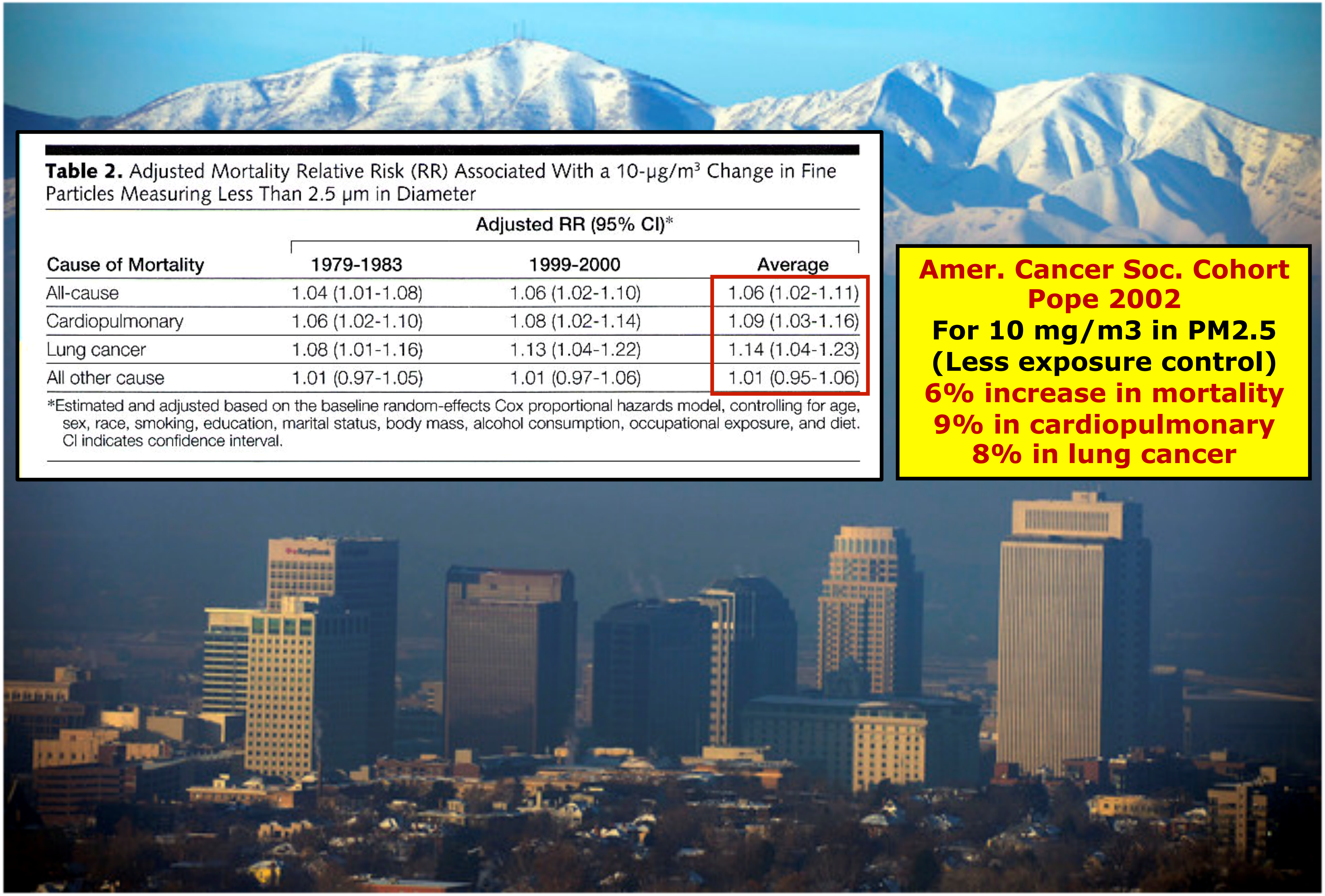


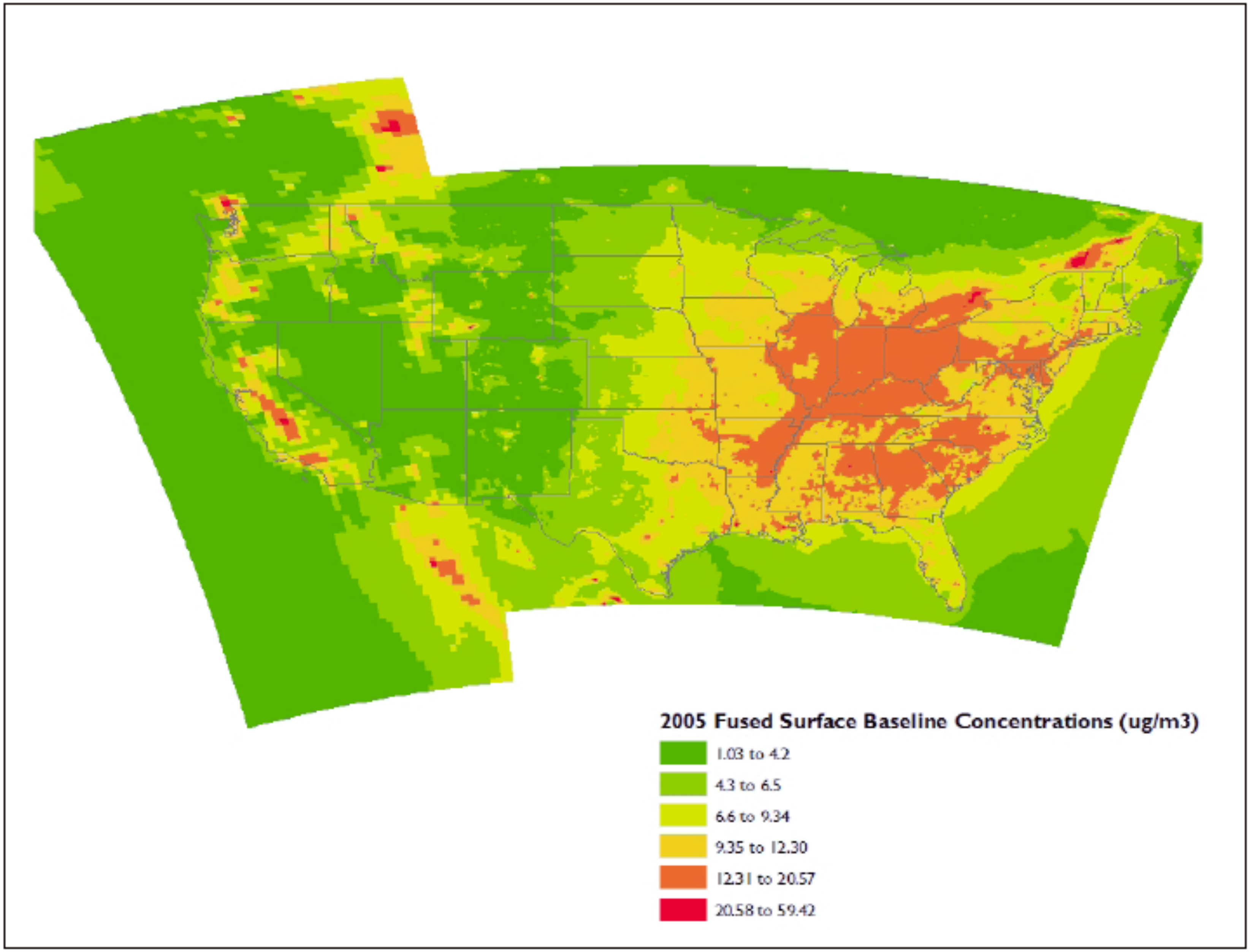
Table 2. Adjusted Mortality Relative Risk (RR) Associated With a 10-μg/m^3 Change in Fine Particles Measuring Less Than 2.5 μm in Diameter

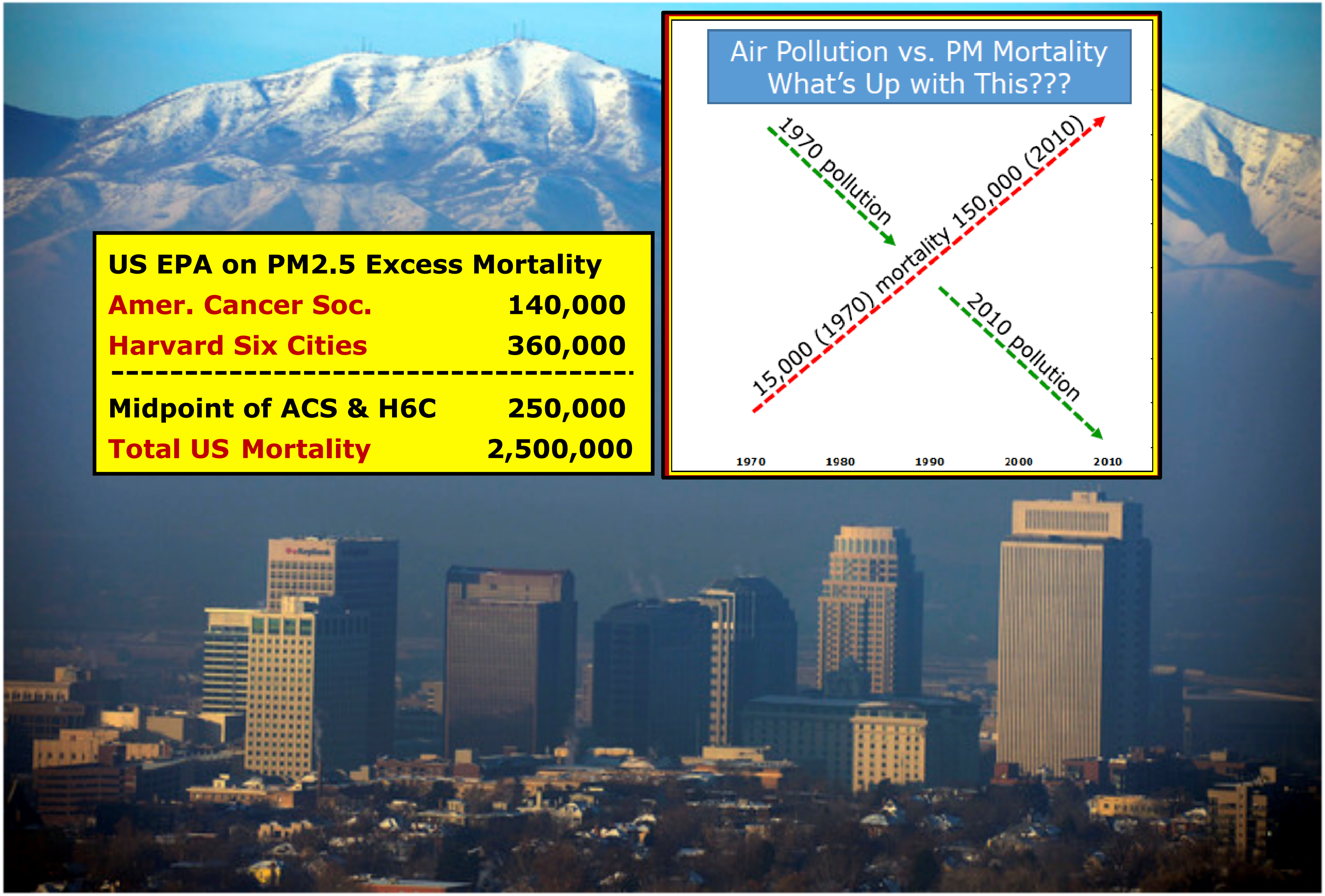
Cause of Mortality	Adjusted RR (95% CI)* 1979-1983	1999-2000	Average
All-cause	1.04 (1.01-1.08)	1.06 (1.02-1.10)	1.06 (1.02-1.11)
Cardiopulmonary	1.06 (1.02-1.10)	1.08 (1.02-1.14)	1.09 (1.03-1.16)
Lung cancer	1.08 (1.01-1.16)	1.13 (1.04-1.22)	1.14 (1.04-1.23)
All other cause	1.01 (0.97-1.05)	1.01 (0.97-1.06)	1.01 (0.95-1.06)

*Estimated and adjusted based on the baseline random-effects Cox proportional hazards model, controlling for age, sex, race, smoking, education, marital status, body mass, alcohol consumption, occupational exposure, and diet. CI indicates confidence interval.

(Steve Griffin | The Salt Lake Tribune) The sunrise illuminates the peaks of the Oquirrh Mountains as a the inversion blankets the Salt Lake Valley in Salt Lake City, Utah Monday, December 16, 2013. A Salt Lake Tribune poll has found that a majority of Utahns want stricter air quality standards.

Figure 5-2 2005 fused surface baseline $PM_{2.5}$ concentrations





(Steve Griffin | The Salt Lake Tribune) The sunrise illuminates the peaks of the Oquirrh Mountains as a the inversion blankets the Salt Lake Valley in Salt Lake City, Utah Monday, December 16, 2013. A Salt Lake Tribune poll has found that a majority of Utahns want stricter air quality standards.

From the WHO 2010 Global Burden of Disease

Notice the difference in PM2.5 mg/m3 scale

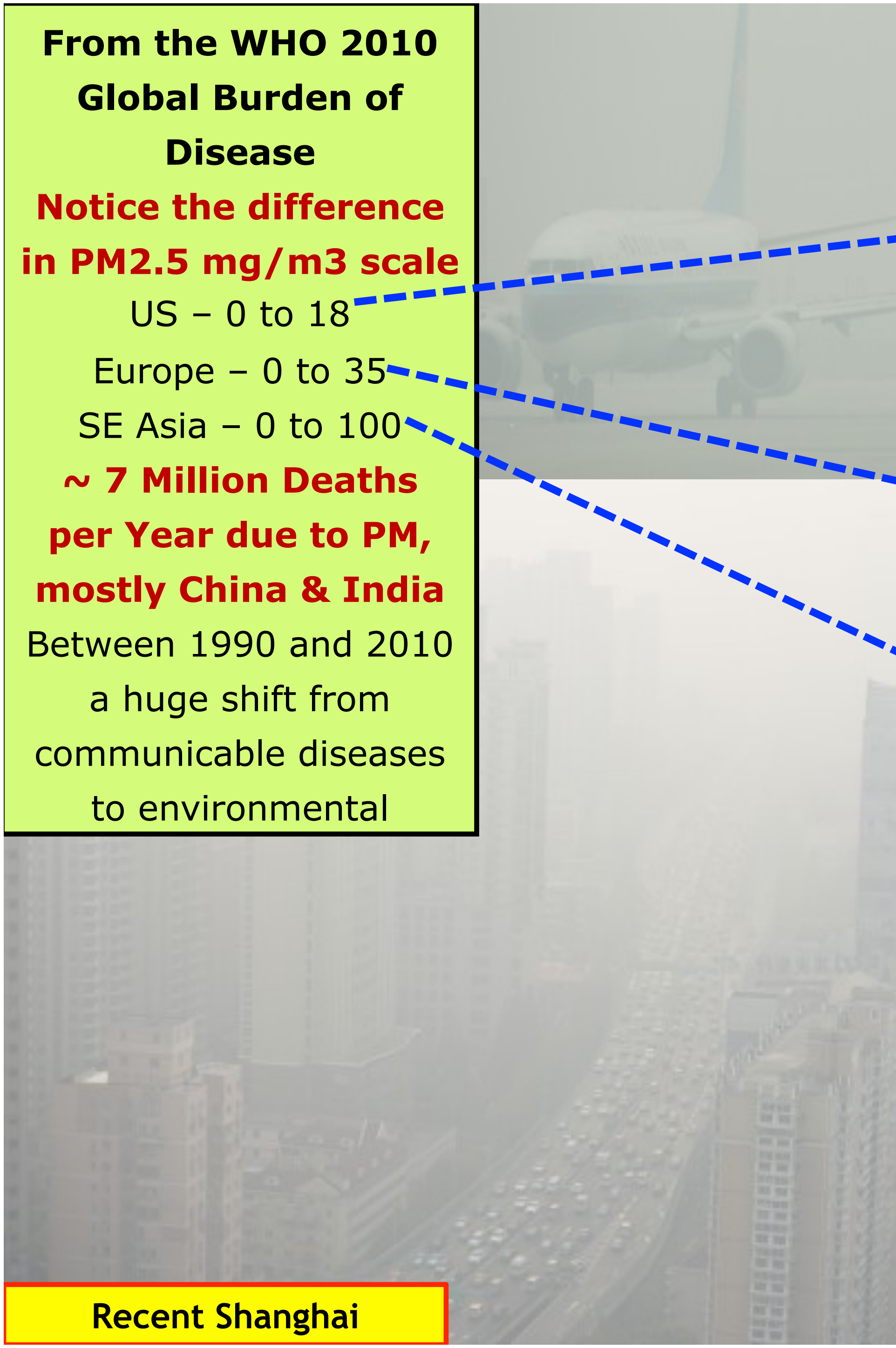
US – 0 to 18

Europe – 0 to 35

SE Asia – 0 to 100

~ 7 Million Deaths per Year due to PM, mostly China & India

Between 1990 and 2010 a huge shift from communicable diseases to environmental



Recent Shanghai

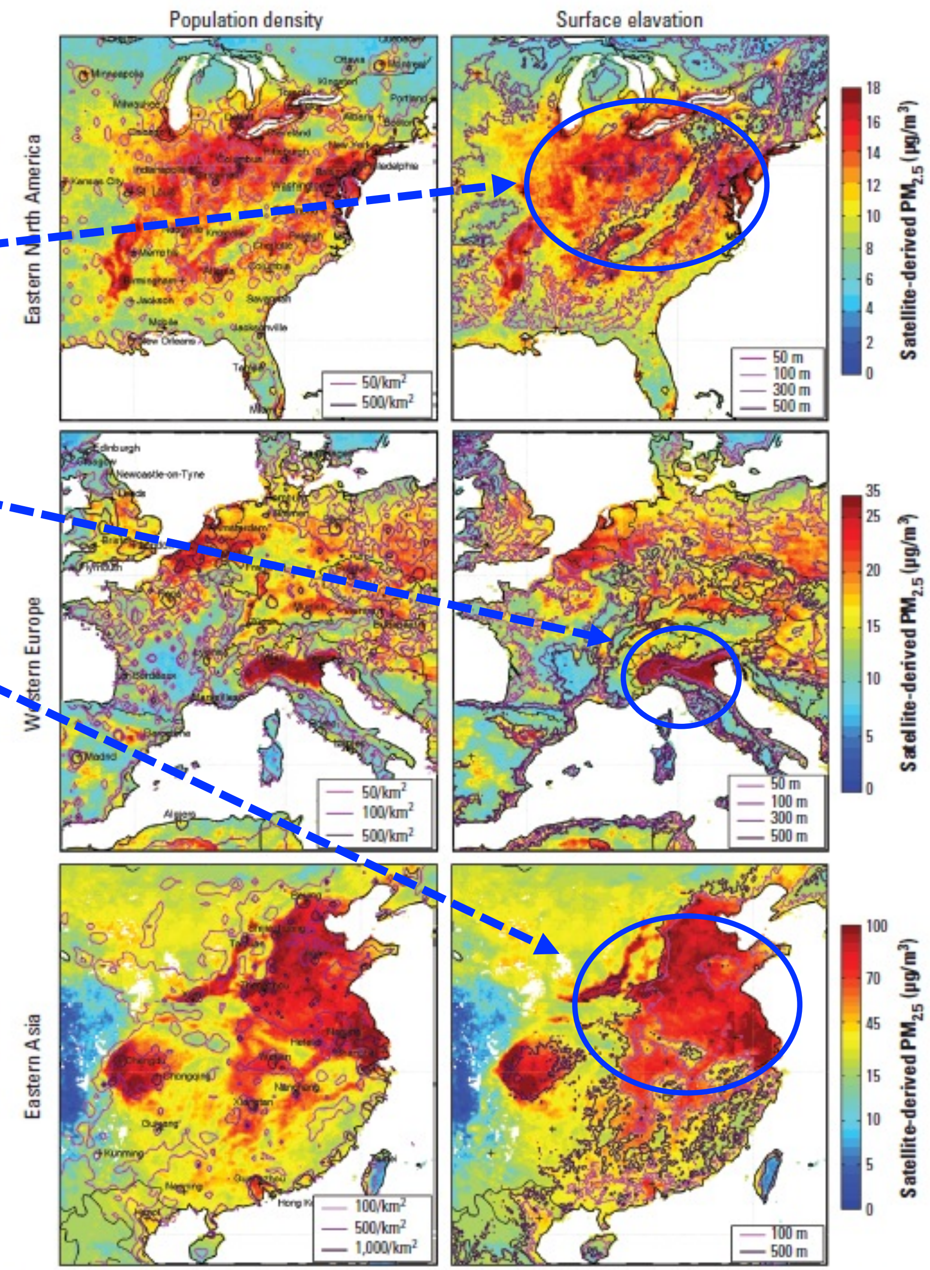
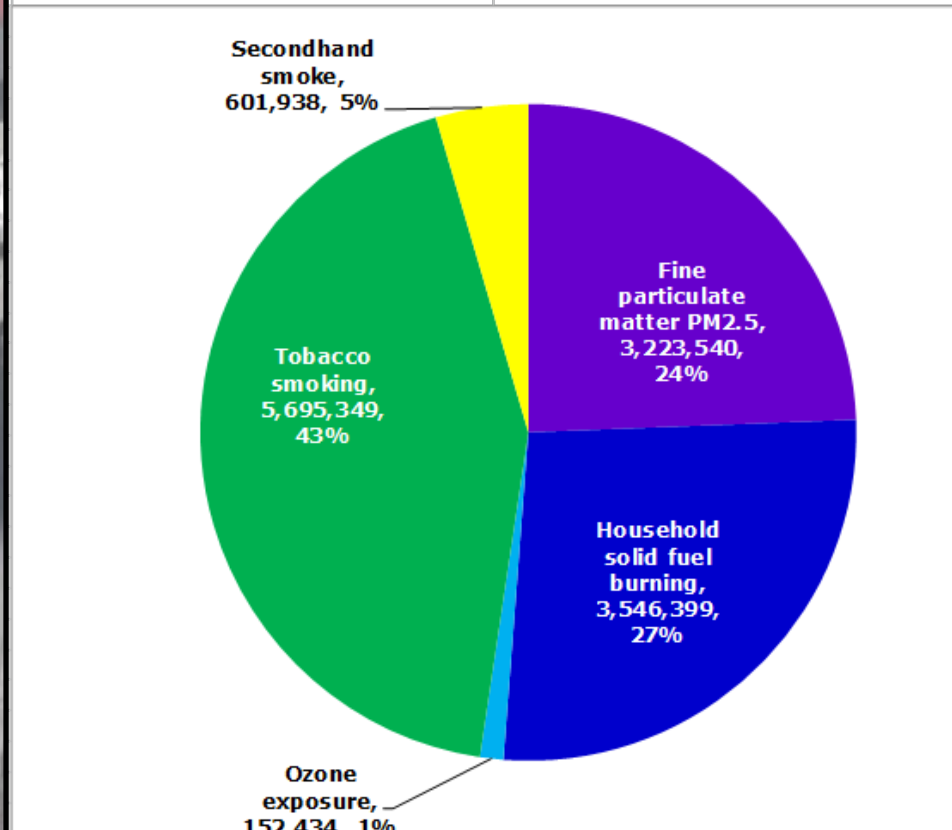


Figure 5. Regional satellite-derived $PM_{2.5}$ concentrations. Columns show mean satellite-derived $PM_{2.5}$ for 2001–2006 at locations that contain at least 50 measurements. Contours denote population density (left) and surface elevation (right). Crosses indicate city centers. Note the different color scales for each region. Altitude data are from the U.S. Geological Survey (1996).

2010 GBD Attributable Deaths from Air Pollution and Smoking Only	
Fine particulate matter PM2.5	3,223,540
Household solid fuel burning	3,546,399
Ozone exposure	152,434
Tobacco smoking	5,695,349
Secondhand smoke	601,938



Lim 2012 Lancet

A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010

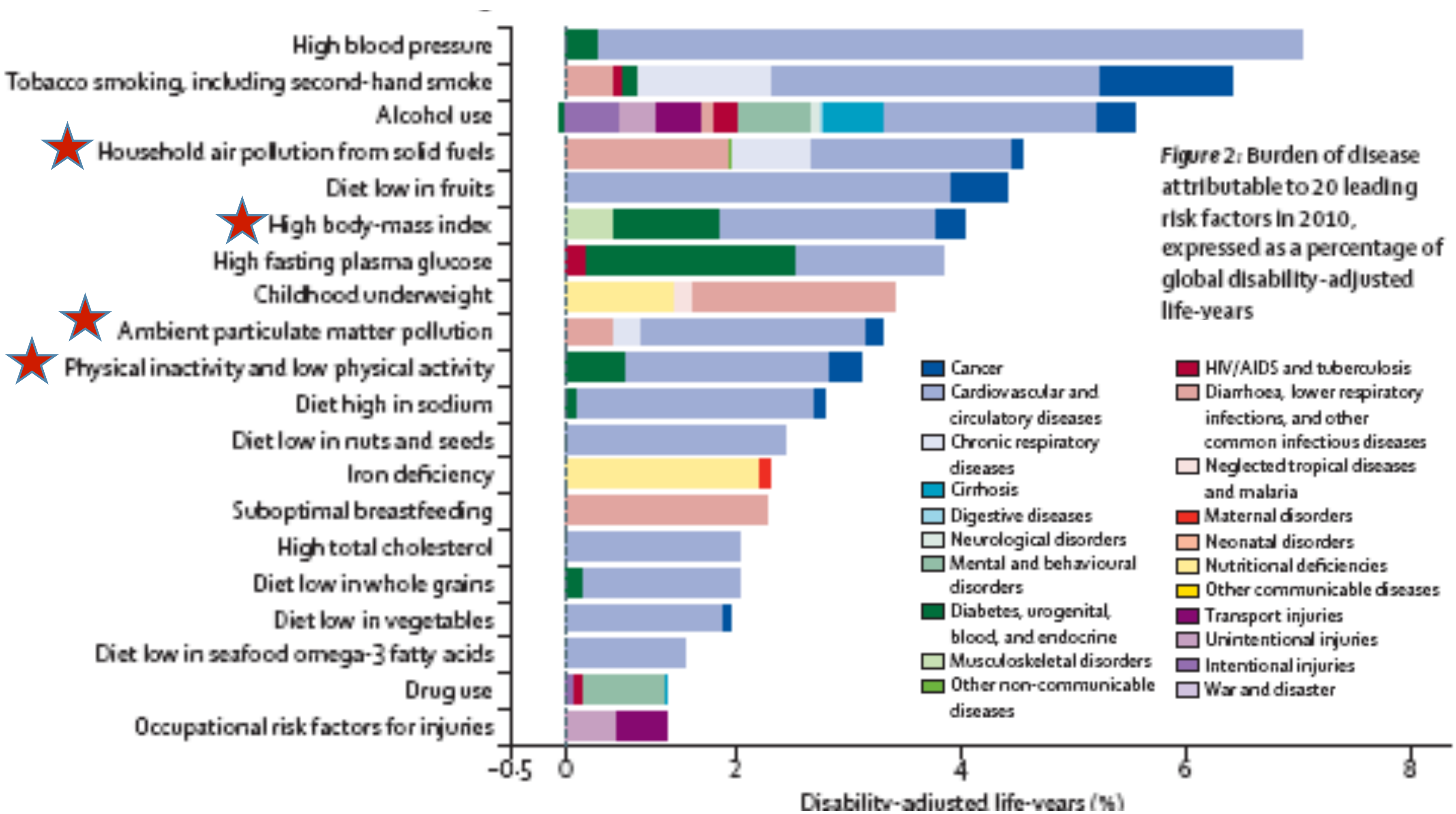
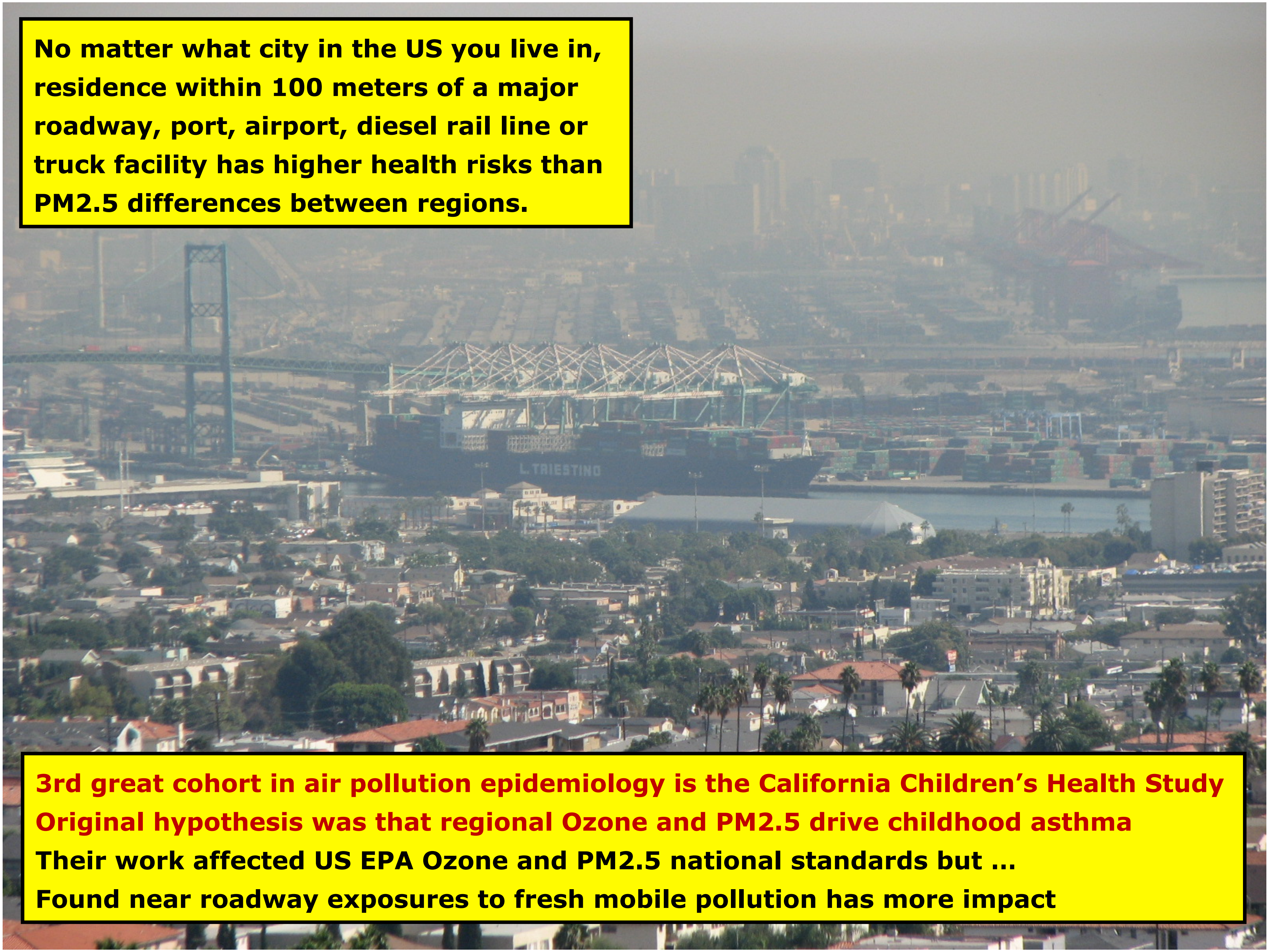


Figure 2: Burden of disease attributable to 20 leading risk factors in 2010, expressed as a percentage of global disability-adjusted life-years


No matter what city in the US you live in, residence within 100 meters of a major roadway, port, airport, diesel rail line or truck facility has higher health risks than PM2.5 differences between regions.
L. TRIESTINO
3rd great cohort in air pollution epidemiology is the California Children's Health Study
Original hypothesis was that regional Ozone and PM2.5 drive childhood asthma
Their work affected US EPA Ozone and PM2.5 national standards but …
Found near roadway exposures to fresh mobile pollution has more impact


Results of best spatial epidemiology studies on high mobile pollution exposures at residence:
Cardiovascular deaths - 50% + higher (solid)
Lung cancer deaths - 50% + higher (solid)
Childhood asthma - 50% + higher (solid)
Childhood autism – 100% + higher (emerging)
Direct traffic exposures (small acute studies):
Heart attacks – 200% higher
but for bicyclists - 300% higher
Cyclist dose – 400% + higher
ECG - ST segment depression 2X
Rapid cardiovascular signaling
I93 on berm
Cardiovascular Disease and Lung Cancer relative risks appear to be similar for truck industry workers, diesel rail engineers & near highway residents
Individual Exposure is determined by:
How big is the source – e.g., vehicles per day
How close are you, how many hours per day
Built or geographic protection or traps
Meteorology – temperature, sun, wind, etc.

Recent Afternoon on I93 at Somerville Medford city line – Citizens still learning to drive!

Individual Exposure is determined by:

How big is the source – e.g., vehicles per day

How close are you, how many hours per day

Built or geographic protection or traps

Meteorology – temperature, sun, wind, etc.

Almost 10% of US lives near large sources

And almost 20% of our rental population

A census of the US near-roadway population: Public health and environmental justice considerations

CrossMark

Gregory M. Rowangould *

Civil Engineering Department, MSC01 1070, University of New Mexico, Albuquerque, NM 87131, USA

ARTICLE INFO

ABSTRACT

This study estimates the size and distribution of the population living near high volume roads in the US, investigates race and income disparities in these near roadway populations, and considers the coverage of the national ambient air quality monitoring network. Every US census block is classified by traffic density and proximity to roads falling within several traffic volume ranges using year 2008 traffic data and the 2010 and 2000 US Census. The results indicate that 19% of the population lives near high volume roads. Nationally, greater traffic volume and density are associated with larger shares of non-white residents and lower median household incomes. Analysis at the county level finds wide variation in the size of near roadway populations and the severity of environmental justice concerns. Every state, however, has some population living near a high volume road and 84% of counties show some level of disparity. The results also suggest that most counties with residents living near high volume roads do not have a co-located regulatory air quality monitor.

G.M. Rowangould / Transportation Research Part D 25 (2013) 59–67

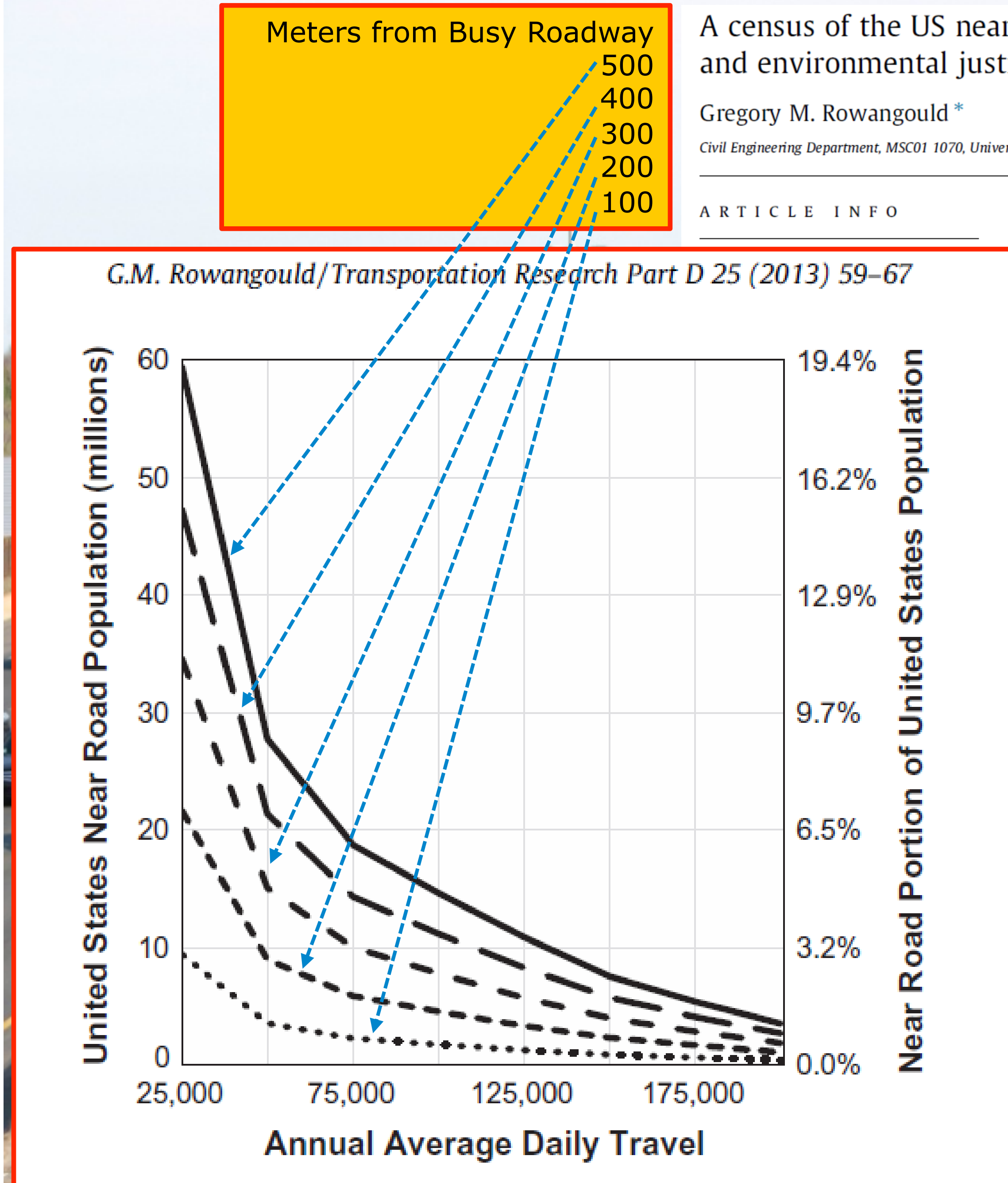
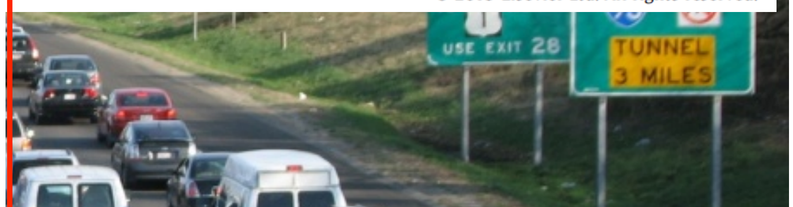
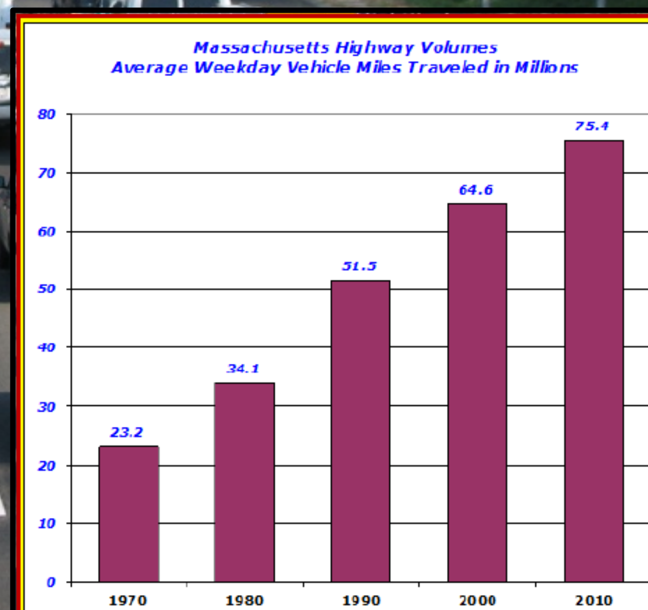


Fig. 1. US population living near high volume roads during the year 2010.





A story of two Somerville MA community groups dealing with LAND USES –> TRANSPORTATION –> AIR QUALITY –> PUBLIC HEALTH and moving on to real community based participatory research

Action-oriented focus of volunteer groups Mystic View and STEP in Somerville evolved as follows:

1998 to 2000 and Beyond

Jobs, Taxes & Open Space

2001 to 2003 and Beyond

Transportation Capacity

2004 to 2006 and Beyond

Air Quality & Public Health

These focal areas turned out to be highly interactive!

Interstate 93 in Somerville - Mystic Housing Project on Right

I93 and Neighborhoods at various distances organize the geography of the CAFEH study of
Air pollutants & cardiovascular health in Somerville, Dorchester & S. Boston, Chinatown & Malden

CAFEH's Steering Committee of community and academic partners meets every 2 weeks

Funded by:

NIEHS ES015462;

NHLBI CA148612;

HUD MALHH0194-09;

EPA STAR FP-91720301-0;

EPA STAR FP-917349-01-0

P.E.O. Scholar Award

And moving on to design strategies with Kresge

Some Field Team Members

CAFEH Partners:

Tufts University School of Medicine

Tufts University School of Engineering

Somerville Transportation Equity Partnership

Chinese Progressive Association

Committee for Boston Public Housing

Chinatown Resident Association

Harvard School of Public Health

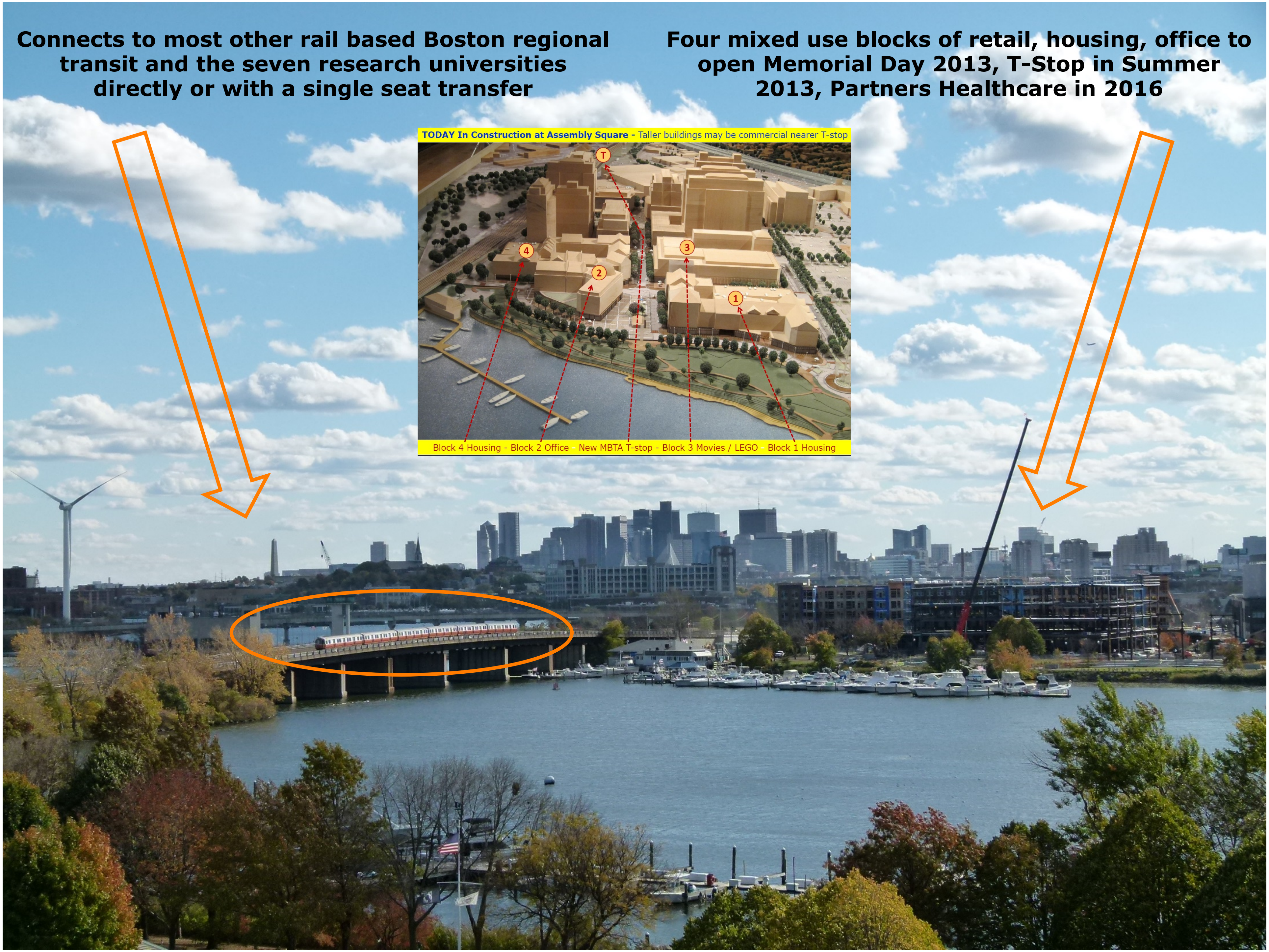
Brigham and Women's Hospital

Mystic View/Assembly Square – Our Last Frontier (1998)

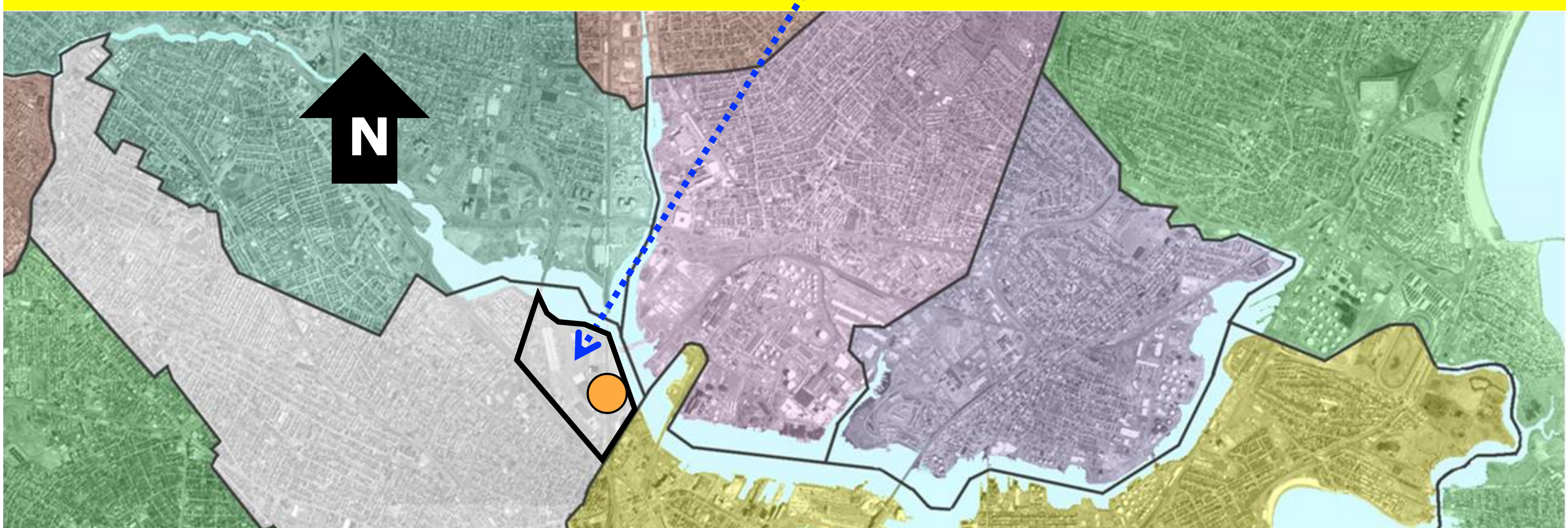
Big box sprawl and financial stagnation for our city,
or……. A vision for the revitalization of Somerville

MYSTIC VIEW TASK FORCE

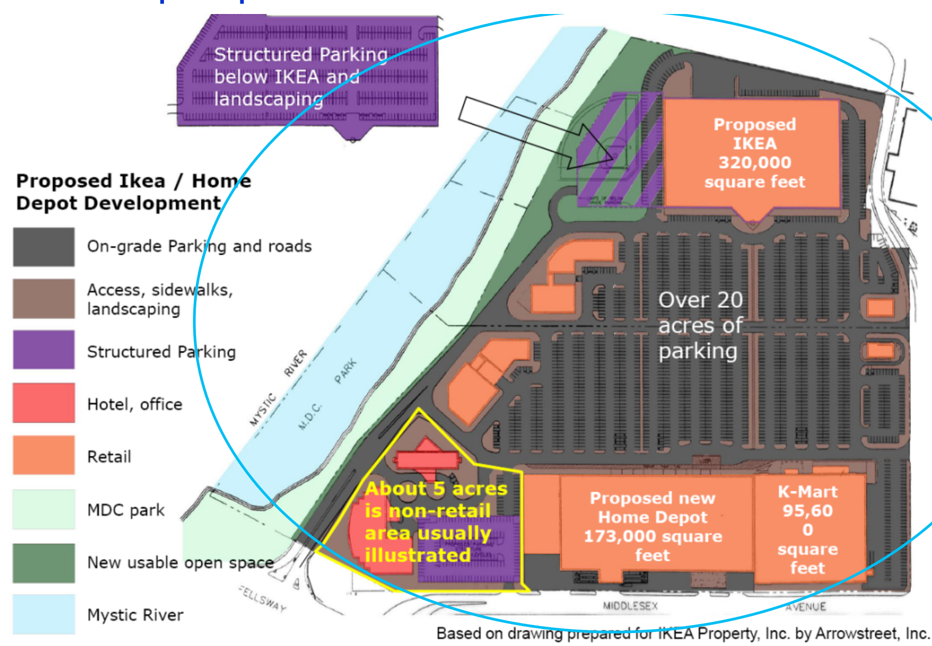
Ford Plant Was Productive For Many Decades


Connects to most other rail based Boston regional transit and the seven research universities directly or with a single seat transfer
Four mixed use blocks of retail, housing, office to open Memorial Day 2013, T-Stop in Summer 2013, Partners Healthcare in 2016
TODAY In Construction at Assembly Square - Taller buildings may be commercial nearer T-stop
T
4
3
2
1
Block 4 Housing - Block 2 Office - New MBTA T-stop - Block 3 Movies / LEGO - Block 1 Housing

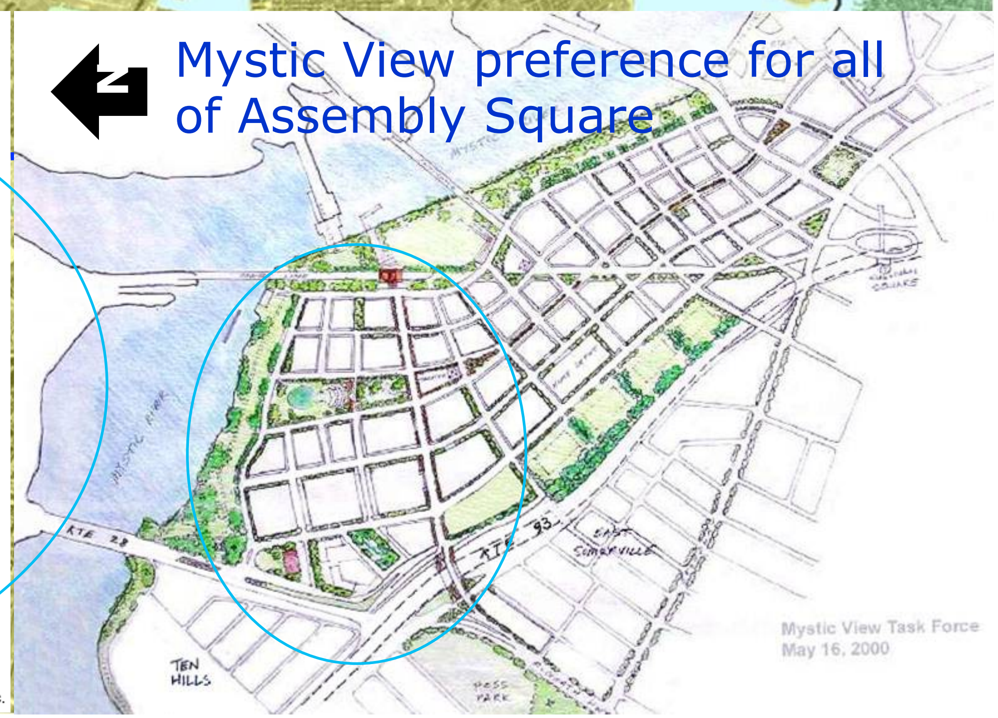
FOCUS of STEP and Mystic View Task Force - Economic development at Assembly Square

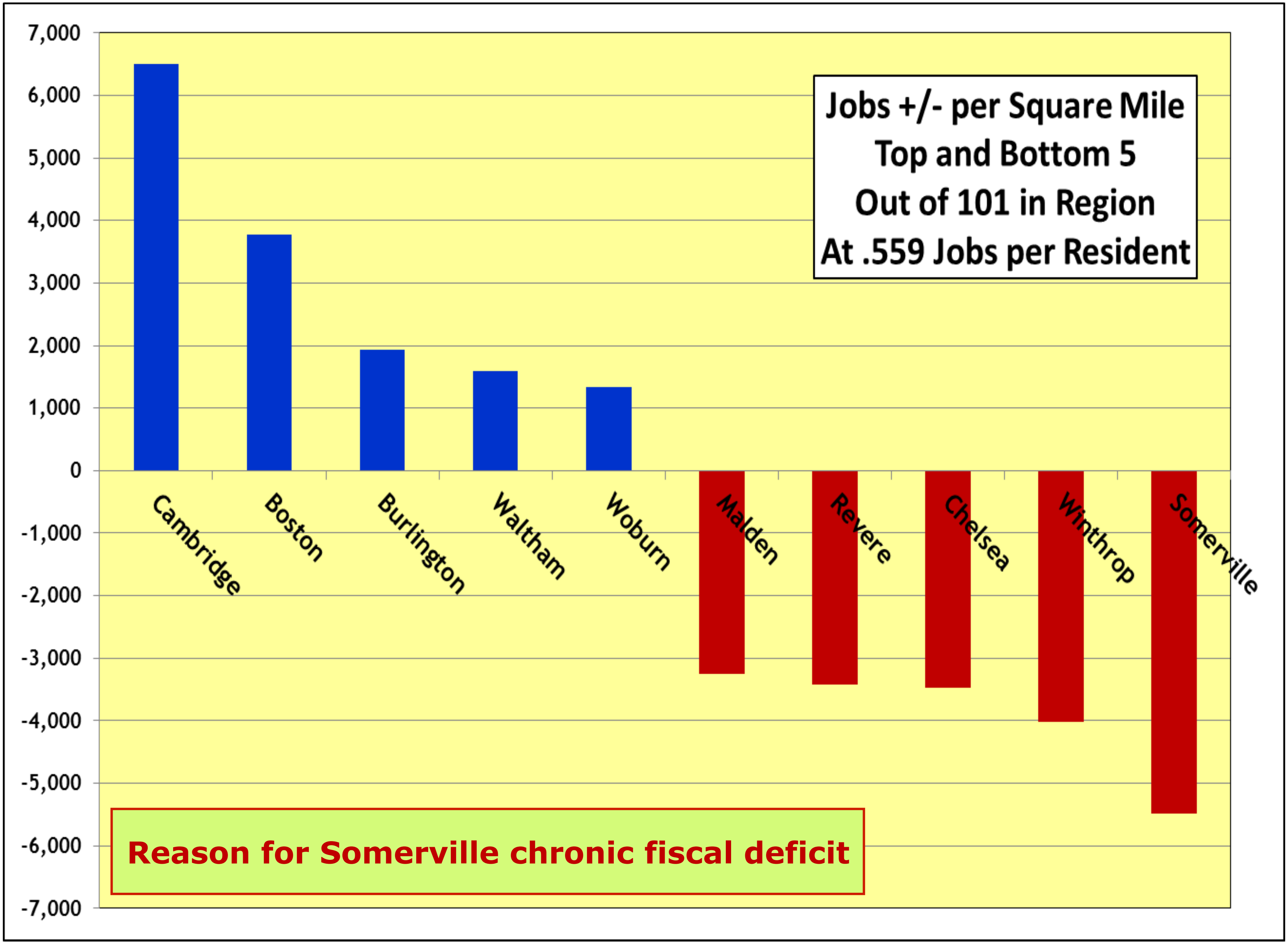


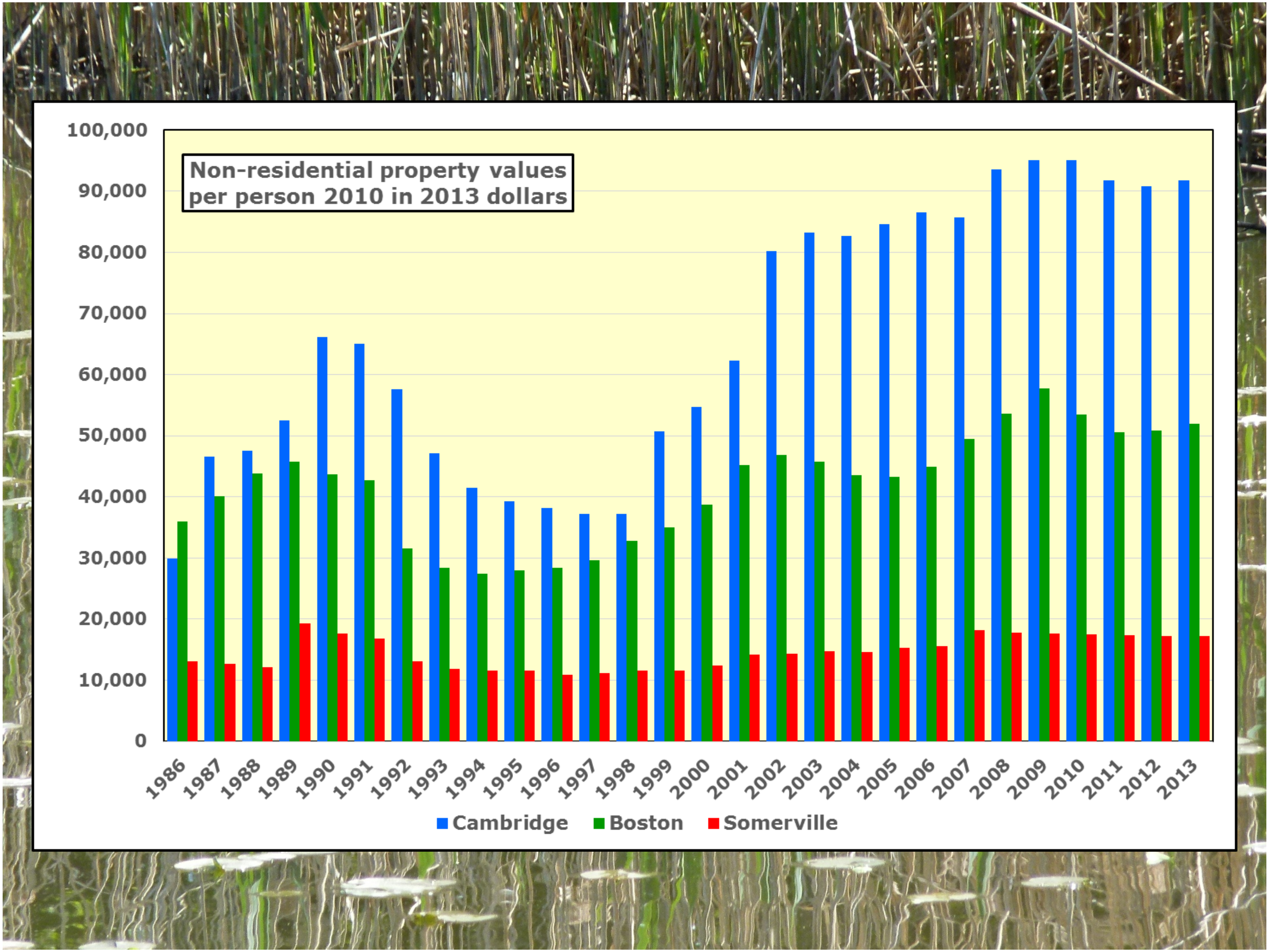
Developer preference for 42 acre waterfront



Mystic View preference for all of Assembly Square

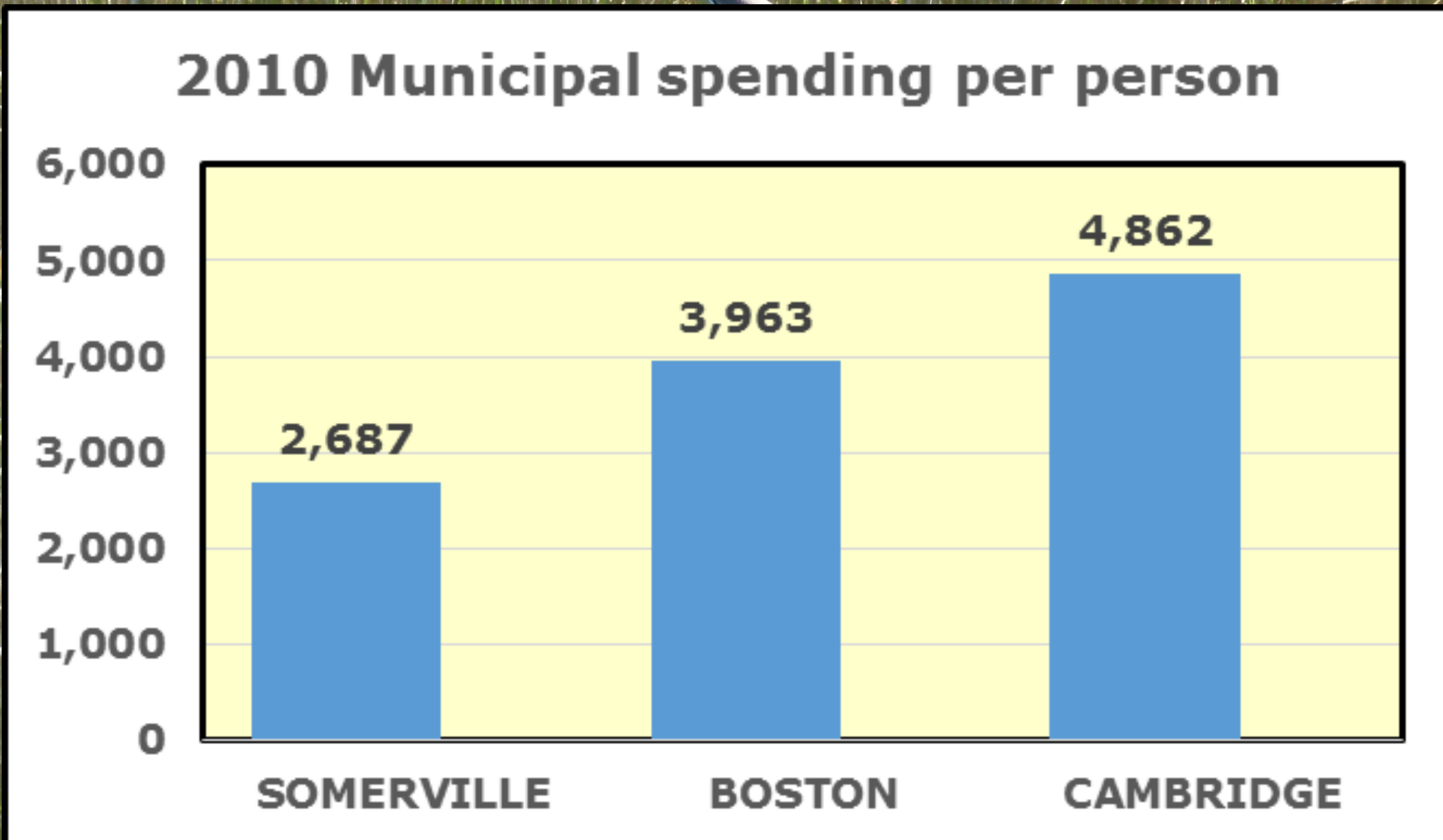



Jobs +/- per Square Mile
Top and Bottom 5
Out of 101 in Region
At .559 Jobs per Resident
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
-1,000
-2,000
-3,000
-4,000
-5,000
-6,000
-7,000
Cambridge
Boston
Burlington
Waltham
Woburn
Malden
Revere
Chelsea
Winthrop
Somerville
Reason for Somerville chronic fiscal deficit

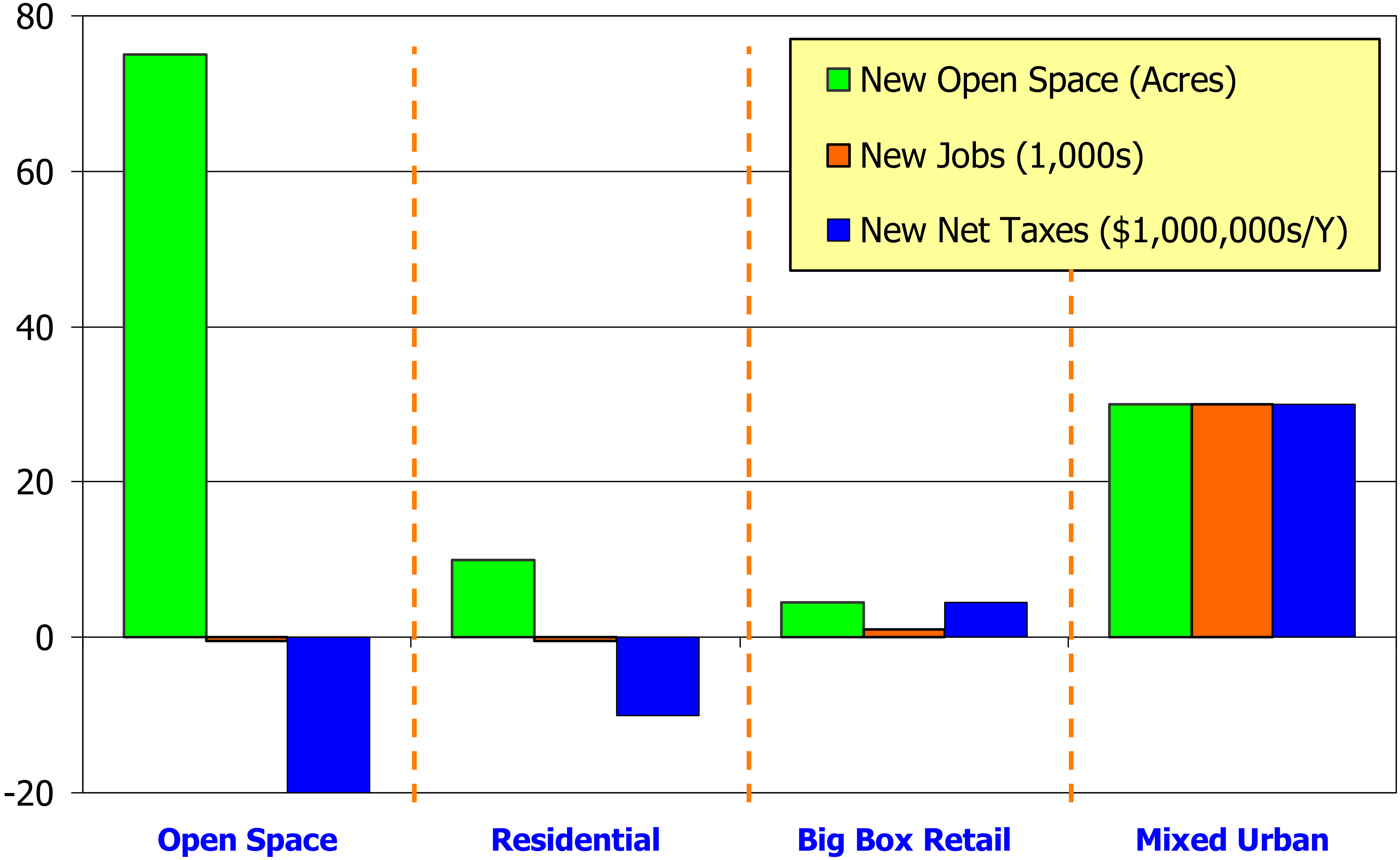


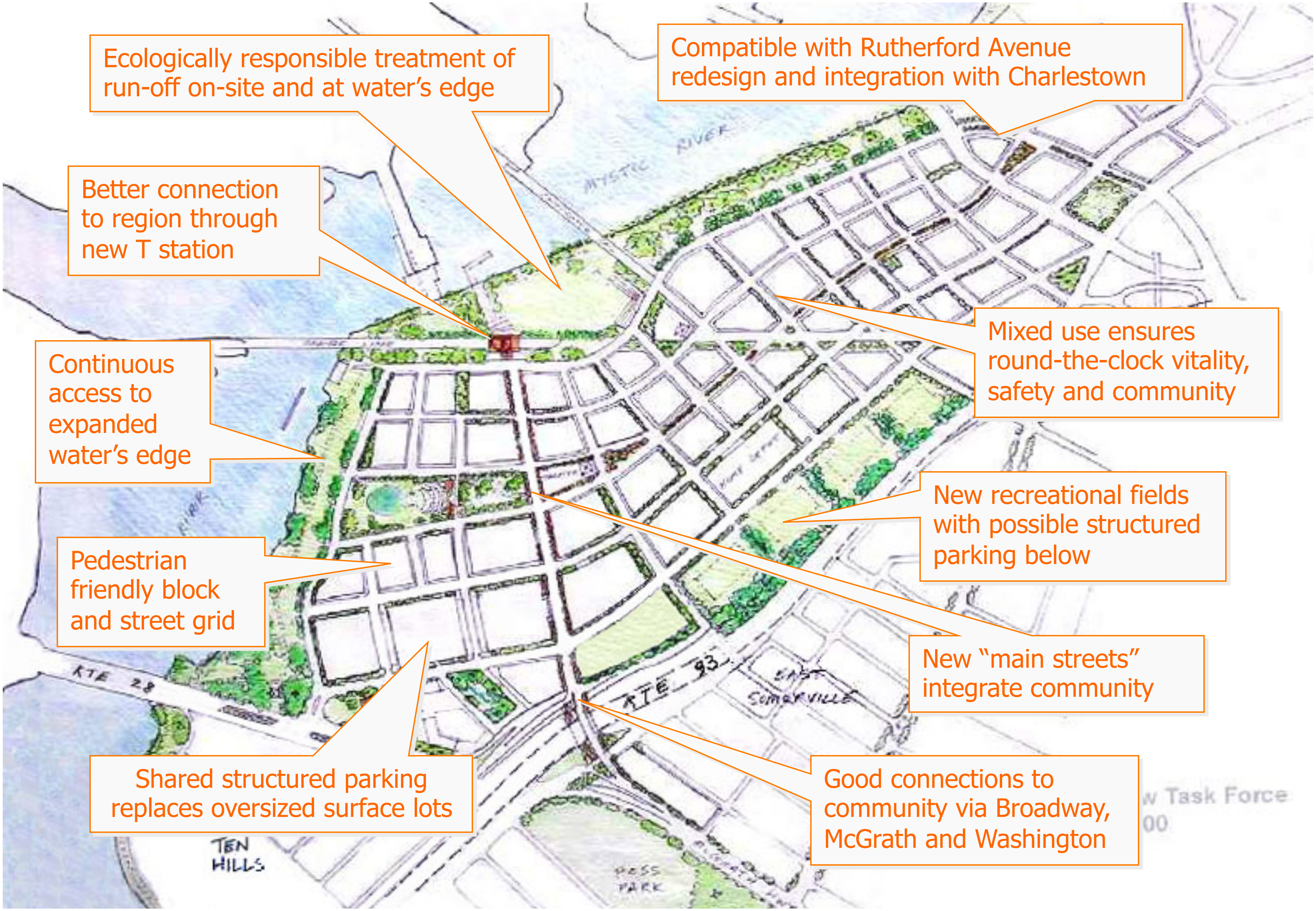
Non-residential property values
per person 2010 in 2013 dollars
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
Cambridge
Boston
Somerville

2010 Municipal Spending per Person		
SOMERVILLE	2,687	100%
BOSTON	3,963	148%
CAMBRIDGE	4,862	181%



Development Alternatives vs. Charrette Priorities
The Best Vision Matches Regional Opportunities & Local Needs





Ecologically responsible treatment of run-off on-site and at water's edge
Compatible with Rutherford Avenue redesign and integration with Charlestown
Better connection to region through new T station
Mixed use ensures round-the-clock vitality, safety and community
Continuous access to expanded water's edge
New recreational fields with possible structured parking below
Pedestrian friendly block and street grid
New "main streets" integrate community
Shared structured parking replaces oversized surface lots
Good connections to community via Broadway, McGrath and Washington
MYSTIC RIVER
RTE 28
RTE 93
EAST SOMERVILLE
TEN HILLS
FOSS PARK

Urban Mixed Commercial

	Acres	Land %	1000 BSF	Value K$	RET K$	Dir. Jobs
Water's Edge	5.0	3.3 %	0	3,336	0	3
Green Space	45.0	30.0 %	0	30,023	0	9
Roads & Infrastructure	30.0	20.0 %	0	60,000	0	30
Office, Retail (10-15%)	50.0	33.3 %	8,250	1,770,000	48,569	33,000
Hotel, Retail (10-15%)			1,250	270,000	7,409	2,000
Residential			1,500	245,000	3,467	75
Industrial & Distribution	10.0	6.7 %	250	30,000	473	313
Structured Parking	10.0	6.7 %	NA	113,333	1,037	42
Total Mystic View Site	150.00	100.0 %	11,250	2,521,692	60,955	35,472

Compromise **Long Term Vision** for all of Assembly Square 2006 Settlement **Legally Binding**

Assembly Square 2006 Settlement Included:

Vehicle trip reduction from 100,000 to 50,000 per day

$15M toward new T-stop (will be open in 2014)

Pedestrian and bike connections added

New riverfront open space

Long Term Vision: 5 MSF office/R&D, diverse housing, 10 MSF mixed use total

Three multi-story mixed use urban blocks open in 2014

No housing within 500 feet of a major highway

~~IKEA~~ – Partners will use second headhouse 2016

Proposed Development

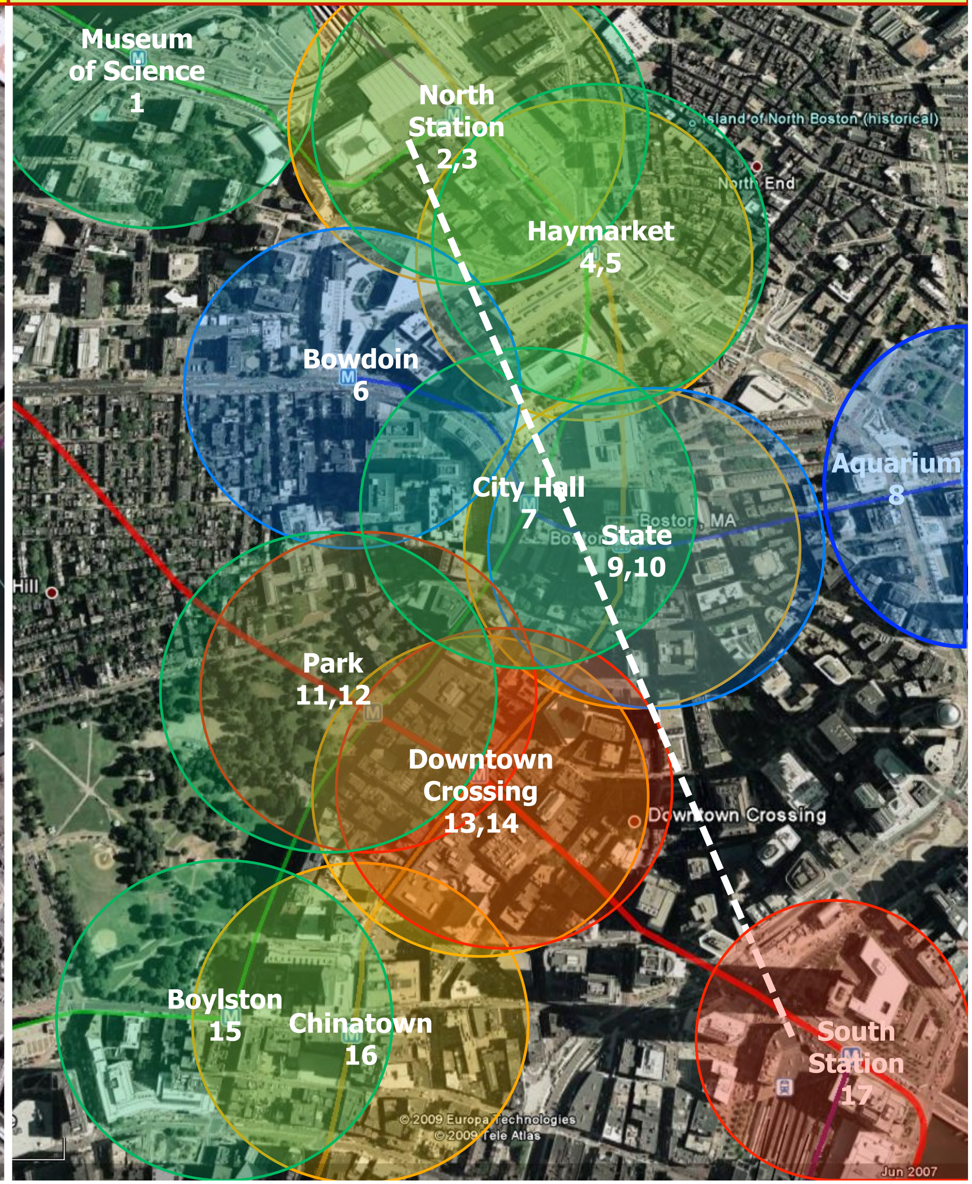
	Proposed (gsf)
Retail	500,000
Ikea	340,000
Marketplace	330,000
Office/R&D	1,775,000
Civic/Flex	105,000
Residential	2,450,000
Total	**5,500,000**
Long Range Plan	**Additional (gsf)**
Retail	230,000
Office/R&D	3,225,000
Civic/Flex	895,000
Residential	550,000
Total	**4,900,000**
Total District Plan	**(gsf)**
Retail	1,400,000
Office/R&D	5,000,000
Civic/Flex	1,000,000
Residential	3,000,000
Total	**10,400,000**

Community activists requested 5+ million SF of Office-R&D within mixed use plan →


Three northern MBTA commuter rail routes run through Assembly Square
Can we tie Transit Oriented Development to diesel rail?

Commuter rail leaves Porter Square for Boston - 250 inbound trips per day. Red Line over 10,000.

Assembly Square Single Station	Downtown Boston Seventeen Stations
Two Headhouses critical or cannot extend benefit of one T-stop to an area the size of Downtown Boston	All Four Lines - Does not include Silver Line or Fifteen Commuter Rail Lines at No. & So. Stations



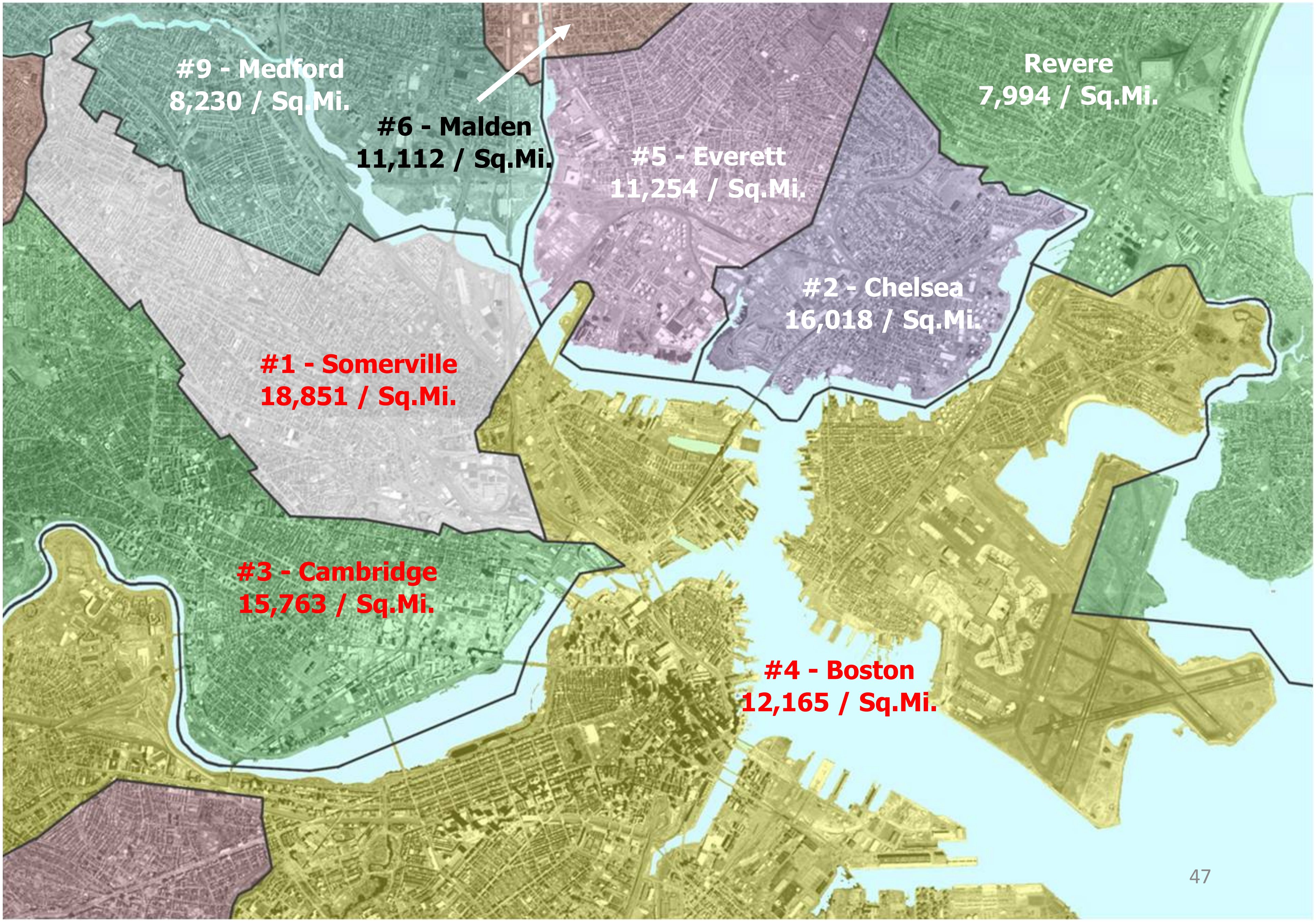
Many MBTA Rapid Transit & Bus Connections Are Available to Assembly Square

Relevant MBTA Boardings

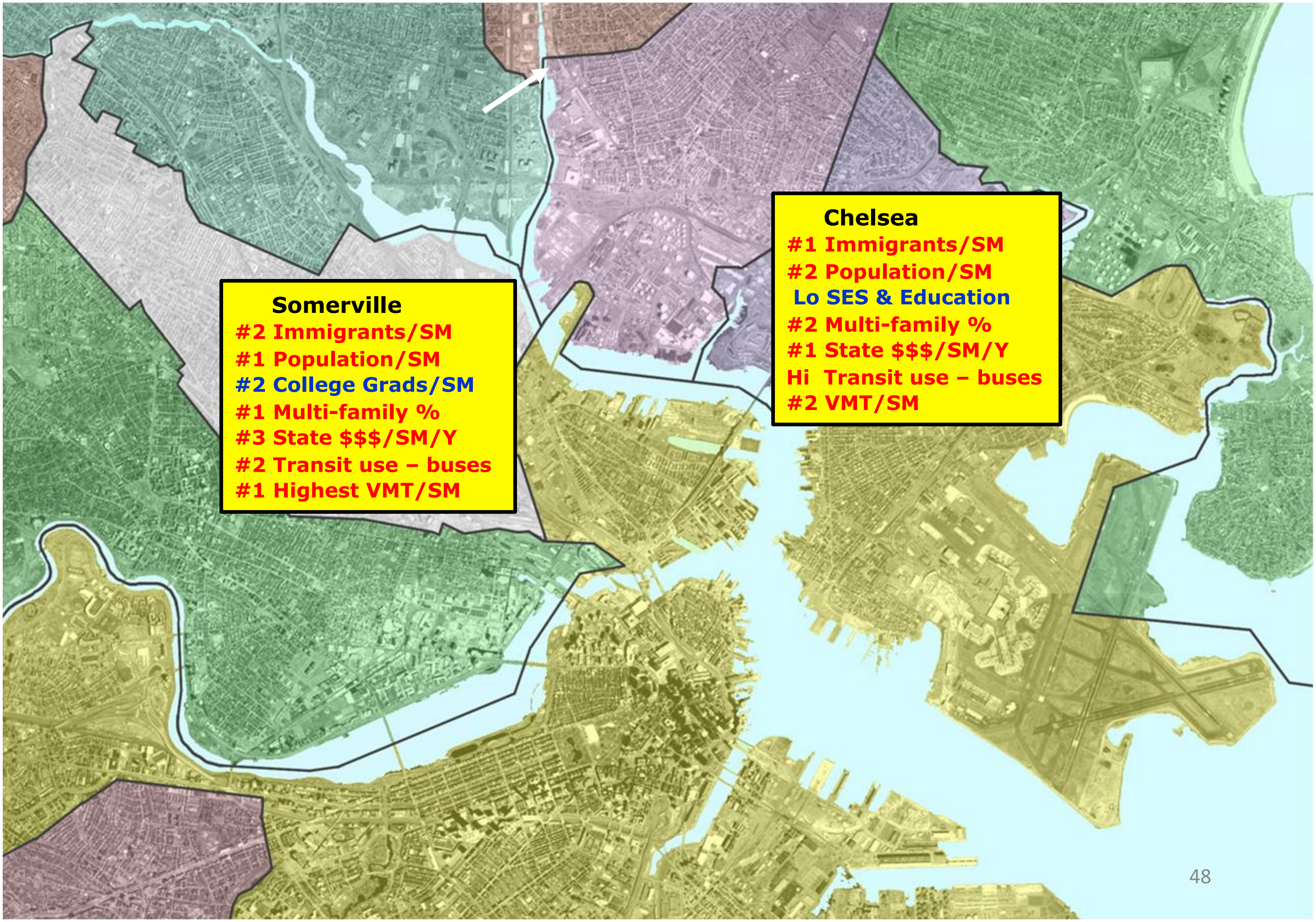
Weekday counts 2005 - 2007

Single Seat Ride:	
Orange Line	216,000
One Transfer (rail based):	
Green Line (NS, Hay)	237,000
Red Line (Down Cross)	226,000
Blue Line (State)	51,000
Commuter North (NS)	49,000
Commuter South (BB)	83,000
SUBTOTAL	646,000
Rapid Transit TOTAL	862,000
One Transfer (BRT or bus based):	
MBTA Bus System	230,000
Silverline 1 - Dudley	15,000
SUBTOTAL	245,000
Zero & One Transfer	1,107,000

BOSTON Metropolitan Area Cities and Densities - 2000



Somerville and Chelsea Characteristics – Susceptible and Vulnerable



Low-Level Environmental Lead Exposure and Children's Intellectual Function: An International Pooled Analysis

Bruce P. Lanphear,[1,2] Richard Hornung,[1,2,3] Jane Khoury,[1,2] Kimberly Yolton,[1] Peter Baghurst,[4] David C. Bellinger,[5] Richard L. Canfield,[6] Kim N. Dietrich,[1,2] Robert Bornschein,[2] Tom Greene,[7] Stephen J. Rothenberg,[8,9] Herbert L. Needleman,[10] Lourdes Schnaas,[11] Gail Wasserman,[12] Joseph Graziano,[13] and Russell Roberts[14]

[1]Cincinnati Children's Hospital Medical Center, Cincinnati, Ohio, USA; [2]Department of Environmental Health, University of Cincinnati College of Medicine, Cincinnati, Ohio, USA; [3]Institute for Health Policy and Health Services Research, Department of Environmental Health, University of Cincinnati, Cincinnati, Ohio, USA; [4]Women and Children's Hospital, North Adelaide, South Australia; [5]Department of Neurology, Children's Hospital Boston and Harvard Medical School, Boston, Massachusetts, USA; [6]Division of Nutritional Sciences, Cornell University, Ithaca, New York, USA; [7]Department of Biostatistics and Epidemiology, Cleveland Clinic Foundation, Cleveland, Ohio, USA; [8]Center for Research in Population Health, National Institute of Public Health, Cuernavaca, Morelos, Mexico; [9]Drew University, Los Angeles, California, USA; [10]University of Pittsburgh School of Medicine, Pittsburgh, Pennsylvania, USA; [11]National Institute of Perinatology, Mexico City, Mexico; [12]Department of Child Psychiatry, Columbia University, New York, New York, USA; [13]Department of Environmental Health Sciences, Columbia University, New York, New York, USA; [14]School of Applied Psychology, Griffith University, Queensland, Australia

Vol. 322 No. 2 LONG-TERM EFFECTS OF EXPOSURE TO LEAD — NEEDLEMAN ET AL. 83

THE LONG-TERM EFFECTS OF EXPOSURE TO LOW DOSES OF LEAD IN CHILDHOOD

An 11-Year Follow-up Report

HERBERT L. NEEDLEMAN, M.D., ALAN SCHELL, M.A., DAVID BELLINGER, PH.D., ALAN LEVITON, M.D., AND ELIZABETH N. ALLRED, M.S.

Abstract To determine whether the effects of low-level lead exposure persist, we reexamined 132 of 270 young adults who had initially been studied as primary schoolchildren in 1975 through 1978. In the earlier study, neurobehavioral functioning was found to be inversely related to dentin lead levels. As compared with those we restudied, the other 138 subjects had had somewhat higher lead levels on earlier analysis, as well as significantly lower IQ scores and poorer teachers' ratings of classroom behavior.

When the 132 subjects were reexamined in 1988, impairment in neurobehavioral function was still found to be related to the lead content of teeth shed at the ages of six and seven. The young people with dentin lead levels >20 ppm had a markedly higher risk of dropping out of high school (adjusted odds ratio, 7.4; 95 percent confidence interval, 1.4 to 40.7) and of having a reading disability (odds ratio, 5.8; 95 percent confidence interval, 1.7 to 19.7) as compared with those with dentin lead levels <10 ppm. Higher lead levels in childhood were also significantly associated with lower class standing in high school, increased absenteeism, lower vocabulary and grammatical-reasoning scores, poorer hand–eye coordination, longer reaction times, and slower finger tapping. No significant associations were found with the results of 10 other tests of neurobehavioral functioning. Lead levels were inversely related to self-reports of minor delinquent activity.

We conclude that exposure to lead in childhood is associated with deficits in central nervous system functioning that persist into young adulthood. (N Engl J Med 1990; 322:83-8.)

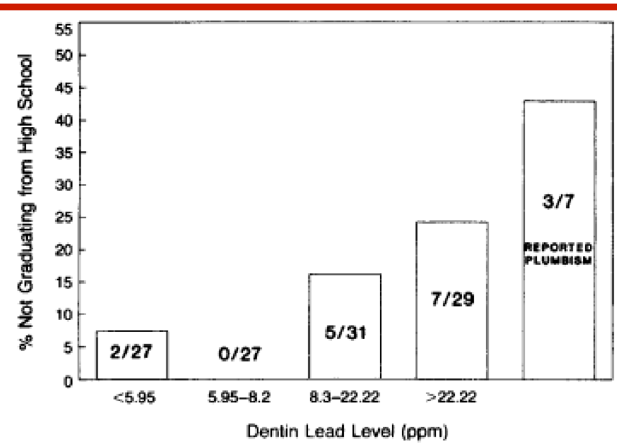
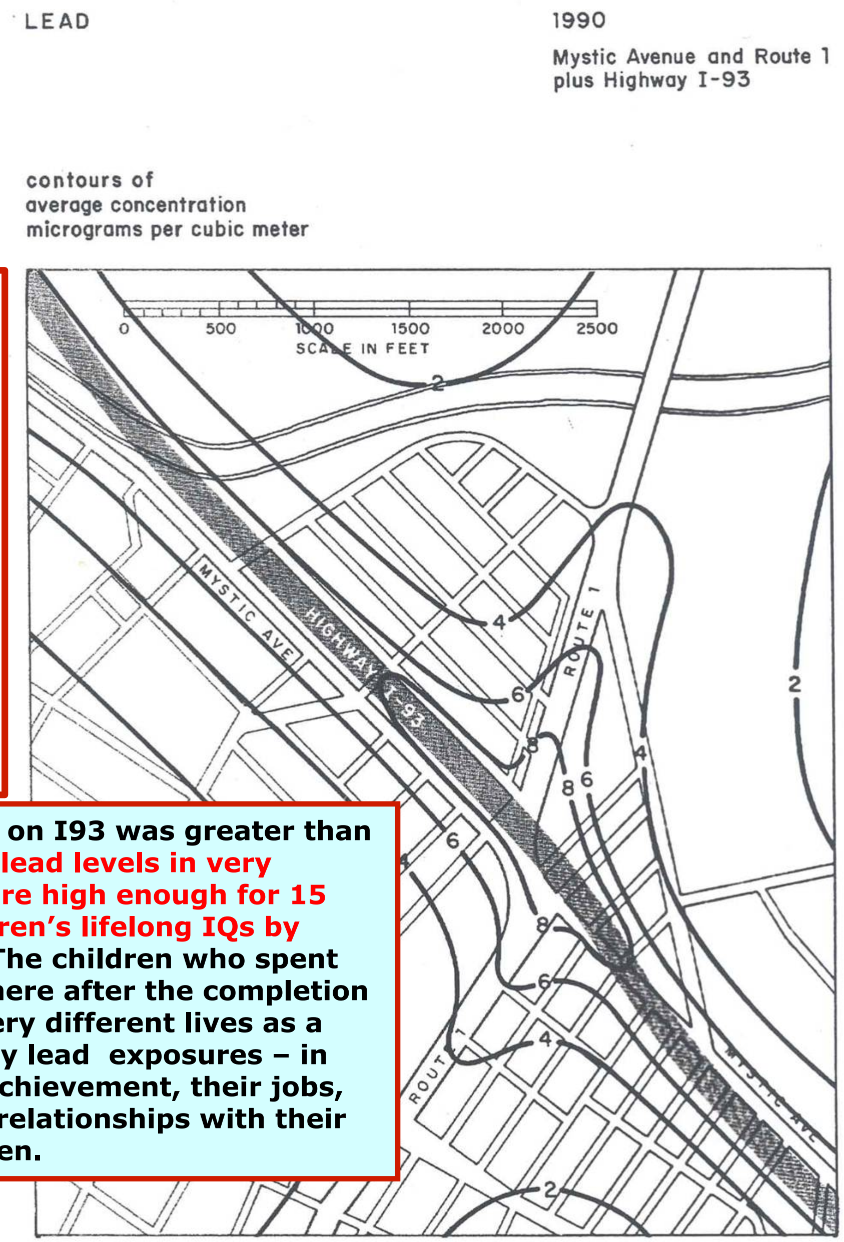
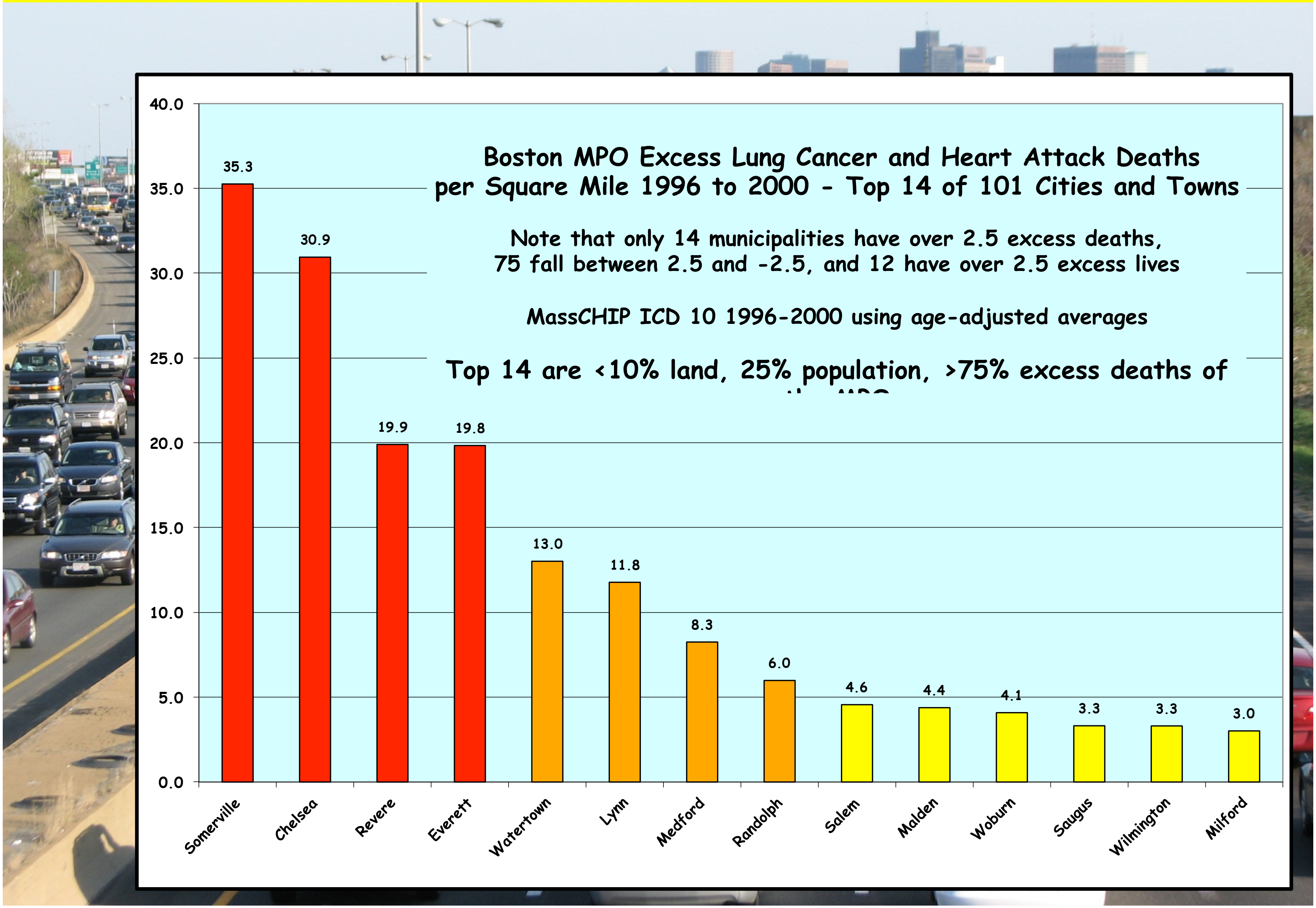


Figure 1. The Proportion of Subjects Who Did Not Graduate from High School, Classified According to Their Past Exposure to Lead.

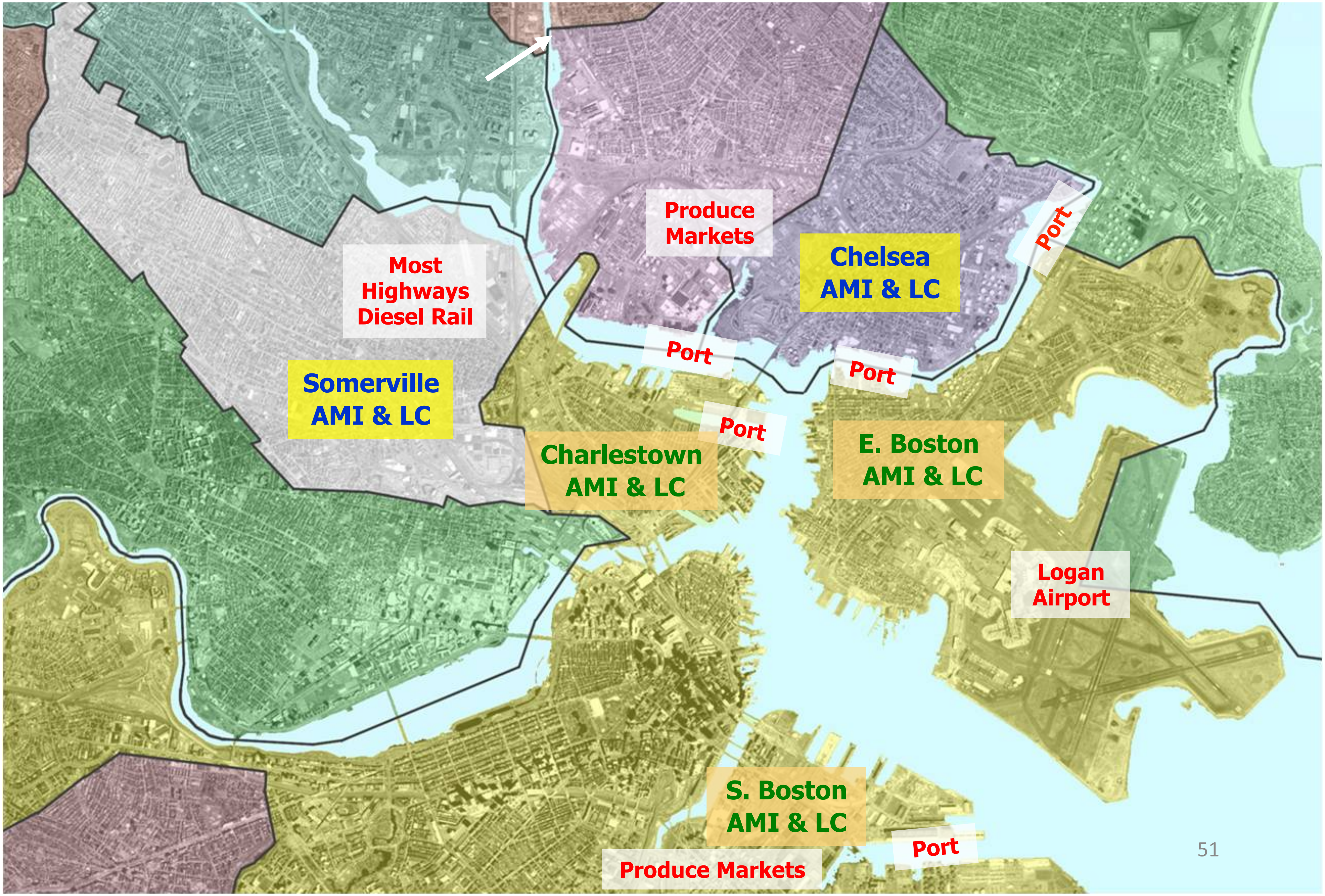


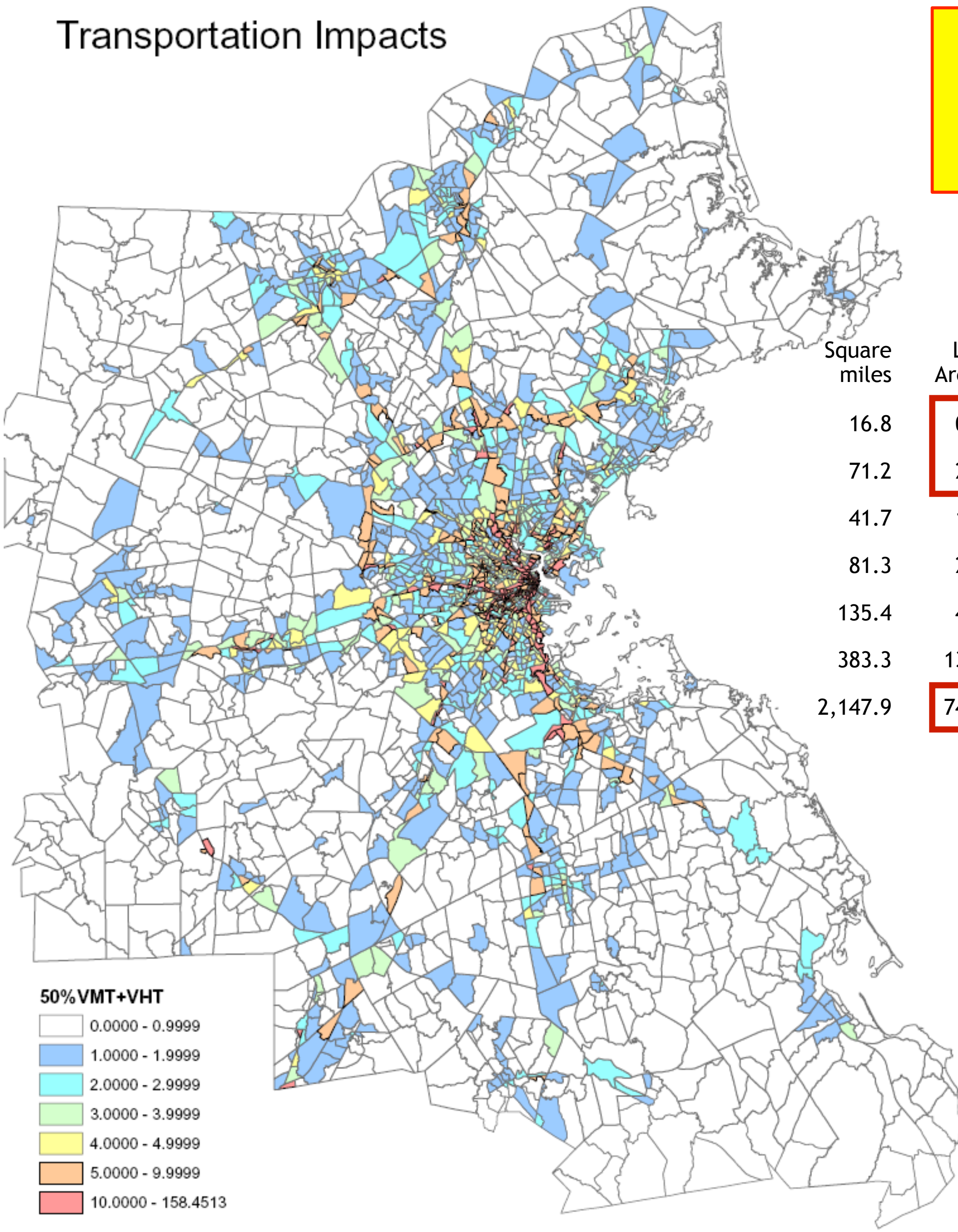
Because the traffic on I93 was greater than expected, average lead levels in very nearby housing were high enough for 15 years to drop children's lifelong IQs by nearly 10 points. The children who spent their first 5 years here after the completion of I93 may have very different lives as a result of these early lead exposures – in their educational achievement, their jobs, and their life-long relationships with their spouses and children.

We looked at mortality records for 5 years for all 351 Massachusetts cities and towns
Premature mortalities were similar to those predicted by near roadway epidemiology



Population Density plus Traffic Related Air Pollution **equals** High Age-adjusted Excess Heart Attack & Lung Cancer per Square Mile

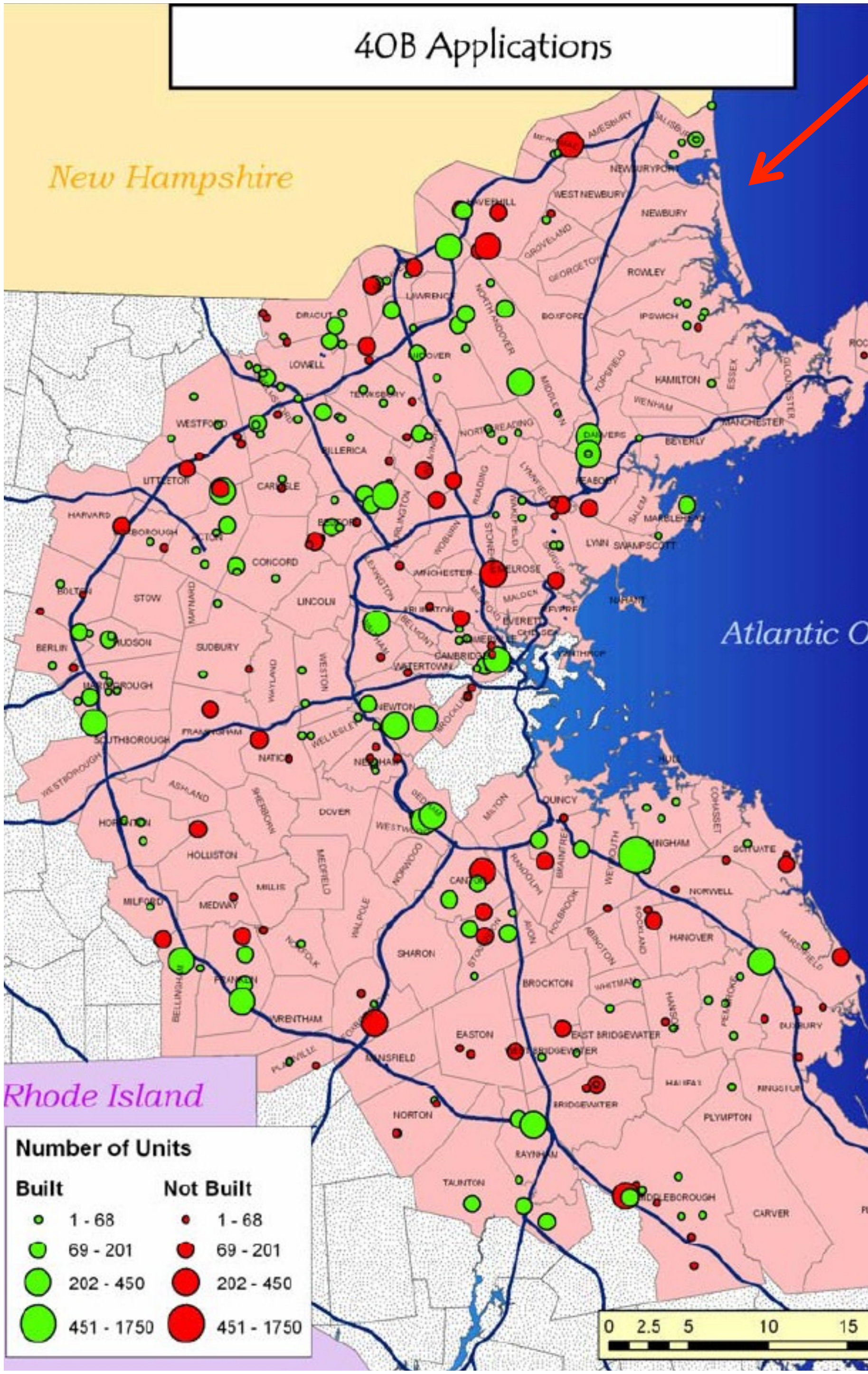




2727 Traffic Analysis Zones (TAZes) in Eastern Massachusetts as Analyzed by the Boston MPO for US EPA, FHWA and FTA Map by Wig Zamore and MAPC

Square miles	Land Area %	TAZ to Region TRAVEL RATIO	2000 TAZ/REG 50% VMT 50% VHT	Median Kilo-grams Daily CO-W/SM	NOx/SM	VOC/SM
16.8	0.6%	TAZ >10X	18.3567	14,517.6	1,732.6	744.5
71.2	2.5%	TAZ > 5X	6.5181	6,004.3	723.1	278.1
41.7	1.4%	TAZ > 4X	4.4535	3,864.6	458.5	188.5
81.3	2.8%	TAZ > 3X	3.4259	3,162.9	380.9	147.5
135.4	4.7%	TAZ > 2X	2.4503	2,243.6	268.6	105.9
383.3	13.3%	TAZ > 1X	1.3845	1,269.5	151.6	60.5
2,147.9	74.6%	TAZ < 1X	0.3625	322.4	37.3	15.9

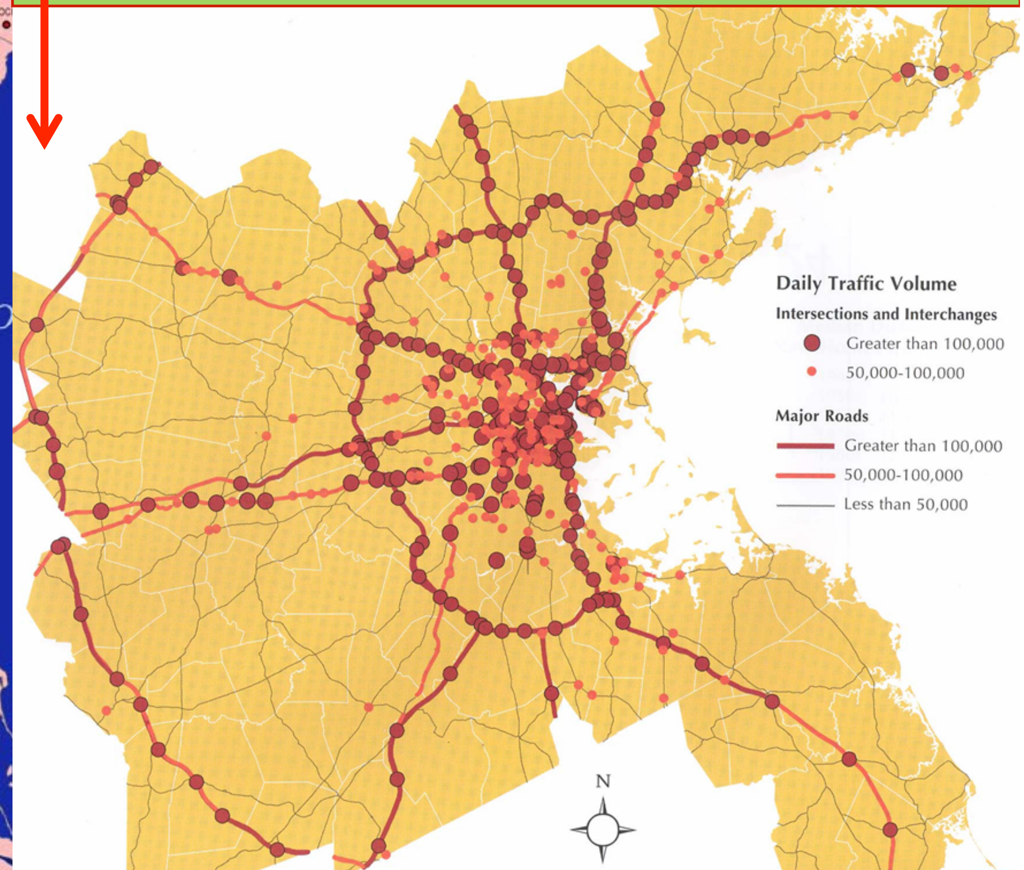
The top 3% of our exposed land areas have 20 to 50 times as much mobile pollution emitted per square mile as the least polluted 75%.

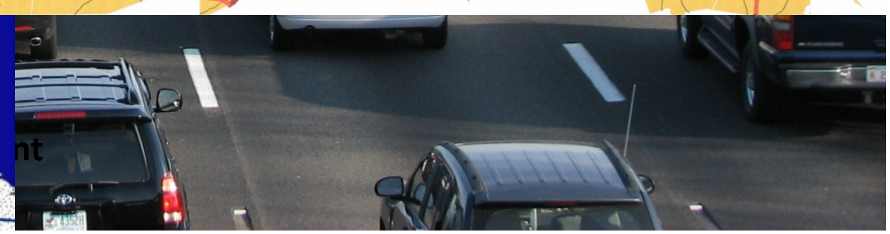


MIT's Map of 40B Affordable Housing Projects and MAPC's Map of Highway Pollution Health Hazards

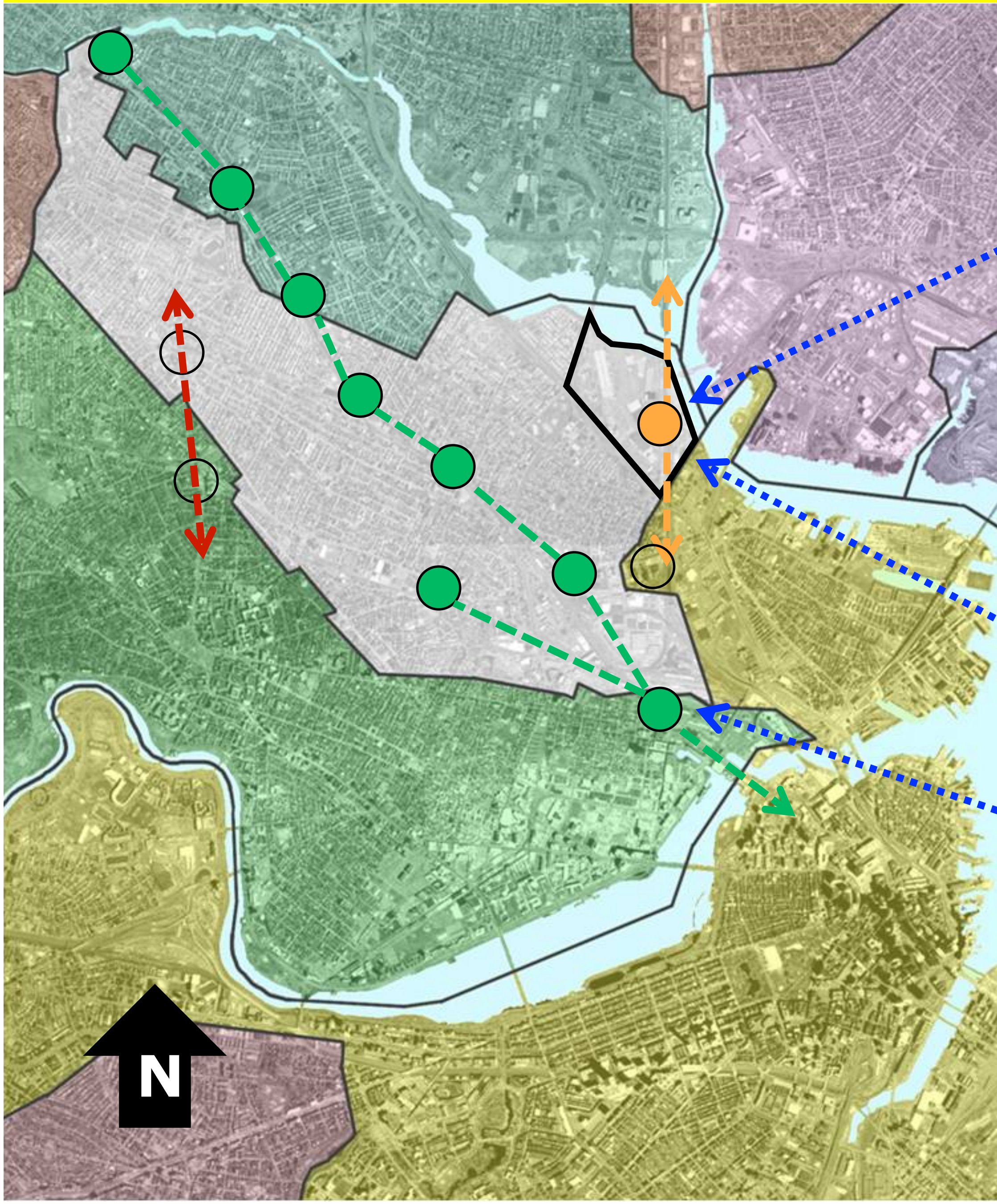
Are virtually THE SAME MAP!

In the US, 9% of all people and 18% of all renters live within a few hundred feet of highways or other large mobile air pollution sources.





Somerville FOCUS of STEP and Mystic View Task Force



Land Use and Economic Development

Assembly Square - 145 acres

Old underutilized industrial site (FORD plant)

Developers preferred Big Boxes

Community wanted transit-oriented-development

30 new acres open space

30,000 jobs

30,000,000 net annual taxes

Settled December 2006 after years of battle

Transportation

Orange Line ~ $60M first T-stop in MA 33 years

216,000 Orange Line Boarders

646,000 Green Red Blue Commuter

245,000 Bus and Silverline Connectors

Green Line Extension ~ $1.5B first light rail branches in several generations

Solid T circles represent new stations

Community Path (not shown) from Bedford MA through Davis Square to Green Line and Boston

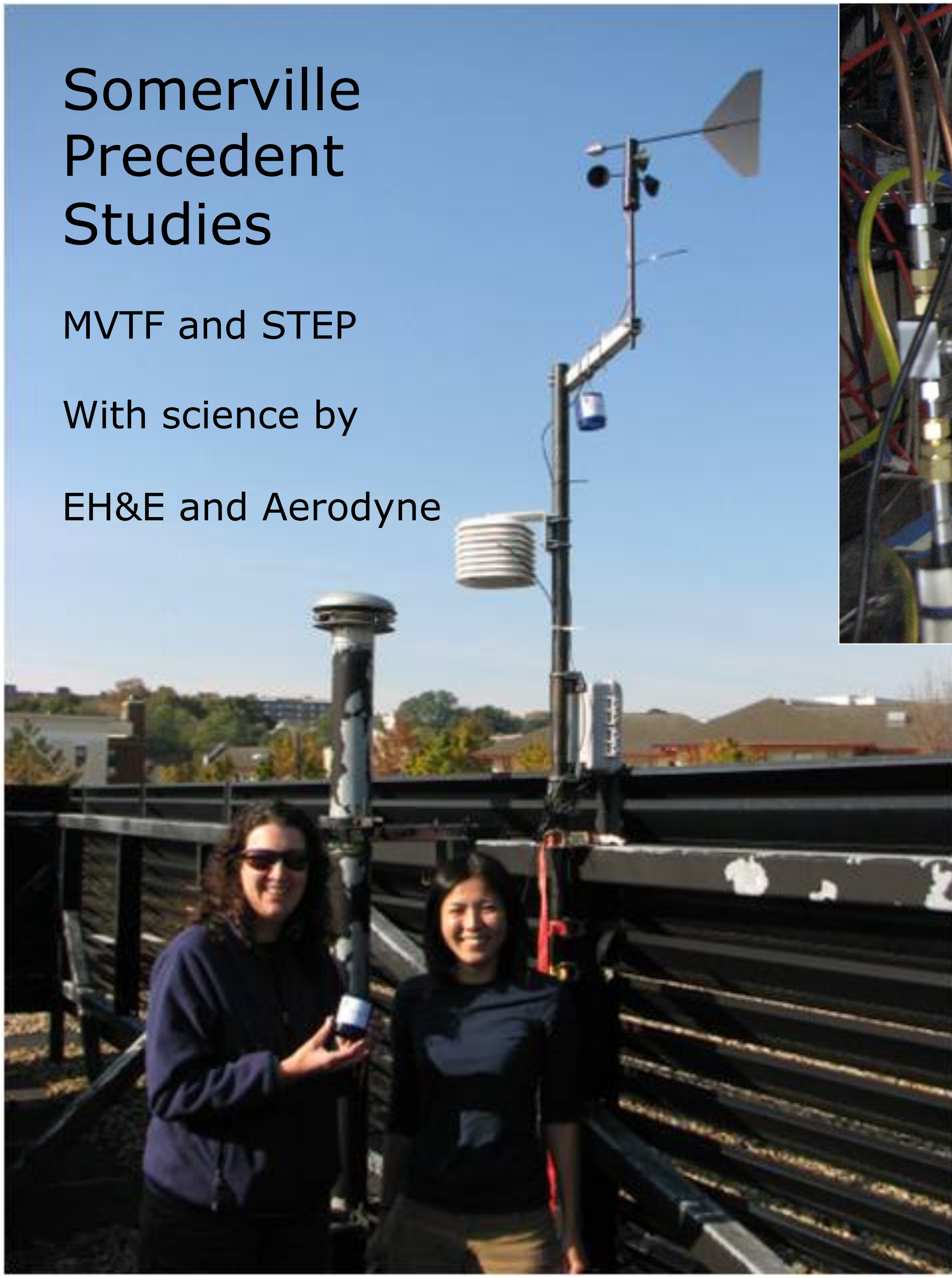
STEP and Mystic View used air quality and health in their advocacy for local and regional changes

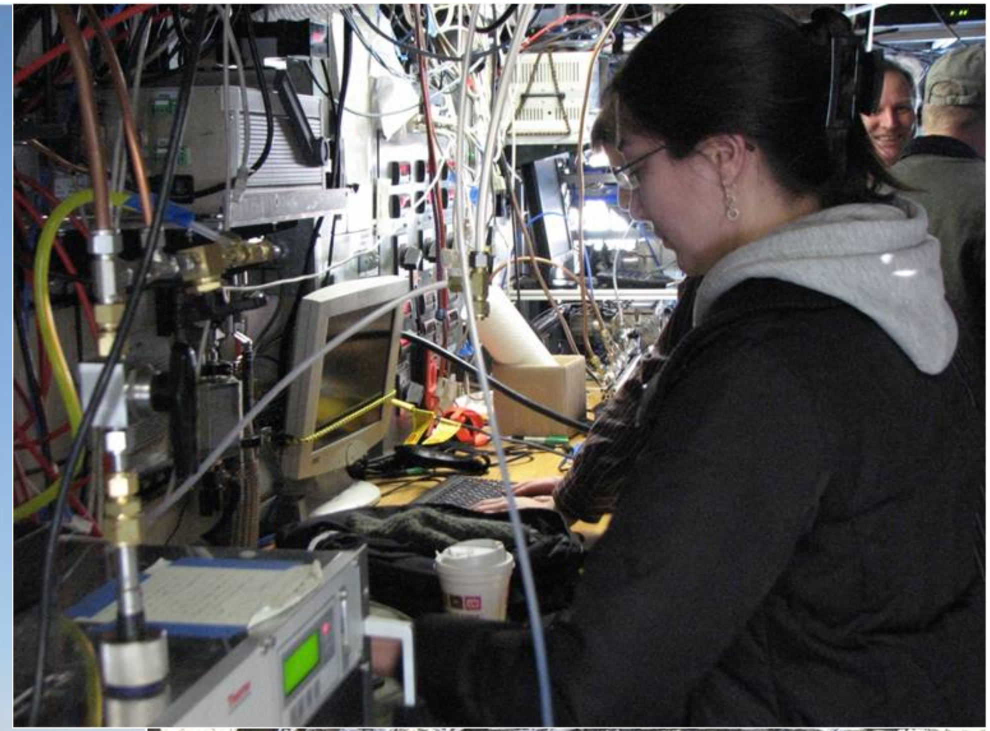
Somerville Precedent Studies

MVTF and STEP

With science by

EH&E and Aerodyne

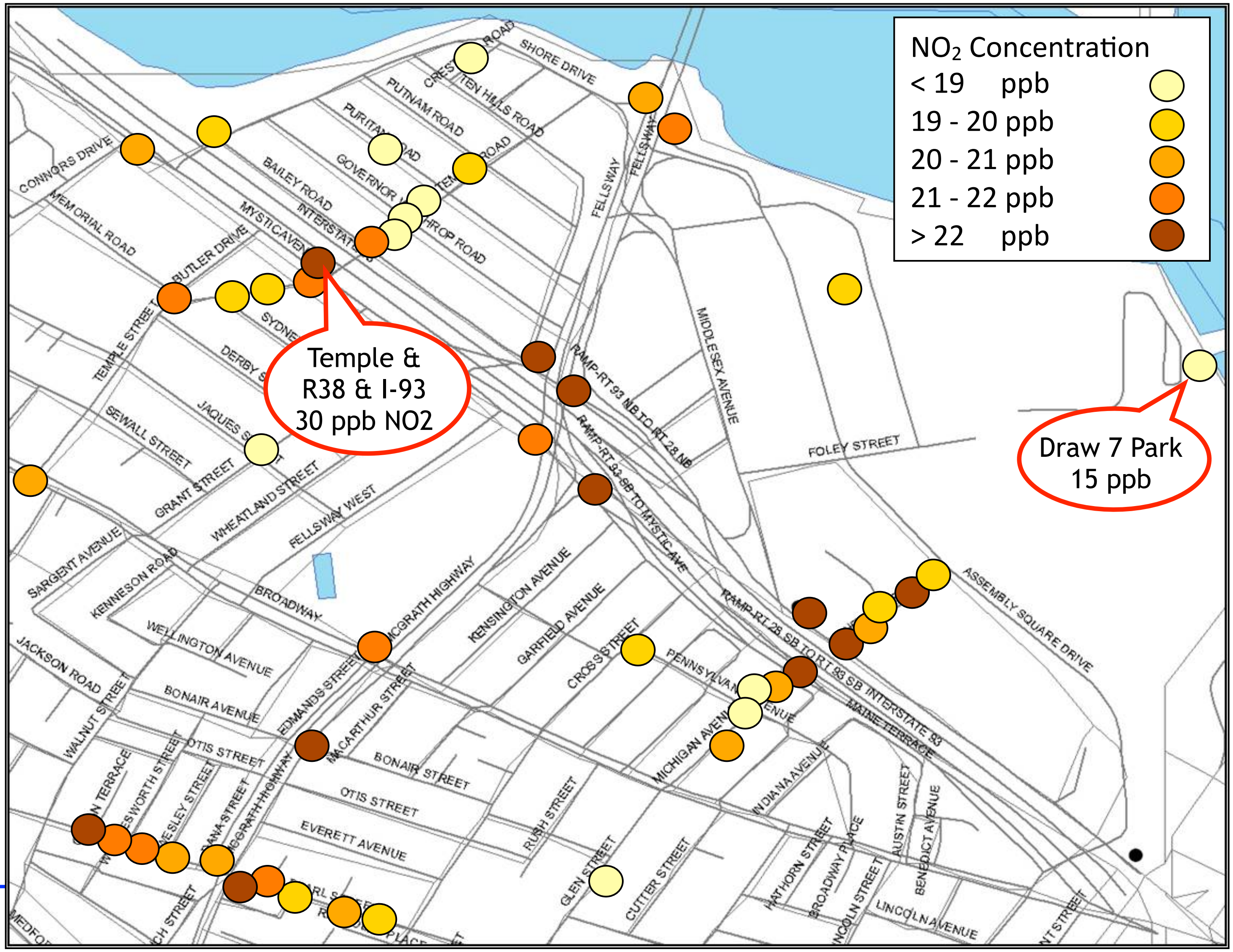




Lynn urban background is ~ 10 ppb

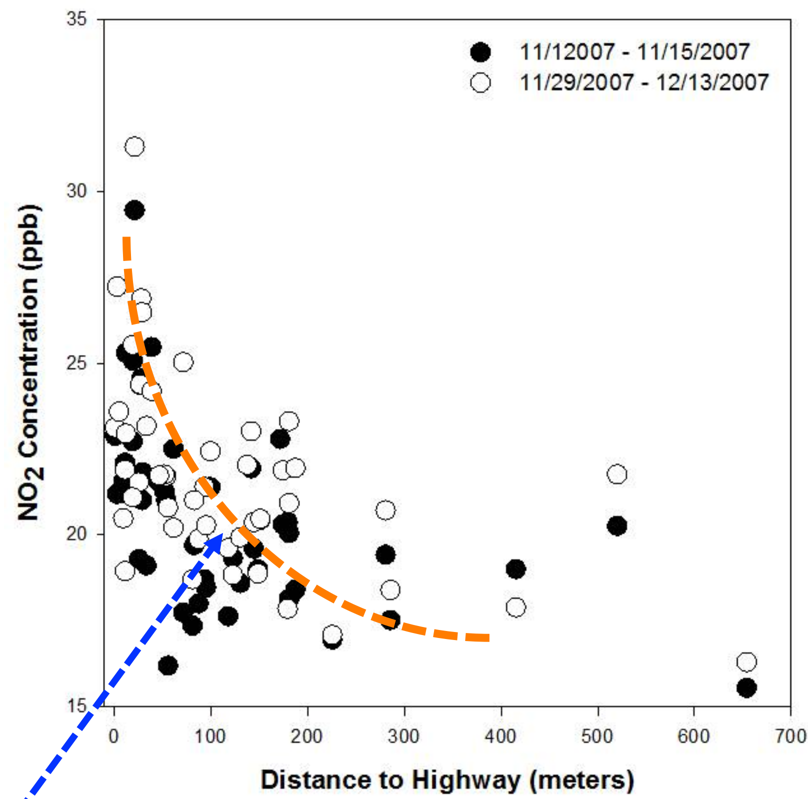
NO_2 Along Somerville Roads

- Clear traffic-related pattern
- NO_2 measured near I-93 is twice as high as the level in Draw 7 park
- NO_2 within 50 m of I-93 is similar to concentrations at Roxbury Crossing and Kenmore Sq.



NO_2 Levels

- Two-week averages
  - Mean (SD): 20.6 (2.7) ppb
  - Range: 15 – 32 ppb
- NO_2 weakly correlated with distance (m) to highway
  - I-93: -0.19 (p=0.06)
  - MA-28: -0.28 (p=0.006)
- NO_2 strongly correlated with traffic density (TD)
  - TD_{25m}: 0.61 ($p<0.0001$)
  - TD_{50m}: 0.60 ($p<0.0001$)
  - TD_{100m}: 0.48 ($p<0.0001$)



Very steep decline in primary traffic pollution within 200 meters of highways

Pilot study by Mystic View Task Force, Aerodyne Research and Tufts showed Elevated pollutants downwind of highway during first half of AM rush hour

Atmos. Chem. Phys., 10, 8341–8352, 2010
www.atmos-chem-phys.net/10/8341/2010/
doi:10.5194/acp-10-8341-2010

Atmospheric Chemistry and Physics

I93 AM Rush Hour Somerville MA
Higher traffic pollution early

Short-term variation in near-highway air pollutant gradients on a winter morning

J. L. Durant[1], C. A. Ash[1], E. C. Wood[2], S. C. Herndon[2], J. T. Jayne[2], W. B. Knighton[3], M. R. Canagaratna[2], J. B. Trull[1], D. Brugge[4], W. Zamore[5], and C. E. Kolb[2]

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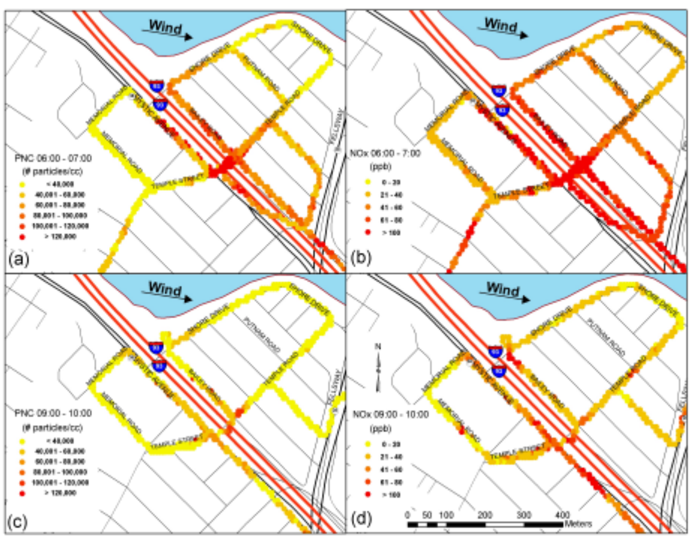
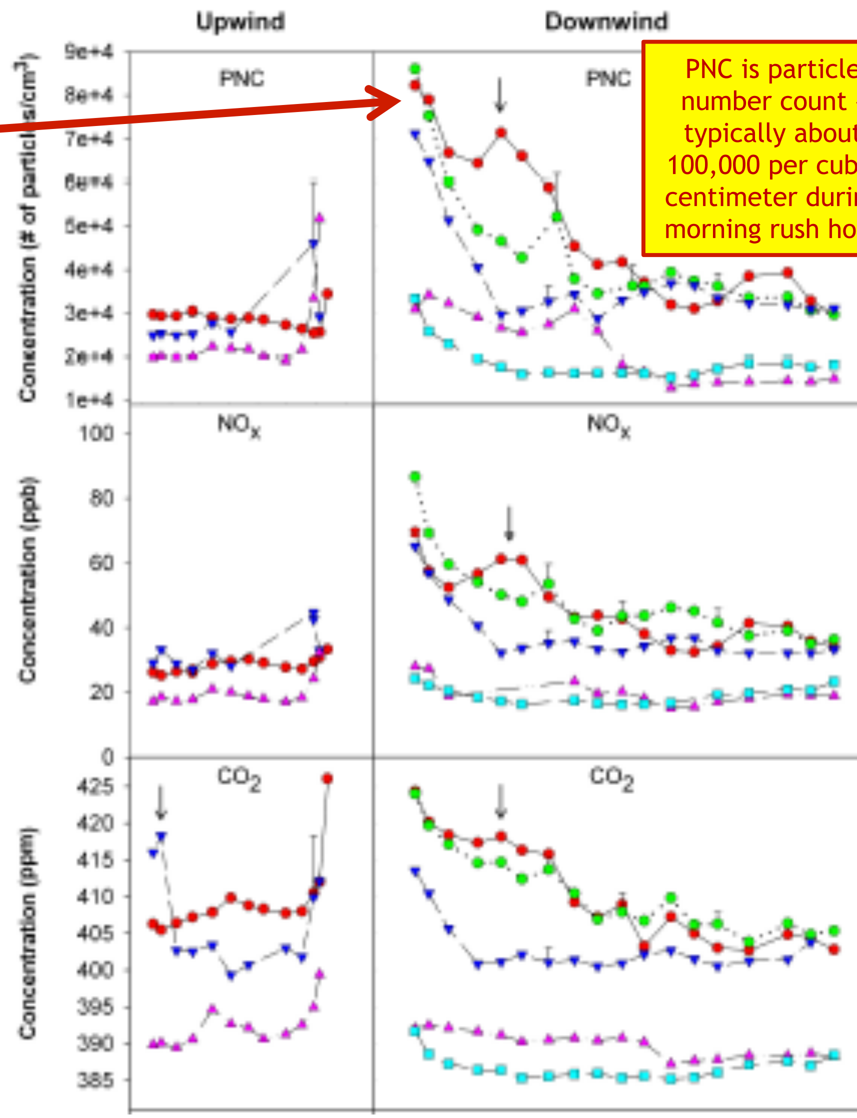


Fig. 8. Spatial distribution of particle number concentration (7–1000 nm) (a and c) and NO_x concentration (b and d) measured between 06:00–07:00 and between 09:00–10:00.



PNC is particle number count - typically about 100,000 per cubic centimeter during morning rush hour

Data collected January 16 2008

Somerville Precedent Studies

MVTF and STEP

With science by

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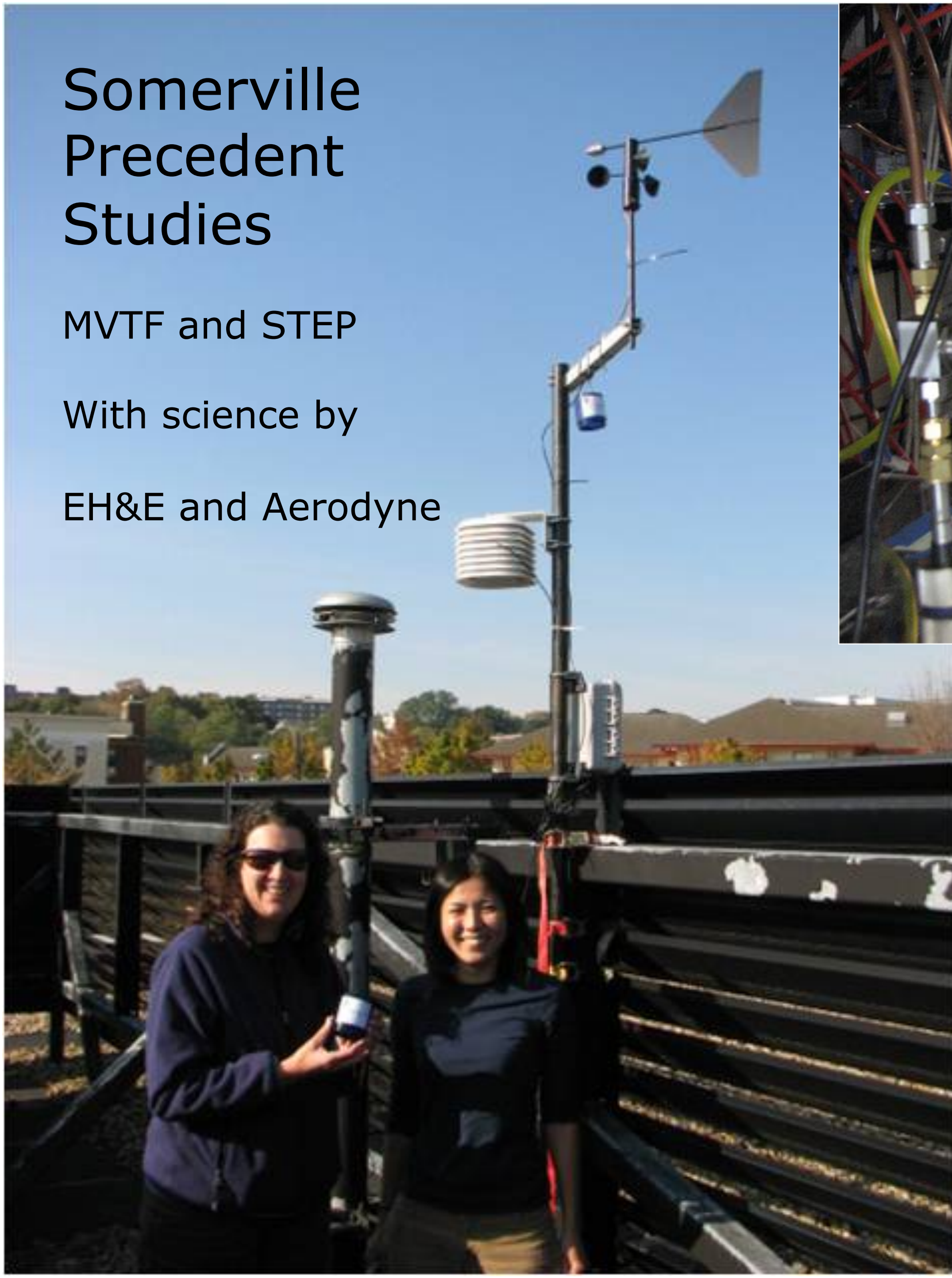

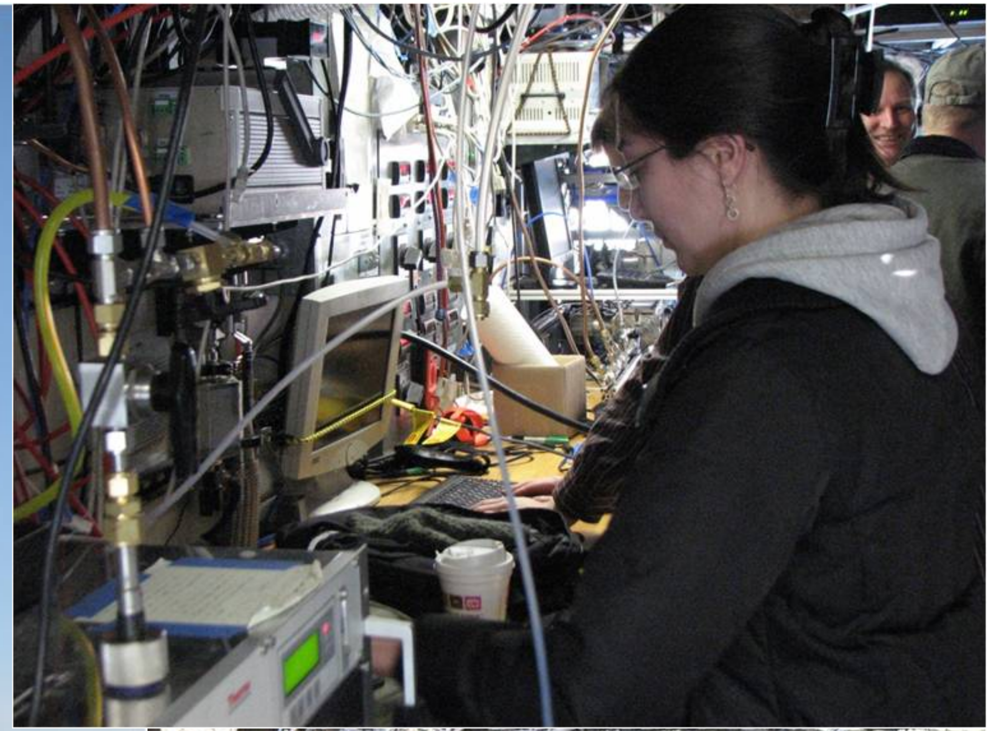

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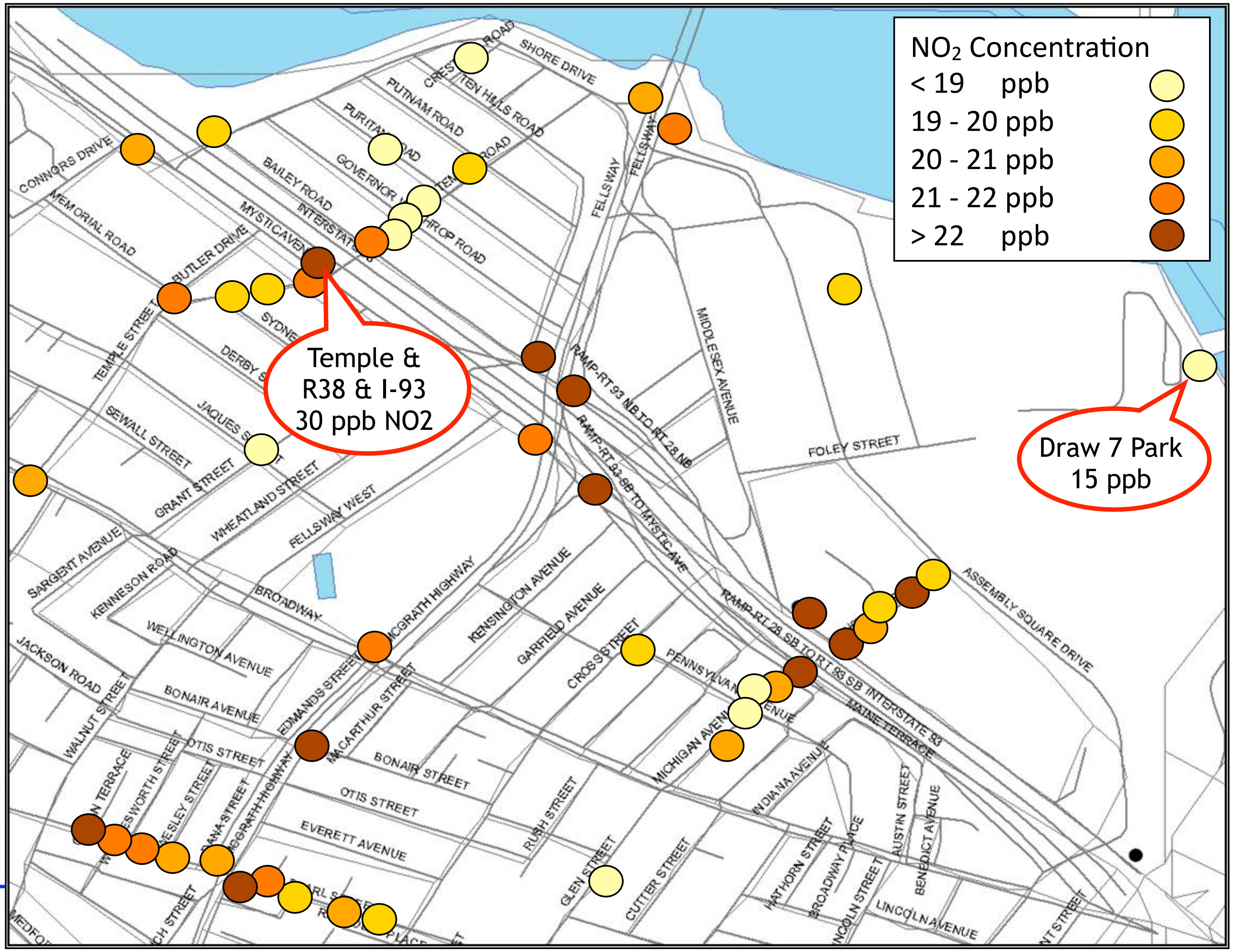

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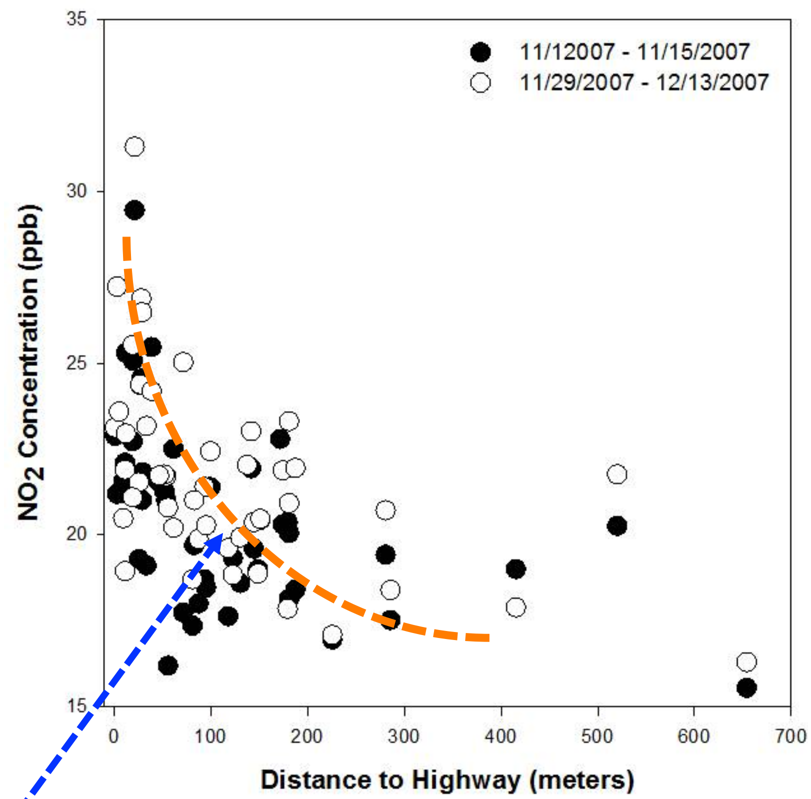

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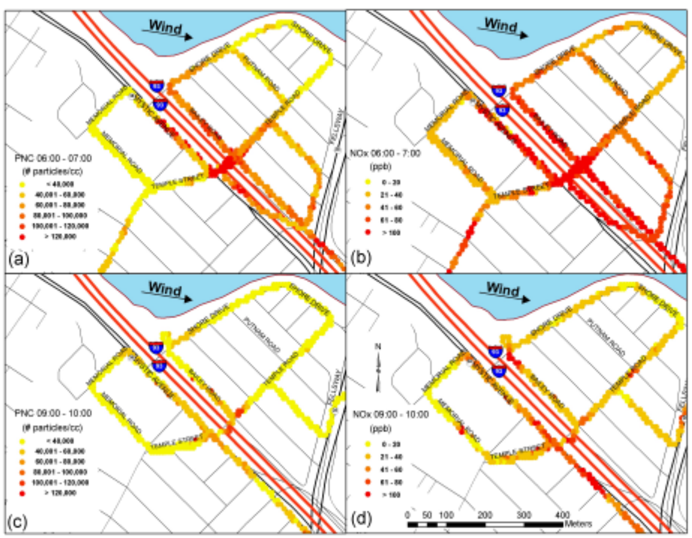

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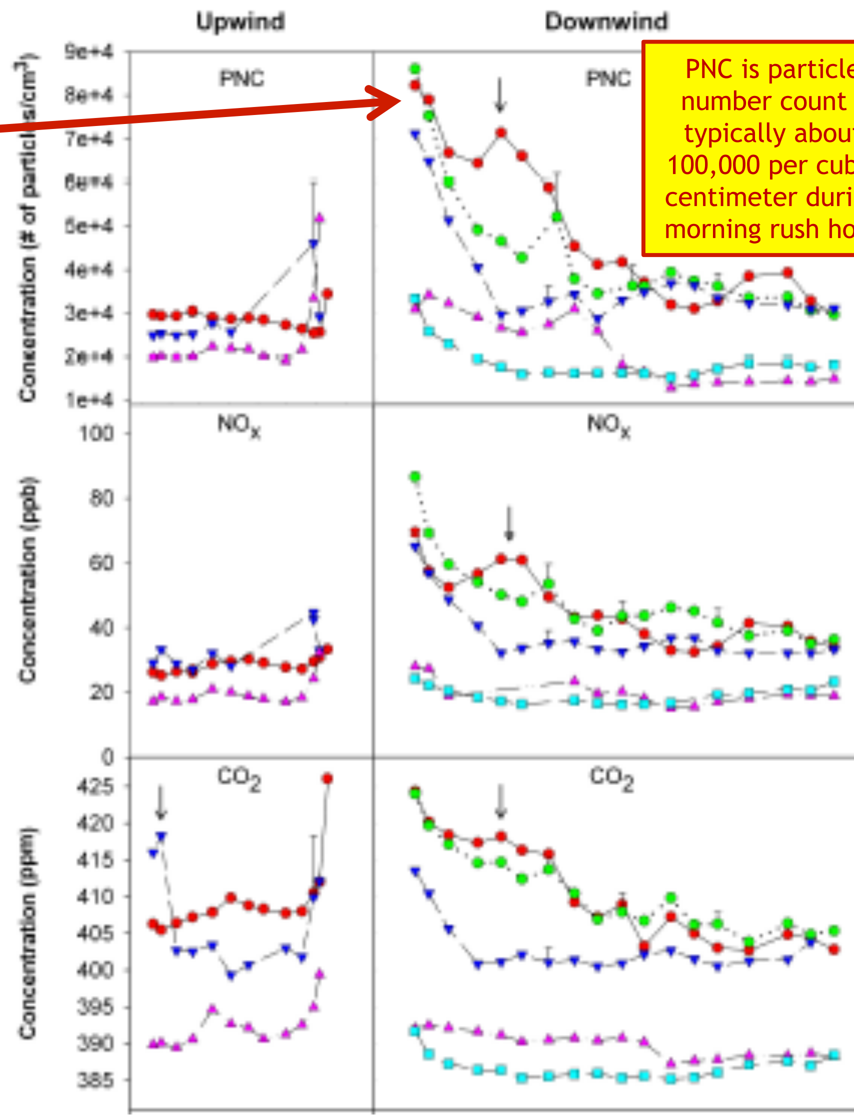

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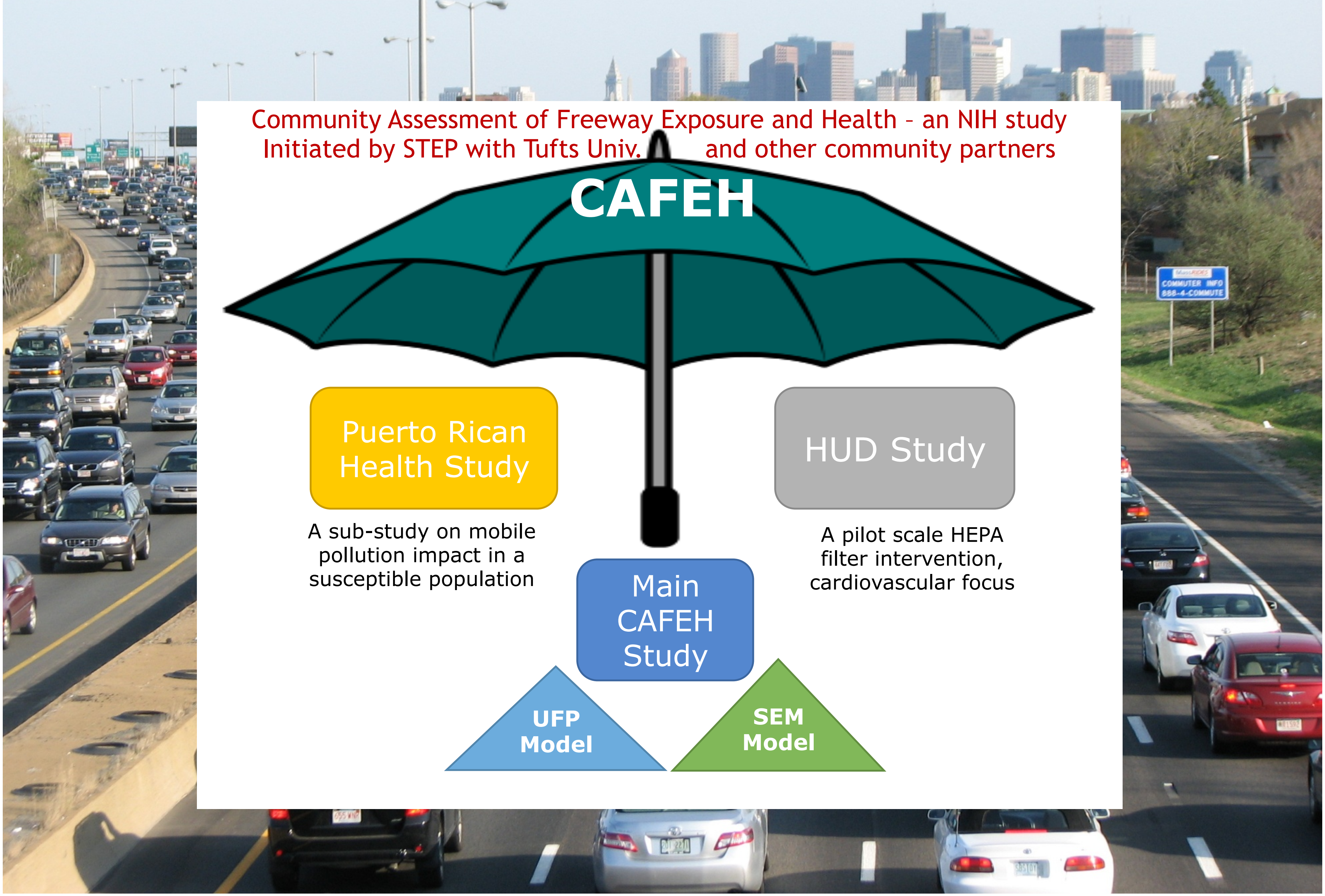
Data collected January 16 2008

Future activities



"RV" = Research Vehicle

Particle Pollutants:

Particle number concentration and size distribution, $PM_{2.5}$, black carbon, and pPAHs

Allison Patton and Jess Perkins of Tufts University in mobile lab

Gas Pollutants:

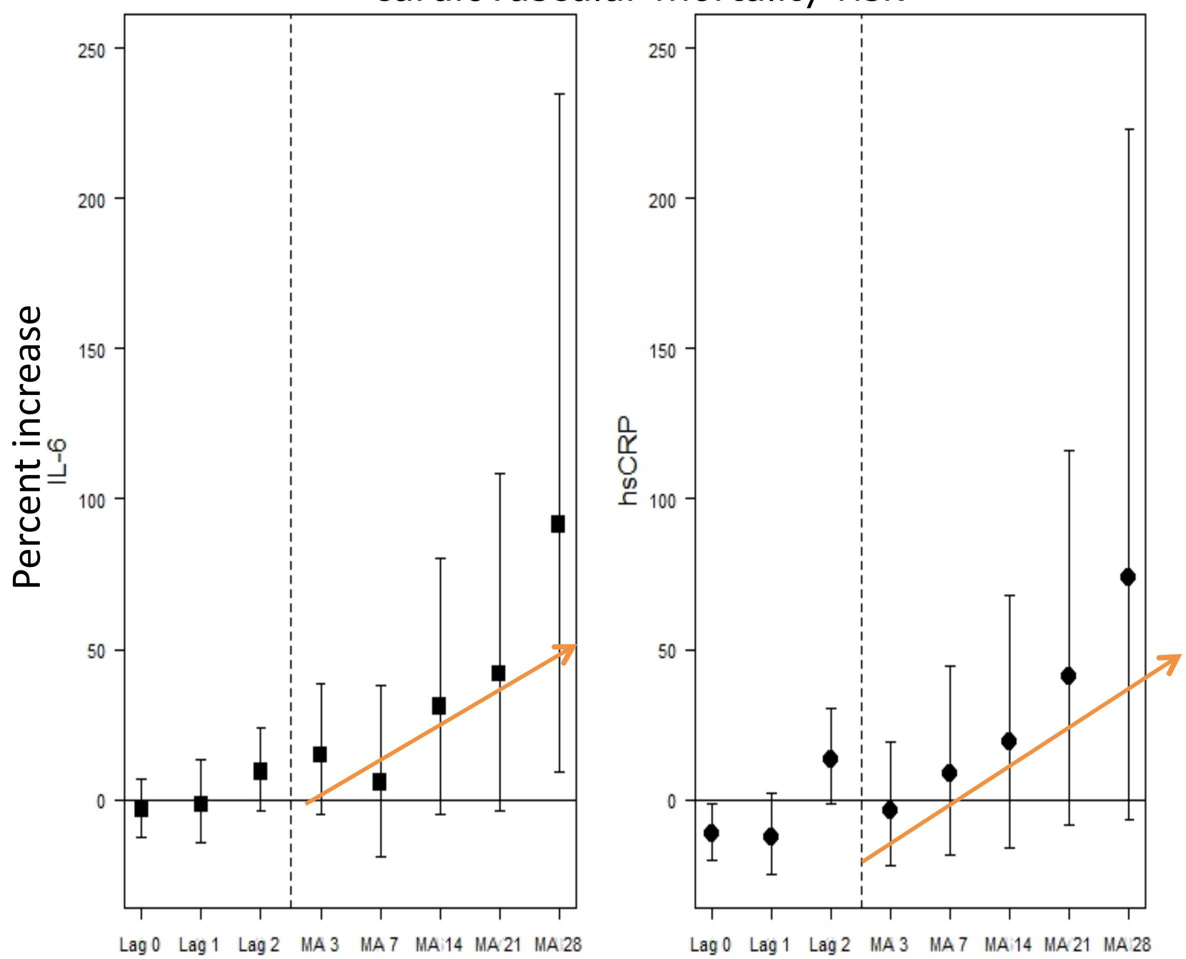
NO_X, NO, CO

Photographs courtesy of Alonso Nichols, Tufts University Photography

Trends in Somerville near highway **inflammatory cardiovascular biomarkers** - presented by Wig and Christina via NIEHS webinar

Characteristic	No. (%)
Age (years) (Mean ± SD)	58.6 (11.8)
Sex	
Female	99 (70)
Male	43 (30)
Race/ethnicity	
White	111 (78)
Non-white	29 (20)
Education	
Less than High School	29 (20)
Completed High School	59 (42)
Completed Jr. College or college	53 (38)
Employment	
Work full- or part-time	63 (45)
Retired, disabled or unemployed	76 (55)
Smoking	
Current	31 (23)
Past	56 (41)
Never	50 (36)
BMI (kg/m^2) (Mean ± SD)	29.4 (7.0)
Medications	
Statins	38 (27)
Anti-hypertensives	30 (21)
Diabetes	22 (15)
Anti-inflammatories	35 (24)

High sensitivity C Reactive Protein (hsCRP), used in most statin studies, is a good biomarker for cardiovascular mortality risk



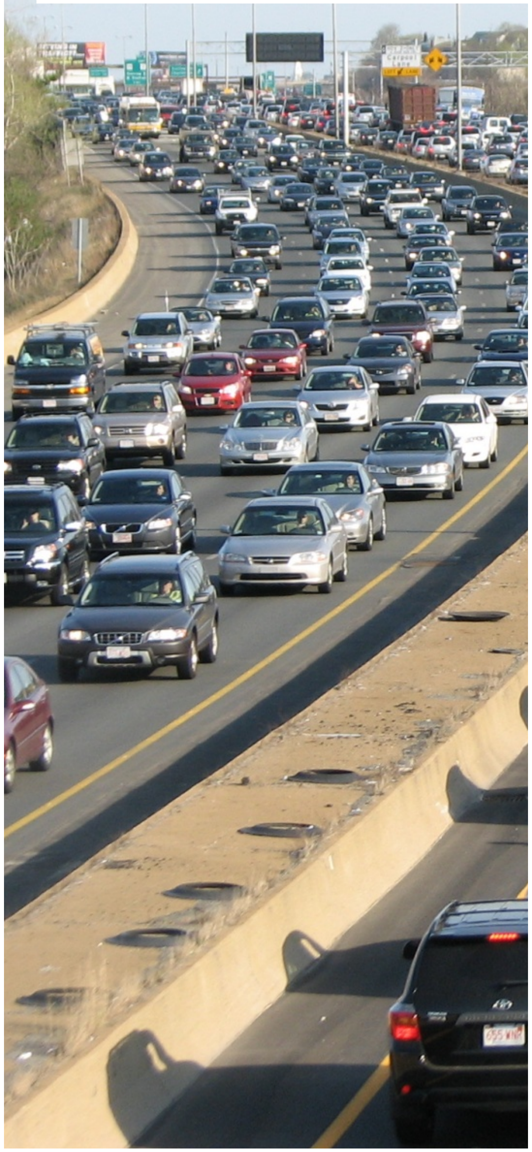
Early acute biomarker analyses by Christina Fuller of HSPH

Spatial variability in Particle Number Count in Somerville – Using the Tufts CAFEH mobile laboratory to survey 55 days (4 hours or more) in a year

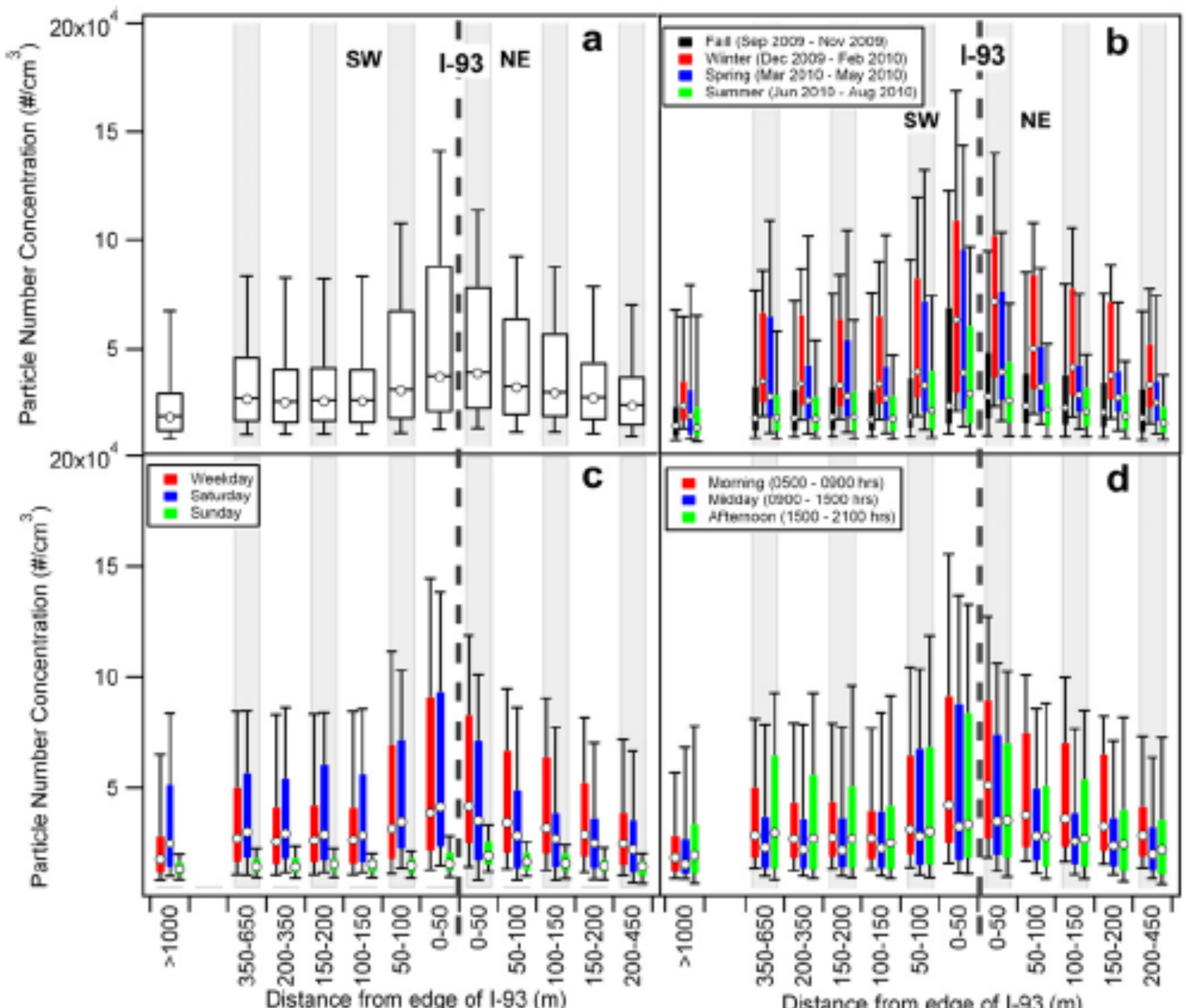
Mobile monitoring of particle number concentration and other traffic-related air pollutants in a near-highway neighborhood over the course of a year

Luz T. Padró-Martínez [a], Allison P. Patton [a], Jeffrey B. Trull [a,1], Wig Zamore [b], Doug Brugge [c], John L. Durant [a,*]

[a] Department of Civil & Environmental Engineering, Tufts University, Medford, MA, USA
[b] Somerville Transportation Equity Partnership, Somerville, MA, USA
[c] Department of Public Health and Community Medicine, Tufts University, Boston, MA, USA

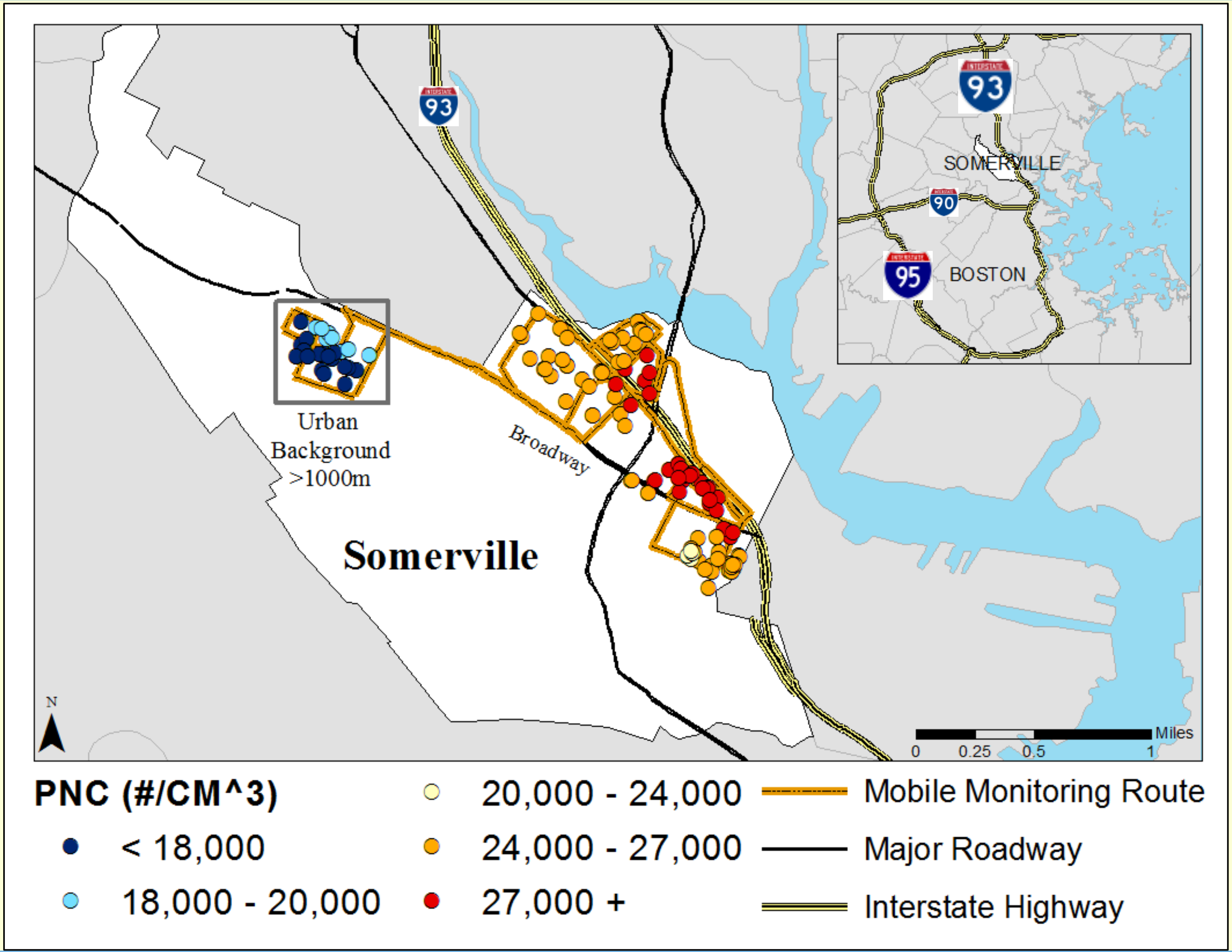


L.T. Padró-Martínez et al. / Atmospheric Environment 61 (2012) 253–264



PNC Residential Annual Average (N=140)

K. Lane CAFEH - Research in Development – DO NOT CITE

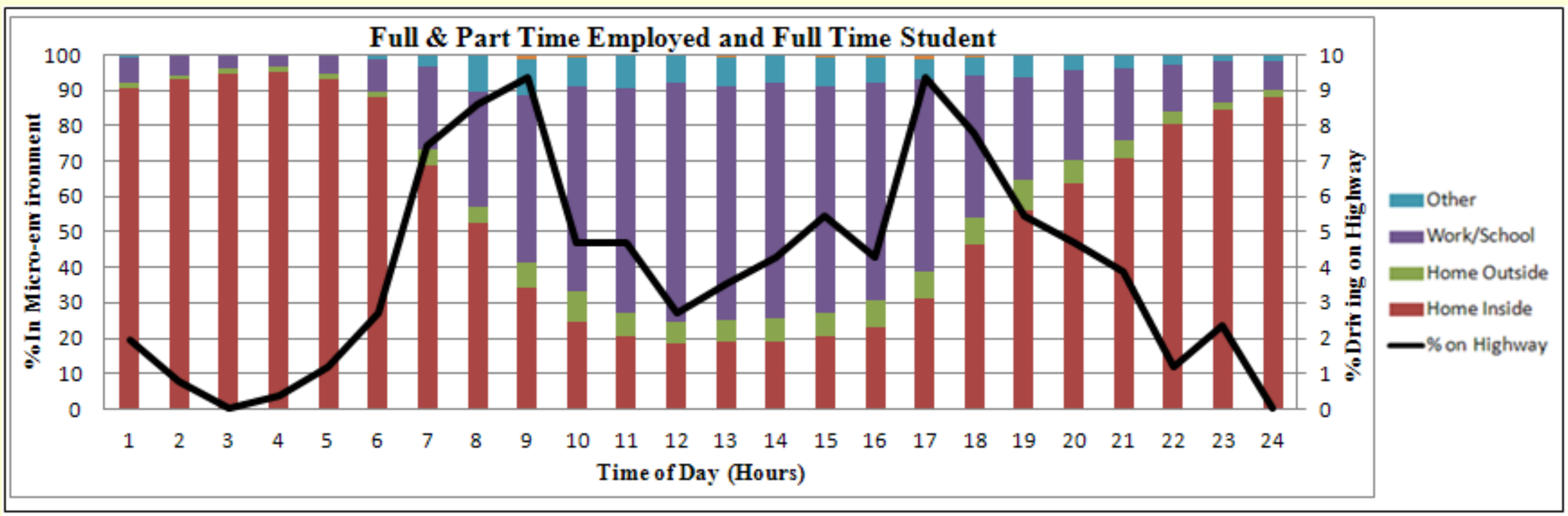


Problem with Exposure Assignment

K. Lane CAFEH - Research in Development – DO NOT CITE

1) UFP concentrations vary greatly over space and time.
(Zhu et al., 2006; Karner et al., 2010; Durant et al., 2010; Padro-Martinez et al., 2012)

2) People do not spend all their time at home so exposure assignment for TRAPs like UFPs should account for time-activity patterns. (Beckx et al., 2008; Luc Int Panis, 2010; Dons et al., 2011; Buonanno et al., 2013)



(Lane et al., Under Review)

Time-Activity Exposure Adjustment

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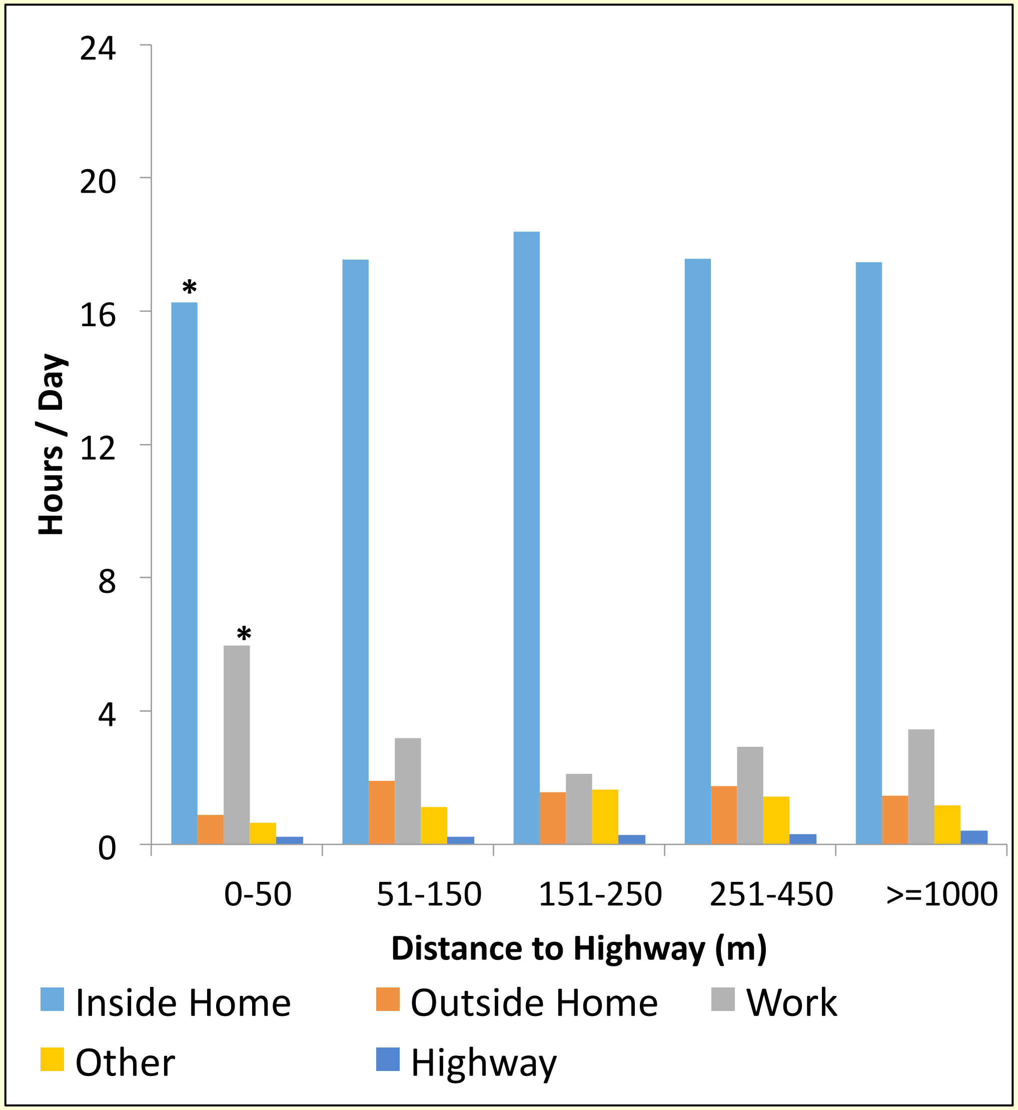
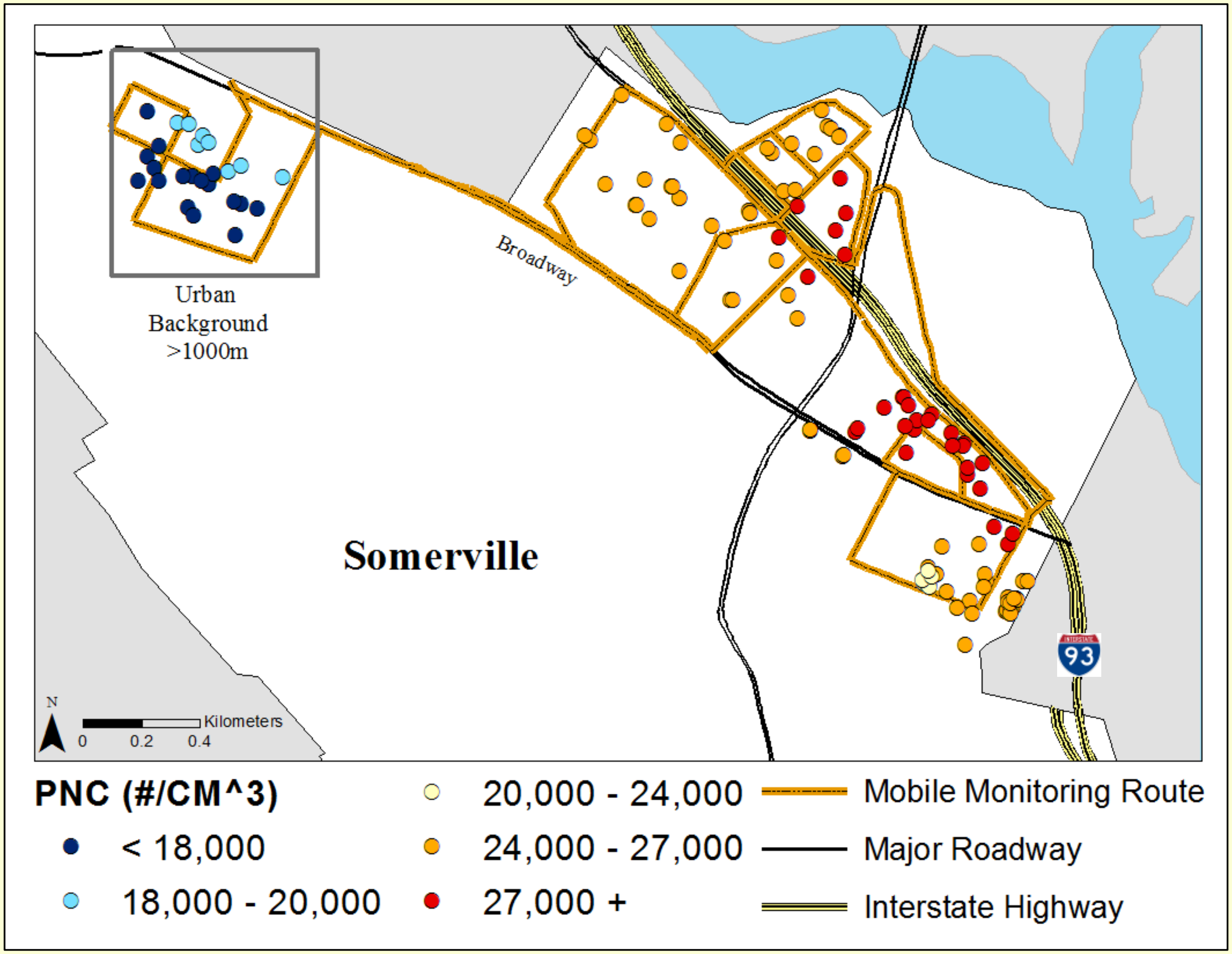
- Outside of Home
  - Modeled Ambient Residential PNC
- Inside of Home
  - Modeled Ambient Residential PNC (Fuller et al., 2013)
- Highway Travel
  - Modeled Ambient Highway PNC
- Other Non-Highway
  - Urban Background Hourly Average
- Work
  - Outdoor with combustion (i.e. taxi driver/traffic guard) = Average of participants.



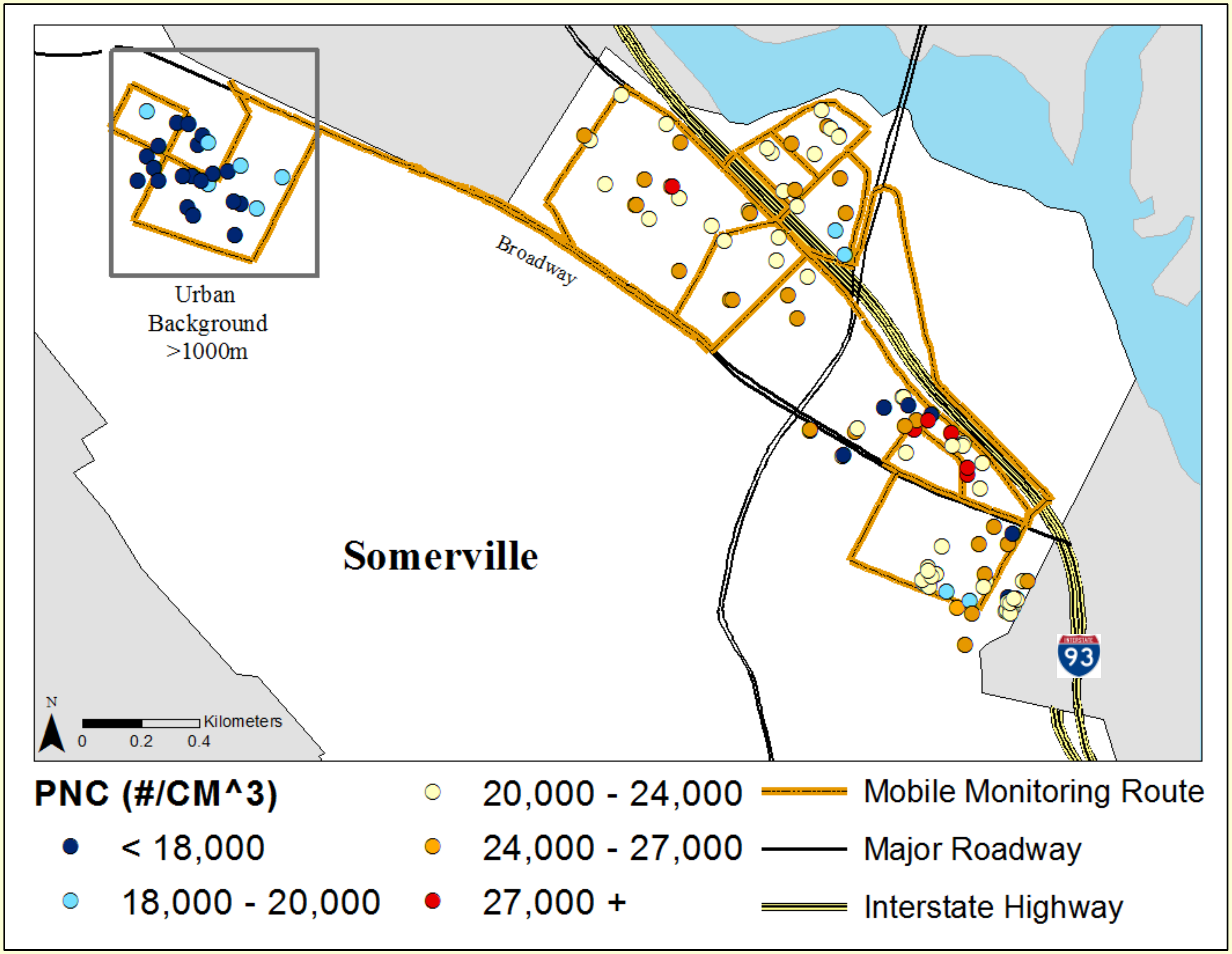
Comparison of PNC Annual Average Exposure Models (N=140)

K. Lane CAFEH - Research in Development – DO NOT CITE



Ambient Residential Annual Average

Comparison of PNC Annual Average Exposure Models (N=140)



Exposure Adjusted Time-Activity Annual Average

Effects of Time-Activity adjusted LN PNC on association of LN hsCRP.

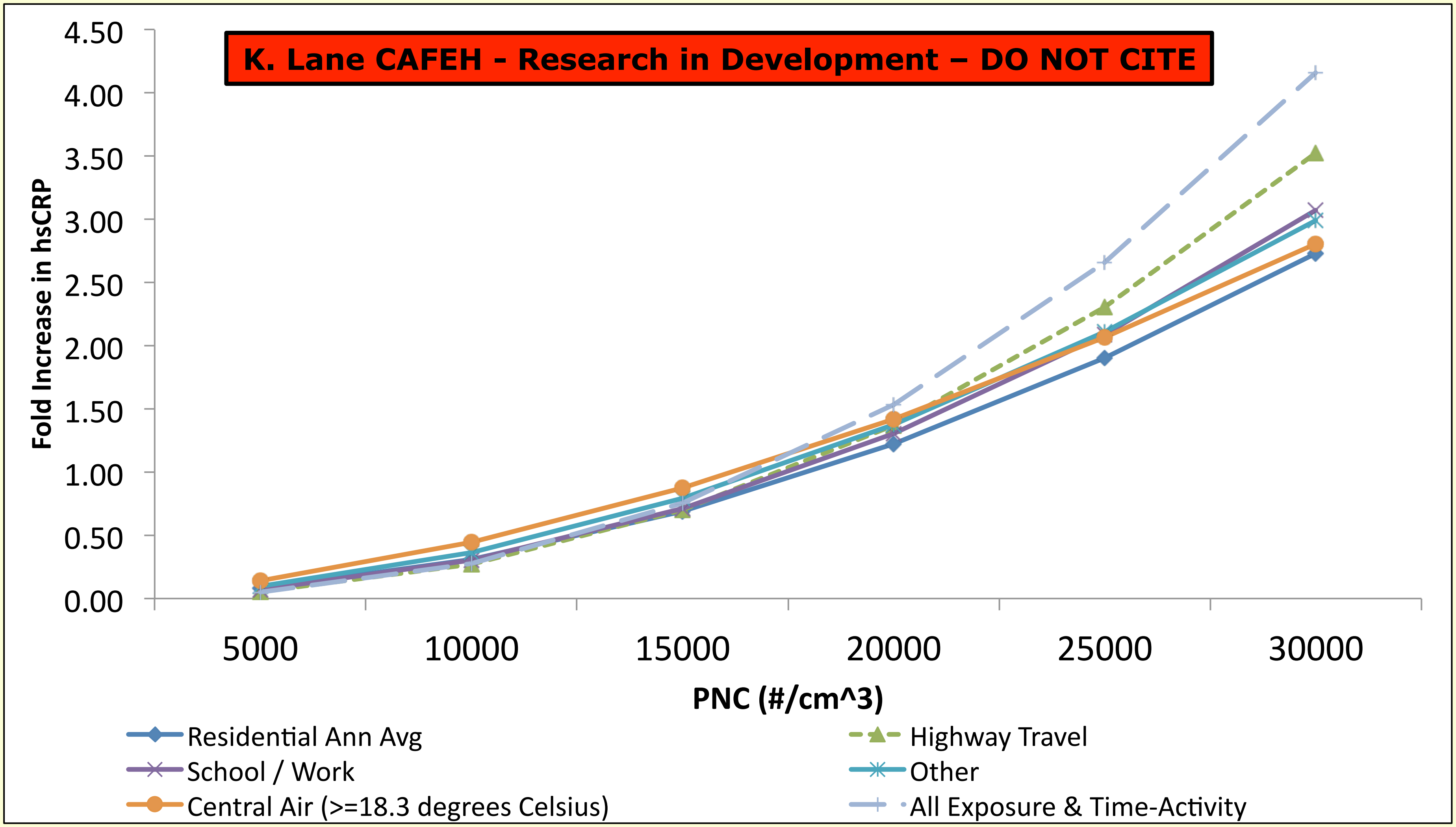
K. Lane CAFEH - Research in Development – DO NOT CITE

Model	% Change	95% CI
Residential Annual Average	1.14	(-0.06%, 2.35%)

Additive Models	% Change	95% CI
Inside Home	1.16	(-0.08%, 2.4%)
Outside Home	1.24	(0.01%, 2.46%)
Work	1.36	(0.03%, 2.69%)
Other (Non-Highway)	1.51	(0.09%, 2.94%)
Highway Travel	1.86	(0.32%, 3.14%)
Central Air (>=18.3 degrees Celsius)	1.79	(0.49%, 3.09%)

*All models adjusted for age, gender, smoking status and BMI.

Effects of Time-Activity adjusted PNC on association of hsCRP.



*All models adjusted for age, gender, smoking status and BMI.

Accepted Manuscript

Title: Ultrafine particles near a major roadway in Raleigh, North Carolina: downwind attenuation and correlation with traffic-related pollutants

Authors: G.S.W. Hagler, R.W. Baldauf, E.D. Thoma, T.R. Long, R.F. Snow, J.S. Kinsey, L. Oudejans, B.K. Gullett

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DOI: 10.1016/j.atmosenv.2008.11.024
Reference: AEA 8726

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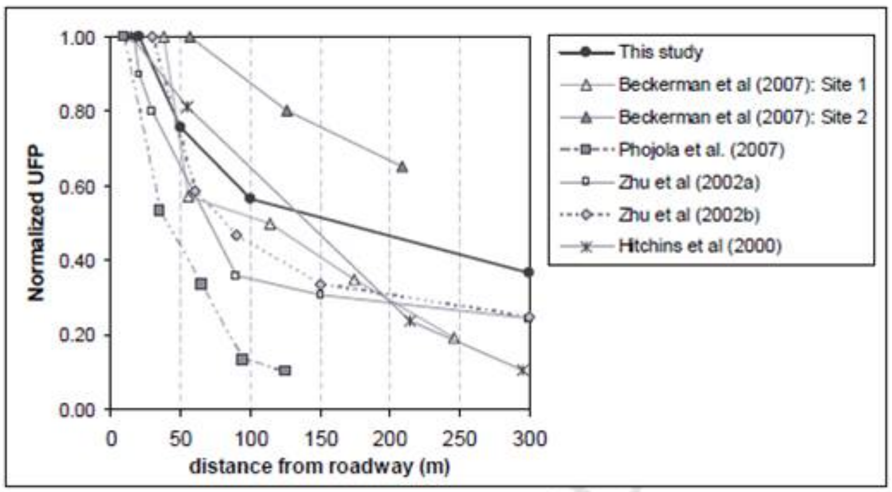
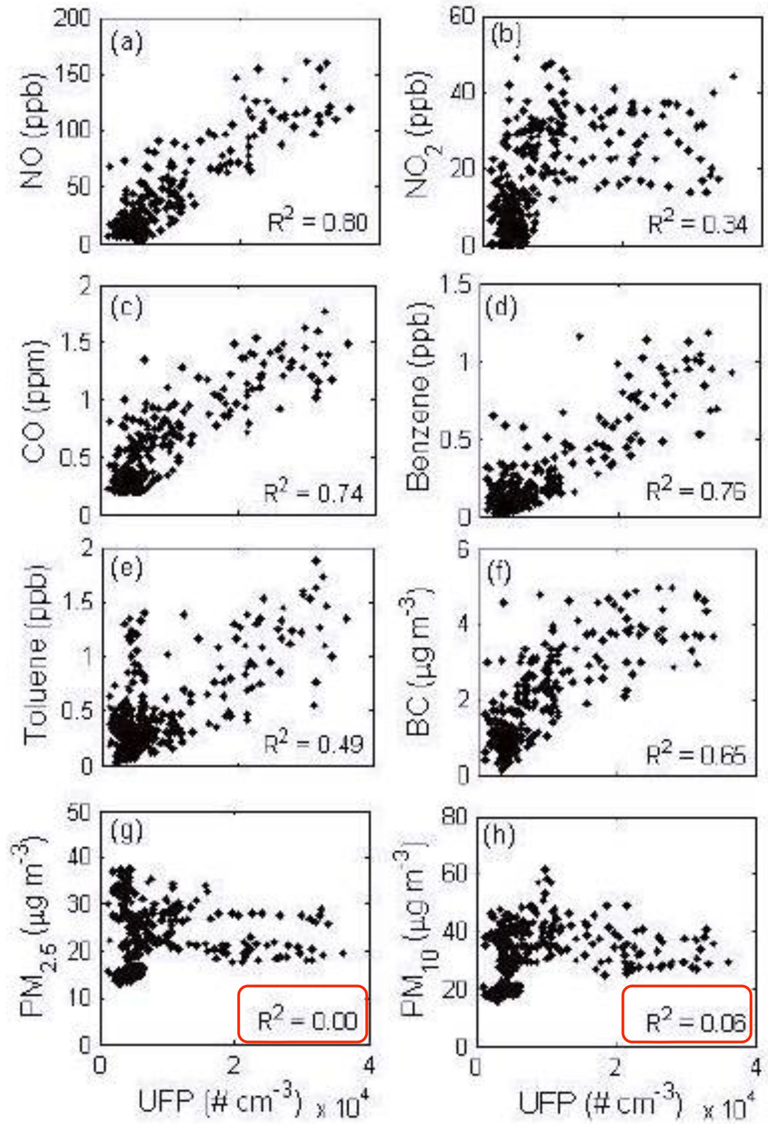




Nice work by EPA & NOAA – Hagler Raleigh NC - UFP does not correlate with PM2.5 or PM10 - PM2.5 regulations DO NOT PROTECT vulnerable populations from UFP-TRAP

Nyberg Stockholm 2000 – All statistical significance is in highest NO2 decile when viewing association of lung cancer with long term residential exposures Nafstad's Oslo NOx lung cancer study had higher concentration response

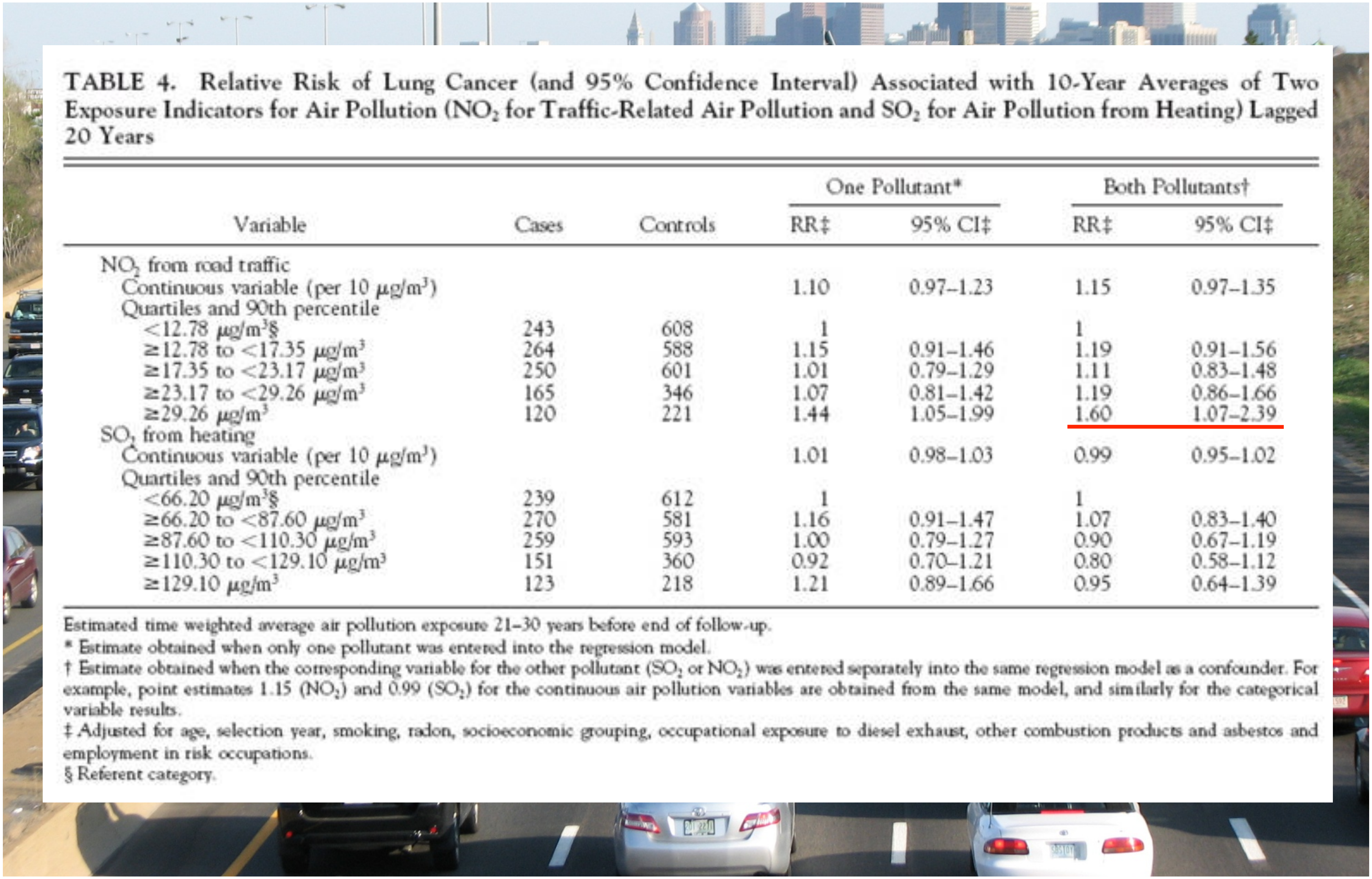


TABLE 4. Relative Risk of Lung Cancer (and 95% Confidence Interval) Associated with 10-Year Averages of Two Exposure Indicators for Air Pollution (NO_2 for Traffic-Related Air Pollution and SO_2 for Air Pollution from Heating) Lagged 20 Years

Variable	Cases	Controls	One Pollutant*		Both Pollutants†	
			RR‡	95% CI‡	RR‡	95% CI‡
NO_2 from road traffic						
Continuous variable (per 10 $\mu g/m^3$)			1.10	0.97–1.23	1.15	0.97–1.35
Quartiles and 90th percentile						
$<12.78\ \mu g/m^3$§	243	608	1		1	
≥ 12.78 to $<17.35\ \mu g/m^3$	264	588	1.15	0.91–1.46	1.19	0.91–1.56
≥ 17.35 to $<23.17\ \mu g/m^3$	250	601	1.01	0.79–1.29	1.11	0.83–1.48
≥ 23.17 to $<29.26\ \mu g/m^3$	165	346	1.07	0.81–1.42	1.19	0.86–1.66
$\geq 29.26\ \mu g/m^3$	120	221	1.44	1.05–1.99	1.60	1.07–2.39
SO_2 from heating						
Continuous variable (per 10 $\mu g/m^3$)			1.01	0.98–1.03	0.99	0.95–1.02
Quartiles and 90th percentile						
$<66.20\ \mu g/m^3$§	239	612	1		1	
≥ 66.20 to $<87.60\ \mu g/m^3$	270	581	1.16	0.91–1.47	1.07	0.83–1.40
≥ 87.60 to $<110.30\ \mu g/m^3$	259	593	1.00	0.79–1.27	0.90	0.67–1.19
≥ 110.30 to $<129.10\ \mu g/m^3$	151	360	0.92	0.70–1.21	0.80	0.58–1.12
$\geq 129.10\ \mu g/m^3$	123	218	1.21	0.89–1.66	0.95	0.64–1.39

Estimated time weighted average air pollution exposure 21–30 years before end of follow-up.

* Estimate obtained when only one pollutant was entered into the regression model.

† Estimate obtained when the corresponding variable for the other pollutant (SO_2 or NO_2) was entered separately into the same regression model as a confounder. For example, point estimates 1.15 (NO_2) and 0.99 (SO_2) for the continuous air pollution variables are obtained from the same model, and similarly for the categorical variable results.

‡ Adjusted for age, selection year, smoking, radon, socioeconomic grouping, occupational exposure to diesel exhaust, other combustion products and asbestos and employment in risk occupations.

§ Referent category.

Changes in Residential Proximity to Road Traffic and the Risk of Death From Coronary Heart Disease

Wen Qi Gan,[a] Lillian Tamburic,[b] Hugh W. Davies,[a] Paul A. Demers,[a,c] Mieke Koehoorn,[a,c] and Michael Brauer[a]

Heart Disease Mortality highest for those living near highways

In a related Gan multi-pollutant paper PM2.5 lost all statistical significance when compared with NO2 and BC

Background: Residential proximity to road traffic is associated with increased coronary heart disease (CHD) morbidity and mortality. It is unknown, however, whether changes in residential proximity to traffic could alter the risk of CHD mortality.
Methods: We used a population-based cohort study with a 5-year exposure period and a 4-year follow-up period to explore the association between changes in residential proximity to road traffic and the risk of CHD mortality. The cohort comprised all residents aged 45–85 years who resided in metropolitan Vancouver during the exposure period and without known CHD at baseline (n = 450,283). Residential proximity to traffic was estimated using a geographic information system. CHD deaths during the follow-up period were identified using provincial death registration database. The data were analyzed using logistic regression.
Results: Compared with the subjects consistently living away from road traffic (>150 m from a highway or >50 m from a major road) during the 9-year study period, those consistently living close to traffic (≤150 m from a highway or ≤50 m from a major road) had the greatest risk of CHD mortality (relative risk [RR] = 1.29 [95% confidence interval = 1.18–1.41]). By comparison, those who moved closer to traffic during the exposure period had less increased risk than those who were consistently exposed (1.20 [1.00–1.43]), and those who moved away from traffic had even less increase in the risk (1.14 [0.95–1.37]). All analyses were adjusted for baseline age, sex, pre-existing comorbidities (diabetes, chronic obstructive pulmonary disease, hypertensive heart disease), and neighborhood socioeconomic status.
Conclusions: Living close to major roadways was associated with increased risk of coronary mortality, whereas moving away from major roadways was associated with decreased risk.

(*Epidemiology* 2010;21: 000–000)

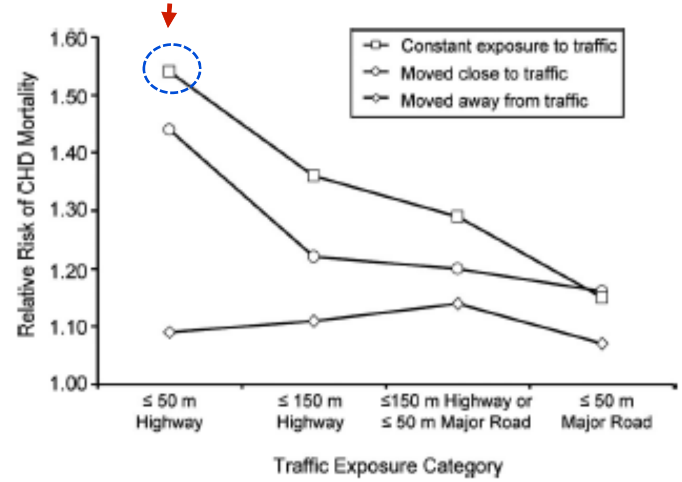
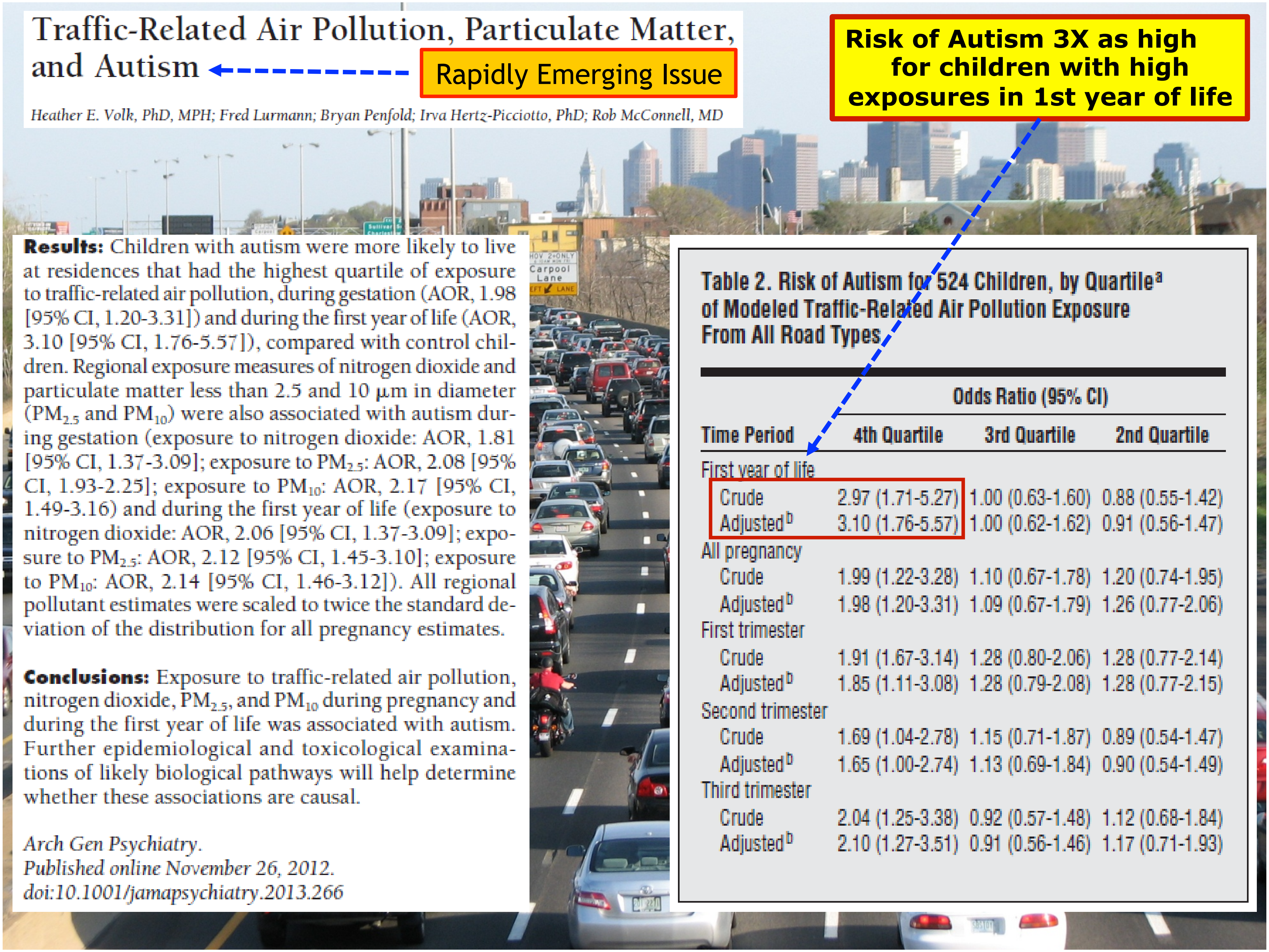


FIGURE 1. Association of road traffic exposure with coronary heart disease mortality by road types and distances. RRs adjusted for age, sex, neighborhood SES, and pre-existing comorbidities.



Traffic-Related Air Pollution, Particulate Matter, and Autism ← Rapidly Emerging Issue

Heather E. Volk, PhD, MPH; Fred Lurmann; Bryan Penfold; Irva Hertz-Picciotto, PhD; Rob McConnell, MD

Risk of Autism 3X as high for children with high exposures in 1st year of life

Results: Children with autism were more likely to live at residences that had the highest quartile of exposure to traffic-related air pollution, during gestation (AOR, 1.98 [95% CI, 1.20-3.31]) and during the first year of life (AOR, 3.10 [95% CI, 1.76-5.57]), compared with control children. Regional exposure measures of nitrogen dioxide and particulate matter less than 2.5 and 10 μm in diameter ($PM_{2.5}$ and PM_{10}) were also associated with autism during gestation (exposure to nitrogen dioxide: AOR, 1.81 [95% CI, 1.37-3.09]; exposure to $PM_{2.5}$: AOR, 2.08 [95% CI, 1.93-2.25]; exposure to PM_{10}: AOR, 2.17 [95% CI, 1.49-3.16) and during the first year of life (exposure to nitrogen dioxide: AOR, 2.06 [95% CI, 1.37-3.09]; exposure to $PM_{2.5}$: AOR, 2.12 [95% CI, 1.45-3.10]; exposure to PM_{10}: AOR, 2.14 [95% CI, 1.46-3.12]). All regional pollutant estimates were scaled to twice the standard deviation of the distribution for all pregnancy estimates.

Conclusions: Exposure to traffic-related air pollution, nitrogen dioxide, $PM_{2.5}$, and PM_{10} during pregnancy and during the first year of life was associated with autism. Further epidemiological and toxicological examinations of likely biological pathways will help determine whether these associations are causal.

Arch Gen Psychiatry.
Published online November 26, 2012.
doi:10.1001/jamapsychiatry.2013.266

Table 2. Risk of Autism for 524 Children, by Quartile[a] of Modeled Traffic-Related Air Pollution Exposure From All Road Types

	Odds Ratio (95% CI)		
Time Period	**4th Quartile**	**3rd Quartile**	**2nd Quartile**
First year of life			
Crude	2.97 (1.71-5.27)	1.00 (0.63-1.60)	0.88 (0.55-1.42)
Adjusted[b]	3.10 (1.76-5.57)	1.00 (0.62-1.62)	0.91 (0.56-1.47)
All pregnancy			
Crude	1.99 (1.22-3.28)	1.10 (0.67-1.78)	1.20 (0.74-1.95)
Adjusted[b]	1.98 (1.20-3.31)	1.09 (0.67-1.79)	1.26 (0.77-2.06)
First trimester			
Crude	1.91 (1.67-3.14)	1.28 (0.80-2.06)	1.28 (0.77-2.14)
Adjusted[b]	1.85 (1.11-3.08)	1.28 (0.79-2.08)	1.28 (0.77-2.15)
Second trimester			
Crude	1.69 (1.04-2.78)	1.15 (0.71-1.87)	0.89 (0.54-1.47)
Adjusted[b]	1.65 (1.00-2.74)	1.13 (0.69-1.84)	0.90 (0.54-1.49)
Third trimester			
Crude	2.04 (1.25-3.38)	0.92 (0.57-1.48)	1.12 (0.68-1.84)
Adjusted[b]	2.10 (1.27-3.51)	0.91 (0.56-1.46)	1.17 (0.71-1.93)

Exposure to Traffic and the Onset of Myocardial Infarction

Annette Peters, Ph.D., Stephanie von Klot, M.P.H., Margit Heier, M.D.,
Ines Trentinaglia, B.S., Allmut Hörmann, M.S., H. Erich Wichmann, M.D., Ph.D., and Hannelore Löwel, M.D.,
for the Cooperative Health Research in the Region of Augsburg Study Group

N Engl J Med 2004;351:1721-30.

Heart attacks elevated (2.9 to 3.9) after exposure to traffic

BACKGROUND

An association between exposure to vehicular traffic in urban areas and the exacerbation of cardiovascular disease has been suggested in previous studies. This study was designed to assess whether exposure to traffic can trigger myocardial infarction.

METHODS

We conducted a case–crossover study in which cases of myocardial infarction were identified with the use of data from the Cooperative Health Research in the Region of Augsburg Myocardial Infarction Registry in Augsburg, in southern Germany, for the period from February 1999 to July 2001. There were 691 subjects for whom the date and time of the myocardial infarction were known who had survived for at least 24 hours after the event, completed the registry's standardized interview, and provided information on factors that may have triggered the myocardial infarction. Data on subjects' activities during the four days preceding the onset of symptoms were collected with the use of patient diaries.

RESULTS

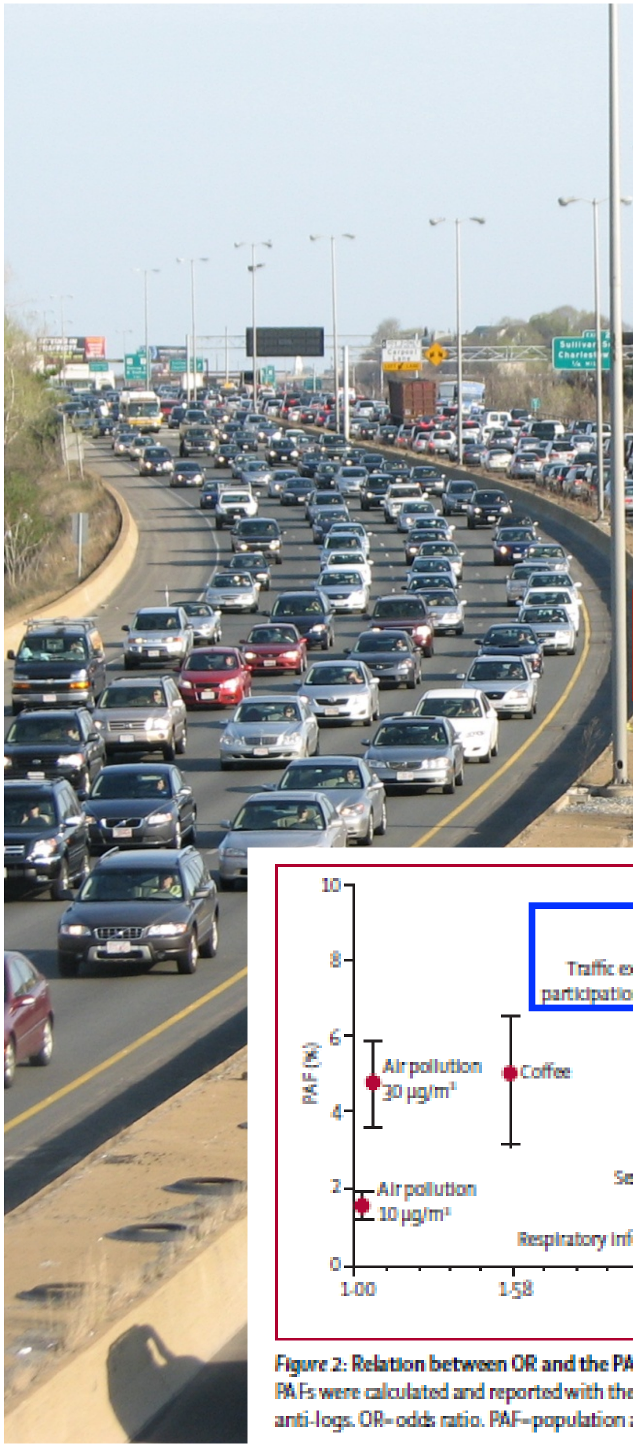
An association was found between exposure to traffic and the onset of a myocardial infarction within one hour afterward (odds ratio, 2.92; 95 percent confidence interval, 2.22 to 3.83; P<0.001). The time the subjects spent in cars, on public transportation, or on motorcycles or bicycles was consistently linked with an increase in the risk of myocardial infarction. Adjusting for the level of exercise on a bicycle or for getting up in the morning changed the estimated effect of exposure to traffic only slightly (odds ratio for myocardial infarction, 2.73; 95 percent confidence interval, 2.06 to 3.61; P<0.001). The subject's use of a car was the most common source of exposure to traffic; nevertheless, there was also an association between time spent on public transportation and the onset of a myocardial infarction one hour later.

CONCLUSIONS

Transient exposure to traffic may increase the risk of myocardial infarction in susceptible persons.

Table 2. Odds Ratios for the Onset of Myocardial Infarction (MI) after Time Spent in Traffic, According to the Means of Transportation.*

Type of Transportation and Hours before MI	No. of Subjects	Frequency of Exposure in Case Period on Day of MI (%)	Odds Ratio (95% CI)	P Value
Any means of transportation†				
Concurrent	585	8.0	1.50 (1.07–2.09)	0.02
1 hr	625	12.1	★ 2.92 (2.22–3.83)	<0.001
2 hr	634	8.9	2.01 (1.49–2.72)	<0.001
3 hr	635	5.5	1.15 (0.79–1.66)	0.47
4 hr	638	5.6	1.27 (0.89–1.83)	0.19
5 hr	639	6.8	1.64 (1.17–2.30)	0.004
6 hr	640	6.1	1.34 (0.93–1.92)	0.11
Cars				
Concurrent	585	5.6	1.33 (0.90–1.99)	0.15
1 hr	625	8.3	★ 2.60 (1.89–3.57)	<0.001
2 hr	634	6.5	1.94 (1.37–2.76)	<0.001
3 hr	635	4.2	1.16 (0.76–1.78)	0.49
4 hr	638	4.0	1.21 (0.79–1.86)	0.38
5 hr	639	5.3	1.73 (1.19–2.54)	0.005
6 hr	640	5.0	1.55 (1.04–2.30)	0.03
Bicycles				
Concurrent	585	1.8	2.59 (1.27–5.29)	0.009
1 hr	625	2.4	★ 3.94 (2.14–7.24)	<0.001
2 hr	634	1.6	2.70 (1.37–5.33)	0.004
3 hr	635	1.0	1.66 (0.74–3.74)	0.22
4 hr	638	0.7	1.16 (0.45–2.96)	0.76
5 hr	639	0.9	1.49 (0.63–3.54)	0.37
6 hr	640	0.7	1.02 (0.36–2.87)	0.97
Public transportation				
Concurrent	585	0.5	1.08 (0.33–3.55)	0.90
1 hr	625	1.2	★ 3.09 (1.41–6.75)	0.005
2 hr	634	0.9	2.13 (0.91–5.23)	0.08
3 hr	635	0.3	0.69 (0.17–2.88)	0.62
4 hr	638	0.9	2.27 (0.95–5.41)	0.06
5 hr	639	0.6	1.54 (0.55–4.37)	0.41
6 hr	640	0.3	0.73 (0.17–3.06)	0.67



Public health importance of triggers of myocardial infarction: a comparative risk assessment

Population attributable risk for heart attack highest for traffic exposure followed by exercise

Tim S Nawrot, Laura Perez, Nino Künzli, Elke Munters, Benoit Nemery

Summary

Background Acute myocardial infarction is triggered by various factors, such as physical exertion, stressful events, heavy meals, or increases in air pollution. However, the importance and relevance of each trigger are uncertain. We compared triggers of myocardial infarction at an individual and population level.

Methods We searched PubMed and the Web of Science citation databases to identify studies of triggers of non-fatal myocardial infarction to calculate population attributable fractions (PAF). When feasible, we did a meta-regression analysis for studies of the same trigger.

Findings Of the epidemiologic studies reviewed, 36 provided sufficient details to be considered. In the studied populations, the exposure prevalence for triggers in the relevant control time window ranged from 0·04% for cocaine use to 100% for air pollution. The reported odds ratios (OR) ranged from 1·05 to 23·7. Ranking triggers from the highest to the lowest OR resulted in the following order: use of cocaine, heavy meal, smoking of marijuana, negative emotions, physical exertion, positive emotions, anger, sexual activity, traffic exposure, respiratory infections, coffee consumption, air pollution (based on a difference of 30 μg/m³ in particulate matter with a diameter <10 μm [PM_{10}]). Taking into account the OR and the prevalences of exposure, the highest PAF was estimated for traffic exposure (7·4%), followed by physical exertion (6·2%), alcohol (5·0%), coffee (5·0%), a difference of 30 μg/m³ in PM_{10} (4·8%), negative emotions (3·9%), anger (3·1%), heavy meal (2·7%), positive emotions (2·4%), sexual activity (2·2%), cocaine use (0·9%), marijuana smoking (0·8%) and respiratory infections (0·6%).

Interpretation In view of both the magnitude of the risk and the prevalence in the population, air pollution is an important trigger of myocardial infarction, it is of similar magnitude (PAF 5–7%) as other well accepted triggers such as physical exertion, alcohol, and coffee. Our work shows that ever-present small risks might have considerable public health relevance.

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See Online/Comment
DOI:10.1016/S0140-6736(10)62348-3

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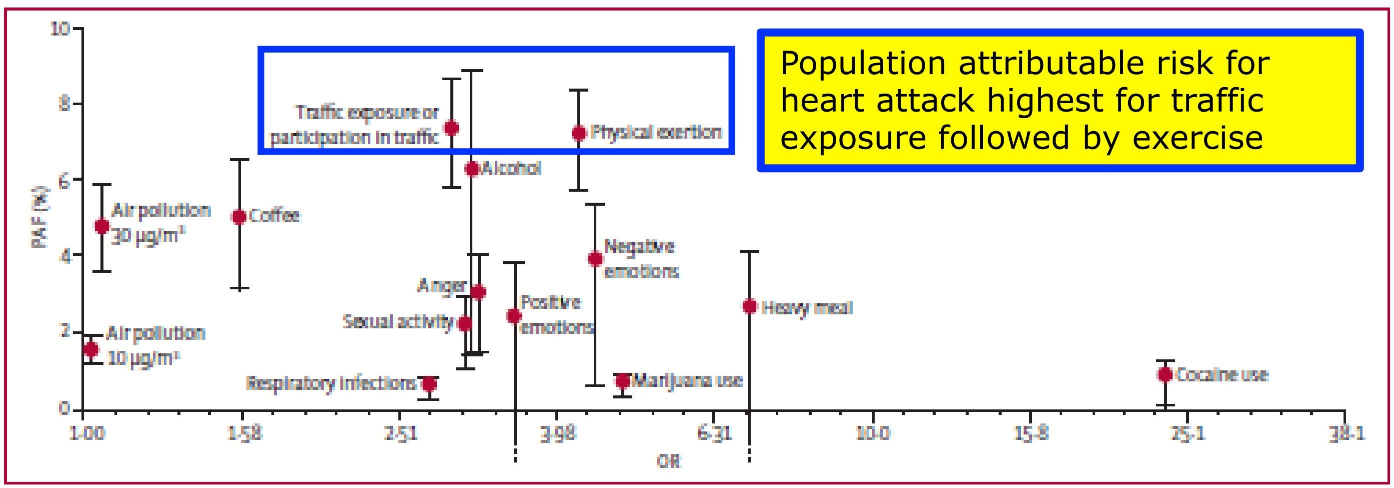
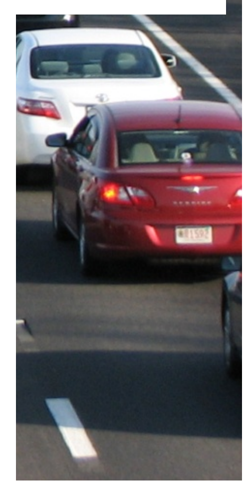


Figure 2: Relation between OR and the PAF for each studies trigger
PAFs were calculated and reported with their 95% CI (error bars). Not significant triggers show 95% CIs that are lower than 0%. X-axis is log scale, and ORs are given as anti-logs. OR=odds ratio. PAF=population attributable fraction.

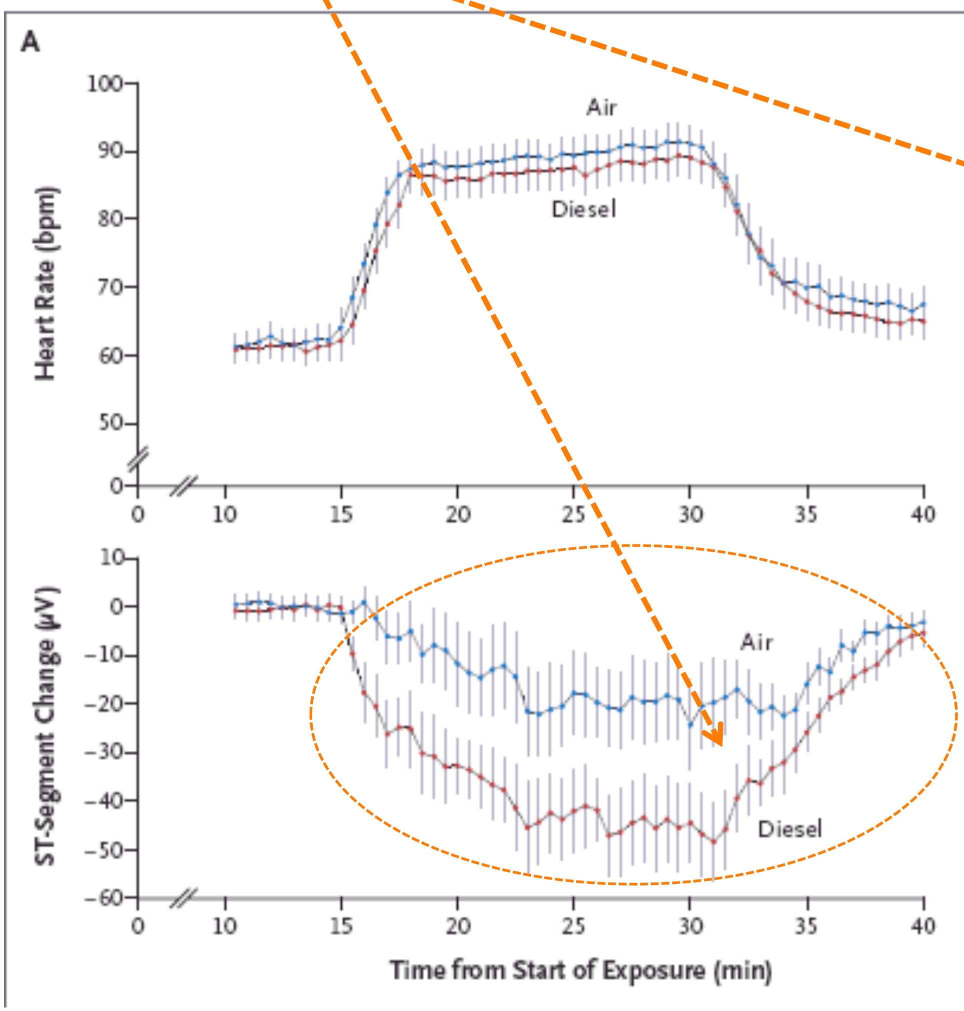


N Engl J Med 2007;357:1075-82.

Ischemic and Thrombotic Effects of Dilute Diesel-Exhaust Inhalation in Men with Coronary Heart Disease

Nicholas L. Mills, M.D., Håkan Törnqvist, M.D., Manuel C. Gonzalez, M.D., Elen Vink, B.Sc., Simon D. Robinson, M.D., Stefan Söderberg, M.D., Ph.D., Nicholas A. Boon, M.D., Ken Donaldson, Ph.D., Thomas Sandström, M.D., Ph.D., Anders Blomberg, M.D., Ph.D., and David E. Newby, M.D., Ph.D.

Large increase in heart muscle stress when exercising with diesel pollution present



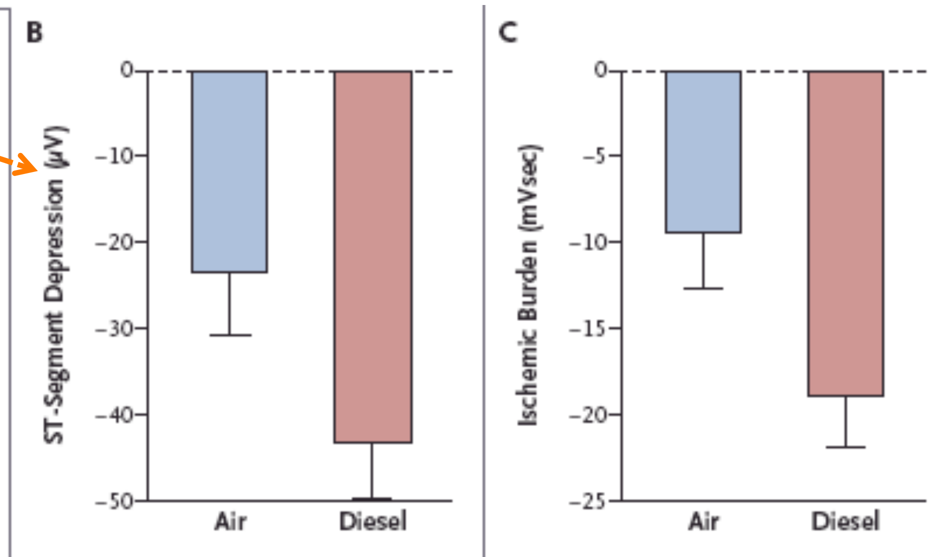


Figure 1. Myocardial Ischemia during 15-Minute Intervals of Exercise-Induced Stress and Exposure to Diesel Exhaust or Filtered Air in the 20 Subjects.

Panel A shows the average change in the heart rate and in the ST segment in lead II. Panel B shows the maximum ST-segment depression during inhalation of diesel exhaust as compared with filtered air (P=0.003), and Panel C shows the total ischemic burden during inhalation of diesel exhaust as compared with filtered air (P<0.001); the values in Panels B and C are averages of the values in leads II, V_2, and V_5. In all three panels, red indicates exposure to diesel exhaust, and blue exposure to filtered air. T bars denote standard errors, and mVsec millivolt seconds.

Exposure to particulate matter in traffic: A comparison of cyclists and car passengers

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A B S T R A C T

Emerging evidence suggests that short episodes of high exposure to air pollution occur while commuting. These events can result in potentially adverse health effects. We present a quantification of the exposure of car passengers and cyclists to particulate matter (PM). We have simultaneously measured concentrations (PNC, PM2.5 and PM10) and ventilatory parameters (minute ventilation (VE), breathing frequency and tidal volume) in three Belgian locations (Brussels, Louvain-la-Neuve and Mol) for 55 persons (38 male and 17 female). Subjects were first driven by car and then cycled along identical routes in a pairwise design. Concentrations and lung deposition of PNC and PM mass were compared between biking trips and car trips.

Mean bicycle/car ratios for PNC and PM are close to 1 and rarely significant. The size and magnitude of the differences in concentrations depend on the location which confirms similar inconsistencies reported in literature. On the other hand, the results from this study demonstrate that bicycle/car differences for inhaled quantities and lung deposited dose are large and consistent across locations. These differences are caused by increased VE in cyclists which significantly increases their exposure to traffic exhaust. The VE while riding a bicycle is 4.3 times higher compared to car passengers. This aspect has been ignored or severely underestimated in previous studies. Integrated health risk evaluations of transport modes or cycling policies should therefore use exposure estimates rather than concentrations.

Large increase in effective biological dose compared with others in same corridor when bicycling

Table 3
Average respiratory parameters. Values are mean (SD).

	# of Test persons	Breathing frequency (breaths min^{-1})	Tidal volume per breath (L)	Minute ventilation (VE) (L min^{-1})	Heart rate (beats min^{-1})	Total inhaled volume during trip (L)
Bike	Male N = 21	27.9 (4.2)	2.2 (0.4)	59.1 (13.7)	129.6 (12.8)	924.8 (182.3)
	Female N = 10	32.7 (7.0)	1.4 (0.3)	46.2 (10.6)	140.0 (13.6)	801.4 (98.2)
Car	Male N = 8	18.3 (3.0)	0.8 (0.2)	13.4 (1.7)	71.9 (9.7)	176.8 (55.8)
	Female N = 1	21.3 (4.8)	0.6 (0.1)	11.3 (1.8)	74.8 (9.0)	153.4 (62.7)
Bike/car ratio	Male N = 9	1.6 (0.3)	2.8 (0.6)	4.5 (1.1)	1.8 (0.2)	5.8 (2.3)
	Female N = 6	1.6 (0.2)	2.6 (0.4)	4.1 (0.6)	1.9 (0.3)	5.9 (2.0)


Who can we afford to throw in the dumpster?
No one! Thank you

Work remains to refine and flesh out the engineering / design elements that will become our primary focus.

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All of the following are engineering tactics:

- Residential and school HEPA filtration and other protective building systems
  - 90 to 95% reductions possible, maybe 80% after human behavior included
- Air intake locations could be chosen more carefully
  - Good idea but no quantification in literature
- Sound proofing through extra window glazing, insulation and other features
  - Large reductions possible as seen in FAA noise proofing

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All of the following are design tactics with potentially strong co-benefits:

- Land use buffers ala California ARB Handbook – distance between sources and receptors
  - 50% or greater exposure reductions from 500 foot buffers for sensitive uses (guess)
- Vegetation or built wall barriers to absorb or block pollution
  - 10 to 25% reductions possible, especially with height, but geometric trade-offs are complex
- Streets trees, hedges and pleasant vegetation
  - -25 to +25% increases / reductions but also heat island and green space co-benefits
- Decking over of highways to link urban areas and block pollution
  - 20 to 50% reductions (est.) of long term urban design as in Back Bay, Freeway Park, etc.
- Urban design such as healthy placement of buildings and open space
  - 10 to 25% reductions (est.) but not much literature, site planning used by San Francisco
- Garden locations, including healthy vegetables
  - Small but strong literature, including from mainland China, about near highway toxins
- Park locations for active recreation and for susceptible people
  - Important due to human ventilation, susceptible populations – children, seniors, co-benefits
- Active travel locations, including bicycling and walking paths
  - Important because of human ventilation rates which yield high effective biological doses