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# ***Costs of Sprawl and Auto Dependence***

## ***Benefits of Compact Development, Transit, and Walking***

***Indianapolis MPO Speaker Series  
June 28, 2007***

***Reid Ewing  
National Center for Smart Growth  
University of Maryland***

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***This is not a “benefits of transit” talk***

***What counts are outcomes, not modes***

***Transportation and land use are  
inseparable***

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***Automobile Dominance and Urban Sprawl Aren't Sustainable***

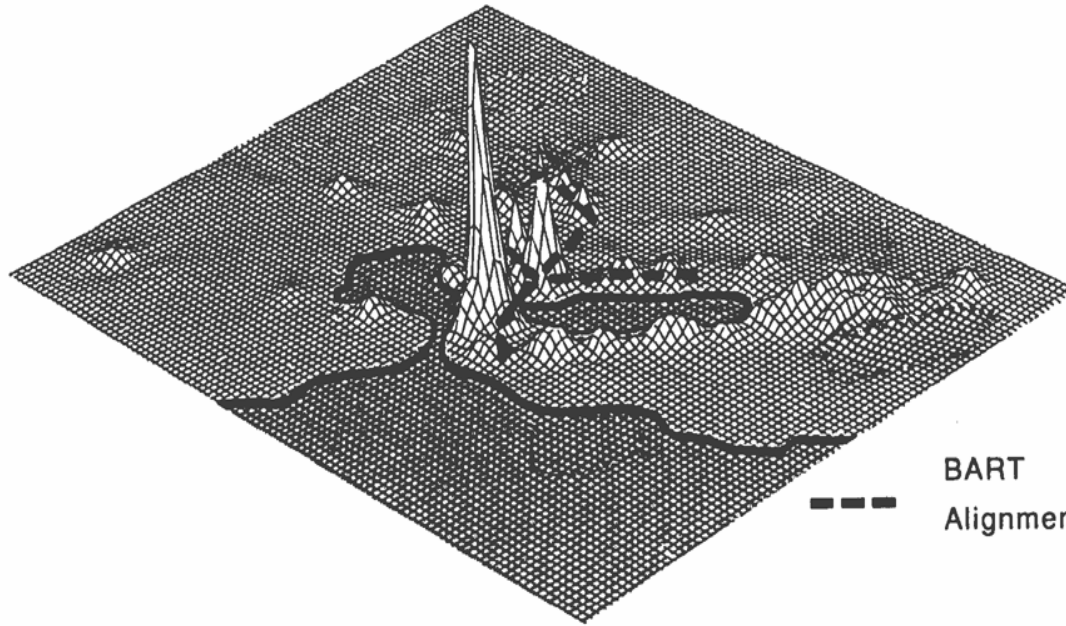
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***All the Negatives of the Automobile Are  
Positives for Transit***

***Two Special Qualities of Transit***

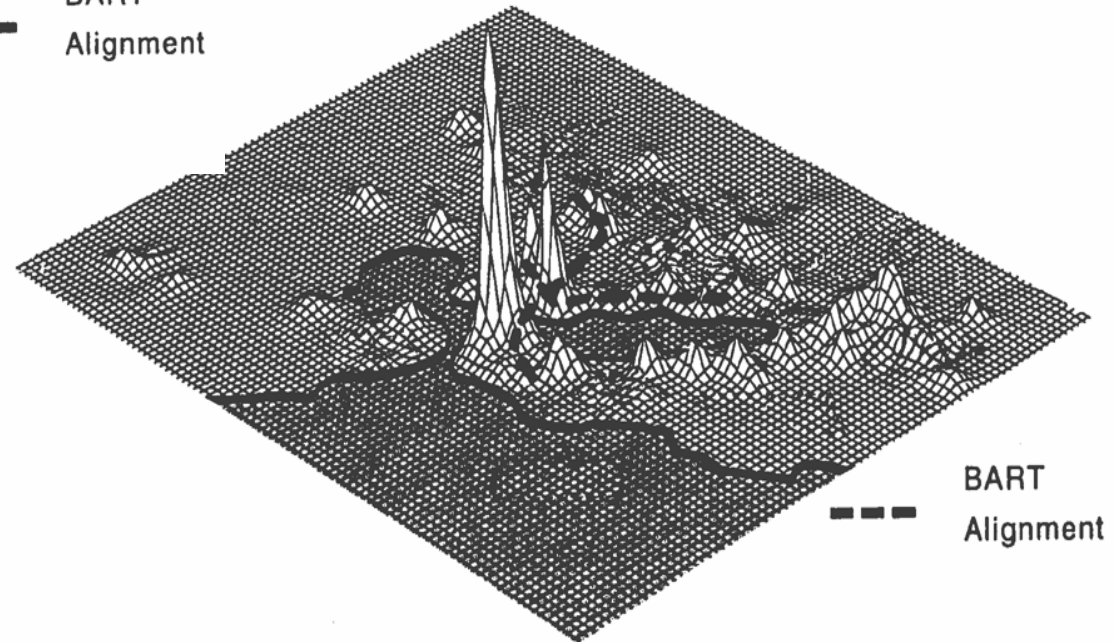
# Ability to Shape Urban Form

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**1980**

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BART  
Alignment

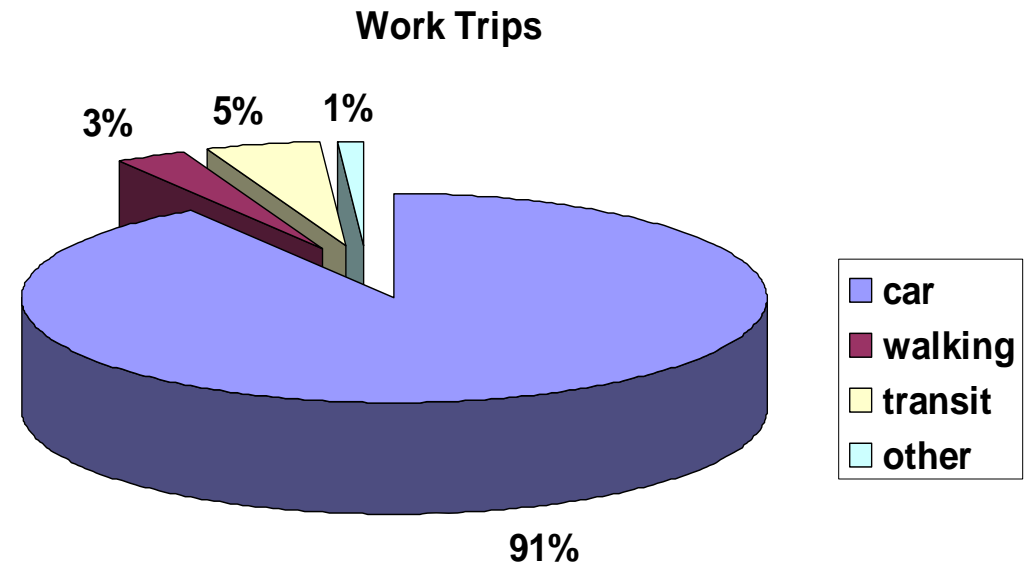
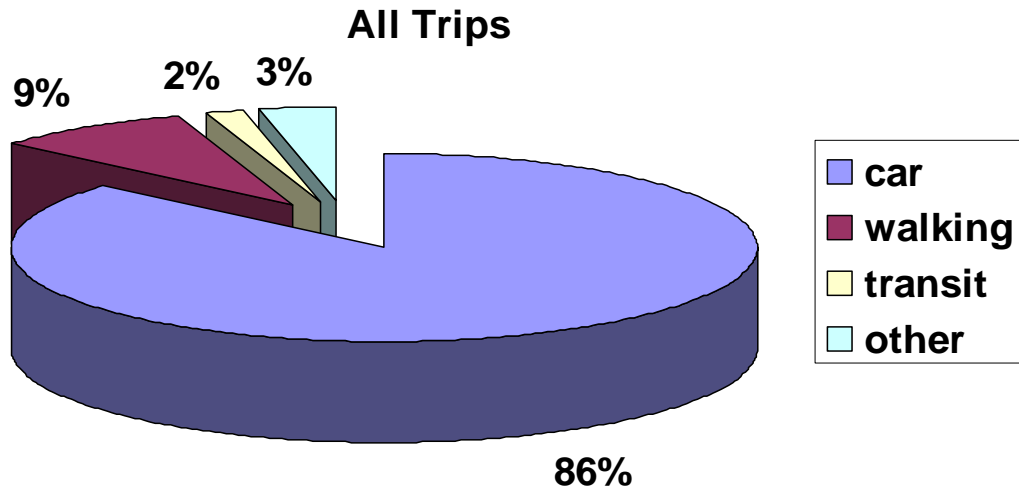


**1990**

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BART  
Alignment

# Ability to Serve Work Trips

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# ***“All Great Cities Have Rail Systems”***

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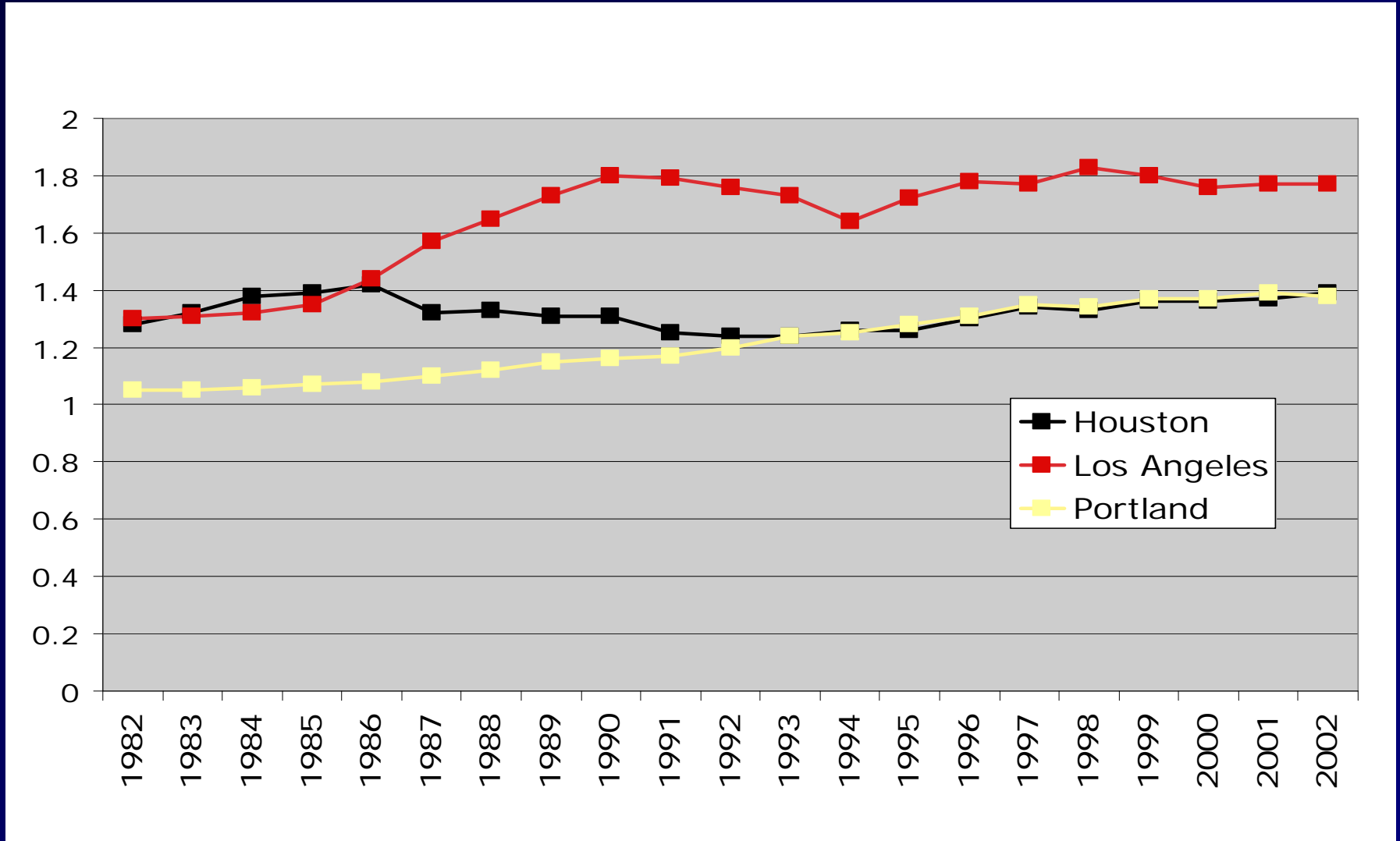
# *Portland vs. Houston*

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# 85 Out of 85



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# *Defining Urban Sprawl*

# ***Scattered Development***

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# ***Segregated Uses***

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# Strips

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# ***Sparse Network***

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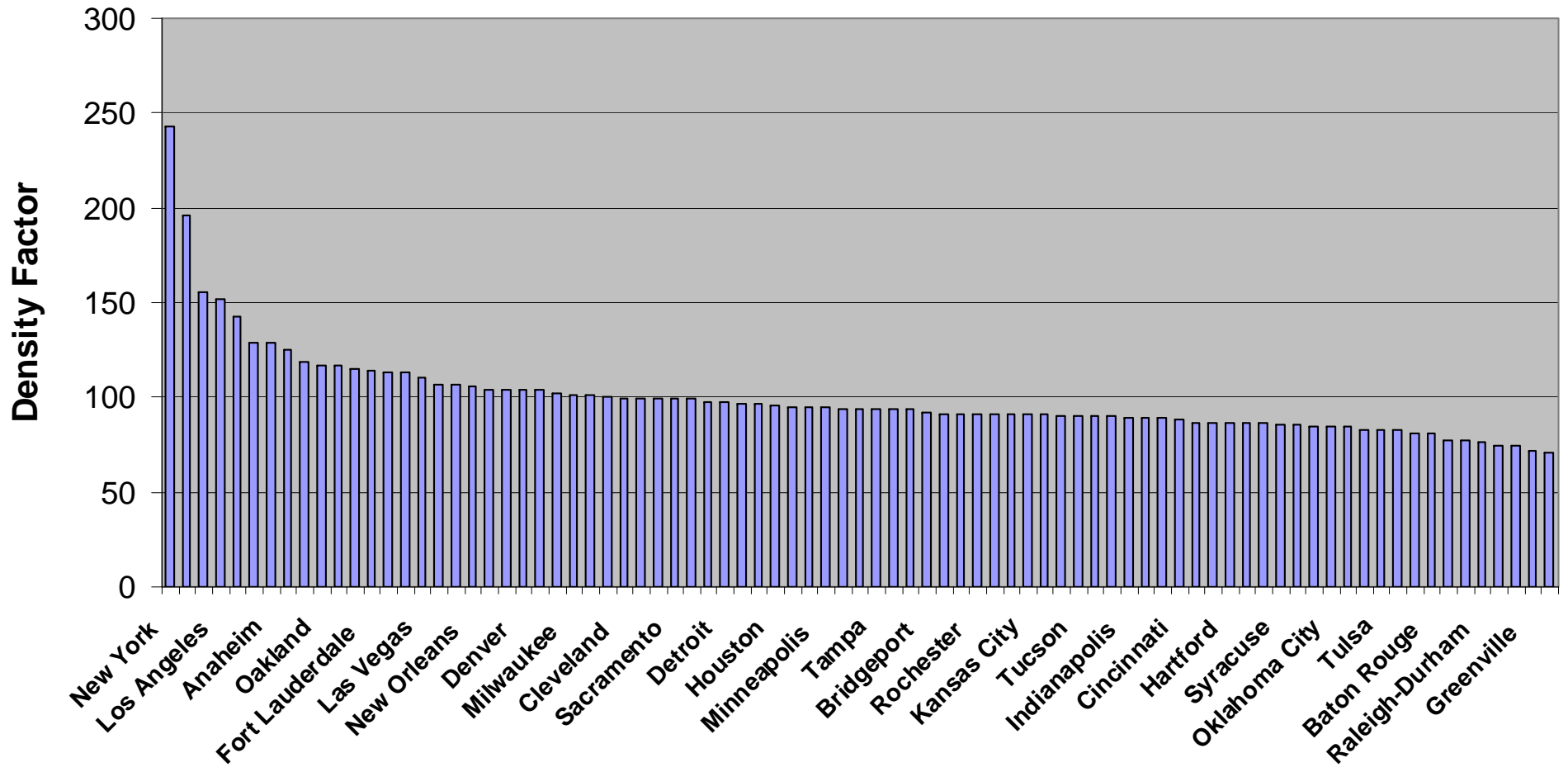


# ***Broad Conception of Sprawl***

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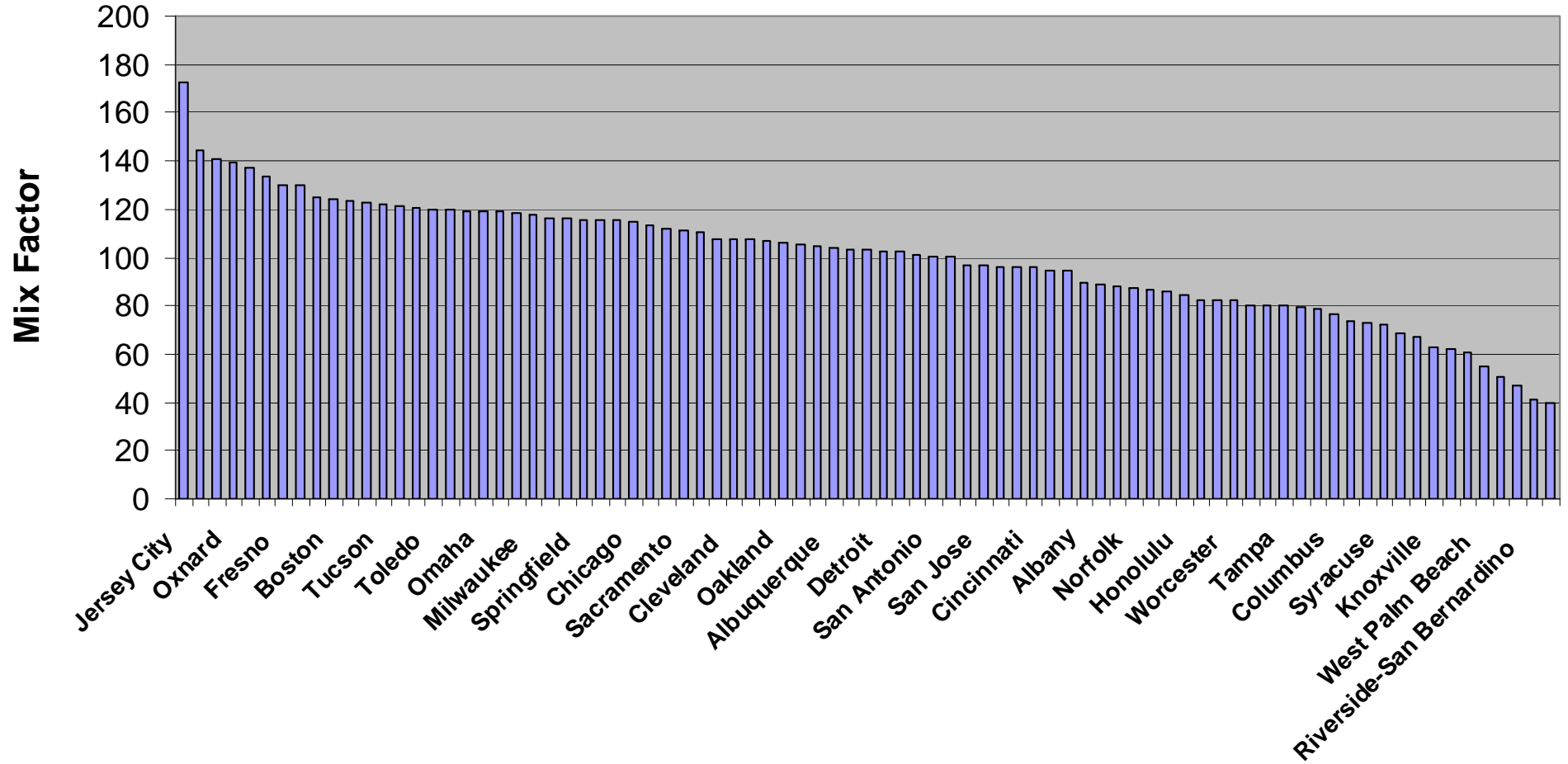
- ***Low Density***
- ***Segregation of Uses***
- ***Lack of Strong Centers***
- ***Sparse Street Network***

# Density Factor Scores – Indianapolis is 58th

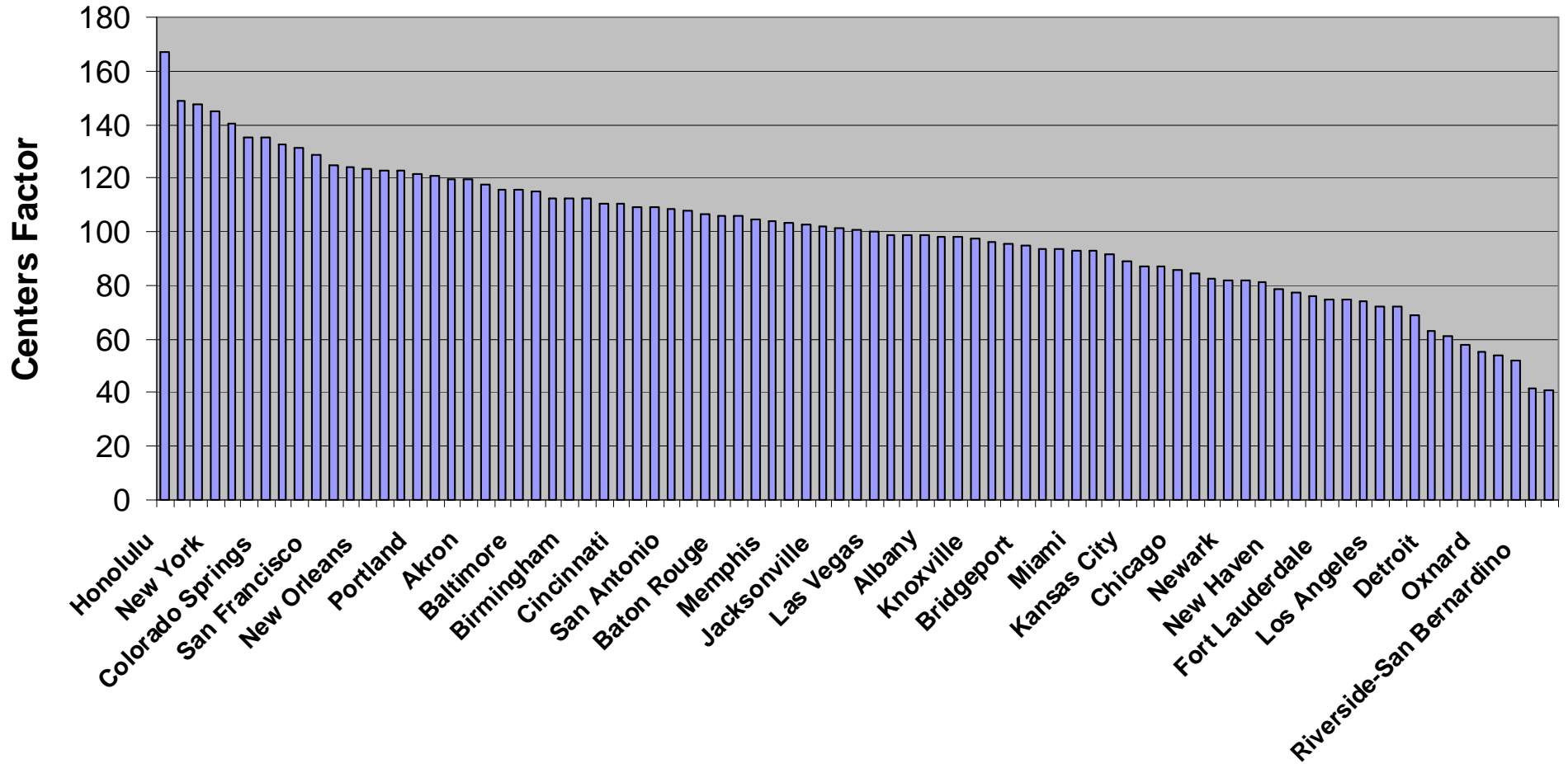




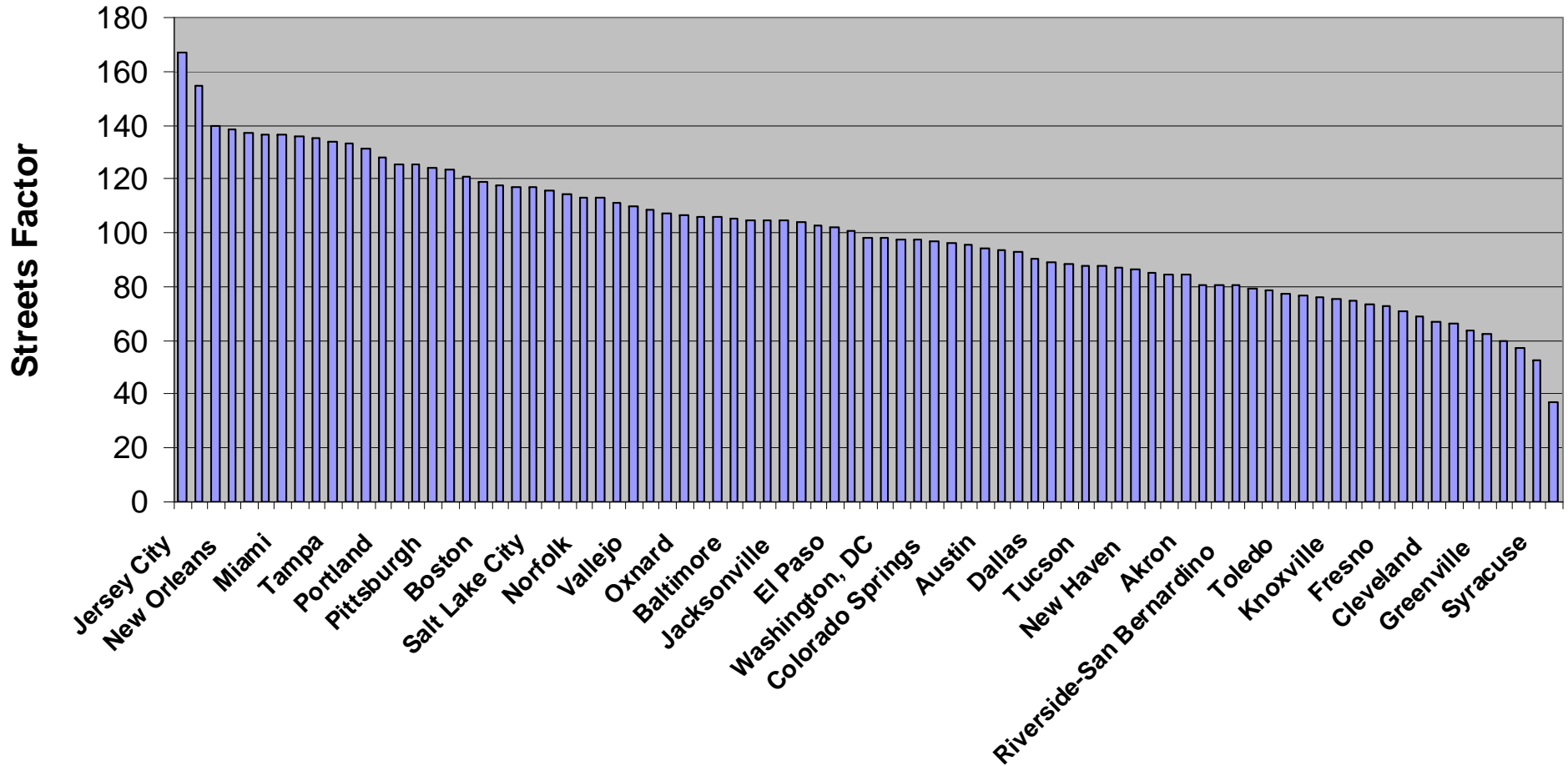
# Mix Factor Scores – 50<sup>th</sup>



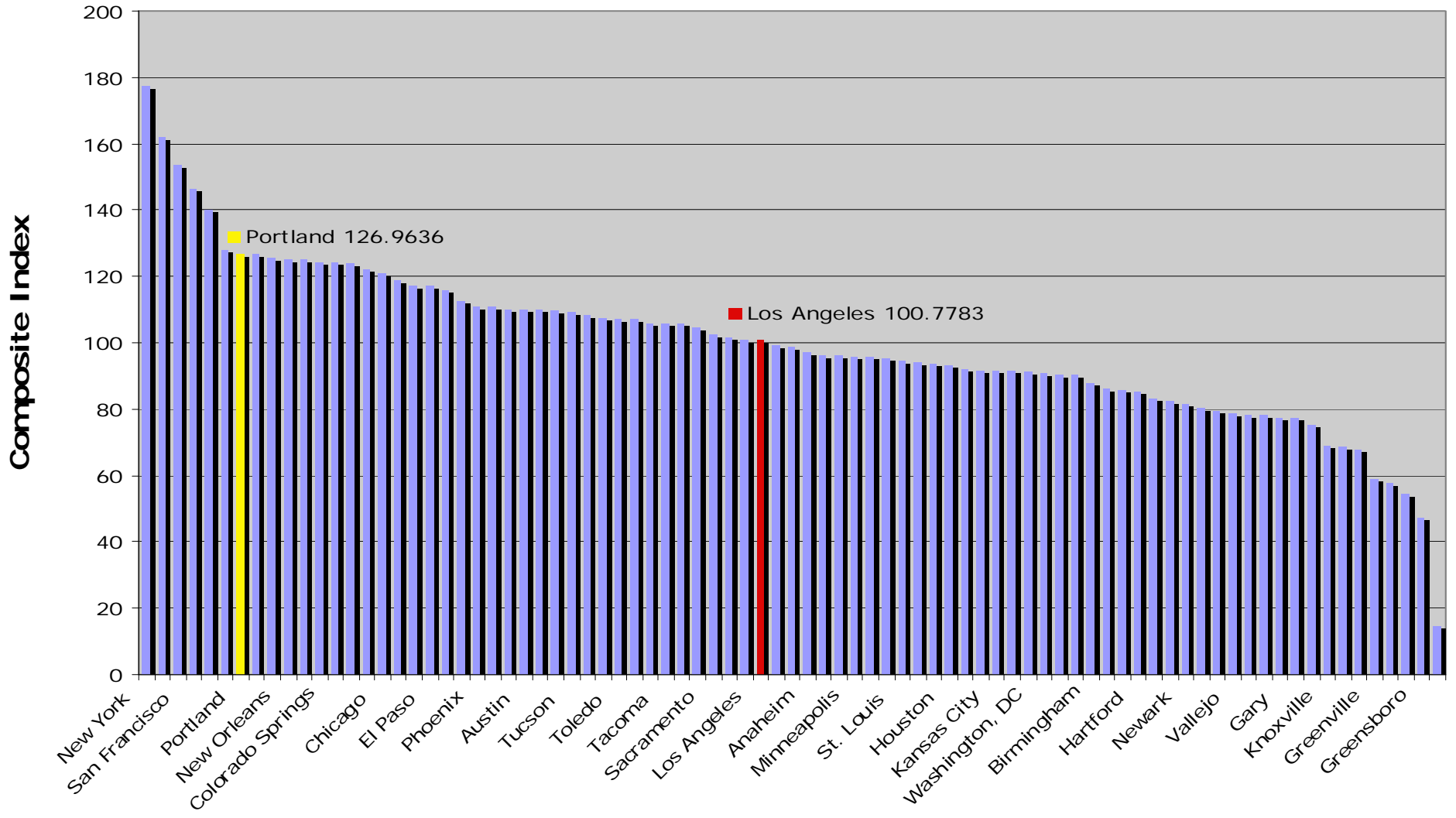
# Centers Factor Scores – 39th



# Streets Factor Scores – 60th



# Overall – 51<sup>st</sup> in Compactness



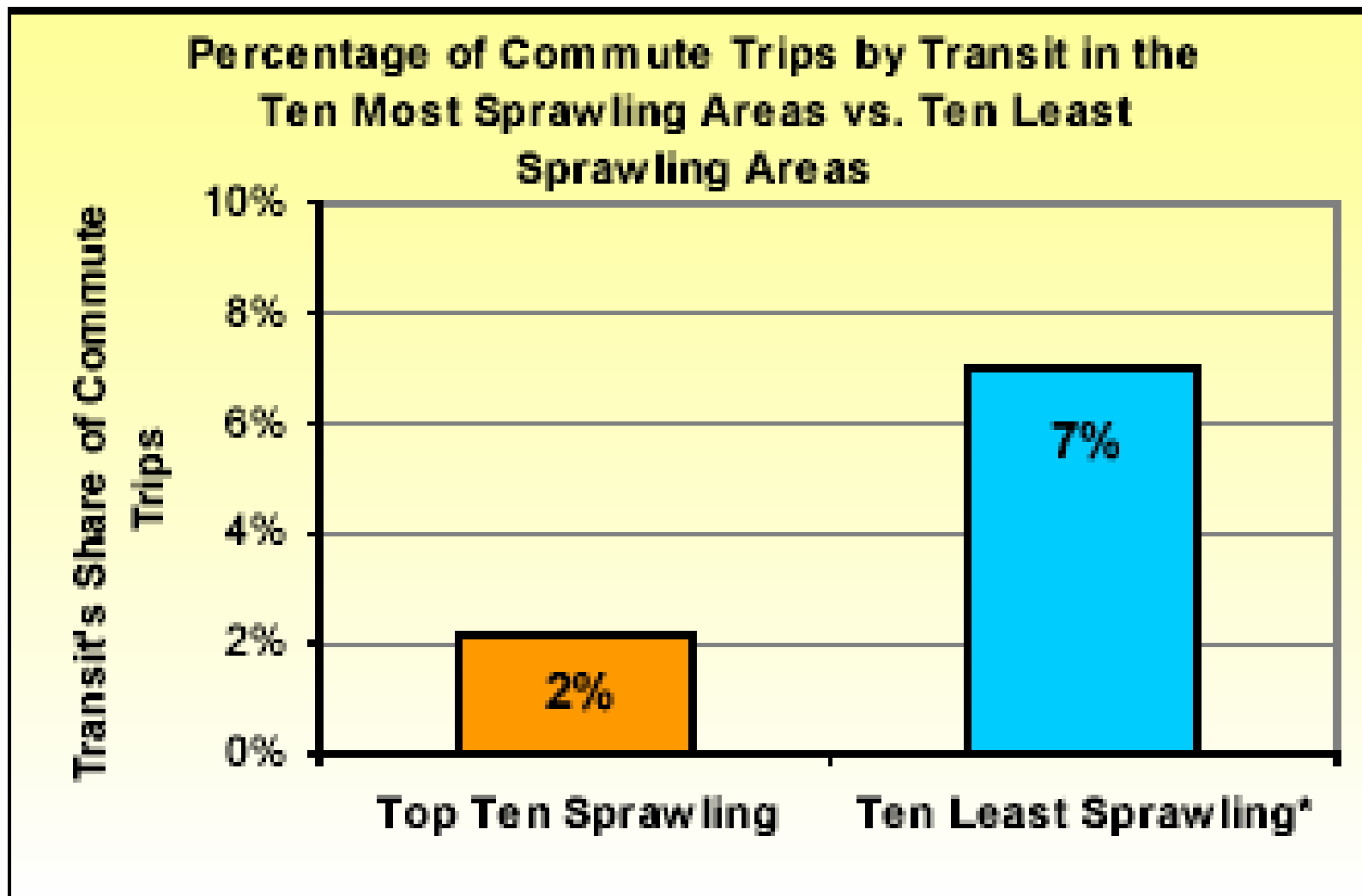
# ***“Cost of Sprawl Revisited”***

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- ***More Vehicle Miles Traveled***
- ***Higher Infrastructure Costs***
- ***Less Cost-Effective Transit***
- ***Loss of Agriculture Lands***
- ***Loss of Environmental Lands***
- ***Higher Energy Consumption***
- ***Greater City Fiscal Distress***
- ***Greater Inner City Deterioration***

## ***Less than 1/3 the Transit Use***

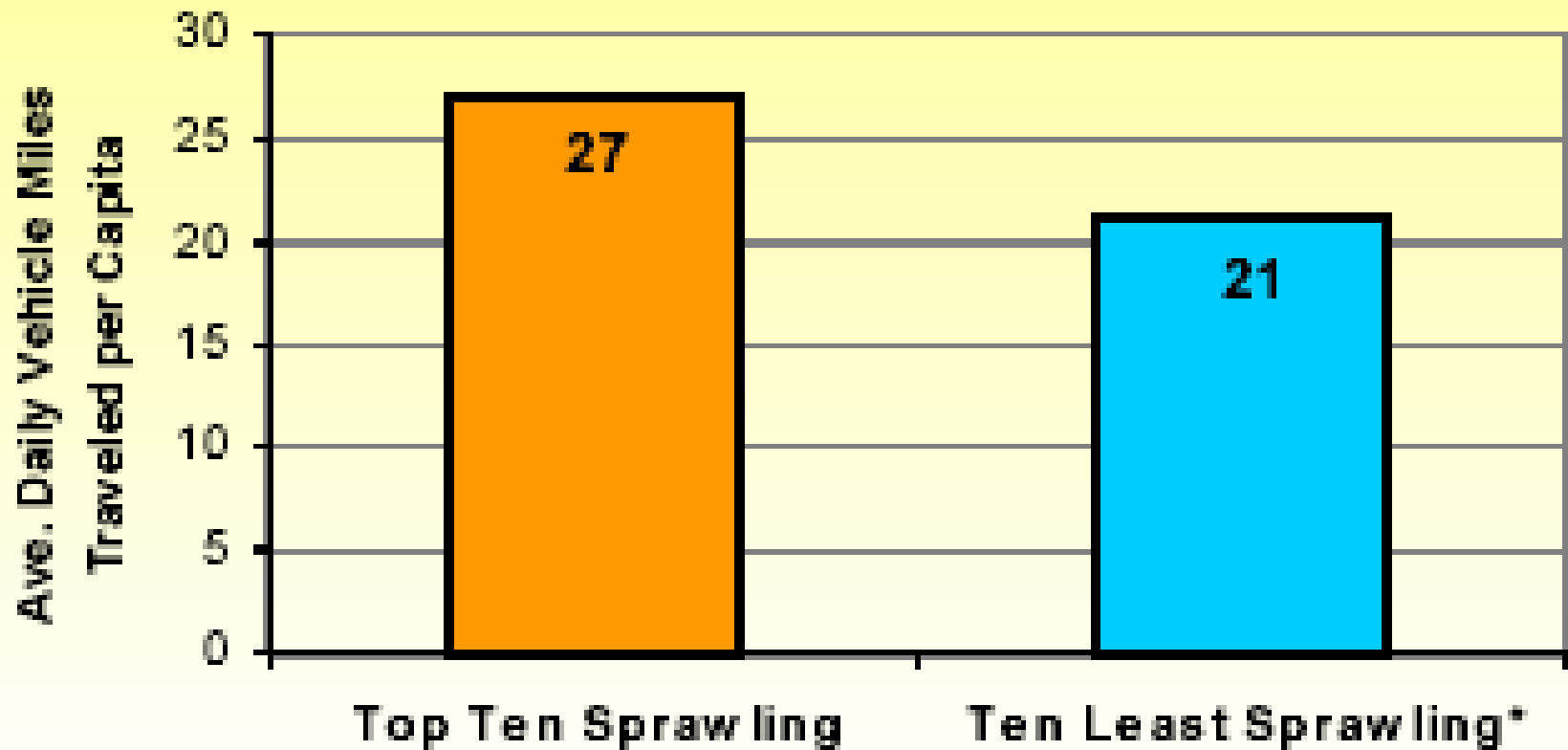
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## 25% More VMT

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Vehicle Miles Traveled per Capita in the Ten Most Sprawling Areas vs. Ten Least Sprawling Areas



# ***Additional Costs in Public Health***

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## ***Traffic Safety***

- ***Air Pollution and Climate Change***
- ***Obesity and Chronic Diseases***



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# ***Traffic Safety***

# ***Traffic Safety Worldwide***

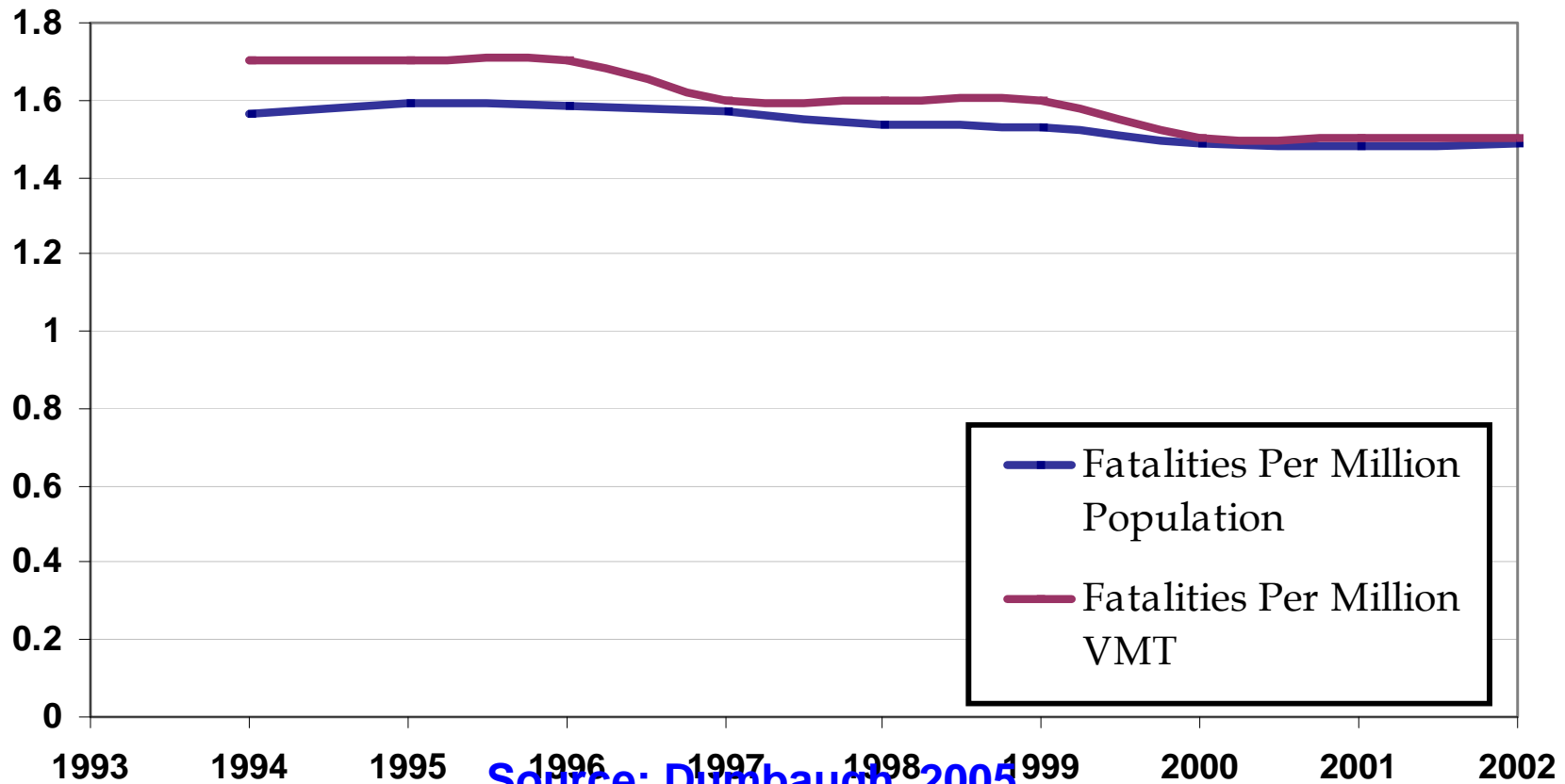
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- ***Worldwide, more than 1 million people are killed in traffic crashes each year.***
- ***Up to 50 million more are injured.***
- ***More than half are pedestrians.***
- ***Traffic injuries and fatalities are projected to increase by 65% by 2020.***

***- Source: World Health Organization, 2004***

# Traffic Safety in the United States

## Fatality Rates for U.S. Roadways



Source: Dumbaugh, 2005

# Peer Comparisons

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*Currently, we rank  
behind all other  
developed  
countries*

Road Traffic Fatalities (2000)	
Country or Area	Per 100,000 Inhabitants
Australia	9.5
European Union*	11
Great Britain	5.9
Japan	8.2
Netherlands	6.8
Sweden	6.7
<b>United States</b>	<b>15.2</b>
Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom	

Source: World Health Organization

# *Mean Streets 2000*

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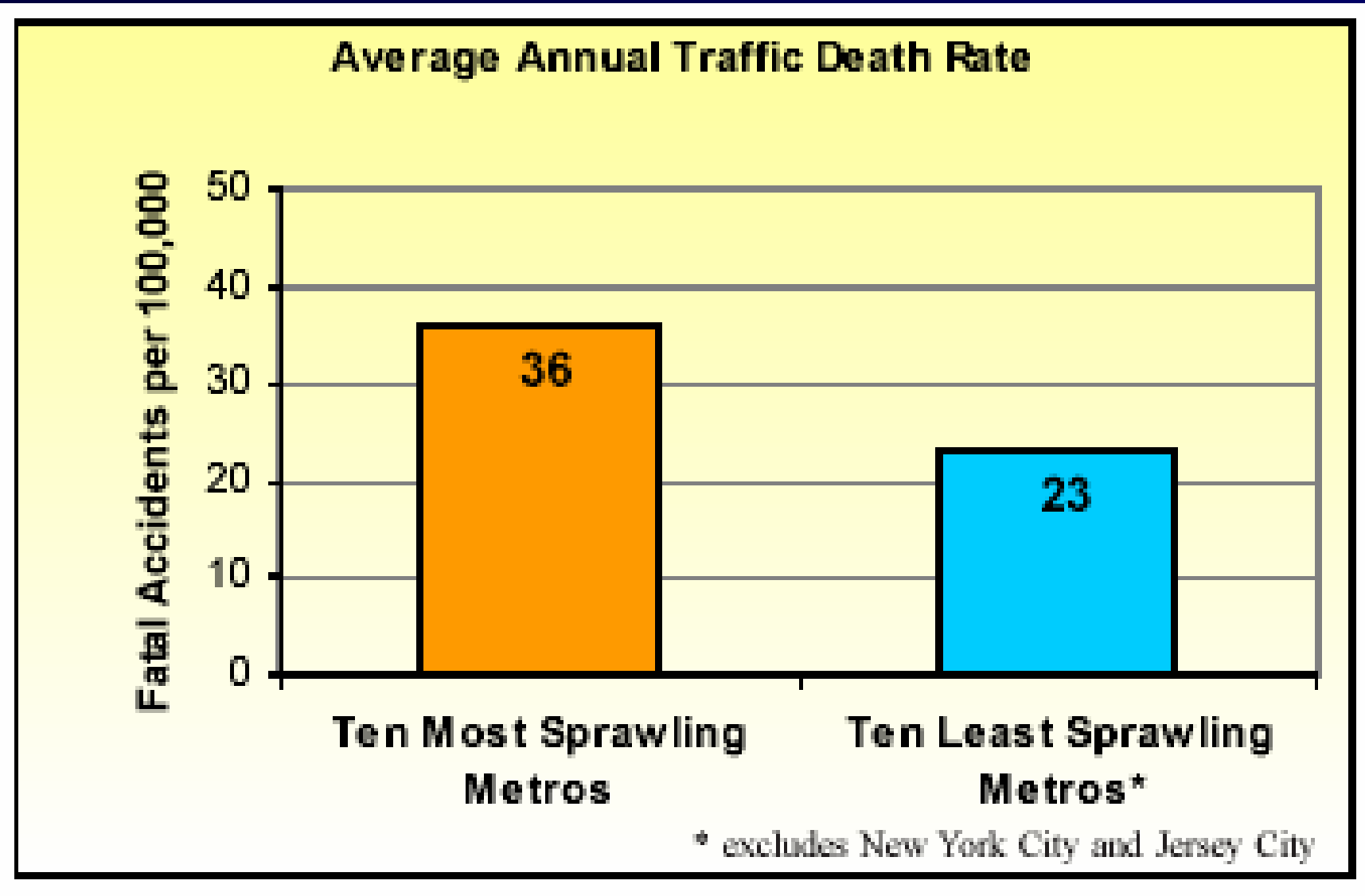
# ***Most Dangerous Metro Areas for Walking***

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<b>Rank</b>	<b>Metro Area</b>	<b>Total Pedestrian Deaths (1997-1998)</b>	<b>Percentage of Commuters Walking to Work</b>	<b>1997-1998 Pedestrian Danger Index</b>
1	Tampa, FL	192	2.27%	91
2	Atlanta, GA	185	1.45%	83
3	Miami-Fort Lauderdale, FL	274	2.25%	81
4	Orlando, FL	139	3.46%	65
5	Jacksonville, FL	71	2.57%	64
6	Phoenix, AZ	190	2.65%	60
7	West Palm Beach, FL	49	1.99%	58
8	Memphis, TN-AR-MS	70	2.96%	52
9	Dallas-Fort Worth, TX	192	1.86%	52
10	New Orleans, LA	88	3.09%	52

# 36% Lower Fatality Rate with Compact Development

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# Urban Sprawl as a Risk Factor in Motor Vehicle Fatalities

## RESEARCH AND PRACTICE

### Urban Sprawl as a Risk Factor in Motor Vehicle Occupant and Pedestrian Fatalities

Reed Ewing, PhD, Richard A. Schwab, MD, MPH, and Charles V. Zegans, MS

Motor vehicle traffic deaths remain the leading cause of death among Americans aged between 1 and 34 years. In 2001, traffic crashes accounted for about 38,000 deaths, of which an estimated 4700 were pedestrians.<sup>1</sup> Although only about 5% of all trips are made on foot,<sup>2</sup> pedestrian fatalities make up about 12% of all traffic deaths, making walking one of the most dangerous modes of travel.<sup>3</sup>

Urban sprawl is suspected to be a major contributing cause of automobile and pedestrian traffic fatalities, but data supporting this suspicion are sparse.<sup>4-6</sup> Although "sprawl" has been variously defined, we consider the term to apply to any environment characterized by the following: a population widely dispersed in low-density residential development; rigid separation of homes, shops, and workplaces; a lack of distinct, thriving activity centers, such as strong downtown or suburban town centers; and a network of roads marked by very large block size and poor access from one place to another.<sup>7</sup> One research group recently found that the most dangerous places to walk were sprawling metropolitan areas in the South and West, especially Orlando, Tampa-St. Petersburg-Clearwater, West Palm Beach-Boca Raton, Memphis, Miami-Ft. Lauderdale, Jacksonville, Houston, Phoenix-Mesa, Dallas-Ft. Worth, and Nashville.<sup>8</sup> However, because sprawl was not measured explicitly, the possible association between sprawl and traffic fatalities could not be tested.

Previous studies modeled pedestrian crashes along roadway segments. The number of pedestrian-motor vehicle collisions has been shown to vary directly with pedestrian volume and traffic volume.<sup>9-12</sup> Suburban and outlying intersections have been significantly overrepresented in pedestrian crashes compared with more urban areas, after control for exposure and other location factors. The hypothesis that suburban roadways are particu-

larly dangerous for pedestrians deserves to be tested at the macrolevel for a greater diversity of settings.

We recently measured urban sprawl at the level of the metropolitan area, using the 4 sprawl indicators just described to create a sprawl index.<sup>6</sup> In this study, the sprawl index was strongly associated with the overall traffic fatality rate, as well as with an array of transportation outcomes (eg, percentage of residents walking or taking transit to work, average vehicle ownership, vehicle miles traveled per capita) and environmental outcomes (eg, ground-level ozone levels).

In another recent study, we measured urban sprawl at the county level, using fewer variables than were available at the metropolitan level, and related county sprawl to leisure time physical activity, obesity, and certain chronic health problems associated with physical inactivity and obesity.<sup>10</sup> After we controlled for individual covariates such as gender, age, race/ethnicity, and education, sprawl proved to be significantly related to leisure time walking, obesity, and hypertension but not to overall physical activity, diabetes, or coronary heart disease.

The current study is a cross between the earlier 2 studies. It related sprawl to traffic fatalities as in the first study but also measured sprawl at the county level as in the second study. Large metropolitan areas usually in-

clude several counties, each with differing development patterns. The finer geographic scale in this study might be expected to increase the explanatory power of resulting sprawl measures relative to the earlier metropolitan-level traffic fatality study.

**Methods.** We created a sprawl index by applying principal components analysis to data for 448 US counties in the largest 101 metropolitan areas. Regression analysis was used to determine associations between the index and traffic fatalities.

**Results.** For every 1% increase in the index (i.e., more compact, less sprawl), of-road traffic fatality rates fell by 1.49% ( $P < .001$ ) and pedestrian fatality rates fell by 1.47%, or 3.50%, after adjustment for pedestrian exposure ( $P < .001$ ).

**Conclusions.** Urban sprawl was directly related to traffic fatalities and pedestrian fatalities. Subsequent studies should investigate relationships at a finer geographic scale and should strive to improve on the measure of exposure used to adjust pedestrian fatality rates. (Am J Public Health. 2003;93:1541-1545)

## METHODS

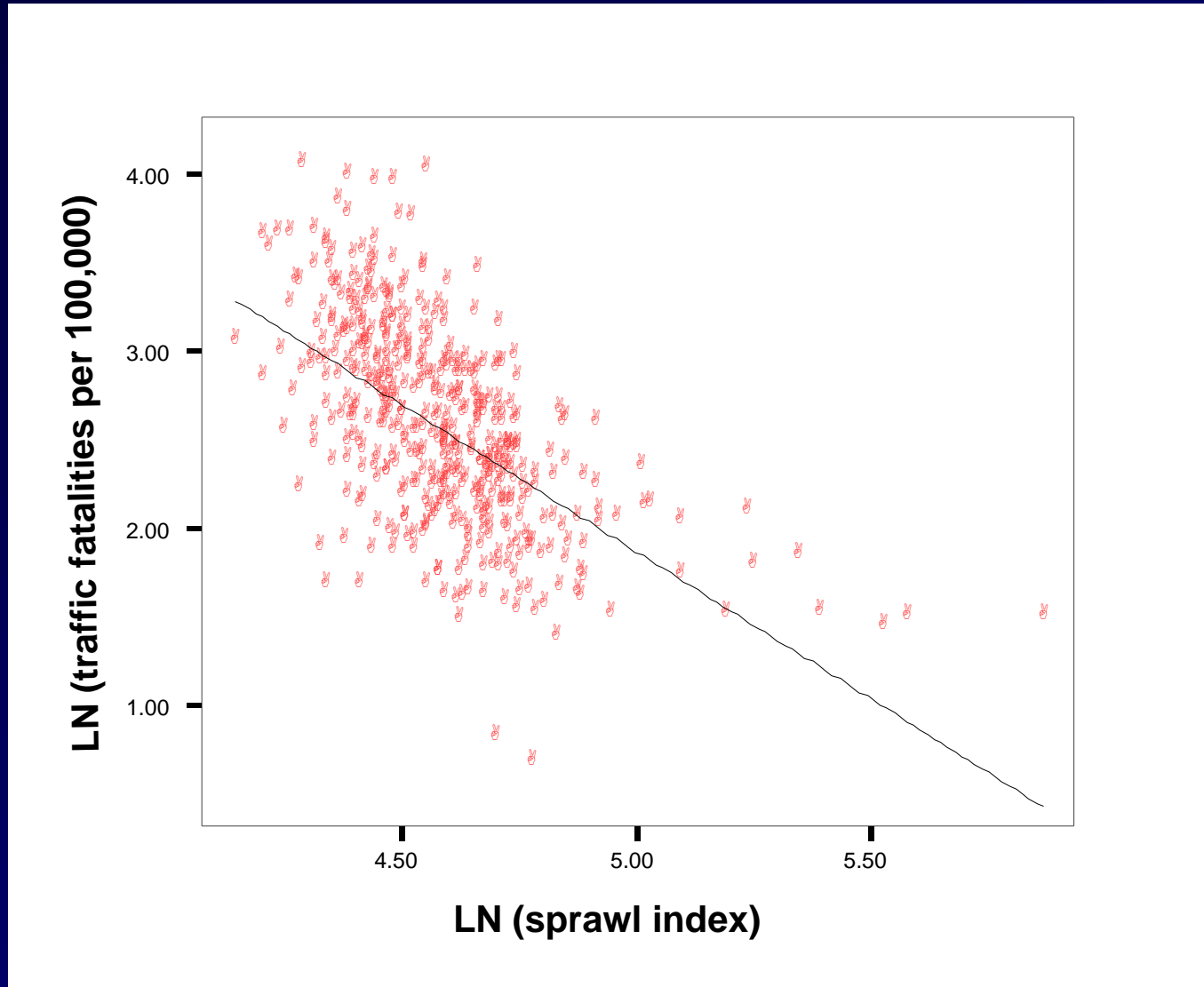
The sample in this study consisted of 448 metropolitan counties or statistically equivalent entities (e.g., independent towns and cities) according to the 1990 census, the latest year for which metropolitan boundaries were defined at the time our study began. These counties made up the 101 most populous metropolitan statistical areas, consolidated metropolitan statistical areas, and New England county metropolitan areas in the United States. Nonmetropolitan counties and metropolitan counties in smaller metropolitan areas were excluded from the sample. More than 183 million Americans—nearly two thirds of the United States population—lived in these 448 counties in 2000.<sup>11</sup>

Although sprawl has the 4 characteristics noted earlier, only 2 have been measured at the county level—low residential density and poor street accessibility. A county-based sprawl index was constructed as the main independent variable. It was composed of 6 observed variables: 4 related to residential dev-

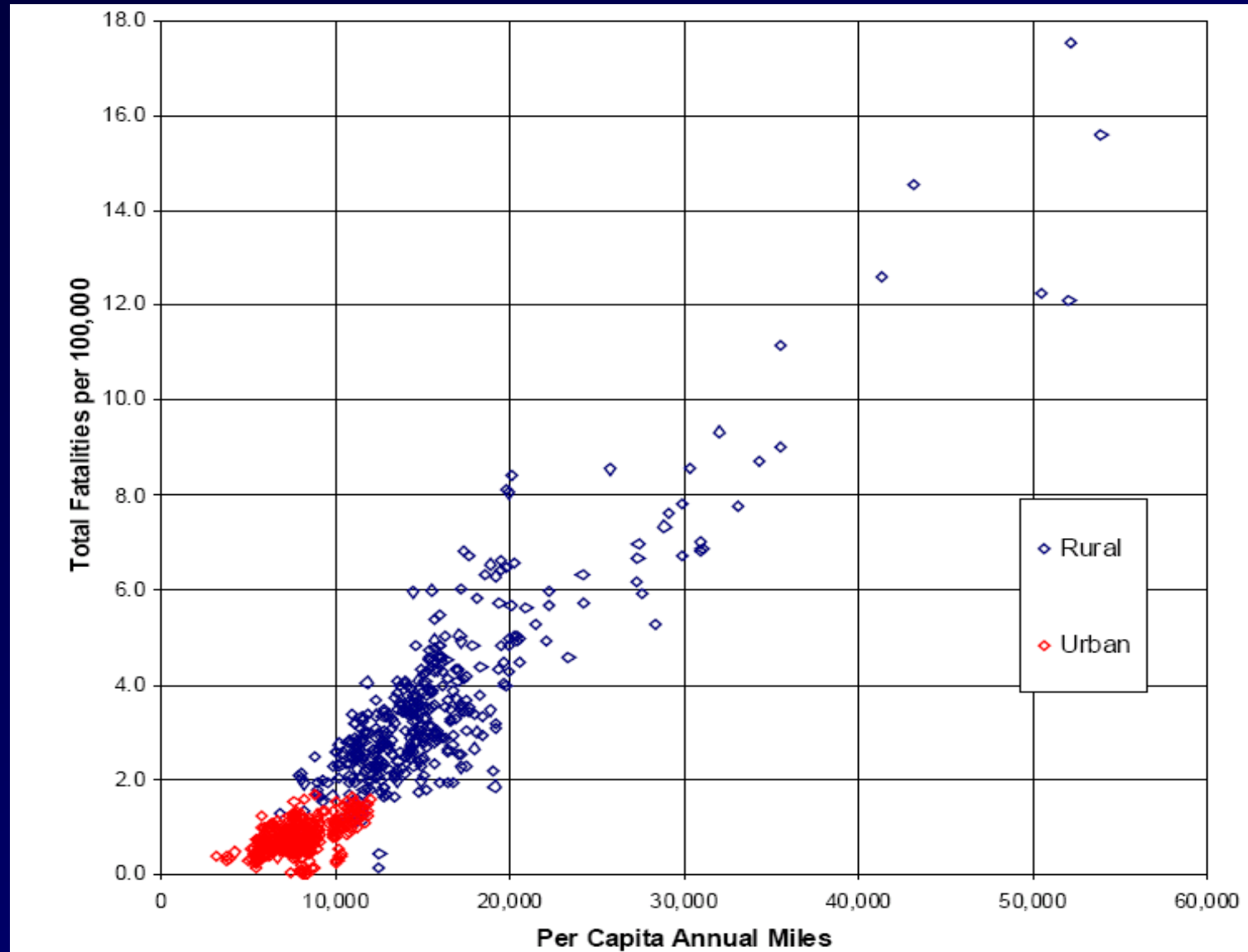


# Traffic Fatality Rate vs. Sprawl

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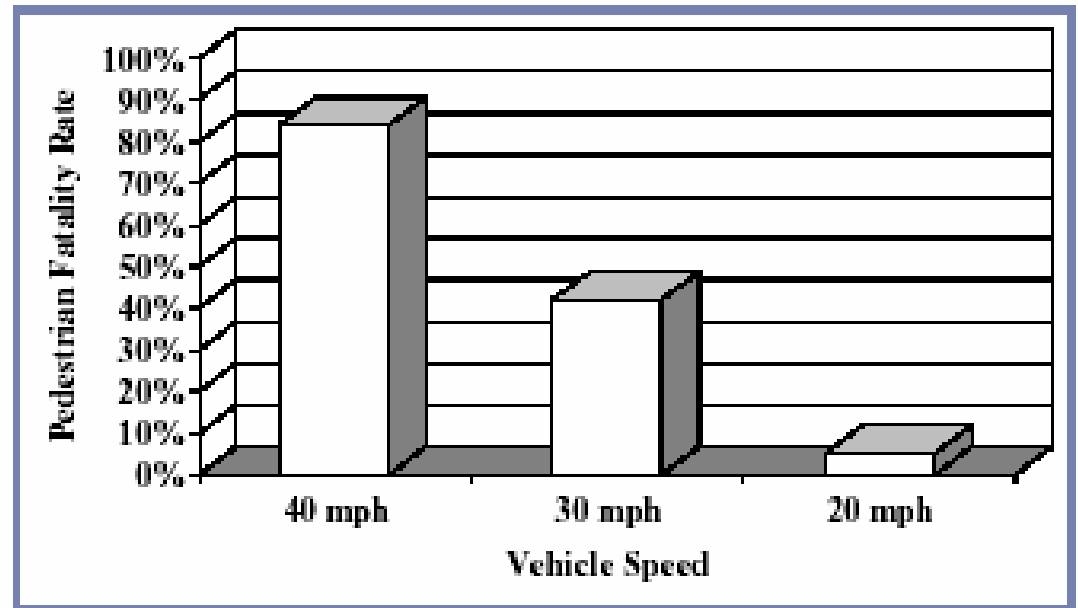
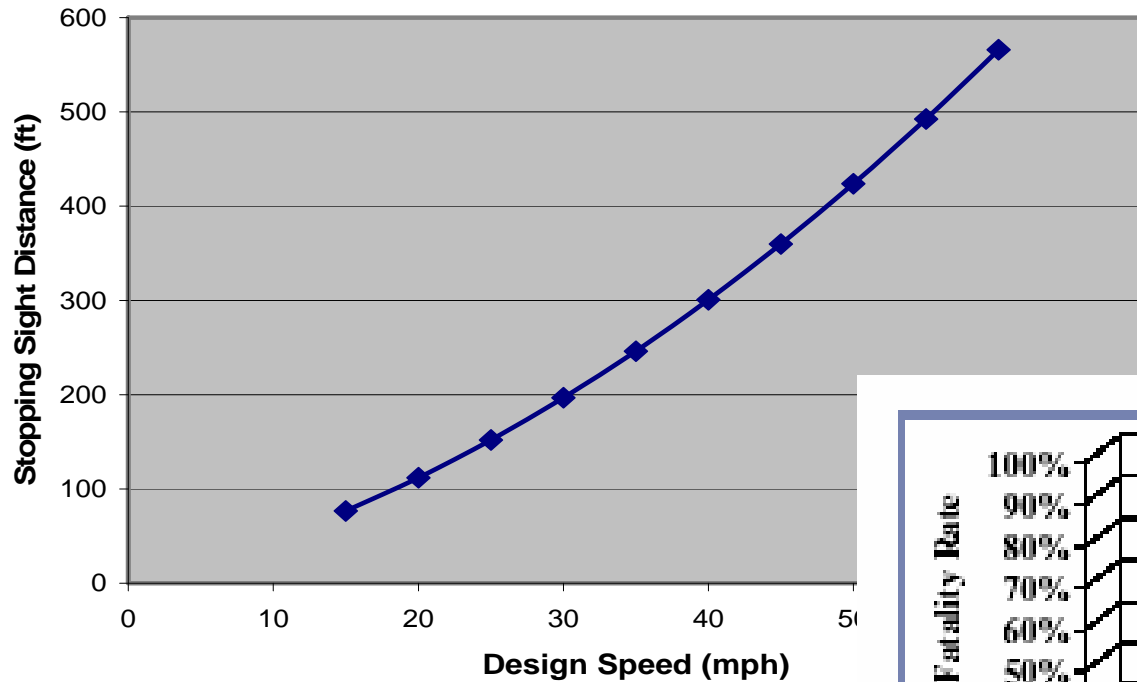


# Mostly Exposure



# Speed Accounts for Difference

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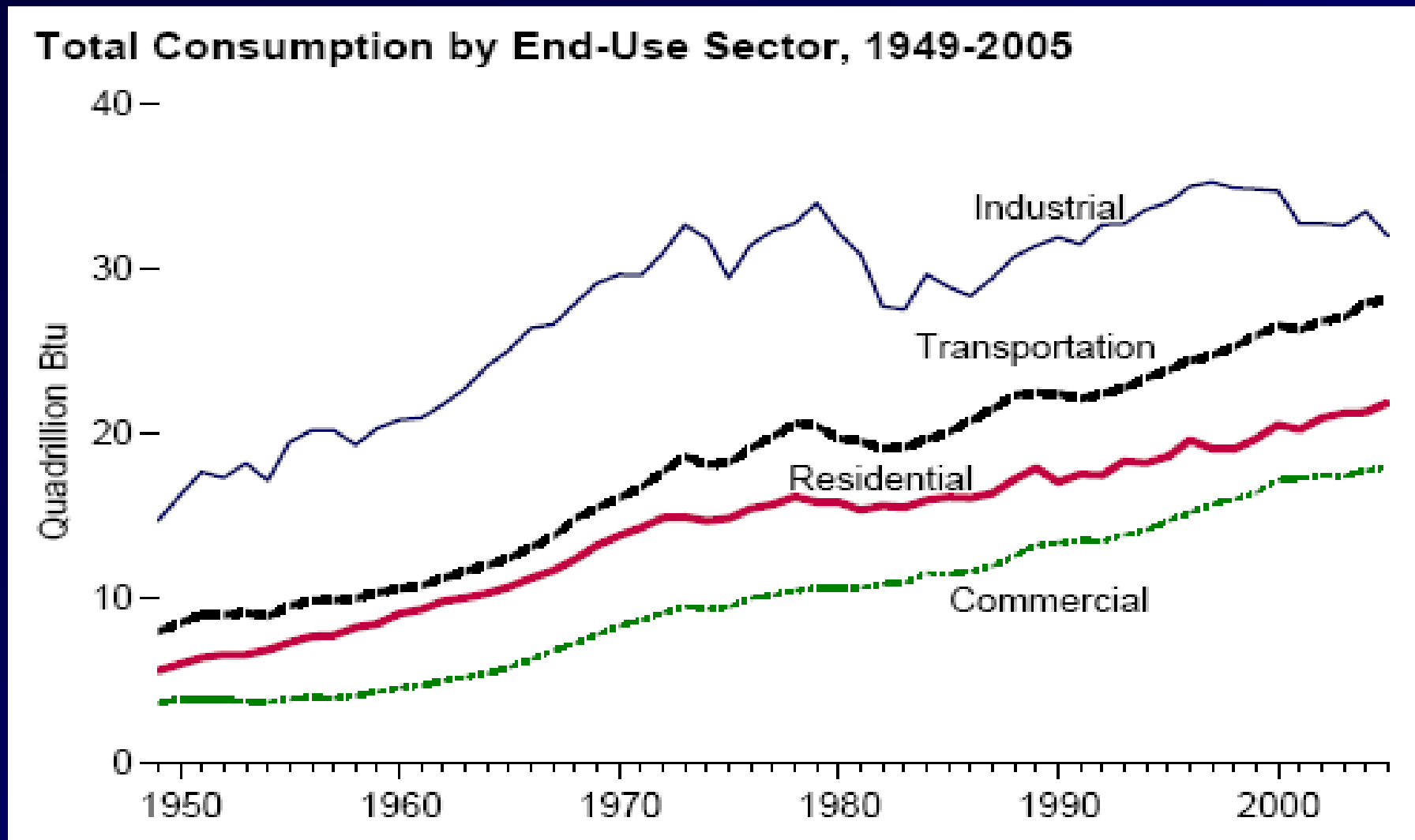
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# ***Air Pollution and Climate Change***

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# *Pew Survey*

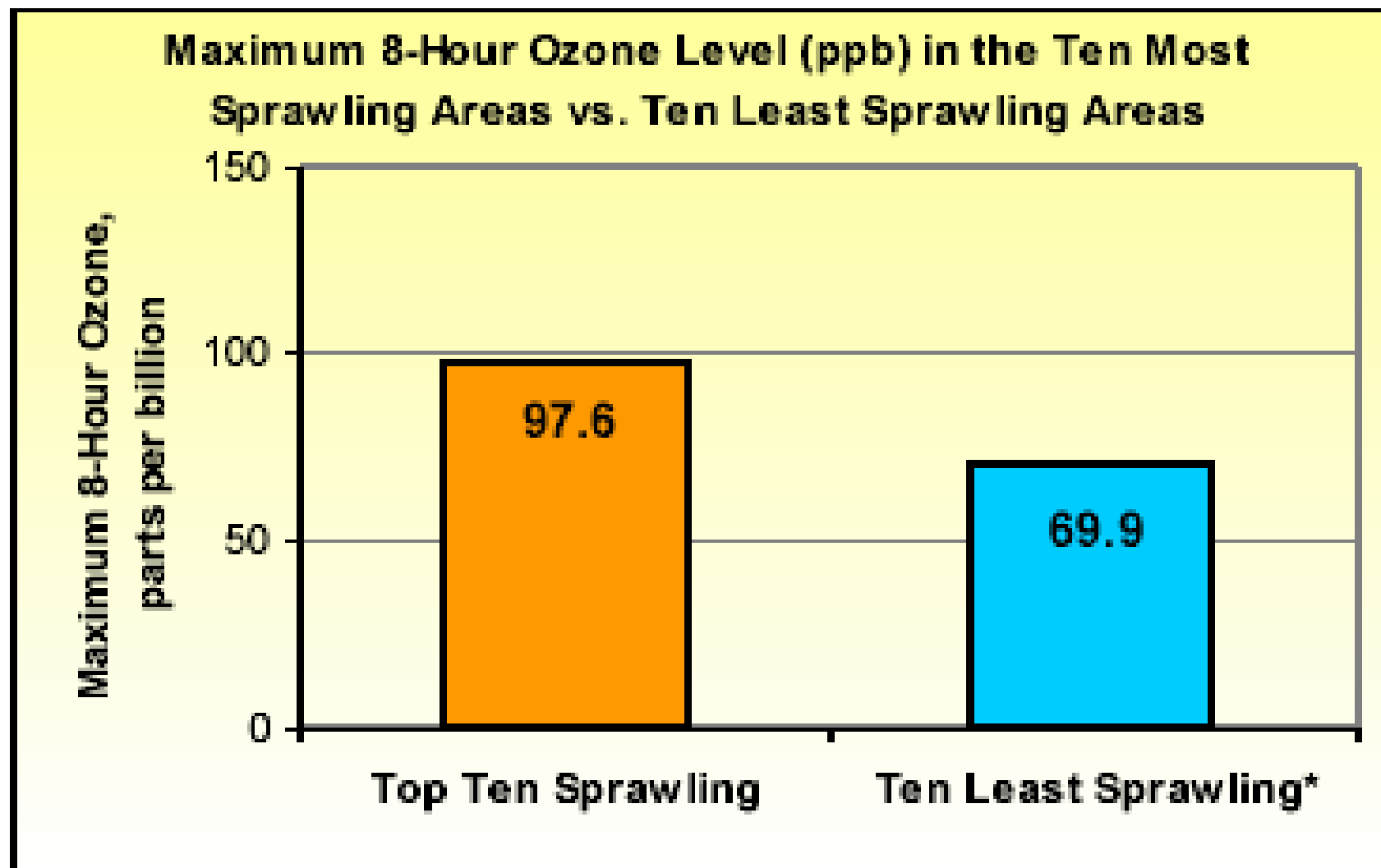
# Trends in Energy Use by Sector



## ***Contribution of Cars and Trucks to U.S. Air Pollution***

<b>Pollutant</b>	<b>Contribution of Cars and Trucks<sup>1</sup></b>
Carbon Monoxide (CO)	77%
Sulfur Oxides (SO <sub>x</sub> )	7%
Nitrogen Oxides (NO <sub>x</sub> )	56%
Particulate Matter (PM <sub>10</sub> )	25% <sup>2</sup>
Particulate Matter (PM <sub>2.5</sub> )	28% <sup>2</sup>
Ozone	N/A
Lead	13%
Volatile Organic Compounds (VOCs)	47%
Air Toxics (e.g. benzene, formaldehyde, methanol, etc.)	31%
Carbon Dioxide (CO <sub>2</sub> )	30%

# ***30% Less Ozone with Compact Development***

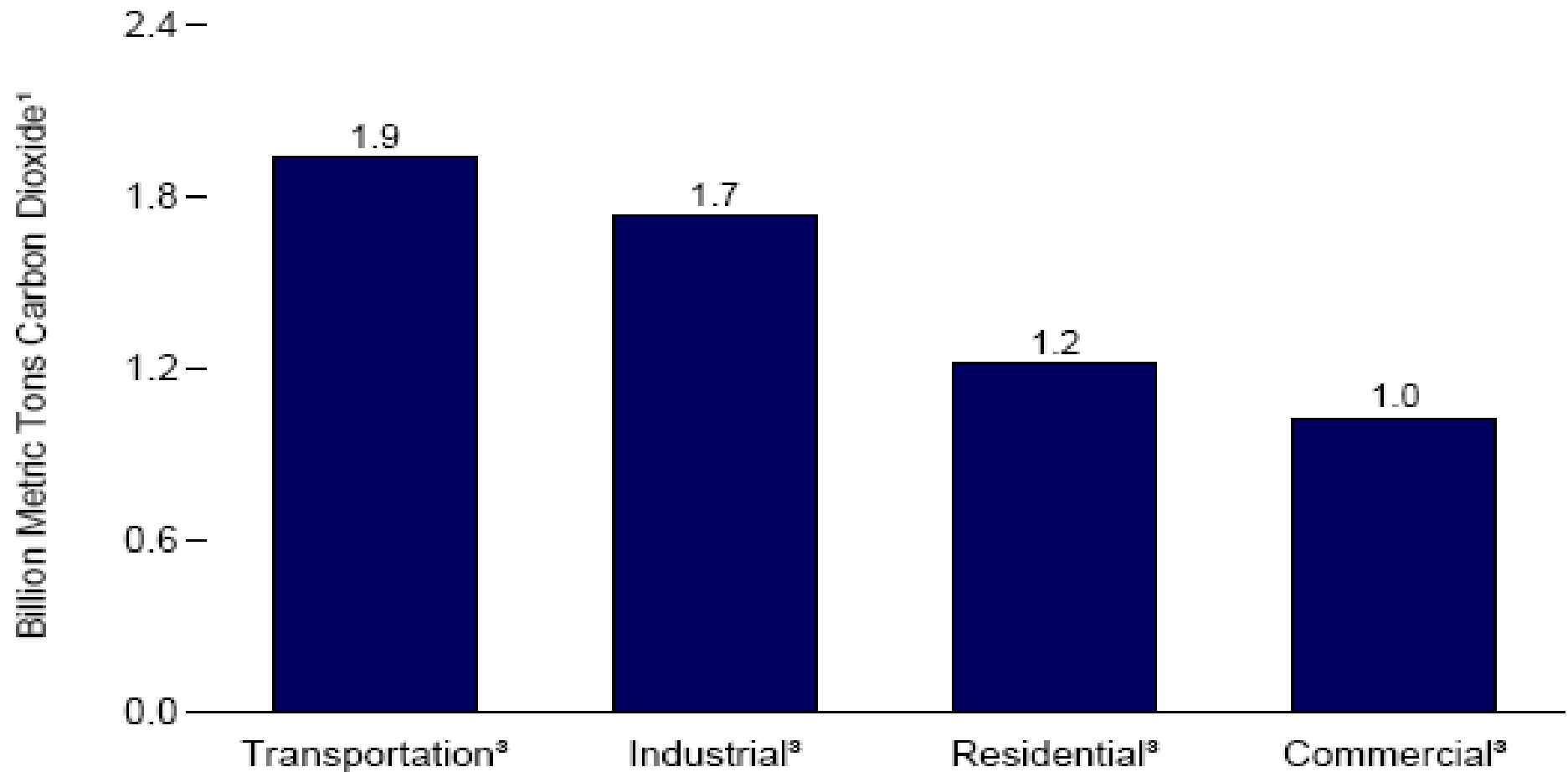




# CO2 Emissions from Energy Consumption by Sector

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By End-Use Sector, 2004



# **Perfect Storm Brewing**

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- ***June 2002: The U.S. government acknowledges for the first time that human activity is contributing to global warming.***
- ***September 2004: California adopts the nation's first rules to reduce greenhouse gas emissions from autos, followed by Massachusetts, Oregon, and nine other states.***
- ***November 2005: Wal-Mart goes green with ambitious goals—25% increase in the efficiency of its vehicle fleet, 30% reduction in the energy used in its stores, and 25% reduction in solid waste over three years.***
- ***February 2007: Al Gore wins an Academy Award for a documentary about global warming, just weeks after being nominated for a Nobel Peace Prize for leadership on this issue.***

## ***At an Accelerating Pace***

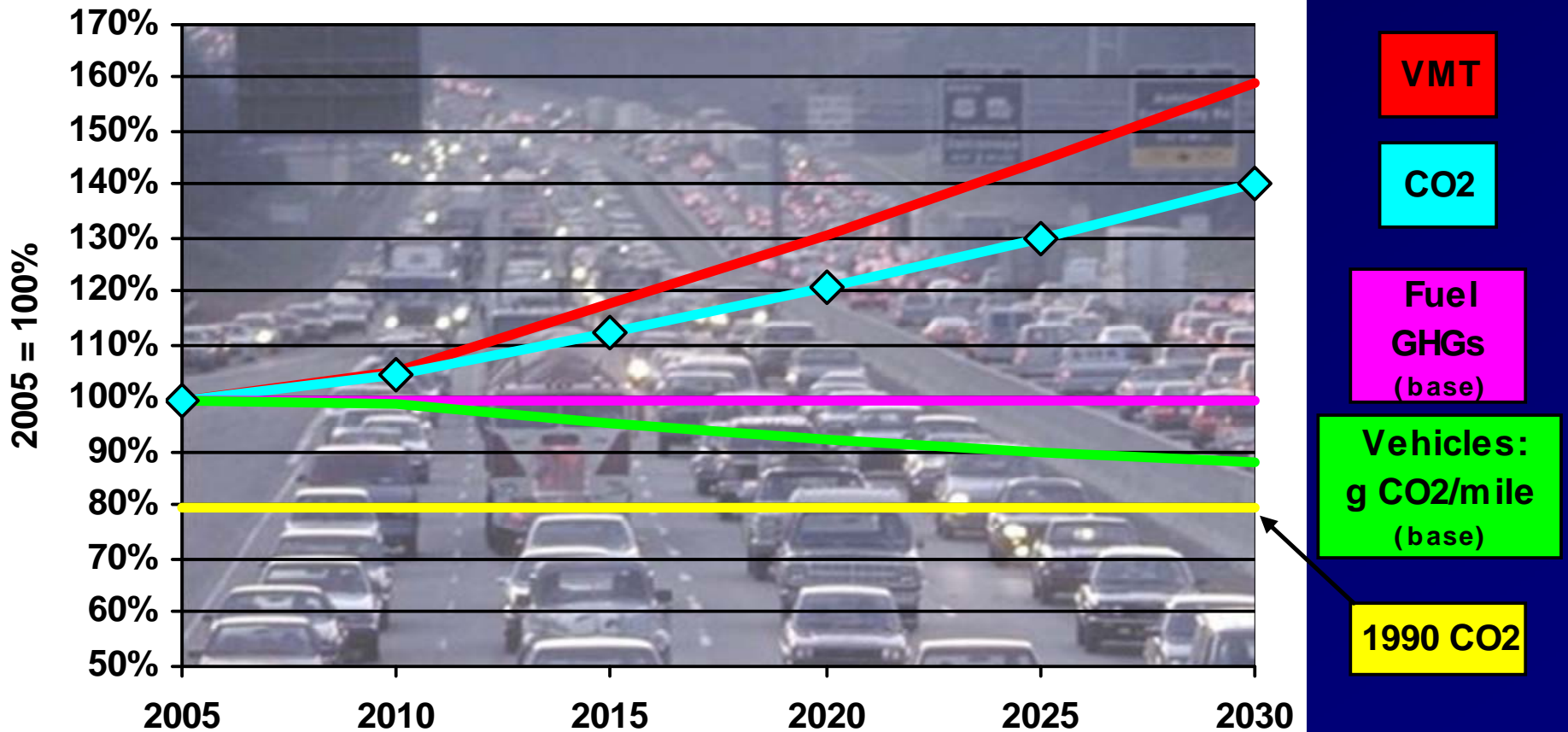
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- ***April 2007: UN Intergovernmental Panel of 2,500 top scientists issues a 1,500 page report predicting mass extinctions, severe storms and flooding, and widespread hunger unless greenhouse gas levels are controlled.***
- ***April 2007: U.S. Supreme Court rules that EPA has the authority and duty to regulate greenhouse gas emissions, unless it can provide a scientific basis for not doing so.***
- ***April 2007: California's Attorney General sues San Bernardino County for failing to deal with impacts of growth on carbon emissions in its 25-year growth plan.***
- ***May 2007: Tulsa, Oklahoma, becomes the 500th city to sign the U.S. Mayors Climate Protection Agreement to reduce greenhouse gas pollution.***

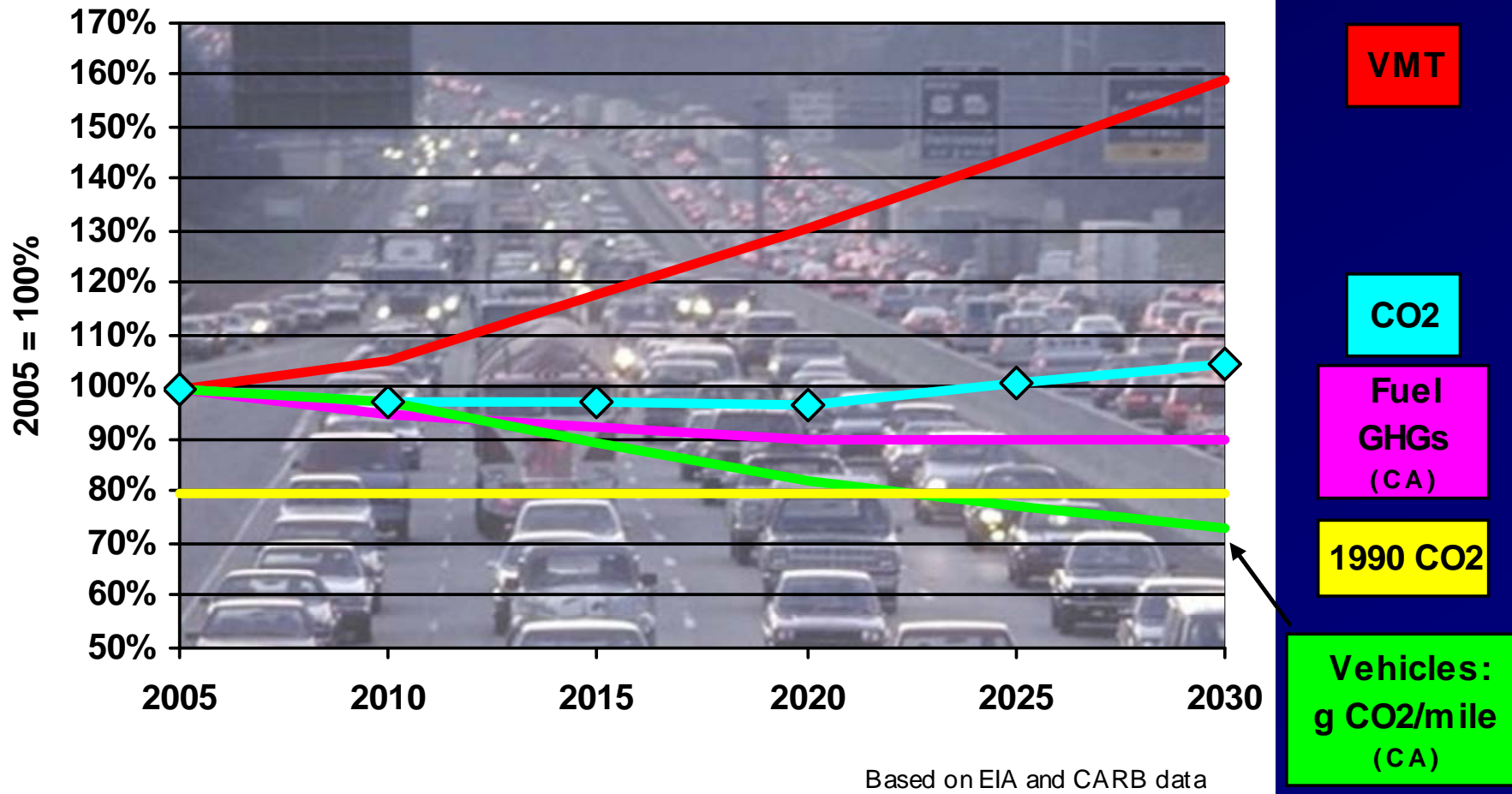
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***White Paper for U.S. Environment Protection  
Agency***

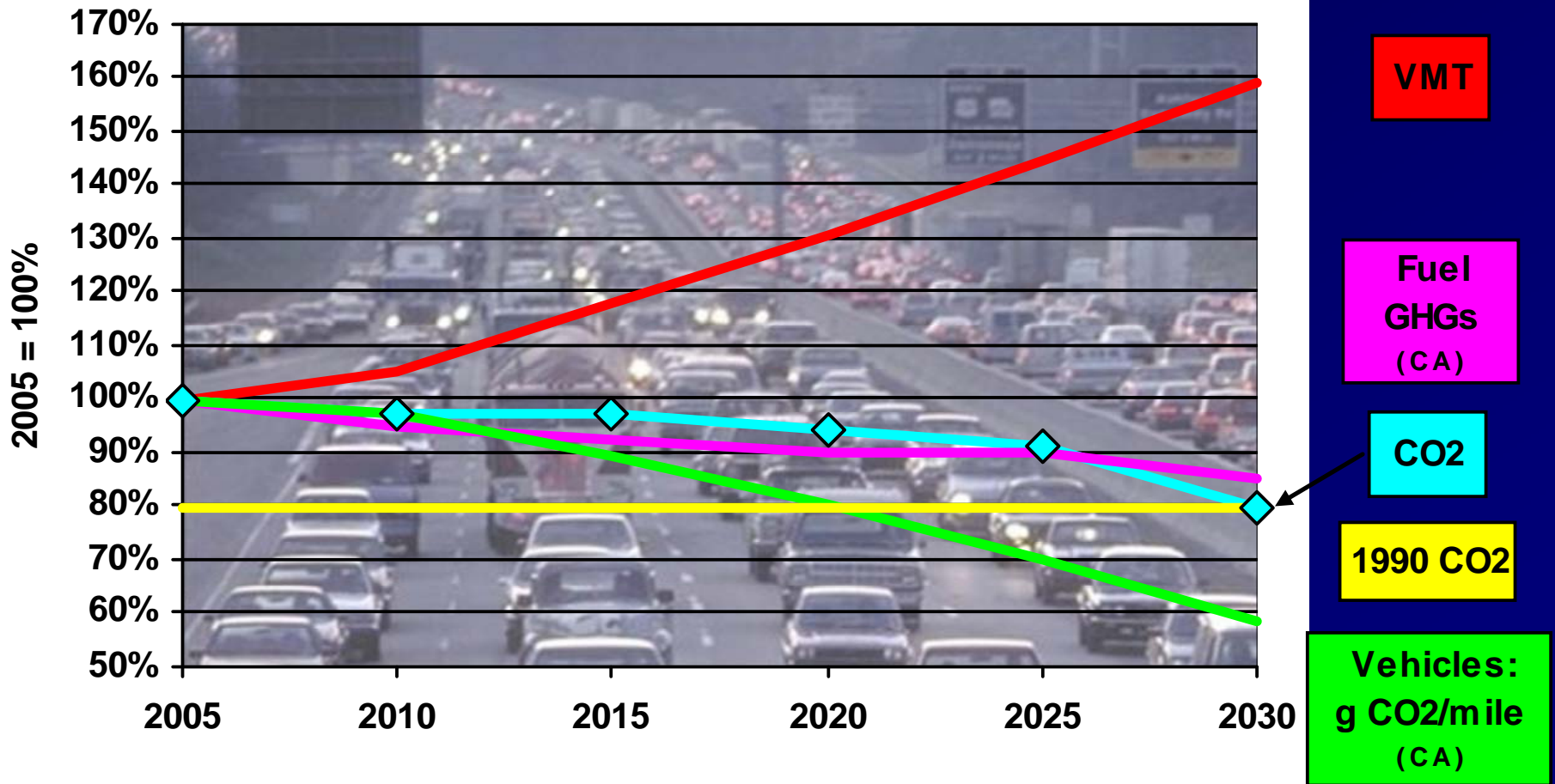
# Projected Growth in CO2 Emissions from Cars and Light Trucks



# Growth in CO2 Emissions assuming California Vehicle and Fuel Standards Adopted Nationally



# Growth in CO2 Emissions assuming more Stringent Vehicle and Fuel Standards



Based on CEC, CARB, CALTRANS and assumed phase 2 standards

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***Third Leg of Stool -> Compact Development***



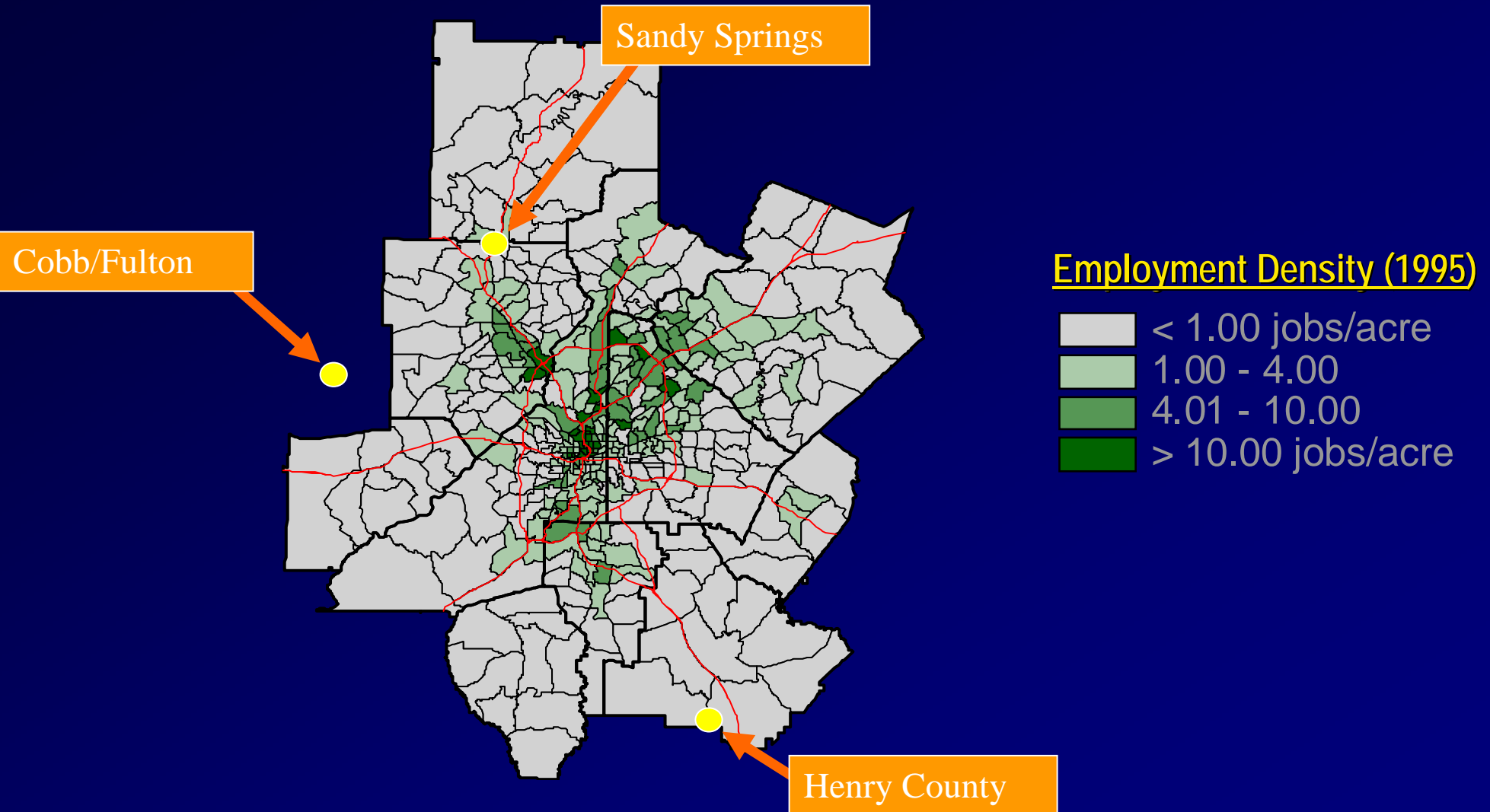
## ***What Is Feasible with Compact Development***

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- ***20-50% reduction in transport CO<sub>2</sub> emissions beyond 2050***
- ***But it all depends...***
- ***3% reduction in total GHG emissions with Smart Growth***

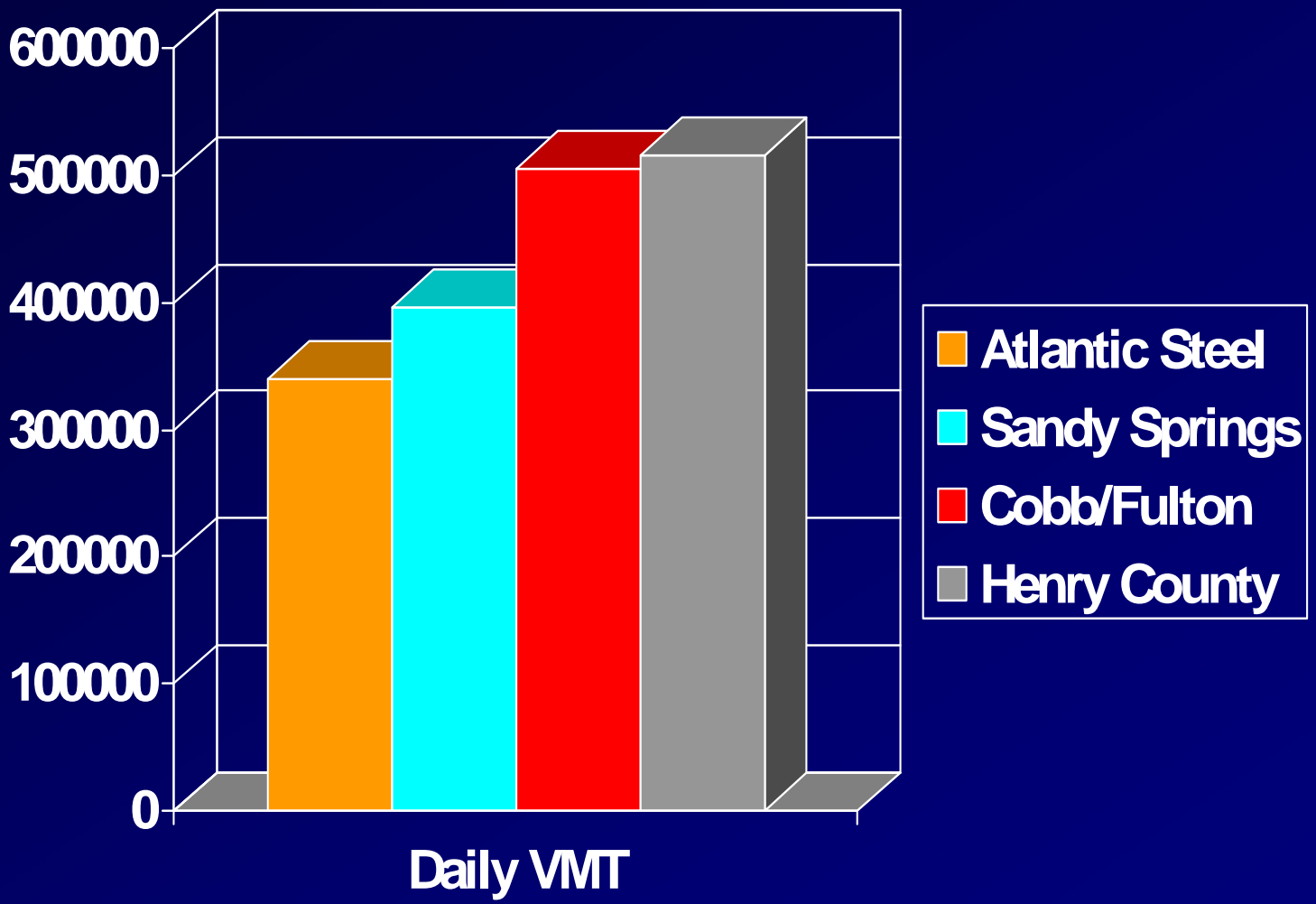
# Comparison Sites

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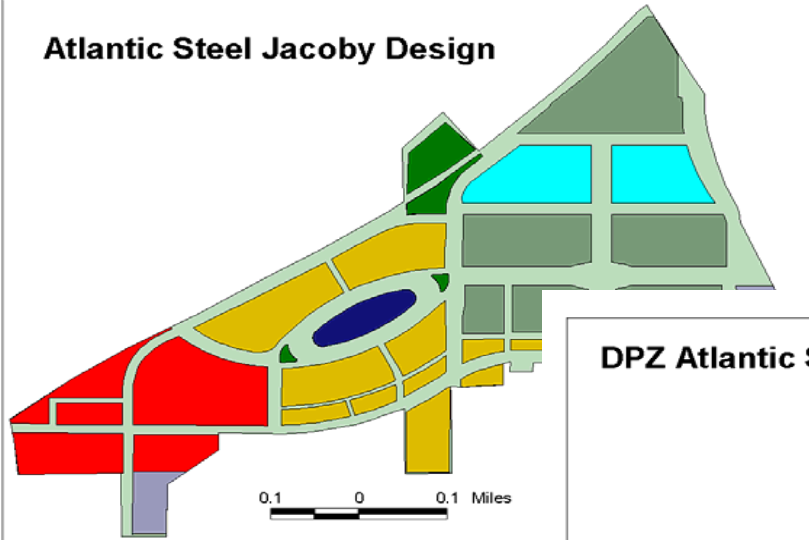
# *1/3 Savings Due to Regional Accessibility*

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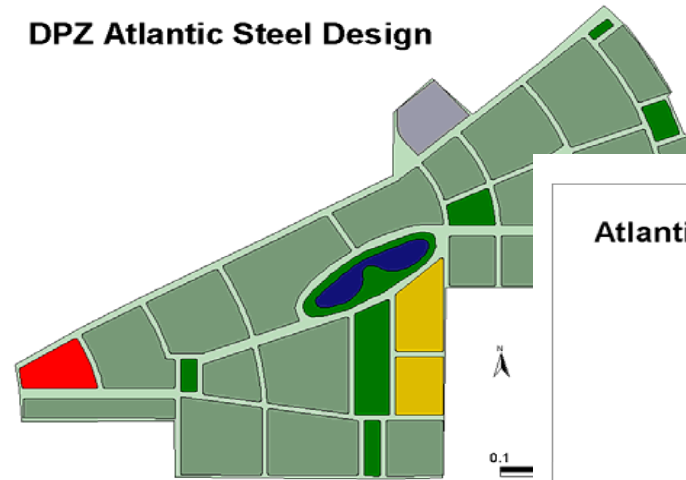


# Alternative Site Plan Comparison

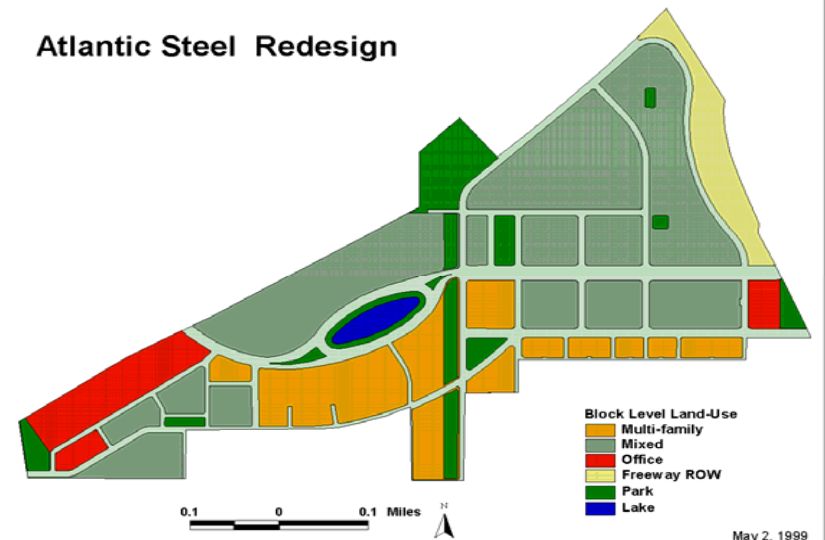
Atlantic Steel Jacoby Design



DPZ Atlantic Steel Design



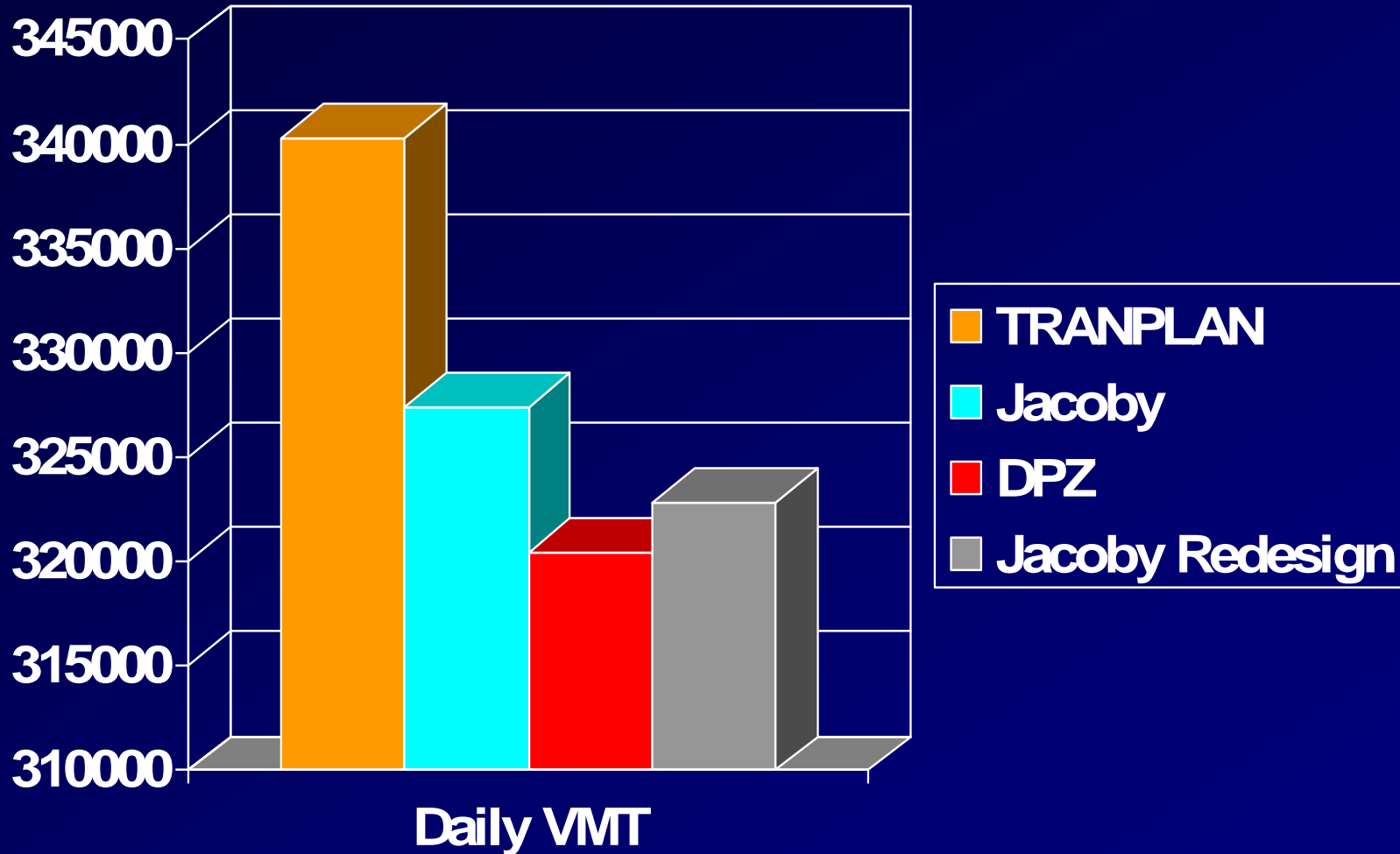
Atlantic Steel Redesign



May 2, 1999

# 5% Savings Due to 3Ds

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## ***Consistent Picture Emerges***

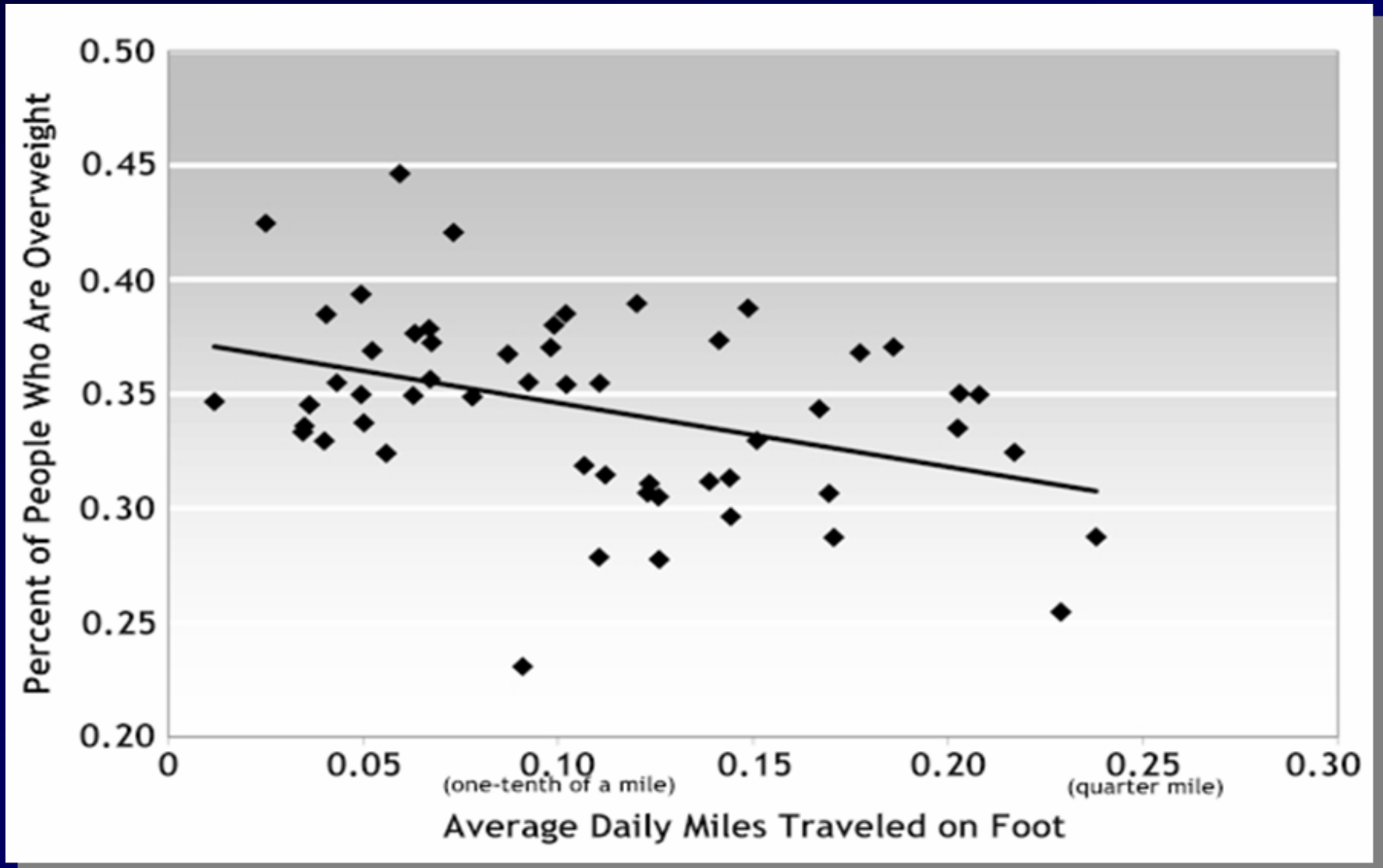
***20+% Less VMT with Compact  
Development than Sprawl***

## ***What Is Feasible with Smart Growth***

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- ***20-50% reduction in transport CO<sub>2</sub> emissions beyond 2050***
- ***But it all depends...***
- ***5% reduction in total GHG emissions with Smart Growth***

# Overweight vs. Daily Miles of Walking



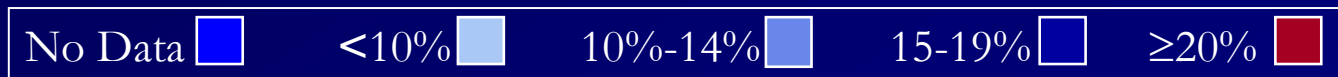
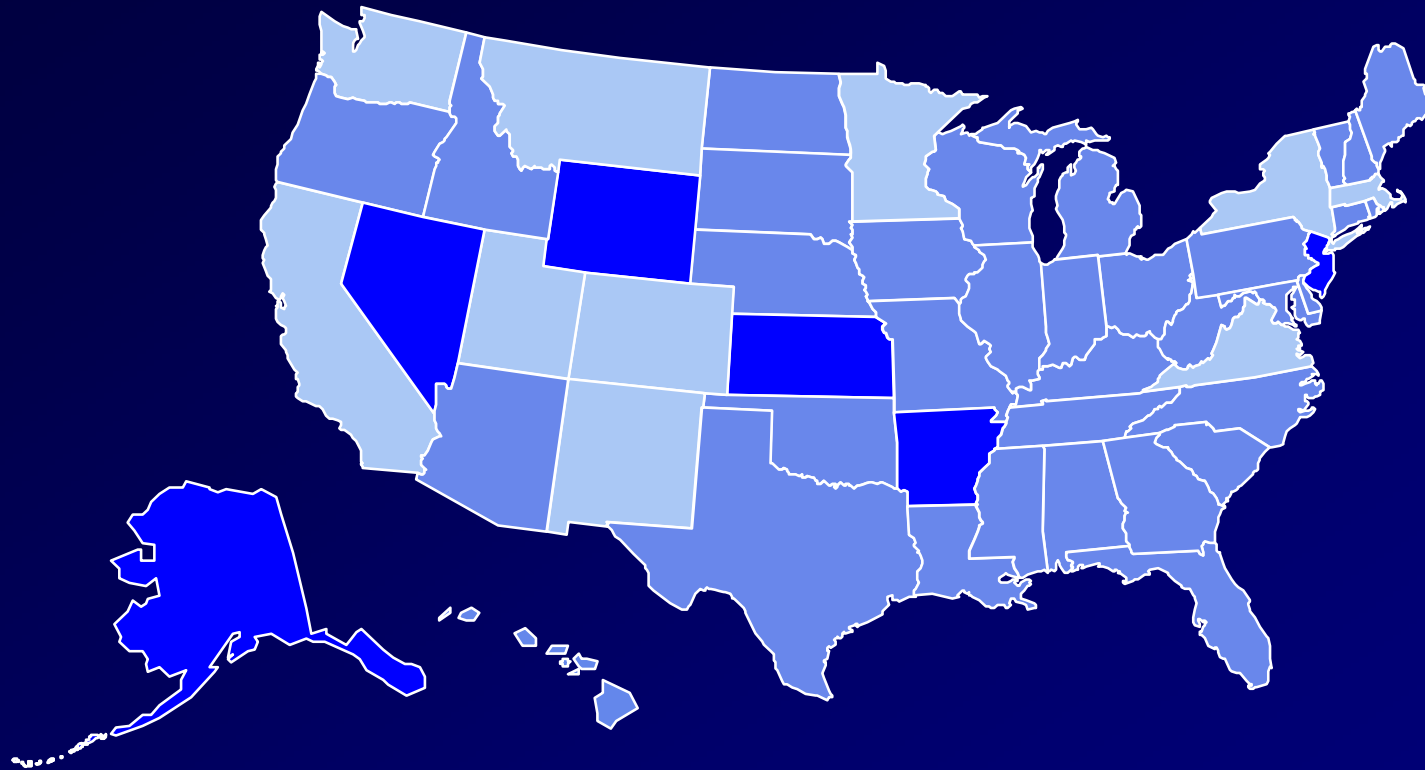


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# ***Obesity and Chronic Disease***

# 1990 Obesity

(\*BMI  $\geq 30$ , or  $\sim 30$  lbs overweight for 5'4" woman)

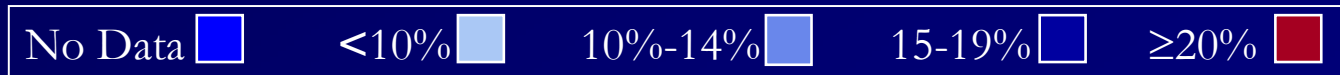
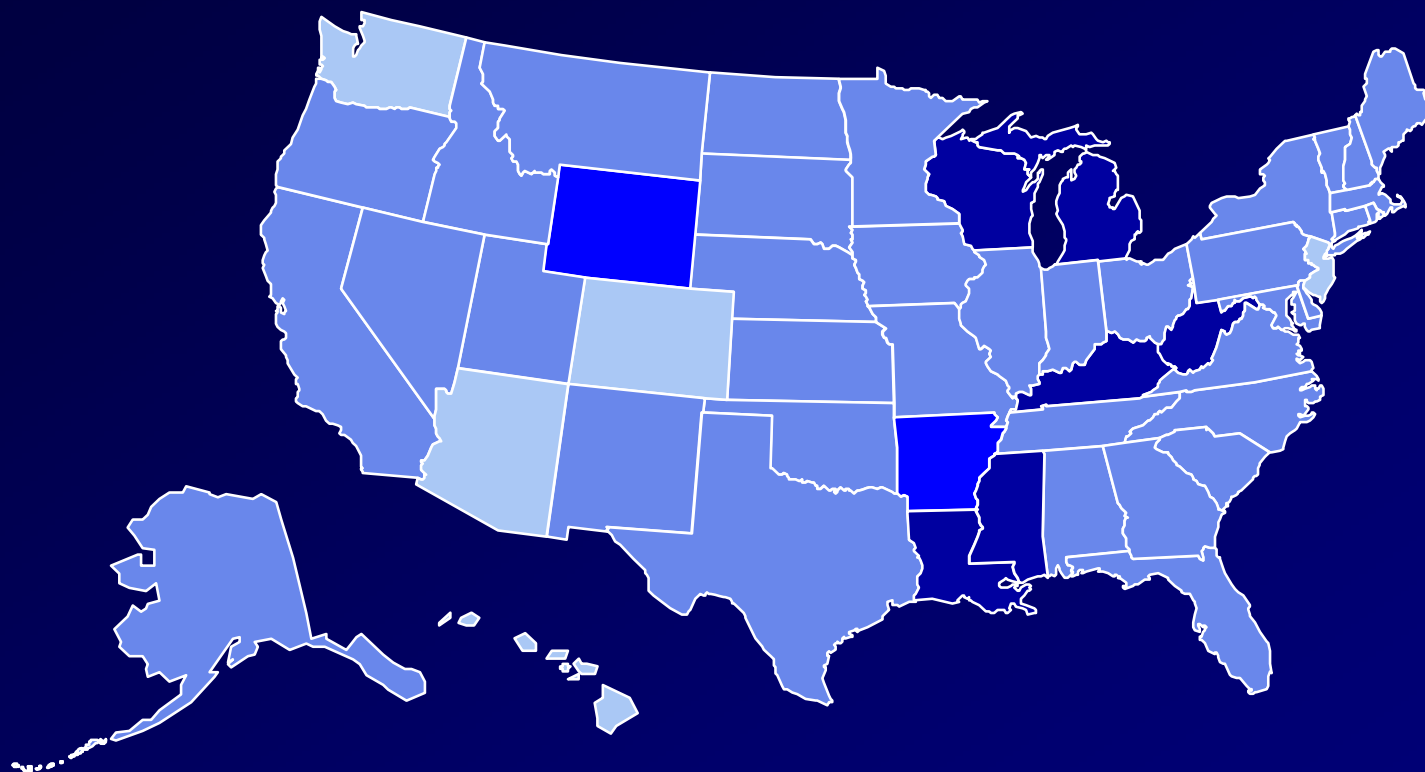


Source: Mokdad AH.



# 1992 Obesity

(\*BMI  $\geq 30$ , or  $\sim 30$  lbs overweight for 5'4" woman)

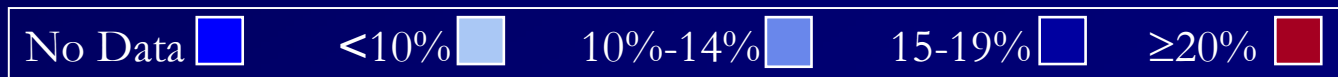
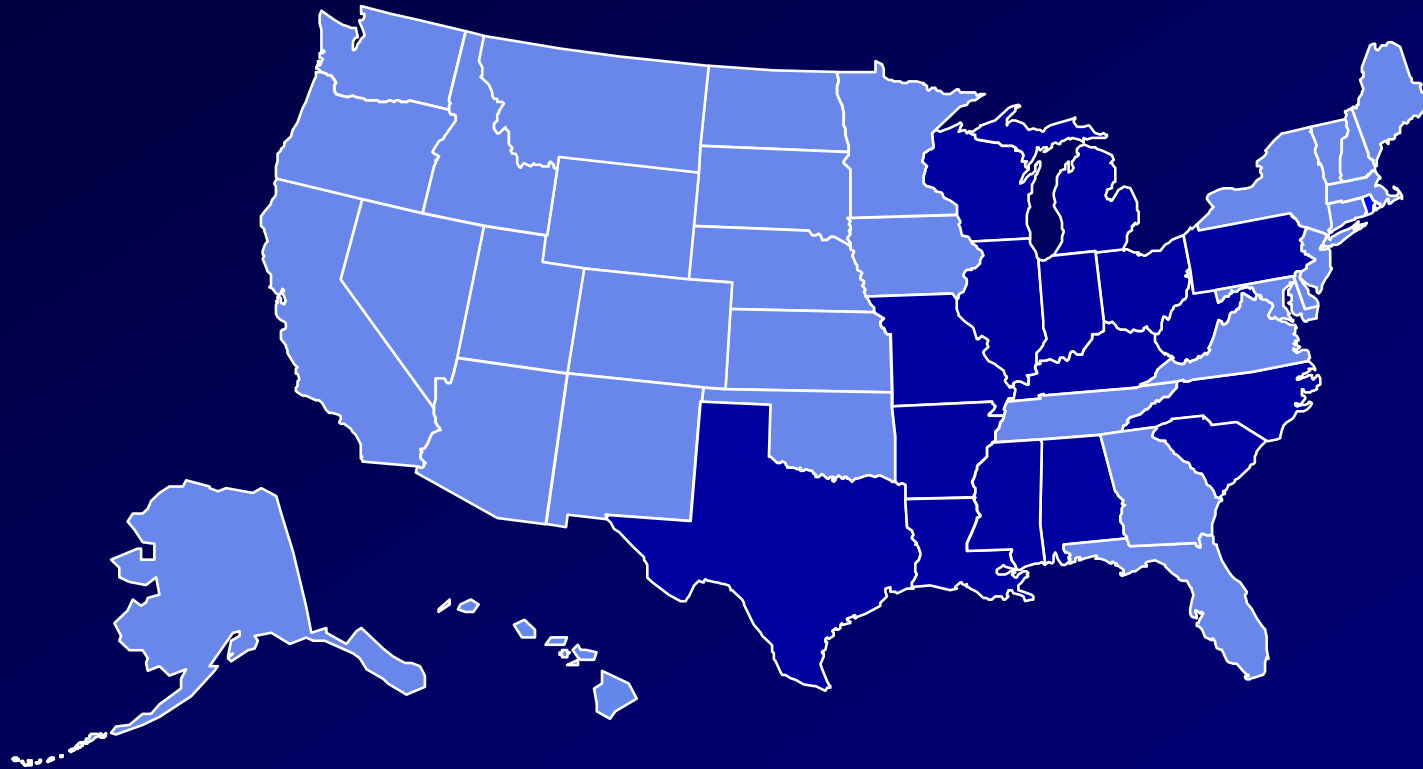


Source: Mokdad A H, et al. *J Am Med Assoc* 2000;284:13



# 1994 Obesity

(\*BMI  $\geq 30$ , or  $\sim 30$  lbs overweight for 5'4" woman)

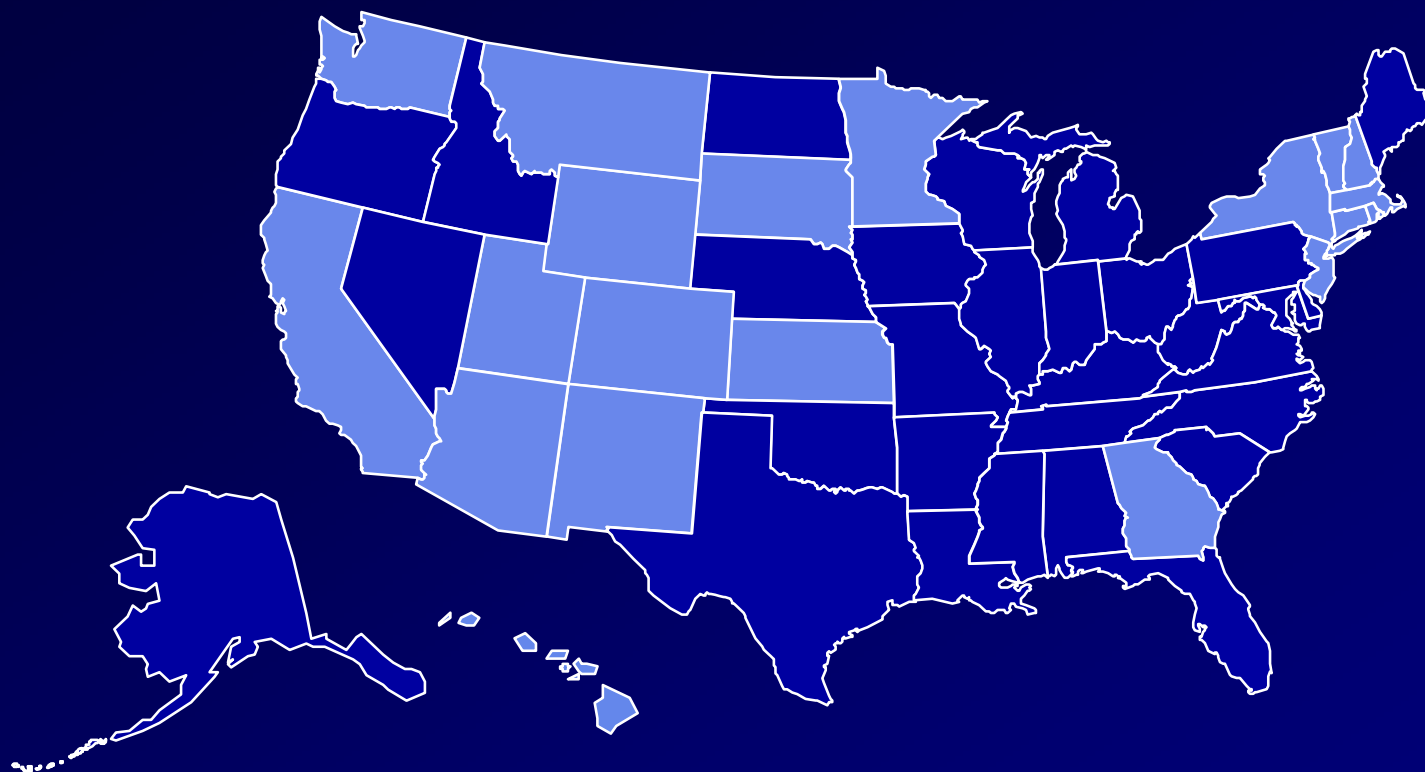







Source: Mokdad A H, et al. *J Am Med Assoc* 2000;284:13



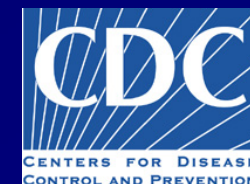
# 1996 Obesity

(\*BMI  $\geq 30$ , or  $\sim 30$  lbs overweight for 5'4" woman)



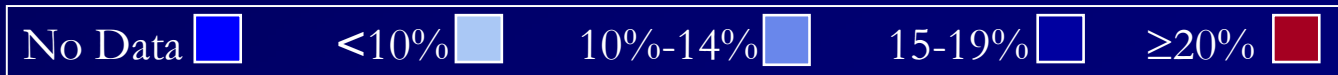
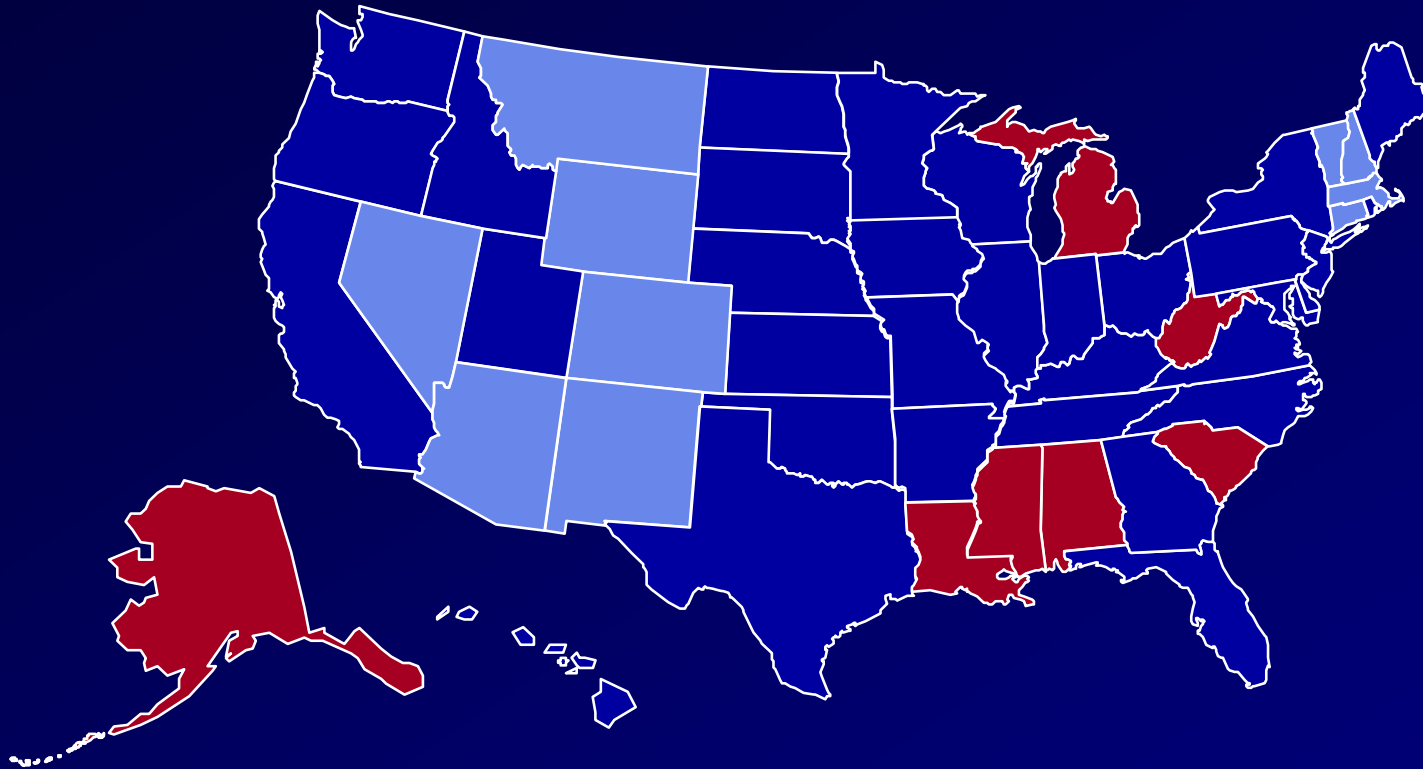
No Data  <10%  10%-14%  15-19%   $\geq 20\%$  

Source: Mokdad A H, et al. *J Am Med Assoc* 2000;284:13



# 1998 Obesity

(\*BMI  $\geq 30$ , or  $\sim 30$  lbs overweight for 5'4" woman)

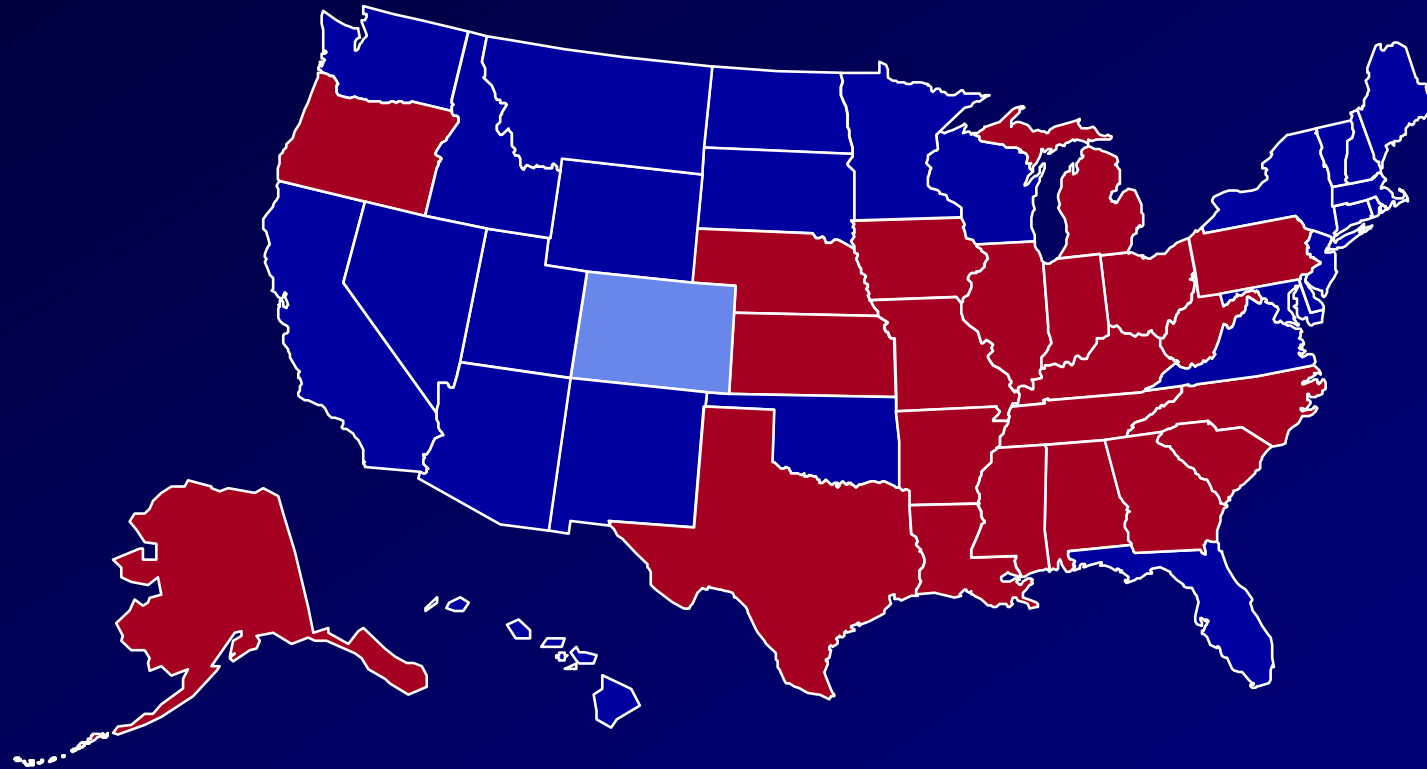







Source: Mokdad A H, et al. *J Am Med Assoc* 2000;284:13



# 2000 Obesity

(\*BMI  $\geq 30$ , or  $\sim 30$  lbs overweight for 5'4" woman)

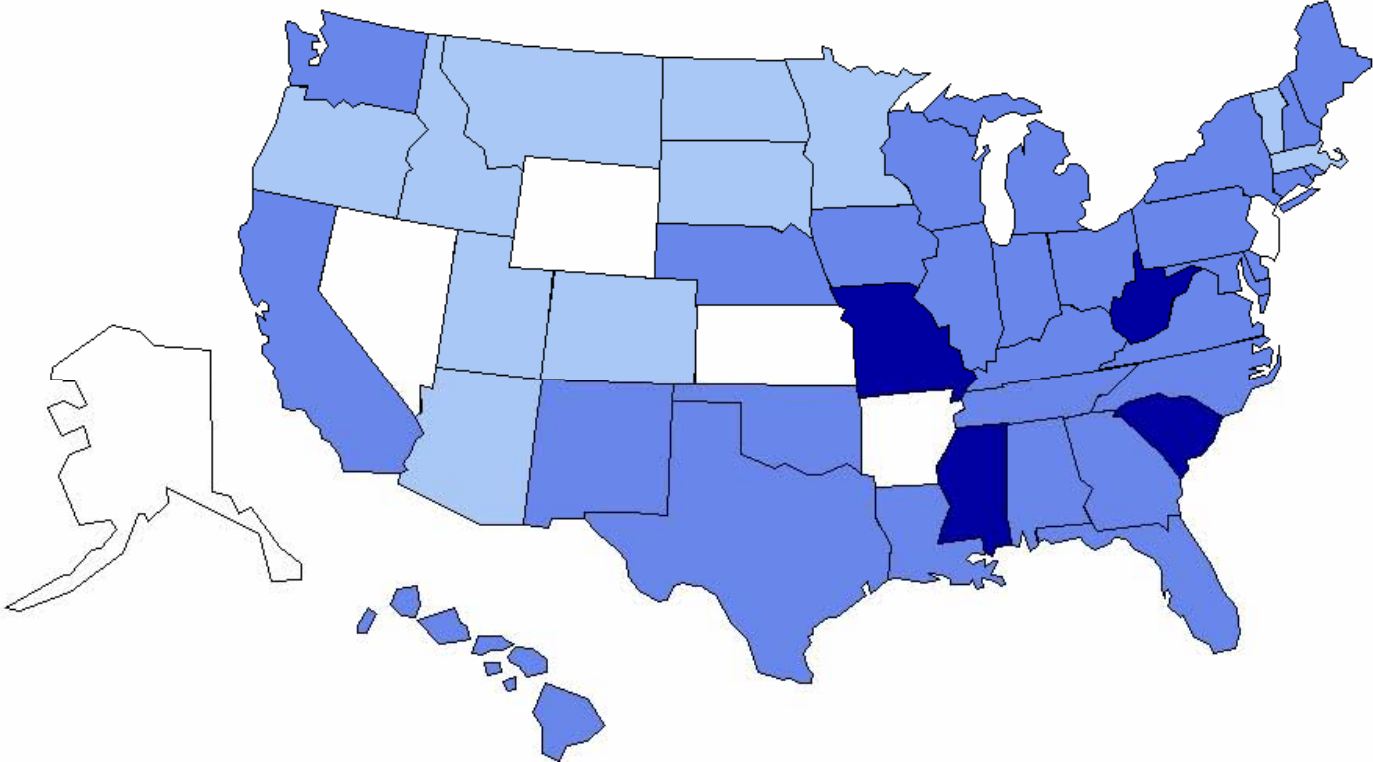


No Data  <10%  10%-14%  15-19%  ≥20% 

Source: Mokdad A H, et al. *J Am Med Assoc* 2001;286:10



# 1990 Diabetes



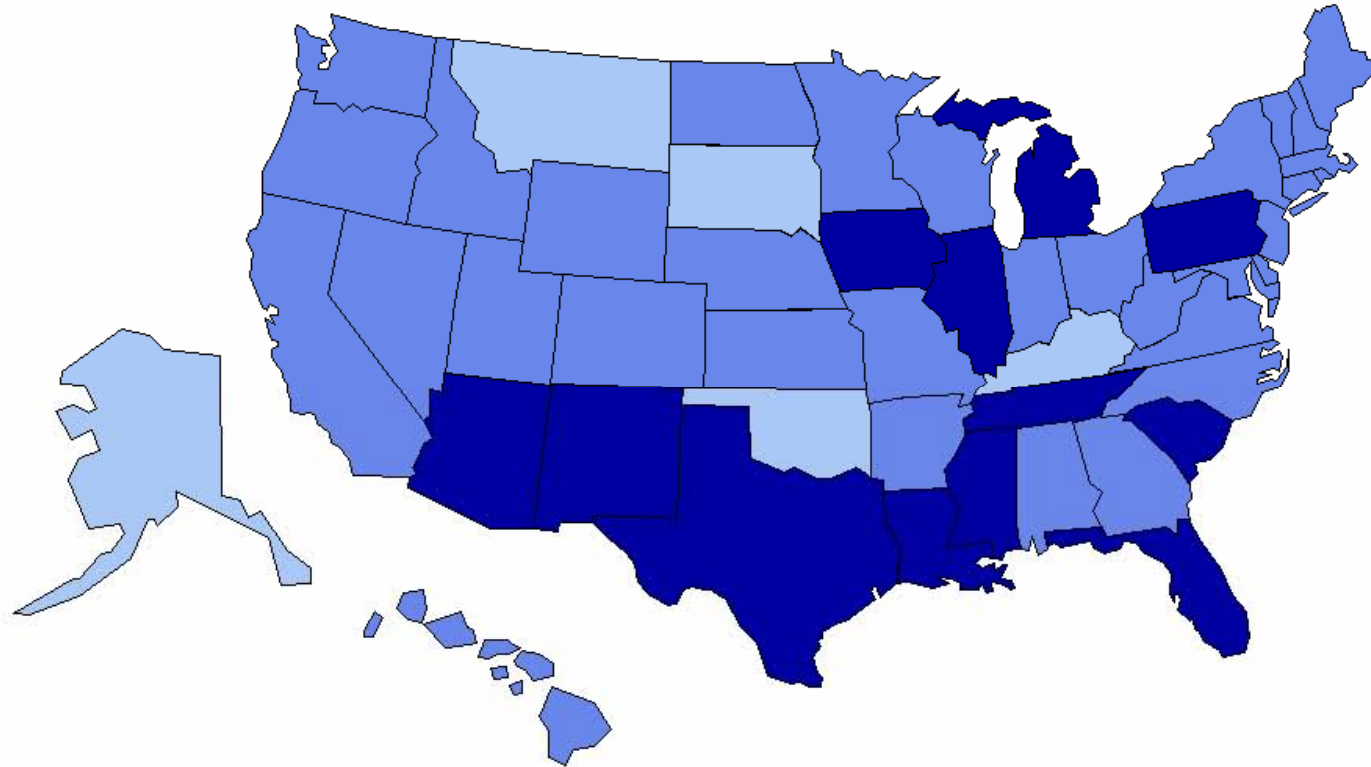
No Data  Less than 4%  4% to 6%  Above 6%

Source: Mokdad et al., *Diabetes Care* 2000;23:1278-83.





# 1995 Diabetes

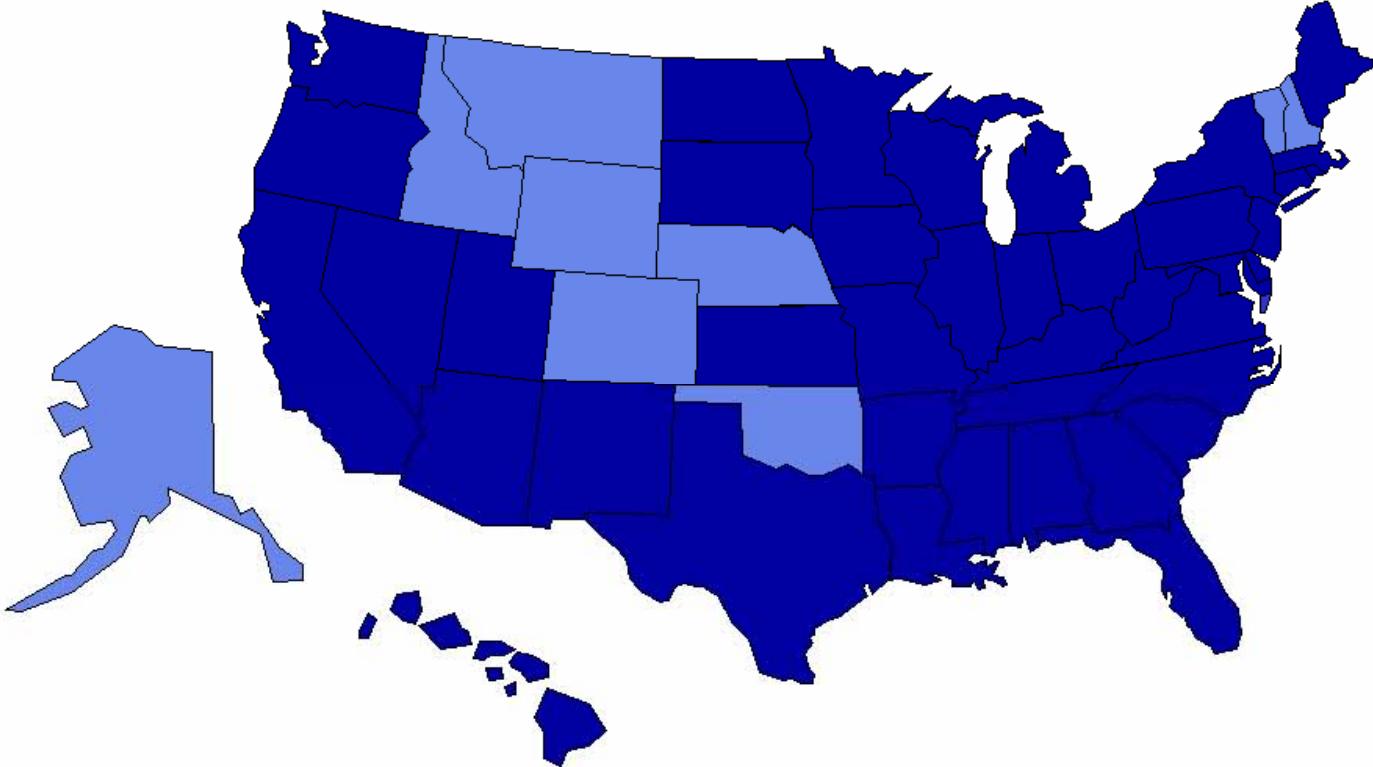


No Data  Less than 4%  4% to 6%  Above 6%

Source: Mokdad et al., *Diabetes Care* 2000;23:1278-83.



# 2000 Diabetes



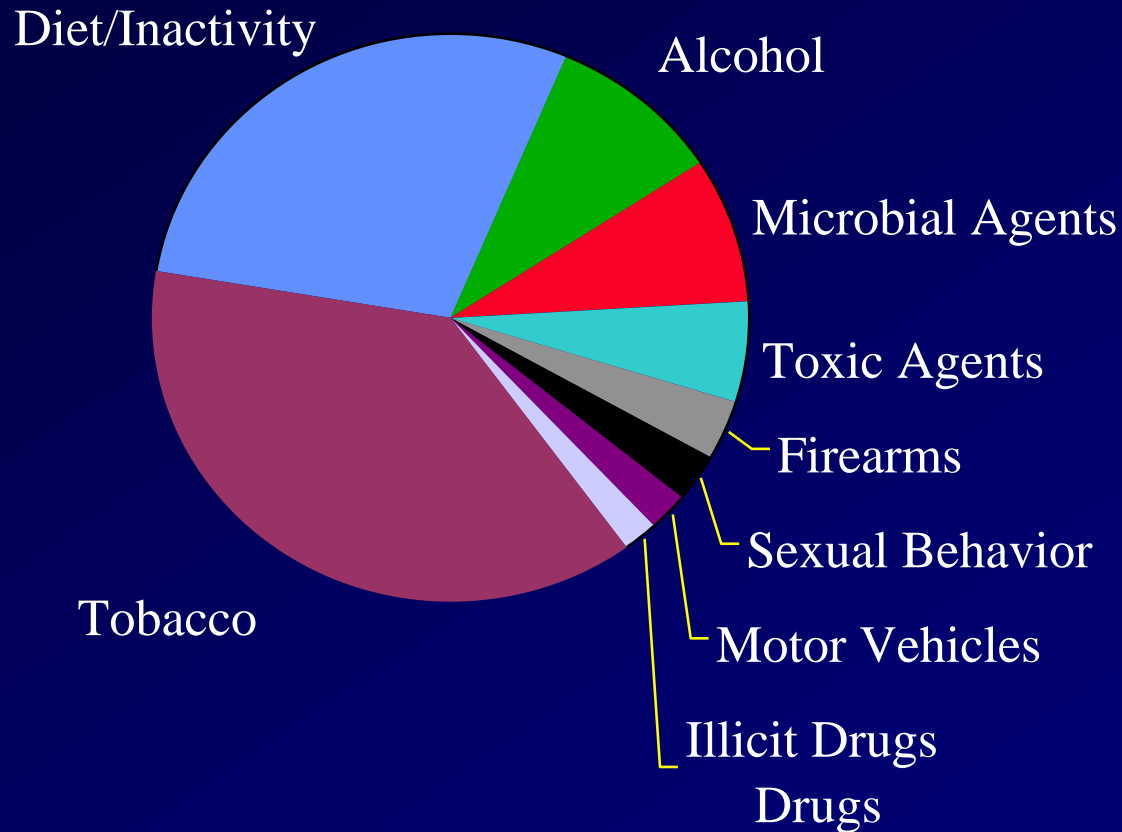
No Data     Less than 4%     4% to 6%     Above 6%

Source: Mokdad et al., *J Am Med Assoc* 2001;286(10).



# Causes of Death (1990)

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\*National Vital Statistics Report; 47 (9) November 10, 1998

†McGinnis JM, Foege WH. Actual causes of death in the United States. JAMA 1993; 270:2207-12

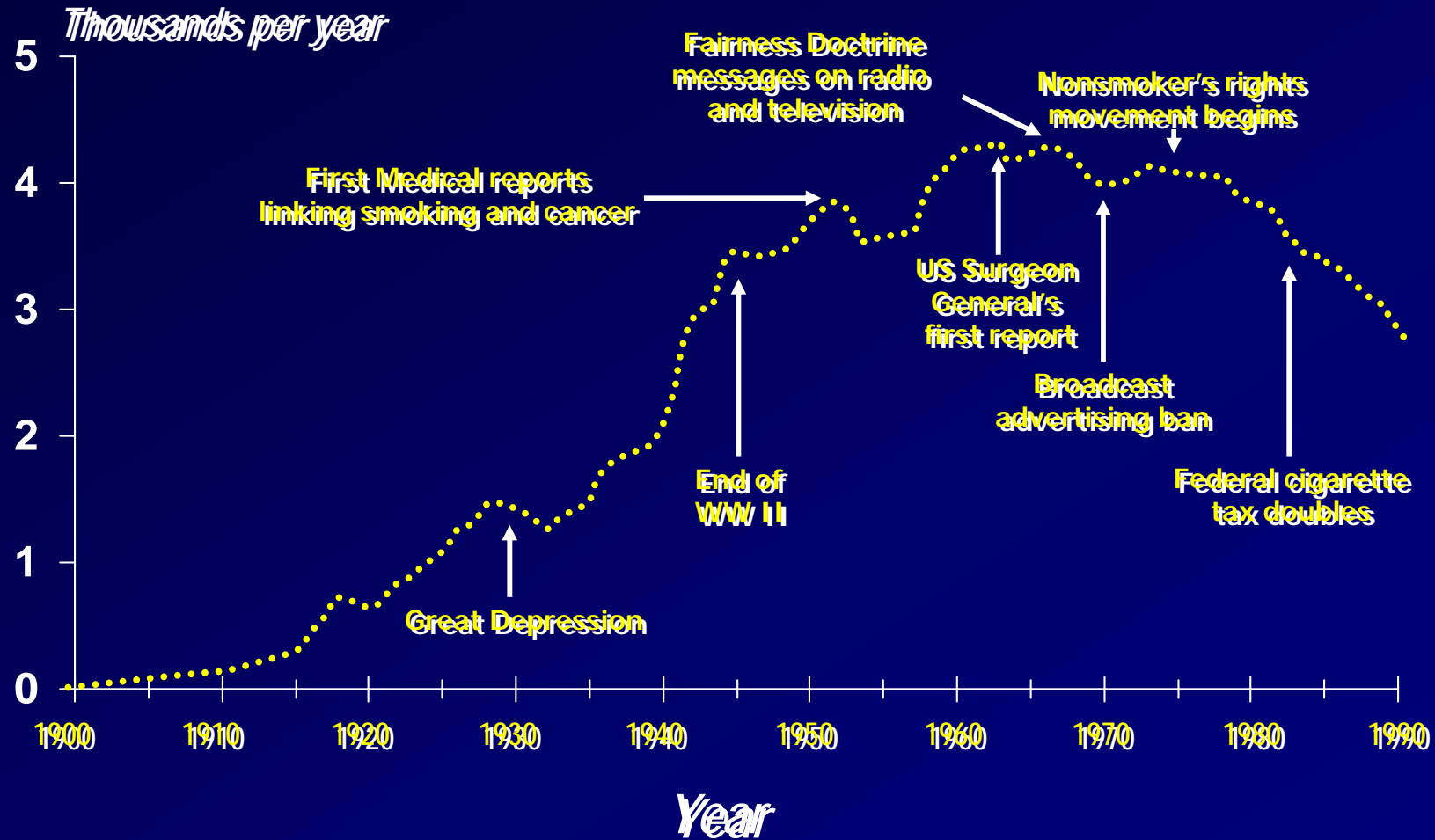
Note: Dark shading denotes conditions and behaviors addressed by NCCDPHP

# ***Costs of Inactivity and Obesity***

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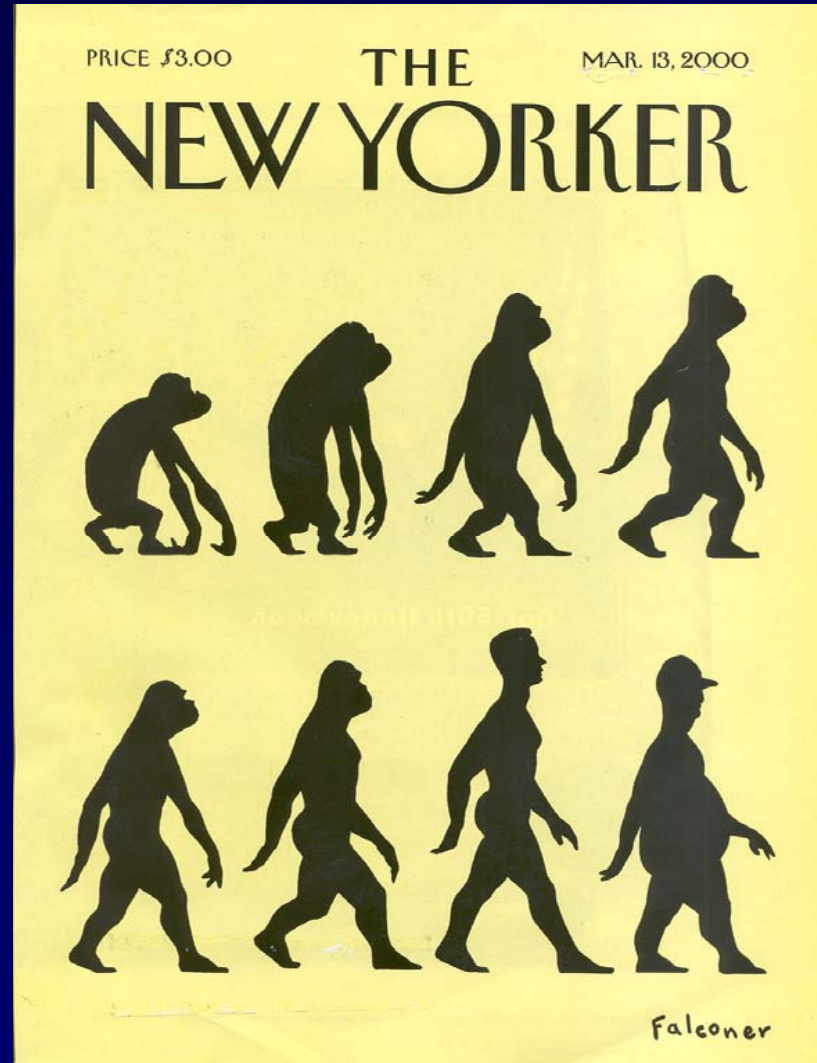
- ***Medical Costs are lower for active people than their inactive counterparts***
  - ***\$866 greater per year of direct medical expenditures (2000)***
  - ***Potential cost savings of \$76.6 Billion (2000).***
  
- ***Medical Costs for Overweight and Obese people are greater than 'healthy weight' people***
  - ***30% greater medical costs for obese than 'healthy weight'***
  - ***\$100 Billion per year: costs associated with obesity***

# Adult per Capita Cigarette Consumption and Major Environmental and Policy Changes in the US 1900-1990



# It's Not Genetic

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First of Its Kind

# The Washington Post

FRIDAY, AUGUST 29, 2003

THE WASHINGTON POST

NATIONAL NEWS

DC MD VA IR

FRIDAY, AUGUST 29,

## Suburbia USA: Fat of the Land?

Report Links Sprawl, Weight Gain

By ROB STEIN  
Washington Post Staff Writer

Suburban sprawl appears to be contributing to the nation's obesity epidemic, making people less likely to walk and more likely to be overweight, researchers reported yesterday.

In the first comprehensive examination of whether suburbs spreading across the U.S. landscape are affecting Americans' health, the researchers studied more than 200,000 people in 448 counties, producing the first concrete evidence supporting suspicions that sprawl is aggravating the nation's growing weight crisis.

People who live in the most spread-out areas spend fewer minutes each month walking and weigh about six pounds more on average than those who live in the most densely populated places. Probably as a result, they are almost as prone to high blood pressure as cigarette smokers, the researchers found.

"There are lots of other reasons why we should work to contain sprawl," said Reid Ewing of the University of Maryland's National Center for Smart Growth, who led the

study. "There is a lot of circumstantial evidence that sprawl is related to health," Ewing said in a telephone interview. "This is certainly the first national study to make the direct connection between the built environment and health."

Ewing and his colleagues analyzed data collected about 206,992 U.S. adults between 1998 and 2000 by the Behavioral Risk Factor Surveillance System, an ongoing federal survey. Using data from the Census Bureau and other federal sources about population density, block size, street patterns and other factors, the researchers calculated a "sprawl index" for 448 counties in the largest metropolitan areas nationwide, where two-thirds of the population reside, including the Washington region.

The index ranged from a low of 63 for the most sprawling county—Geauga, Ohio, just outside Cleveland—to a high of 352 for the densest—New York City. Frederick County in Maryland, one of the 20 least sprawling counties, had an index score of 107.75.

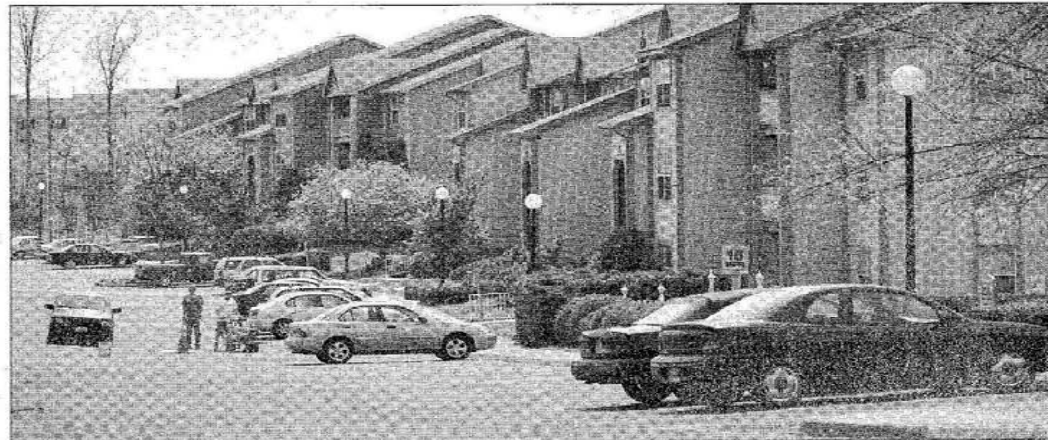
People in more sprawling counties are also likely to have a higher body mass index (BMI), a standard measure of weight. A 50-point increase in the degree of sprawl was associated with an average weight gain of a little more than one pound per person, researchers found.

While researchers found no association between sprawl and diabetes or heart disease, they did find that people who live in the least sprawling areas had a 29 percent lower risk of developing high blood pressure than those in the most sprawling areas.

at the University of Maryland.

The study also looked at heart disease and diabetes, but didn't find any statistically relevant relationship between sprawl and these diseases.

The study did find that the



People who live in the most spread-out areas were found to weigh about six pounds more on average than those in the most densely populated places.

25 densest counties.

People in more sprawling counties are also likely to have a higher body mass index (BMI), a standard measure of weight. A 50-point increase in the degree of sprawl was associated with an average weight gain of a little more than one pound per person, researchers found.

While researchers found no association between sprawl and diabetes or heart disease, they did find that people who live in the least sprawling areas had a 29 percent lower risk of developing high blood pressure than those in the most sprawling areas.

### Sprawl and Obesity

New research links suburban sprawl to obesity. You are more likely to be overweight if you live in an area with low population density and a more expansive street grid.

STATE/COUNTY	The lower the sprawl index score, the greater the amount of sprawl.	More sprawl means you are more likely to have a higher body mass index, ...	... the more pounds you are likely to weigh, ...	... the higher your risk of high blood pressure ...	... a high risk of being overweight
	SPRAWL INDEX SCORE	EXPECTED BMI*	EXPECTED WEIGHT**	PERCENT DIFFERENCE FROM AVERAGE RISK	P DIFFERENCE FROM AVERAGE RISK
<b>Maryland</b>					
Anne Arundel	107.75	26.07	166.47	-0.92%	-1
Calvert	90.84	26.13	166.84	1.10	3
Charles	89.72	26.14	166.87		2

Pickens County, S.C. (83.8) 3.5%

Geauga County, Ohio (63.1) 8.1%

Source: Smart Growth America Surface Transportation Policy Project

on weight, obesity, hypertension and other health factors were gleaned from a continuing phone survey of more than 200,000 adults by the CDC.

The study found that for every 50-point increase in sprawl

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# ***Findings***

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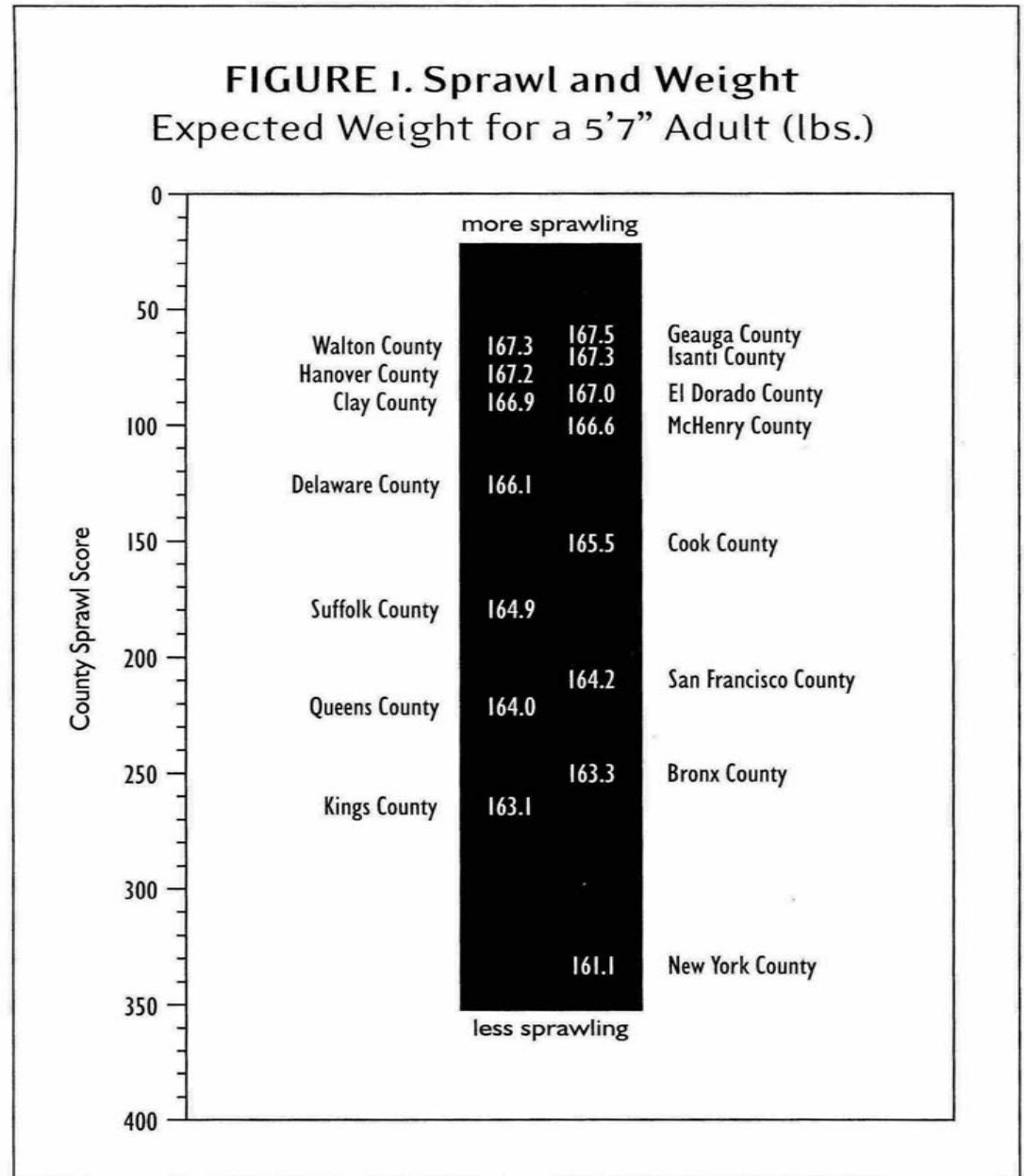
***People living in counties marked by sprawling development:***

- ***Walk less in their leisure time***
- ***Have higher body mass indexes***
- ***Are more likely to be obese***
- ***Are more like to have high blood pressure.***



Difference  
between most  
and least  
sprawling  
counties:

6.3 pounds



# ***Sprawl and Chronic Disease***

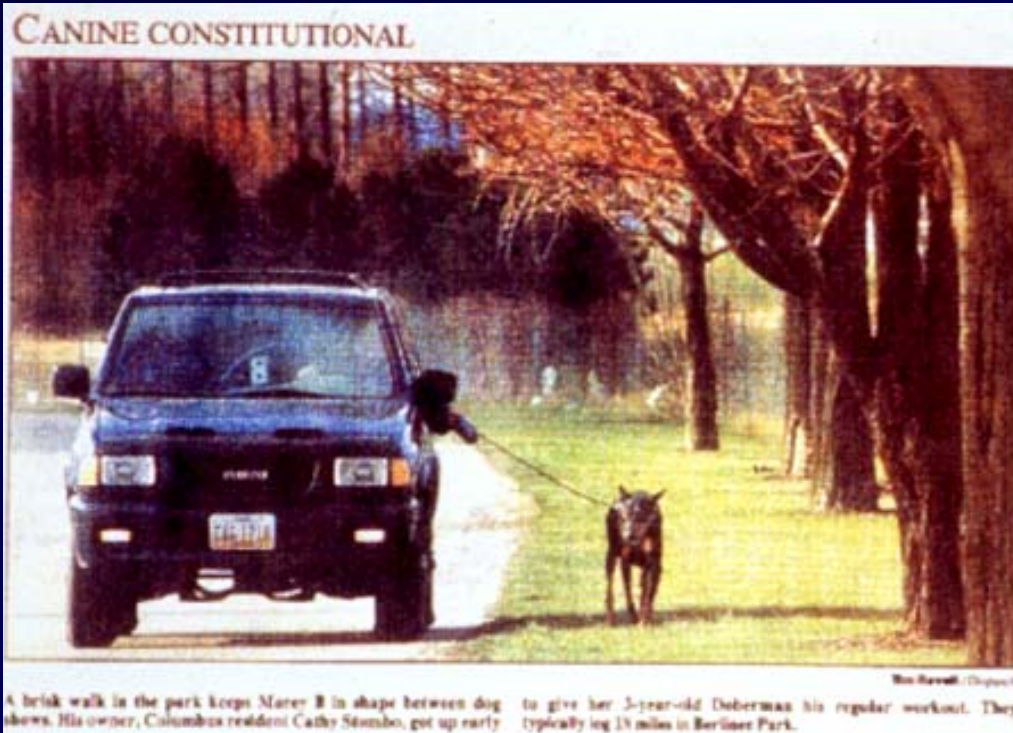
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***Every 50-point increase in the degree of sprawl is  
linked to a***

***6%***

***increase in the odds a resident will have high blood  
pressure.***

# Why The Difference?



# *Sprawl Dwellers Have to Compensate*

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## **Supporting Evidence Since 2003**

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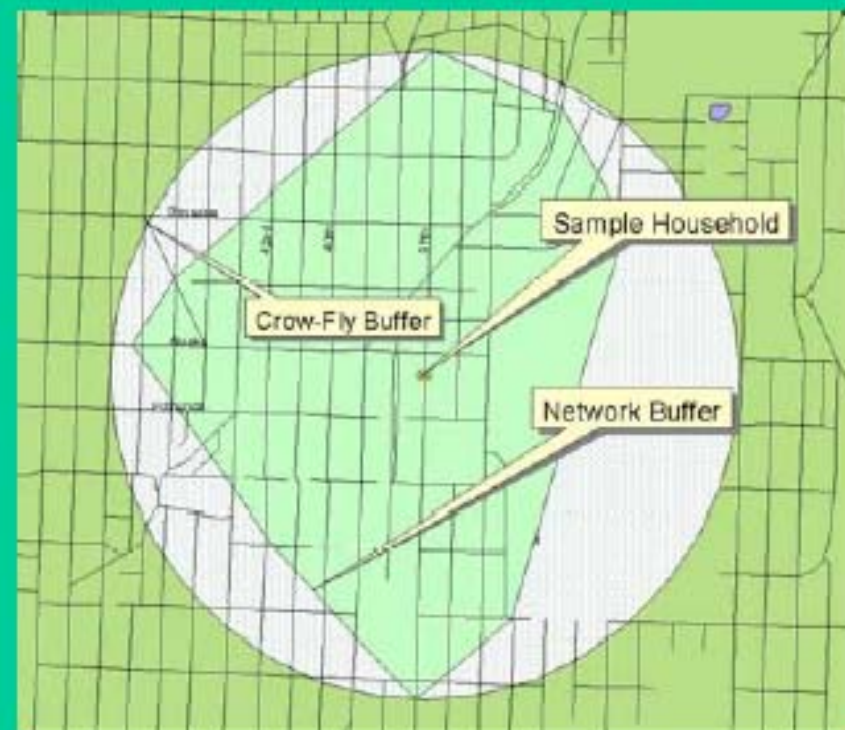
	<b><i>Sprawl Measures</i></b>	<b><i>Health Data</i></b>	
<b><i>Kelly-Schwartz et al./JPER</i></b>	<b><i>our 4 indices for 29 metros</i></b>	<b><i>NHANES – 9,200 adults</i></b>	<b><i>mixed results</i></b>
<b><i>Lopez/AJPH</i></b>	<b><i>own index for 316 metros</i></b>	<b><i>BRFSS – 108,000 adults</i></b>	<b><i>sprawl -&gt; obesity in whites</i></b>
<b><i>Sturm-Cohen/Public Health</i></b>	<b><i>our overall index for 38 metros</i></b>	<b><i>HCC – 8,686 adults</i></b>	<b><i>sprawl -&gt; # of chronic health conditions</i></b>

# Neighborhood Level Studies

## Disconnected



## Connected



# ***Frank's Work in Atlanta***

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## ***Odds of Obesity:***

- 12% for every quartile increase in mixed use***
- 5% for every additional kilometer walked***
- + 6% for every additional hour spent in car per day***

# **Comparable Results**

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## **Frank et al.**

**quartile increase in mix ->**

**12% reduction in the odds of being obese**

## **Ewing et al.**

**quartile increase in compactness ->**

**14% reduction in the odds of being obese**



# ***Epidemic Among Youth Too***

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# ***Bigger Problem than For Adults***

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# First Study of Urban Sprawl and Weight of U.S. Youth

## Relationship Between Urban Sprawl and Weight of United States Youth

Reid Ewing, PhD, Ross C. Brownson, PhD, David Berrigan, PhD

**Background:** Among United States youth there is an obesity epidemic with potential life-long health implications. To date, relationships between the built environment and body mass index (BMI) have not been evaluated for youth, and have not been evaluated longitudinally.

**Objectives:** To determine if urban sprawl is associated with BMI for U.S. youth.

**Methods:** Using data from the 1997 National Longitudinal Survey of Youth (NLSY97), both cross-sectional and longitudinal analyses were conducted. Hierarchical modeling was used to relate characteristics of individuals, households, and places to BMI. Individual and household data were extracted from the NLSY97. The independent variable of interest was the county sprawl index, which was derived with principal components analyses from census and other data.

**Results:** In a cross-sectional analysis, the likelihood of U.S. adolescents (aged 12–17 years) being overweight or at risk of overweight ( $\geq 85$ th percentile relative to the Centers for Disease Control growth charts) was associated with county sprawl ( $p=0.022$ ). In another cross-sectional analysis, after controlling for sociodemographic and behavioral covariates, the likelihood of young adults (aged 18–23 years) being obese was also associated with county sprawl ( $p=0.048$ ). By contrast, in longitudinal analyses, BMI growth curves for individual youth over the 7 years of NLSY97, and BMI changes for individual youth who moved between counties, were not related to county sprawl (although coefficient signs were as expected).

**Conclusions:** Cross-sectional analyses suggest that urban form is associated with being overweight among U.S. youth. The strength of these relationships proved comparable to those previously reported for adults. Longitudinal analyses show no such relationship. It is unclear why these approaches give different results, but sample sizes, latent effects, and confounders may contribute.

(*Am J Prev Med* 2006;31(6):464–474) © 2006 American Journal of Preventive Medicine

### Introduction

In the United States, the prevalence of overweight and obesity has been steadily rising for all age, gender, race, and education subgroups.<sup>1–9</sup> Over the past 3 decades, obesity has more than doubled for preschool children aged 2–5 years and adolescents aged 12–19 years, and has more than tripled for children aged 6–11 years.<sup>5</sup>

As in adults, obesity in children causes hypertension, dyslipidemia, chronic inflammation, increased blood

clotting, endothelial dysfunction, and hyperinsulinemia.<sup>10</sup> Children who are obese have greater prevalence of type 2 diabetes, sleep apnea with daytime somnolence that makes learning difficult, asthma, hypertension, orthopedic problems, and gall bladder disease.<sup>11</sup> About 41% of obese children and 80% of obese teens will become obese adults.<sup>12</sup>

To address the obesity epidemic and its health consequences, there is growing interest in built environments that encourage physical activity. The first studies reporting a direct relationship between the built environment and obesity were published in 2003.<sup>13–16</sup> After controlling for age, education, fruit and vegetable consumption, and other sociodemographic and behavioral covariates, Ewing et al.<sup>13</sup> found that adults living in sprawling counties had higher body mass indices (BMIs) and were more likely to be obese (BMI  $\geq 30$ ) than were their counterparts living in compact counties. Independent studies have since generally confirmed these original findings.<sup>17–26</sup> Specifically, all macrolevel (county or larger) studies, and all but one

From the National Center for Smart Growth Education and Research, University of Maryland (Ewing), College Park, Maryland; Department of Community Health and Prevention Research Center, Saint Louis University School of Public Health (Brownson), St. Louis, Missouri; and Applied Research Program, Division of Cancer Control and Population Sciences, National Cancer Institute (Berrigan), Bethesda, Maryland.

Address correspondence and reprint requests to: Reid Ewing, PhD, University of Maryland, ARCH-Center for Smart Growth Research & Education, 1112 Preinkert Field House, College Park MD 20742. E-mail: rewing1@umd.edu.

The full text of this article is available via AJPM Online at [www.ajpm-online.net](http://www.ajpm-online.net).

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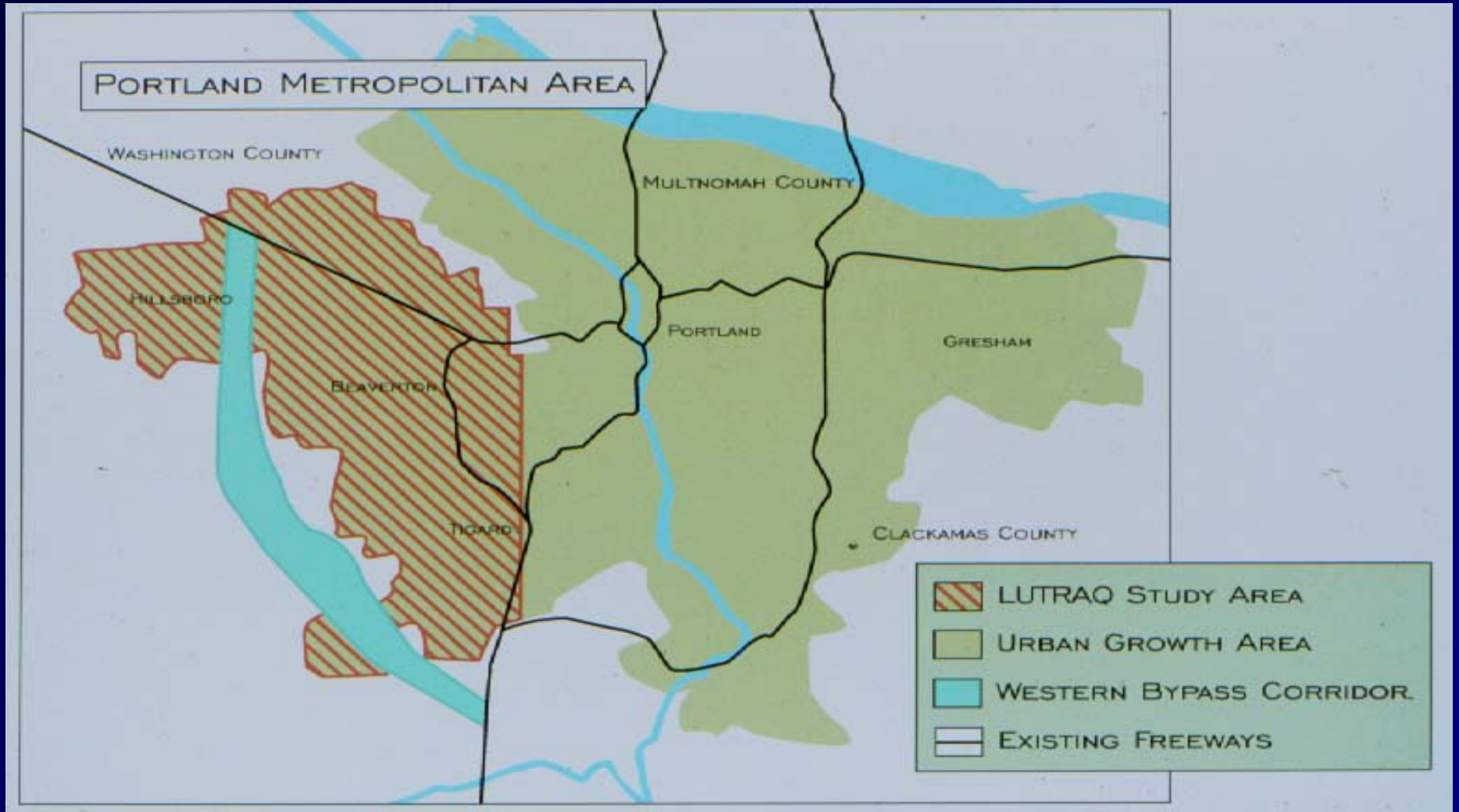
# *Places That Have Chosen a Different Future*

# ***Oregon Growth Management***

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- ***Urban Growth Boundaries***
  - ***Density Targets***
  - ***Transportation Policy Rule***
- +
- ***Transportation Investments***

# Original Plan



# 2040 Regional Goals

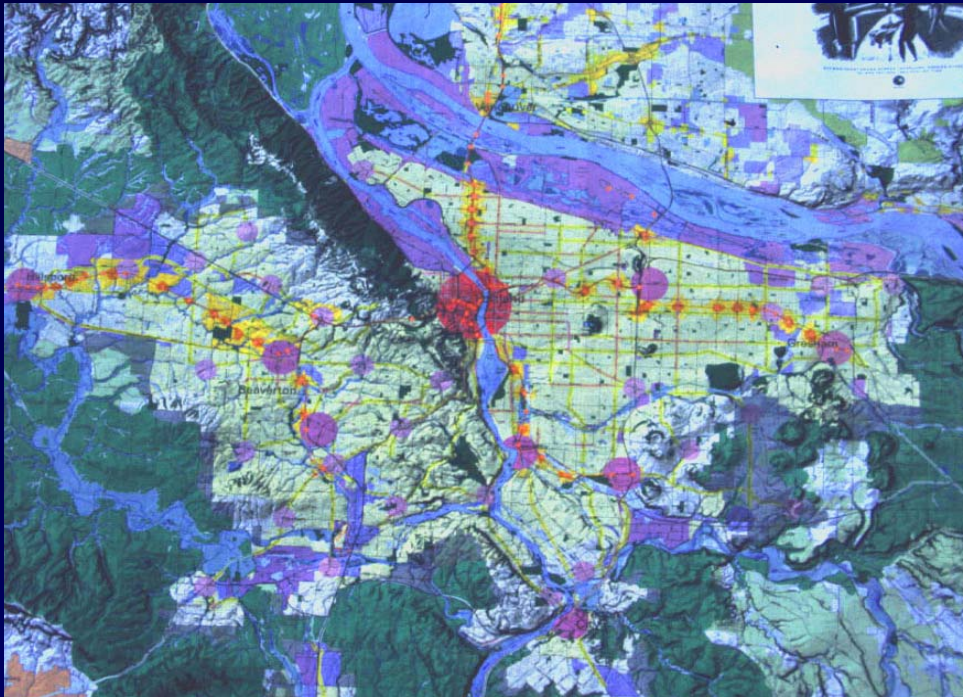
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**METRO**

## 2040 Growth Concept

*Adopted December 8, 1994*



- Balance land use and transportation
- Provide cost-effective solutions
- Provide multi-modal choices
- Protect neighborhoods, environment
- Serve freight, inter-modal and commerce needs
- Enhance safety and preserve the system

# ***Preferred Alternative***

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# *Future TOD*

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# Land-Use Impacts

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## Transit Oriented Communities Next to Westside MAX



*Nearly 7,000 new homes*

# ***Sprawl and Auto Dependence Within the UGB***

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# ***Documented Accomplishments***

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- ***Stronger Downtown Employment Base***
- ***Higher Suburban Densities***
- ***Rural Land Preservation***



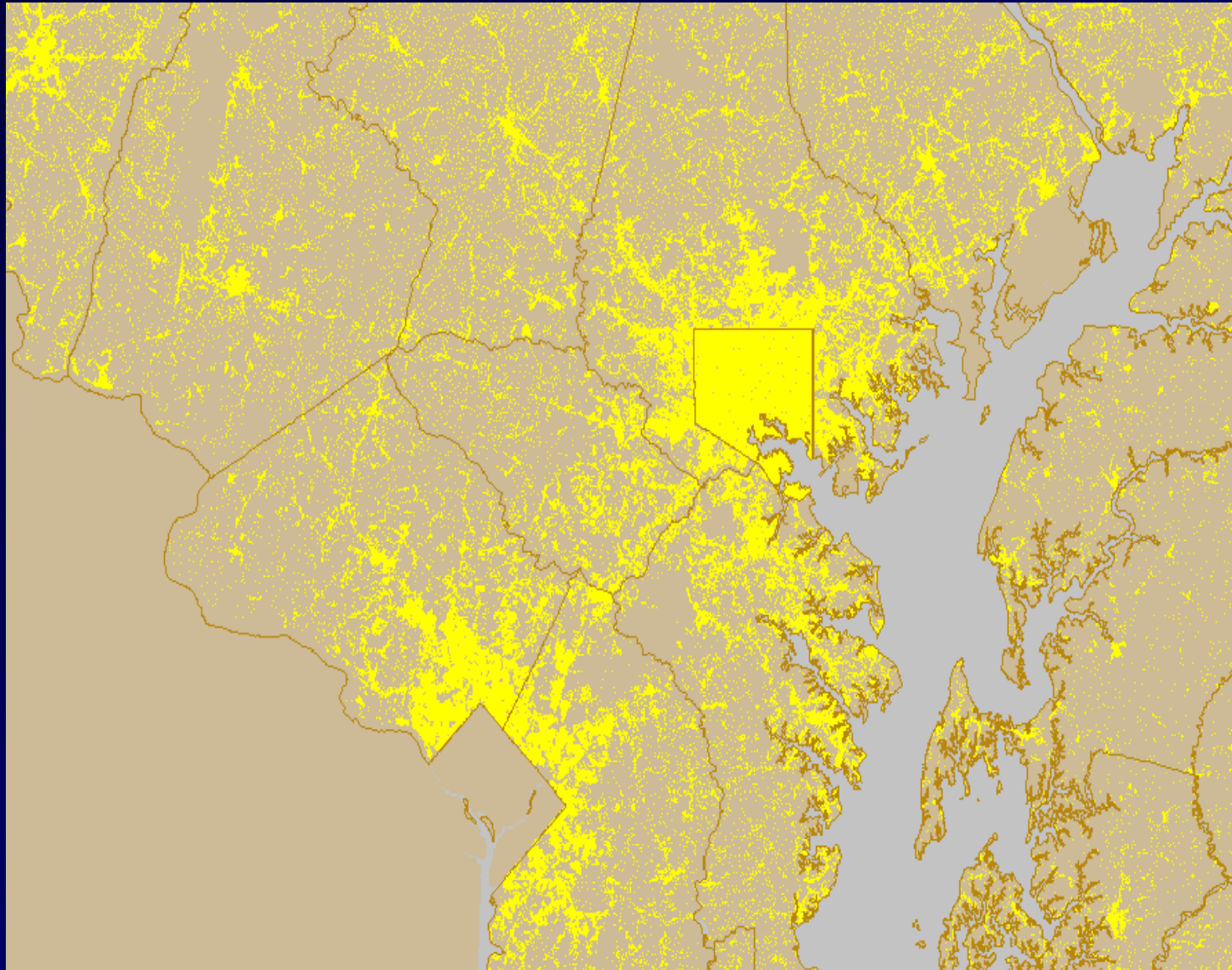
# **Maryland Smart Growth**

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- ***Support and enhance existing communities.***
- ***Permanently preserve our most valuable natural and agricultural resources.***
- ***Save taxpayers the cost of new and often redundant infrastructure needed to support sprawl development.***

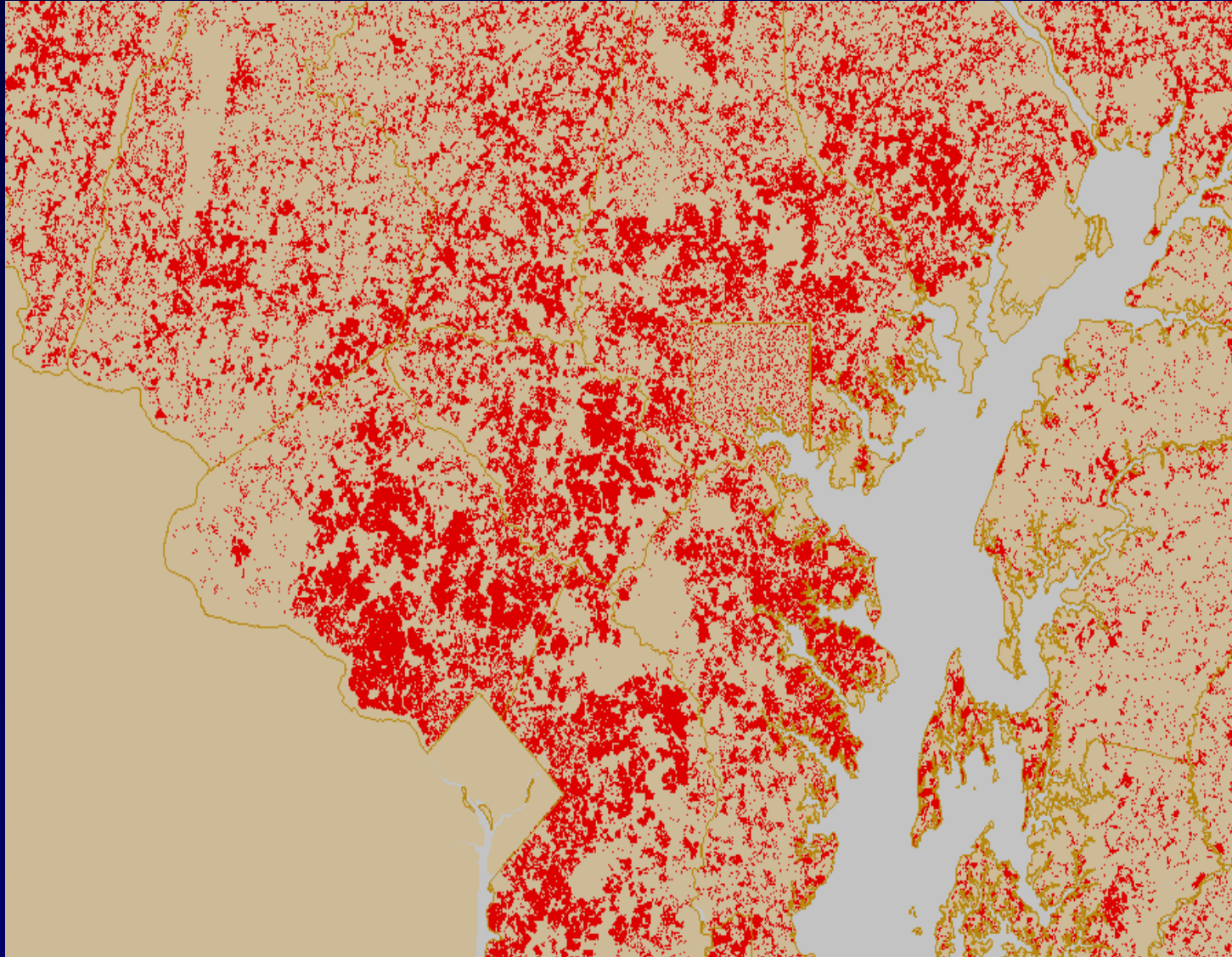
# ***Growth 1900-60***

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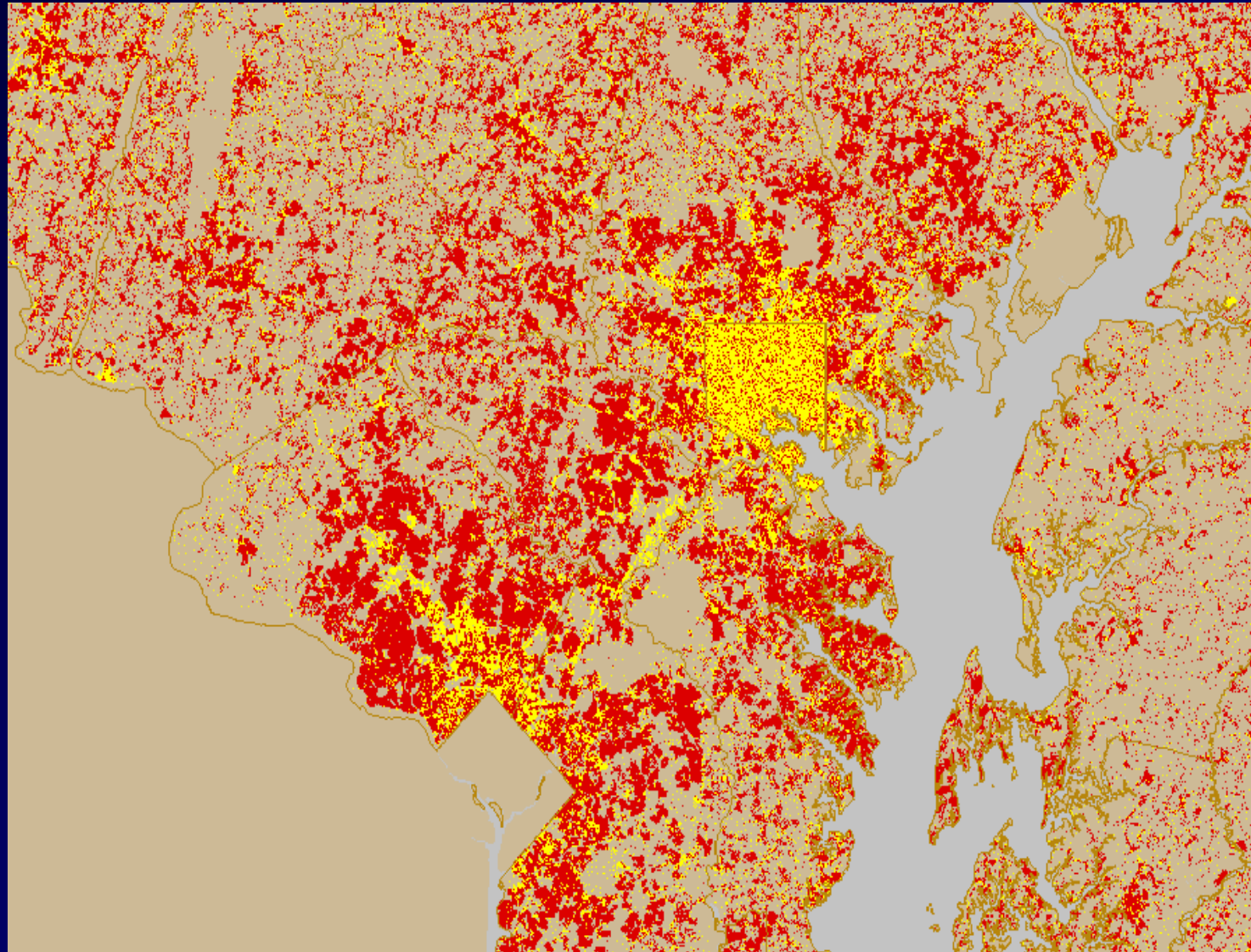
# ***Growth 1961-1997***

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# ***Cumulative Growth 1990-97***

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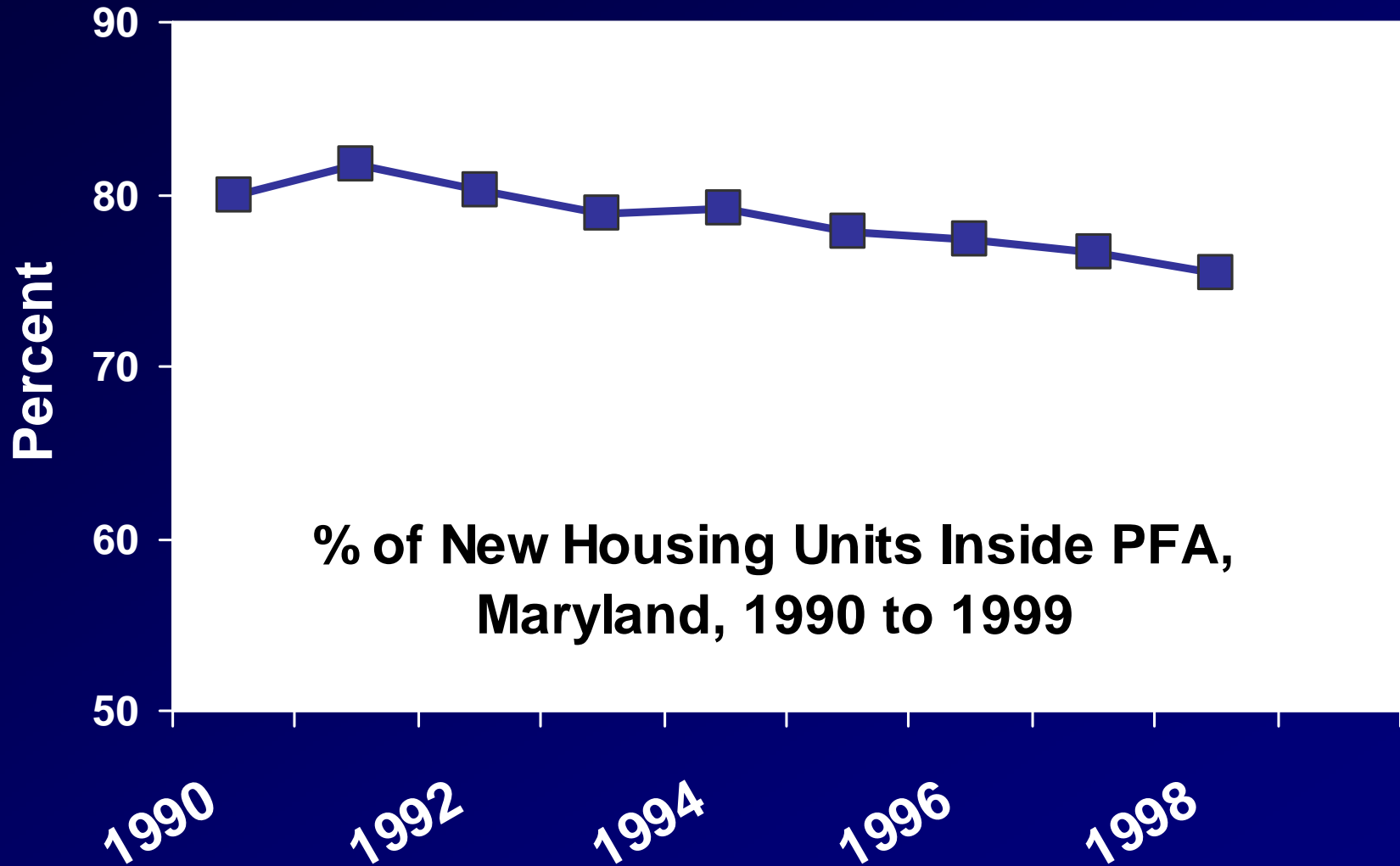
# *Land Consumption*

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*Next 25 Years = Last 368 Years*

# Housing Going to the Wrong Places

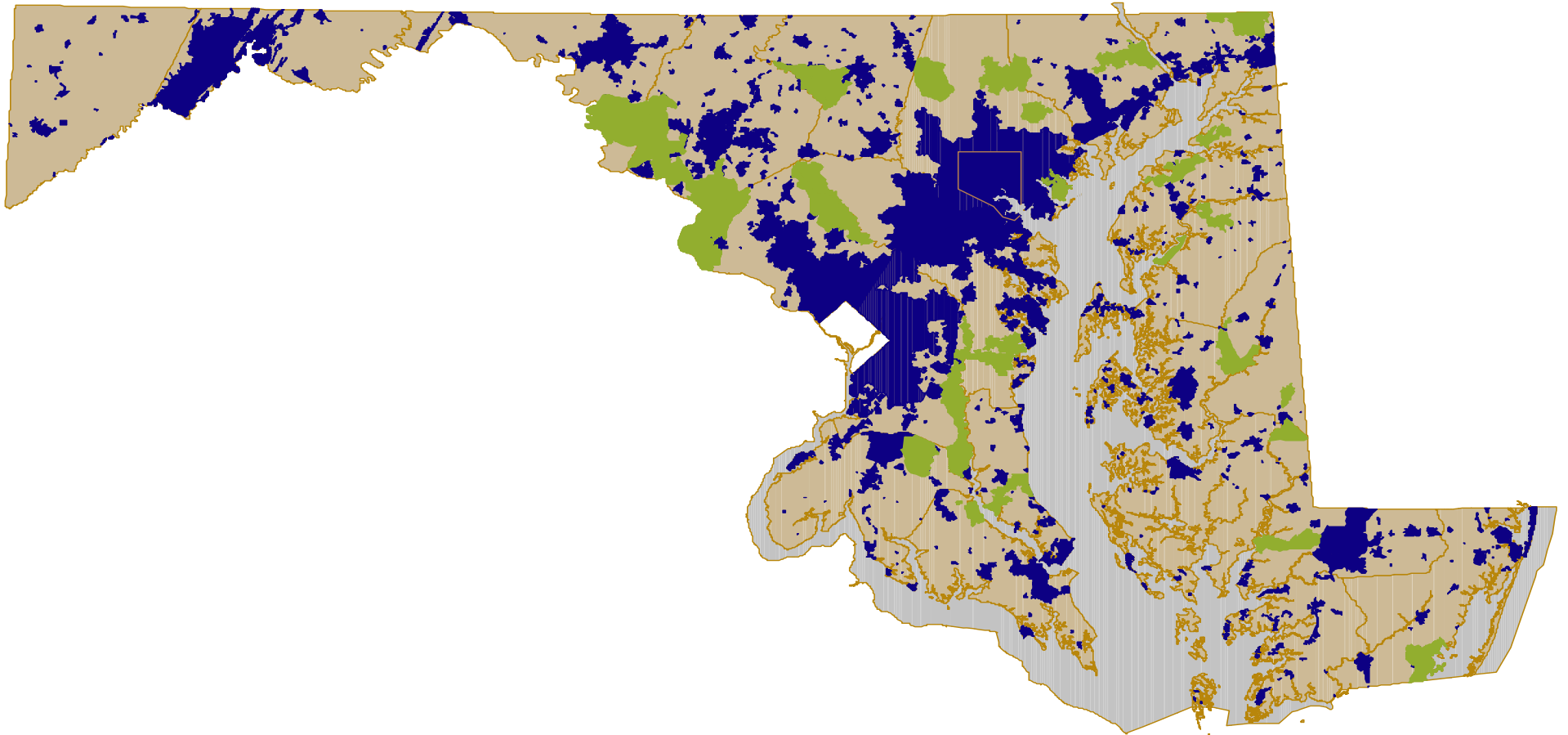
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# Inside and Outside Games

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# ***Smart Growth Tools (Inside Game)***

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- ***Priority Funding Areas Designation***
- ***Community Legacy Program***
- ***Maryland Smart Codes***
- ***Job Creation Tax Credit***
- ***Brownfields Voluntary Cleanup Program***

# ***Smart Growth Tools (Outside Game)***

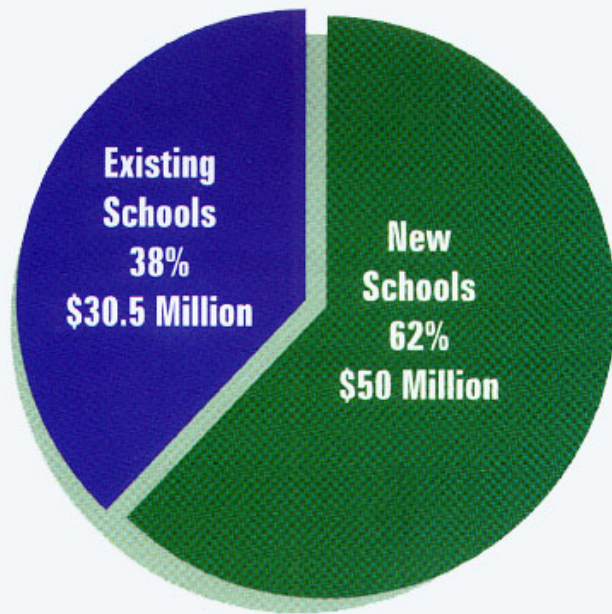
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- ***GreenPrint***
- ***Rural Legacy Program***
- ***Community Parks and Playgrounds***
- ***Buffer Incentive Program***

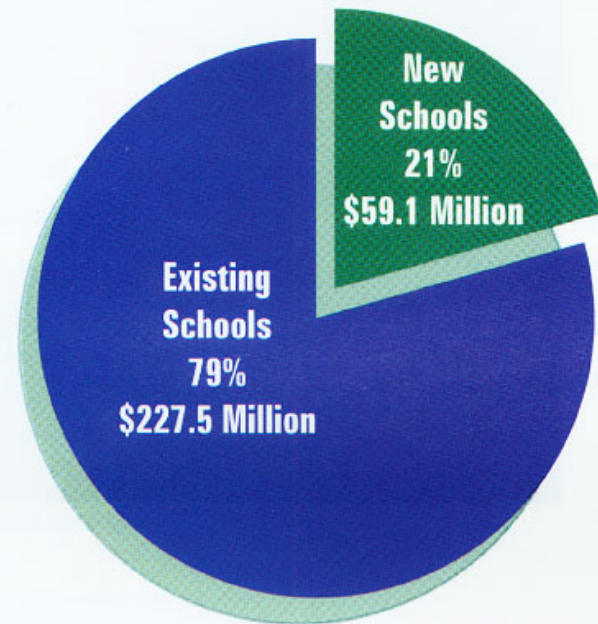
# ***Dramatic Shift in Funding Priority***

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**FY1991 Total \$80.5 Million**



**FY 2002 Total \$286.6 Million**



# Montgomery County's General Plan: "Wedges and Corridors" in 1964 and 1969

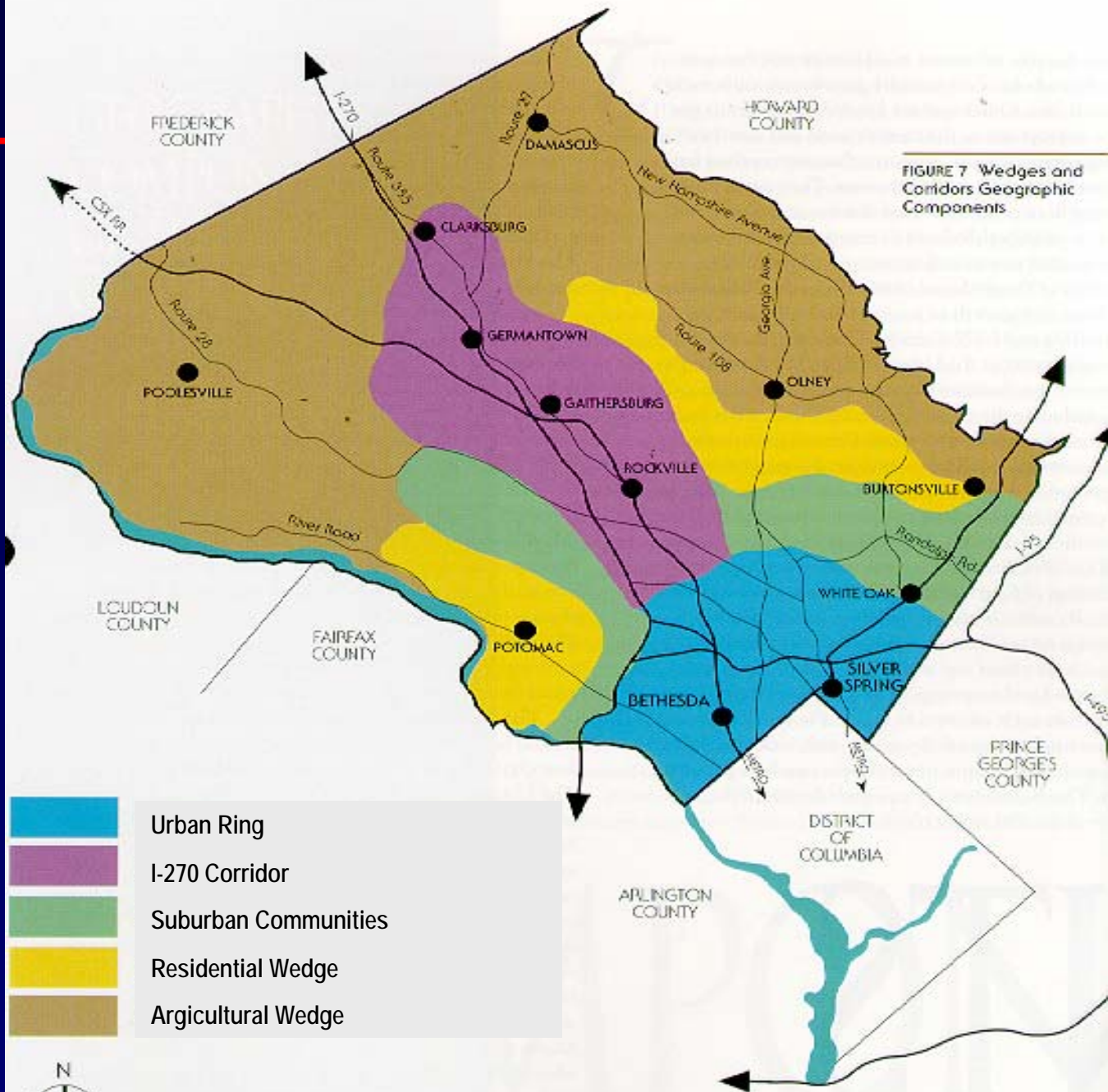


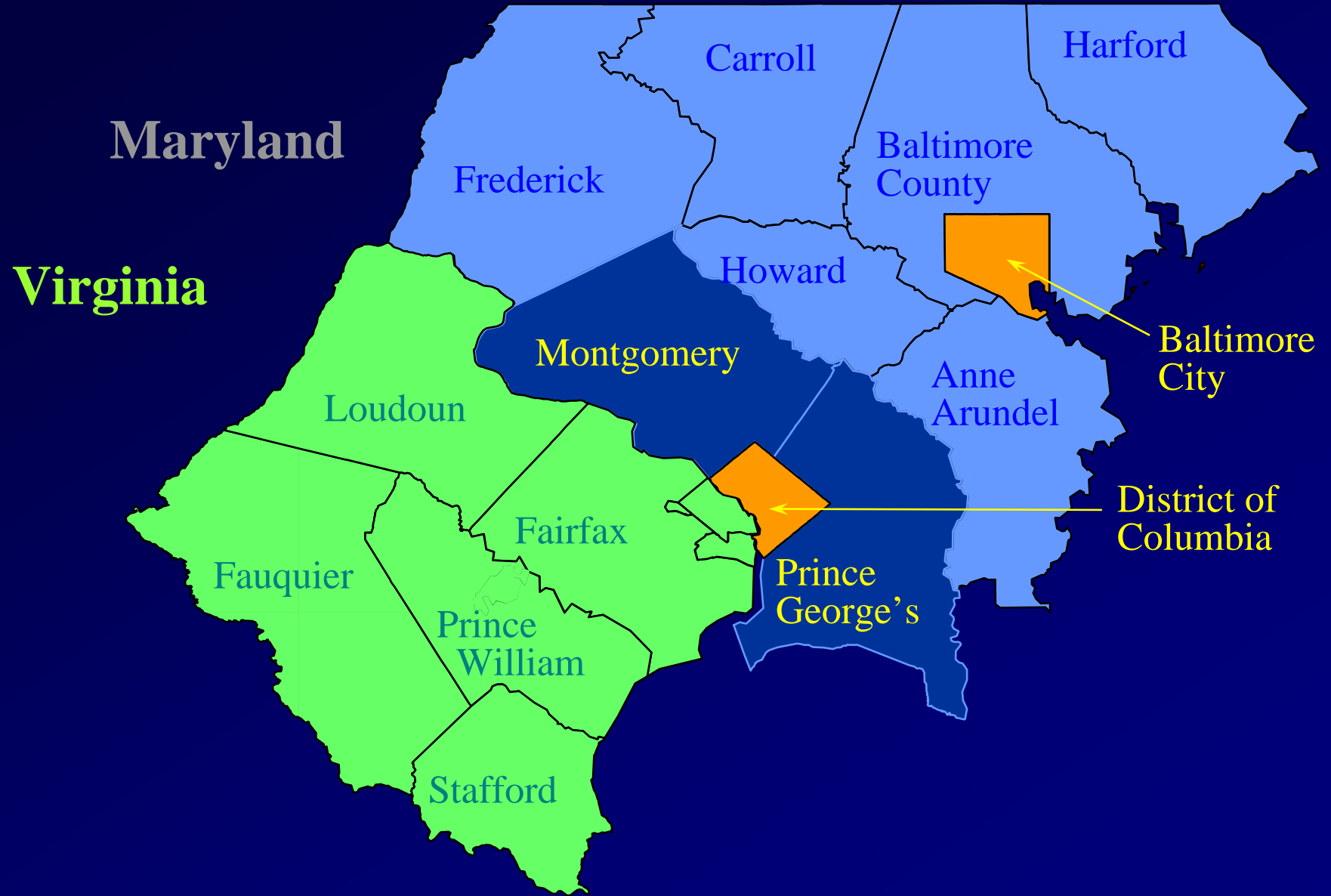
FIGURE 7 Wedges and Corridors Geographic Components

Place names are identified for geographic reference only



# Montgomery County's Location

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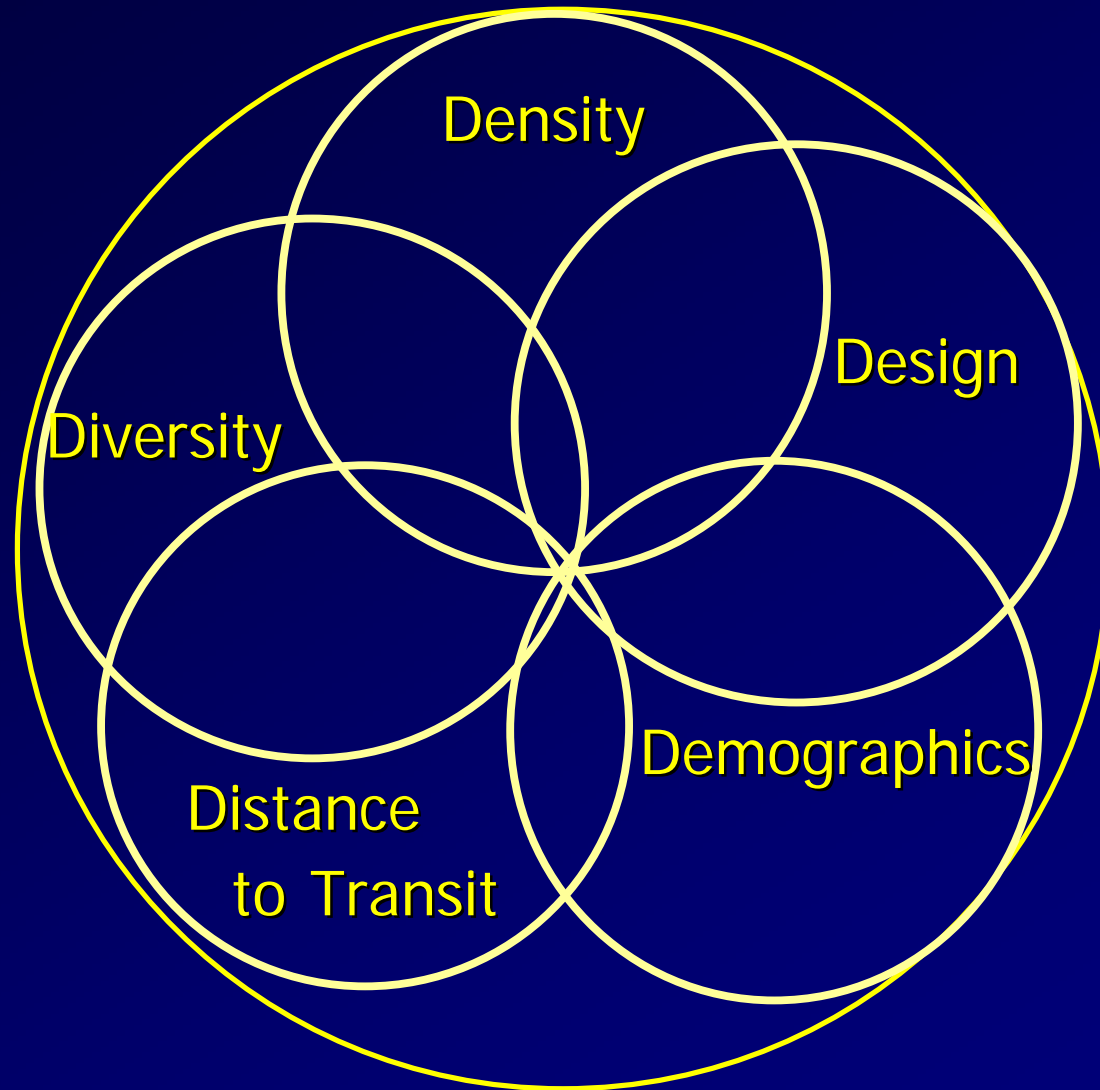
# *The Nation's Best TOD*

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# The D Variables

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# ***Density -- 33 Units per Acre (gross)***

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# Diversity -- Seamless

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# Design -- Interconnected and Varied Spaces



# Continuous Sidewalks Appropriately Scaled

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# Safe Crossings

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# Minimal “Dead” Space

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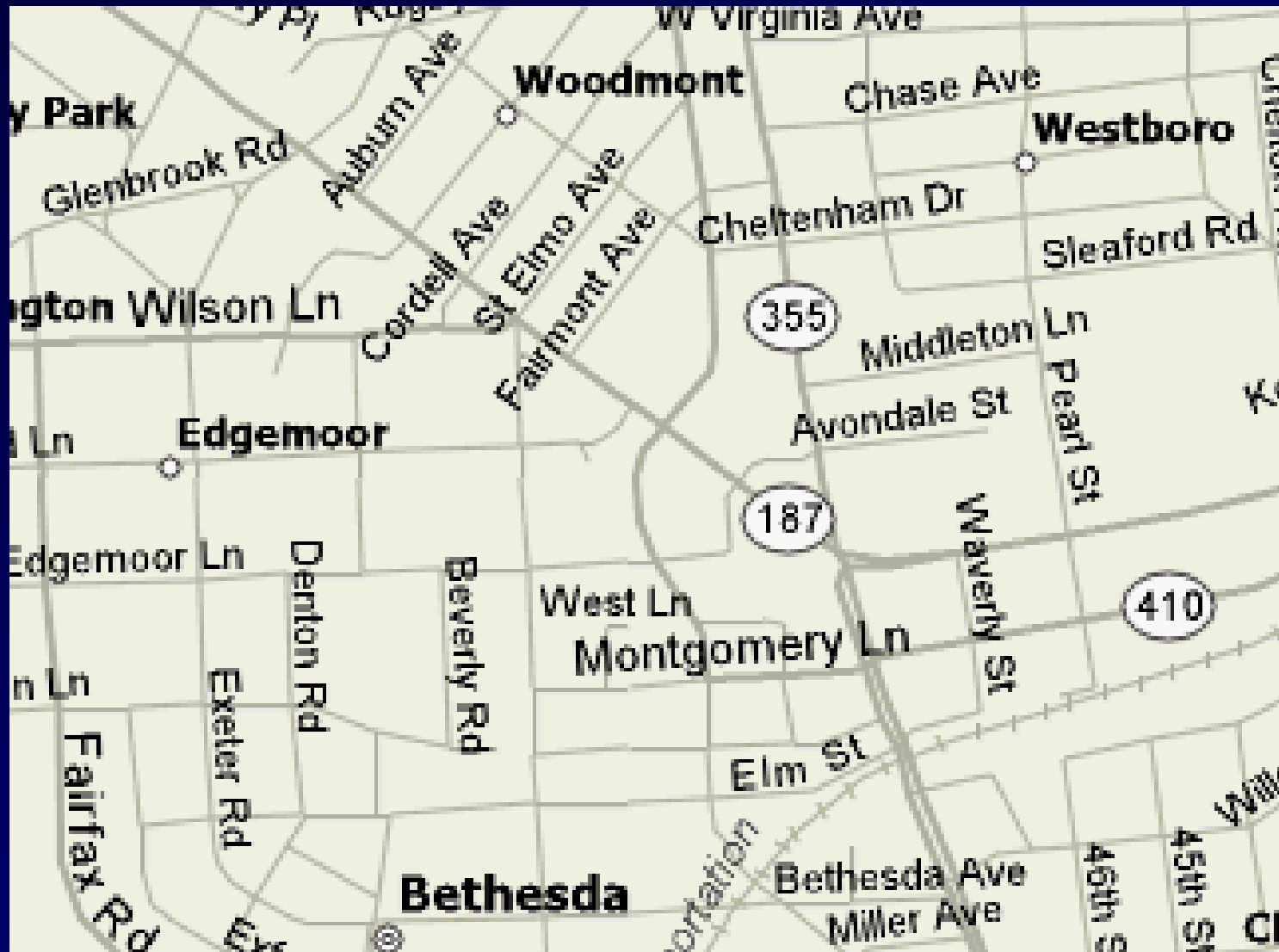
# Human-Scale Buildings

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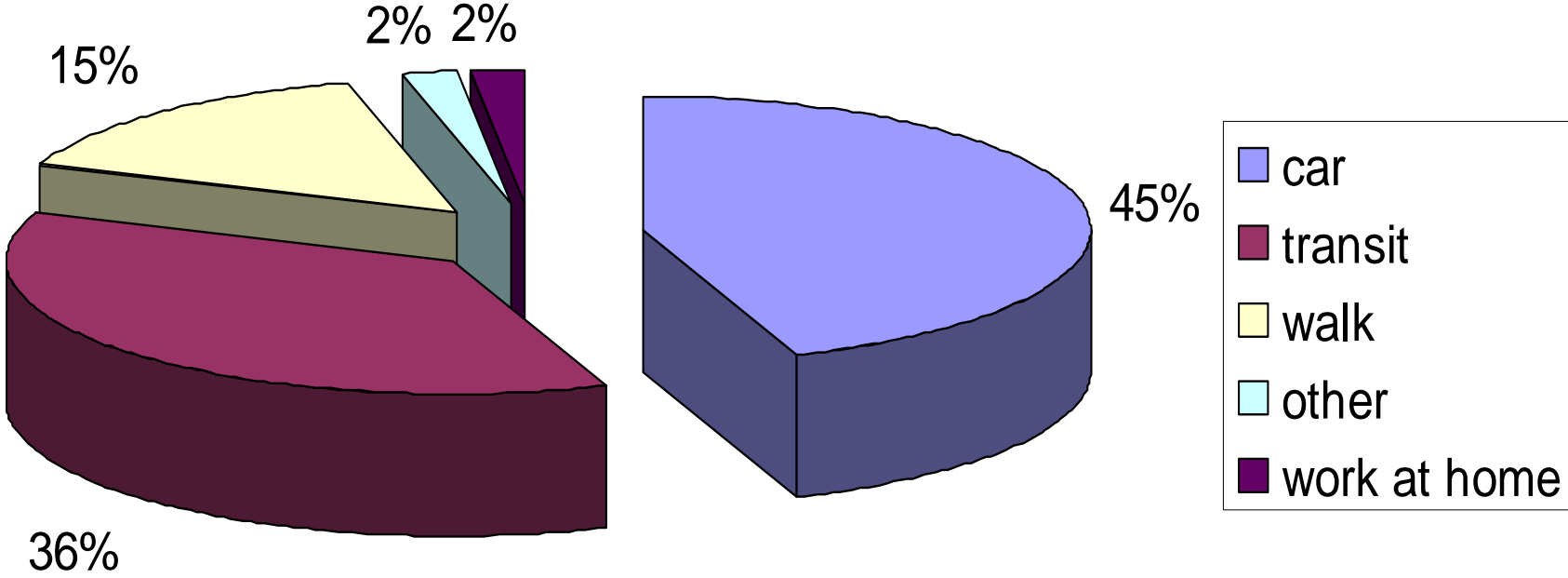


# Bethesda – Index of 1.49

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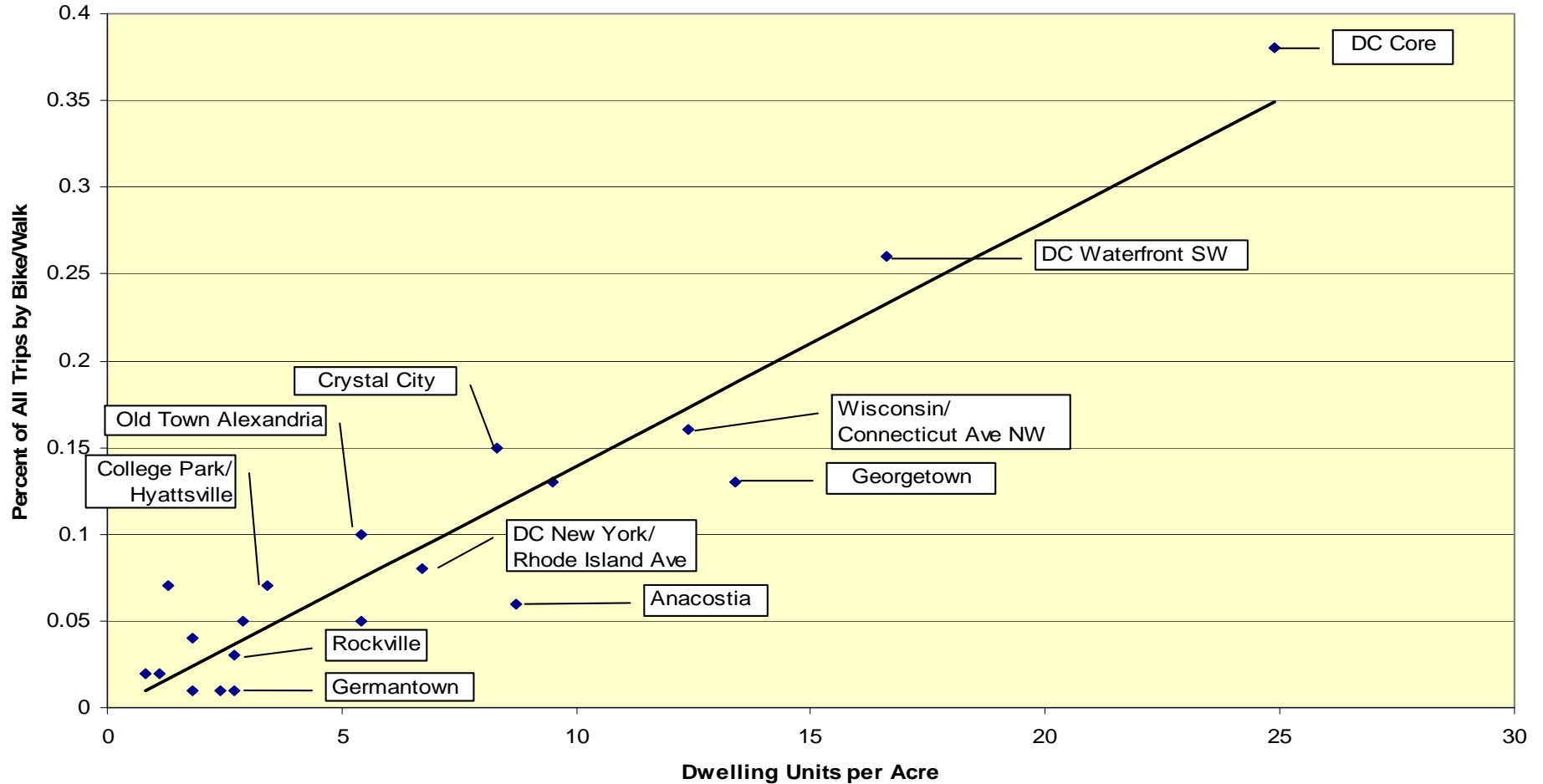
# Bethesda Town Center's Commute



# % Walking and Biking

## Percentage Bike/Walk Trips vs Residential Density

Source: Metropolitan Washington Council of Governments, 1995



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# ***Reshaping Urban America***

# ***Increase Densities***

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# Strengthen Centers

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# Mix Land Uses

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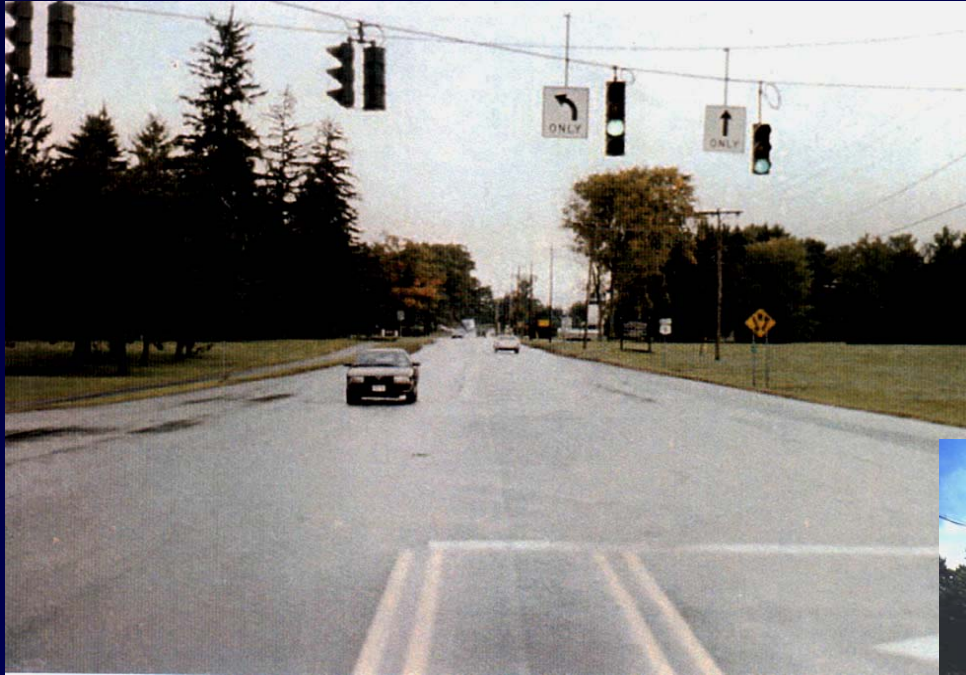
# ***Connect Streets/Shorten Blocks***

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# *Manage and Calm Traffic*

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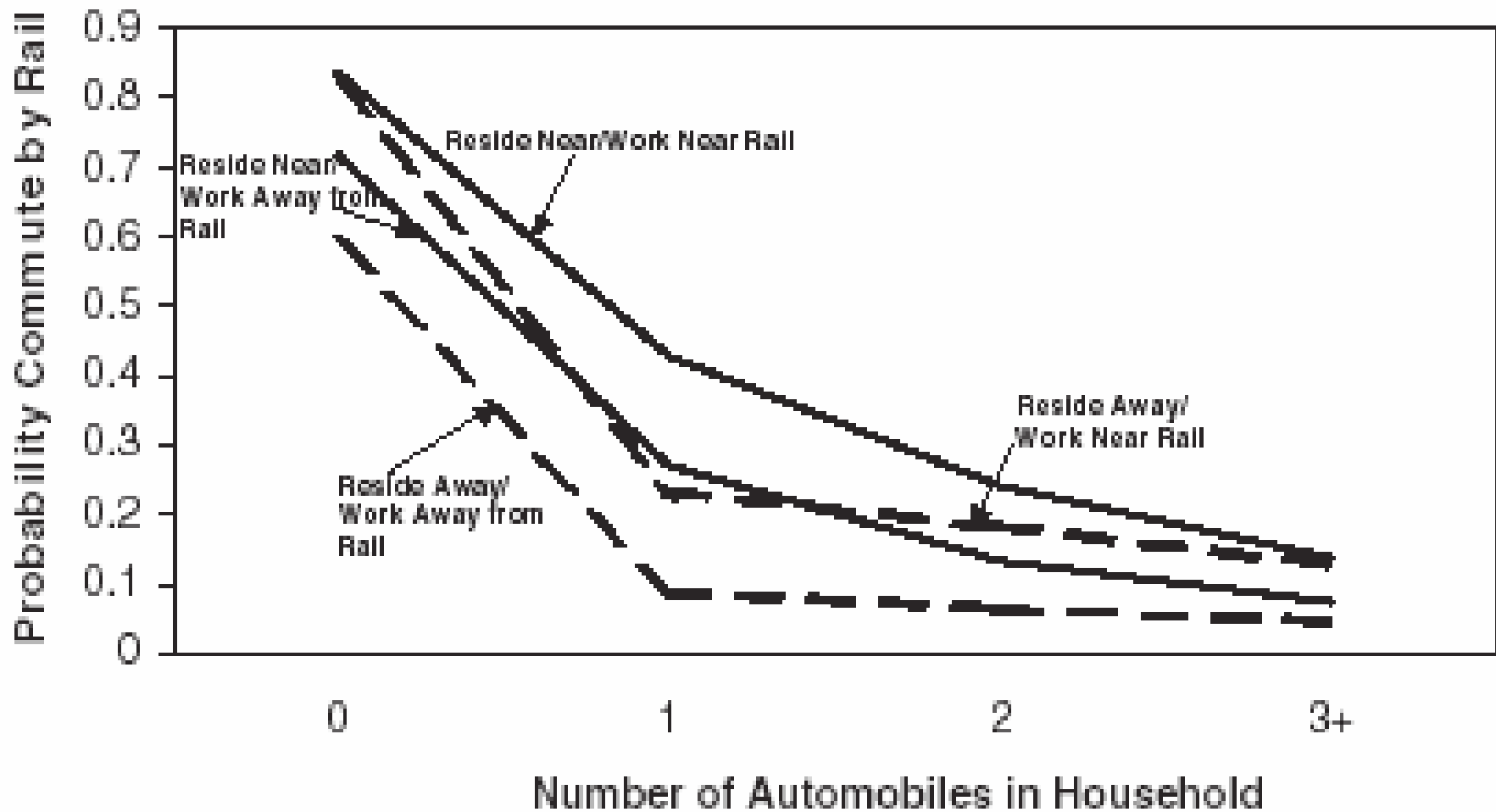


# ***Improve Pedestrian Infrastructure***

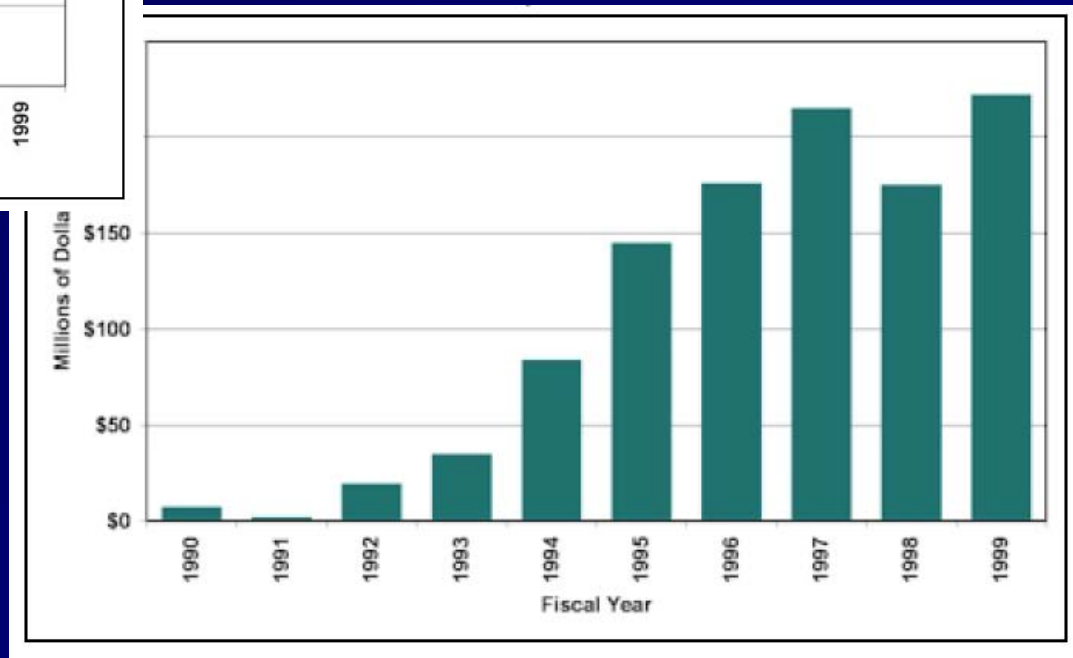
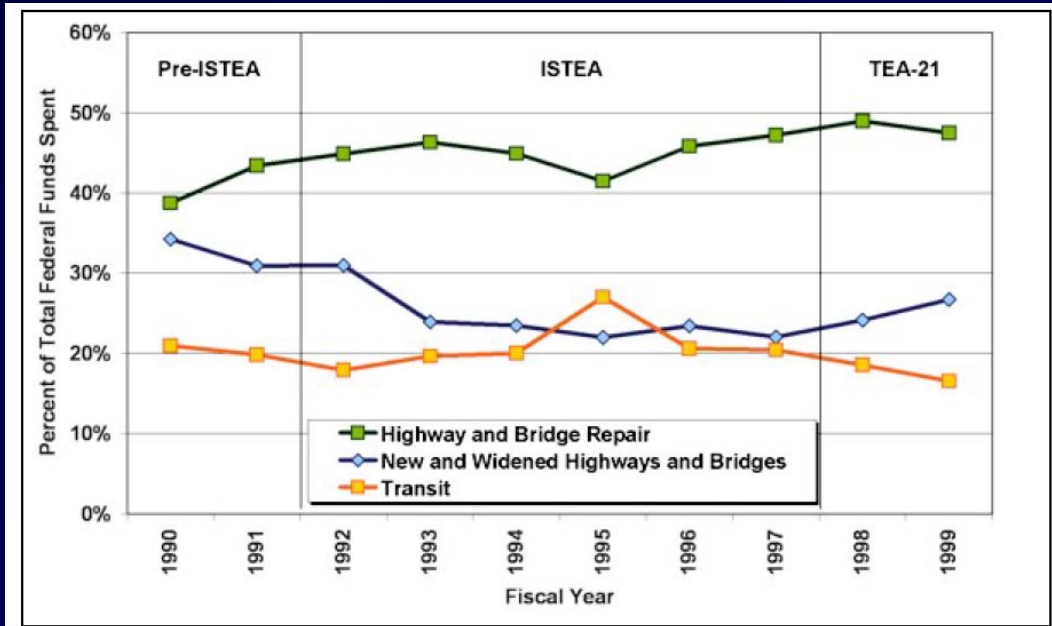
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# Build High-Quality Transit Network



# Change Funding Priorities



# ***Change Economics of Sprawl and Driving***

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- ***Marginal Cost Utility Pricing***
- ***Location-Efficient Mortgages***
- ***Congestion Toll Pricing***
- ***Parking Cash-Out***
- ***Pay-As-You Drive Insurance***

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# ***You Cannot Get There with Planning Requirements Alone***

***Metropolitan Planning Factors***

***New Starts Criteria for Transit Funding***

***NEPA/CEQA***

***Blueprint Planning***



## **Good Place to Start**

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- **Governor's Strategic Growth Infrastructure Bond Package**
  - *no highway funds for high-performance highway expansion without tolls – toll revenues diverted to other modes – connector roads with truly limited access*
  - *other bond funds directed to priority funding areas that have Oregon-like growth controls in place, Maryland-like density transfer mechanisms to ensure permanent open space around them, and Florida-like adequate public facility requirements and impact fee schedules*