Growing Cooler: The Evidence on Urban Development and Climate Change

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GROWING COOLER

THE EVIDENCE ON URBAN DEVELOPMENT AND CLIMATE CHANGE

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Smart Growth America

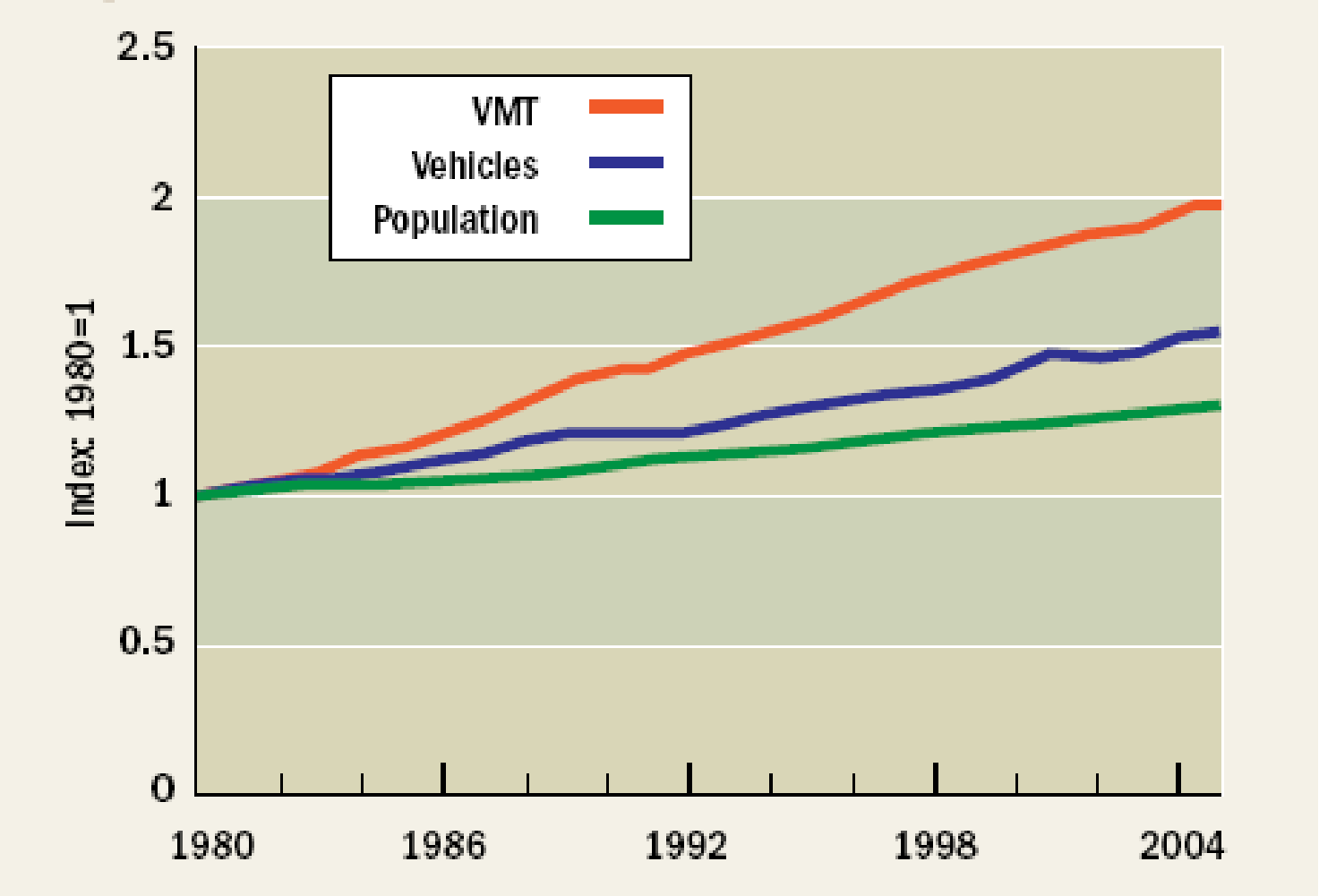
Better Choices For Our Communities

www.support.smartgrowthamerica.org/growing_cooler

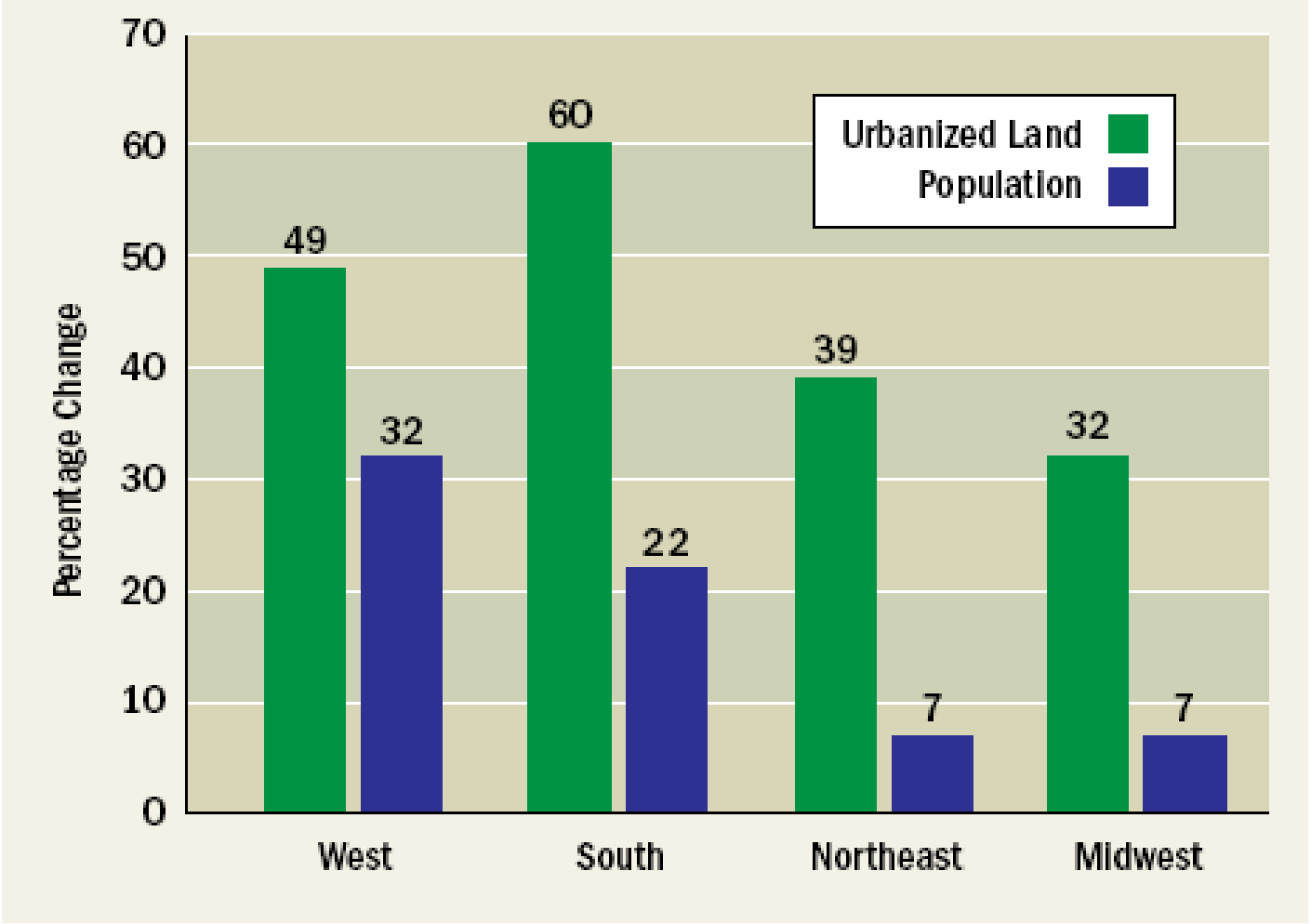
Chapter 2

What Does Urban Development Have to Do with Climate Change?

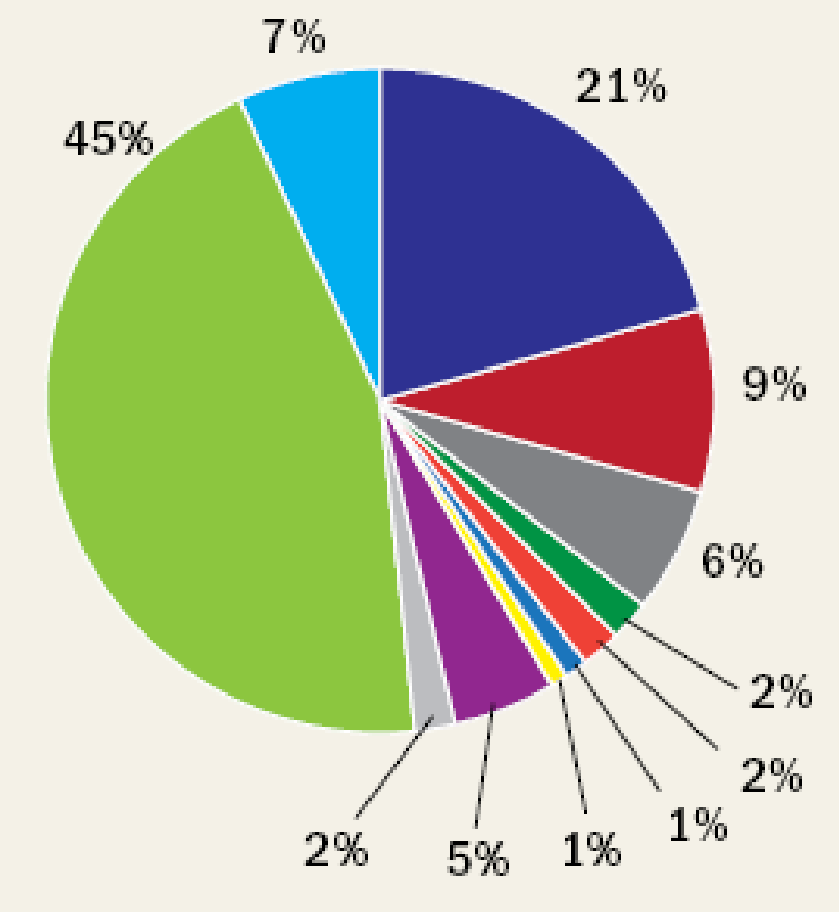
Growth of VMT



Growth of the Urban Footprint



Another Hint



Is It Too Late to Develop in a Different Way?

2/3rd of Development in 2050

- U.S. population will grow to 420 million by 2050
- 89 million new or replaced homes
- 60 billion square feet of new offices, institutions, stores, and other nonresidential + 130 billion of replaced space

Is the Market Ready for Compact Development?

National Survey on Communities

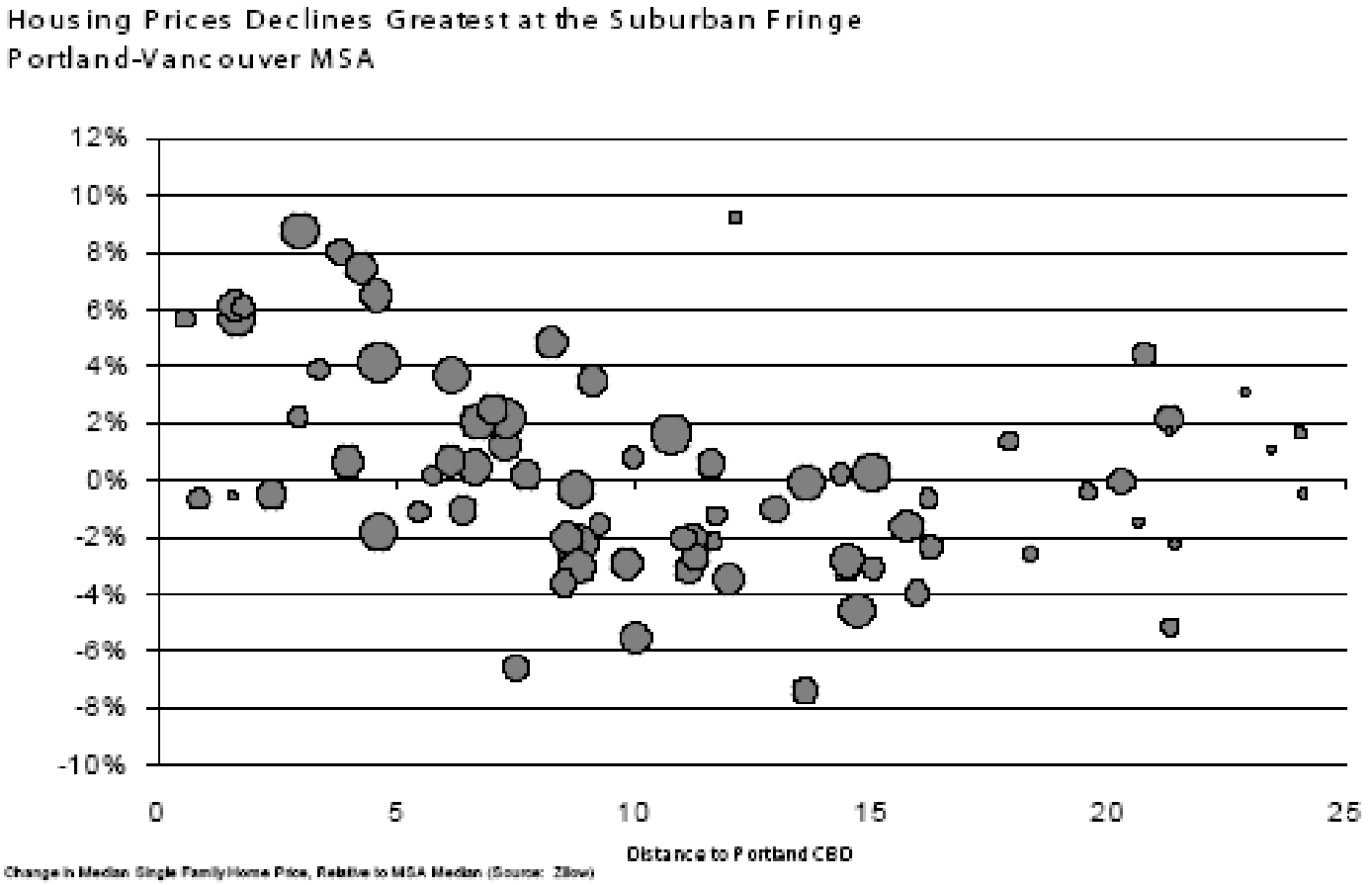
Community A	Community B
There are **only single family houses** on one acre lots	There is a **mix** of single family detached houses, townhouses, apartments and condominiums on various sized lots
There are **no sidewalks**	Almost all the streets have **sidewalks**
Places such as shopping, restaurants, library, and a school are within a **few miles** of your home and you **have to drive** to most	Places such as shopping, restaurants, library, and a school are within **a few blocks** of your home and you can **either walk or drive**
There is enough parking when you drive to local stores, restaurants and other places	Parking is **limited** when you decide to drive to local stores, restaurants and other places
Your one-way commute is **45 minutes or over**	Your one-way commute is less than **45 minutes**
Public transportation, such as train, bus, and light rail, is **distant or unavailable**	Public transportation, such as train, bus, and light rail, is **nearby**

More than Half of Americans

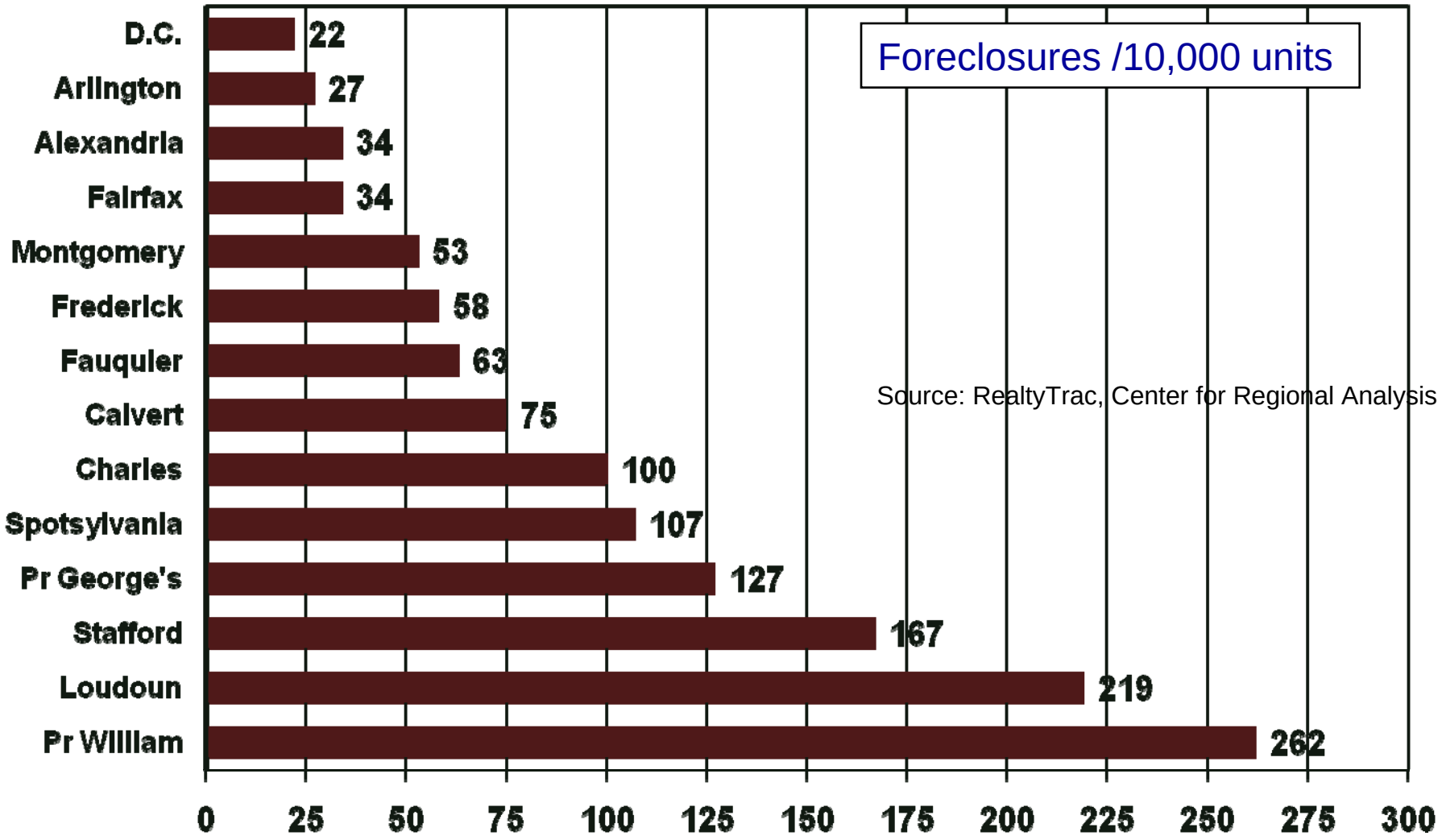
- 55% of Americans select the smart growth community and 45% select the sprawl community.

- 61% who think they will buy a house in the next three years are more likely to look for a home in a smart growth community rather than a sprawl community 39%.

Price Declines Greatest at Fringe (2006 vs. 2007)

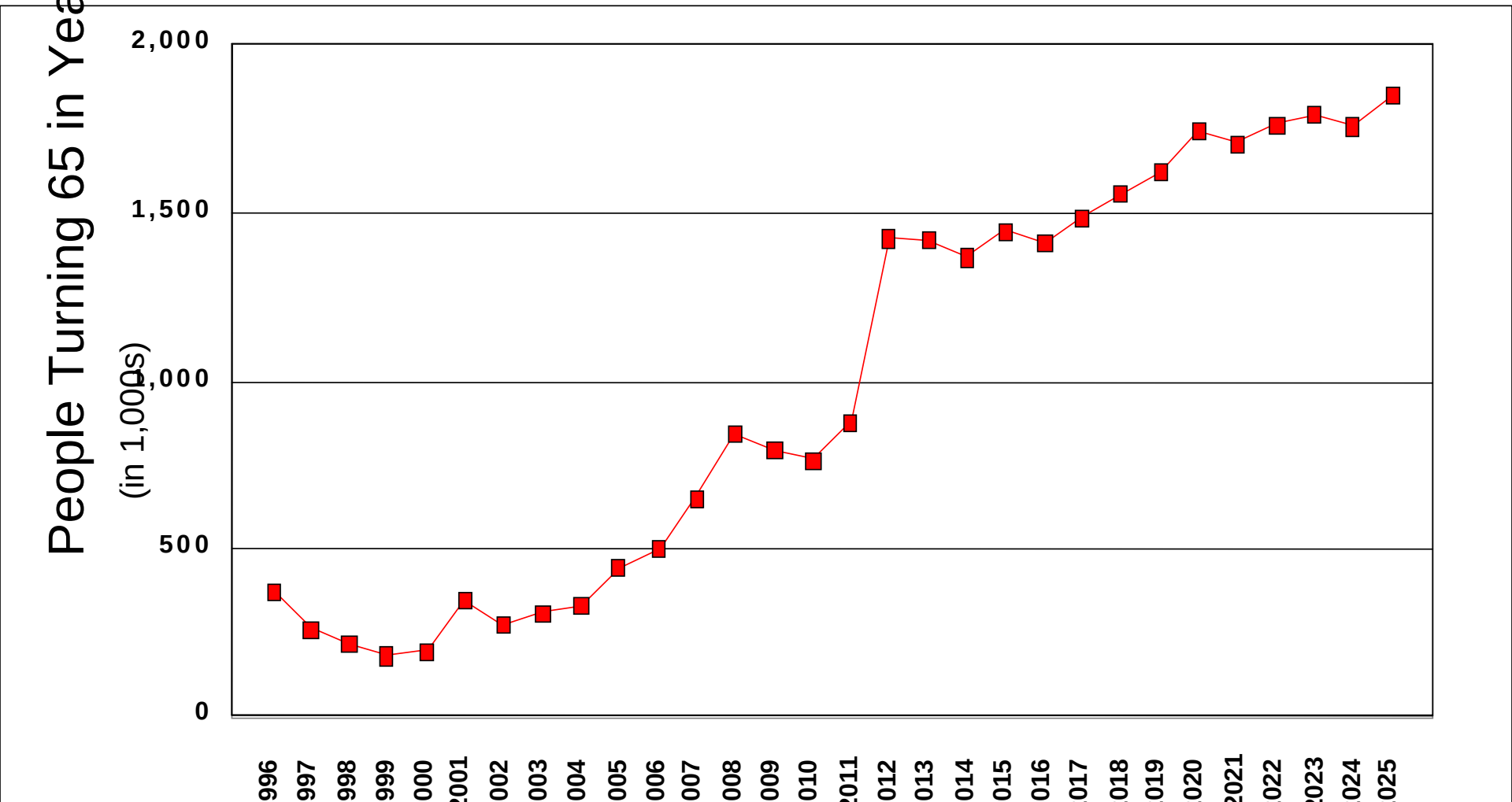


Mortgage Foreclosure Rates by County – Nov 30, 2007



Will the Market for Compact Development Continue to Grow?

Silver Tsunami

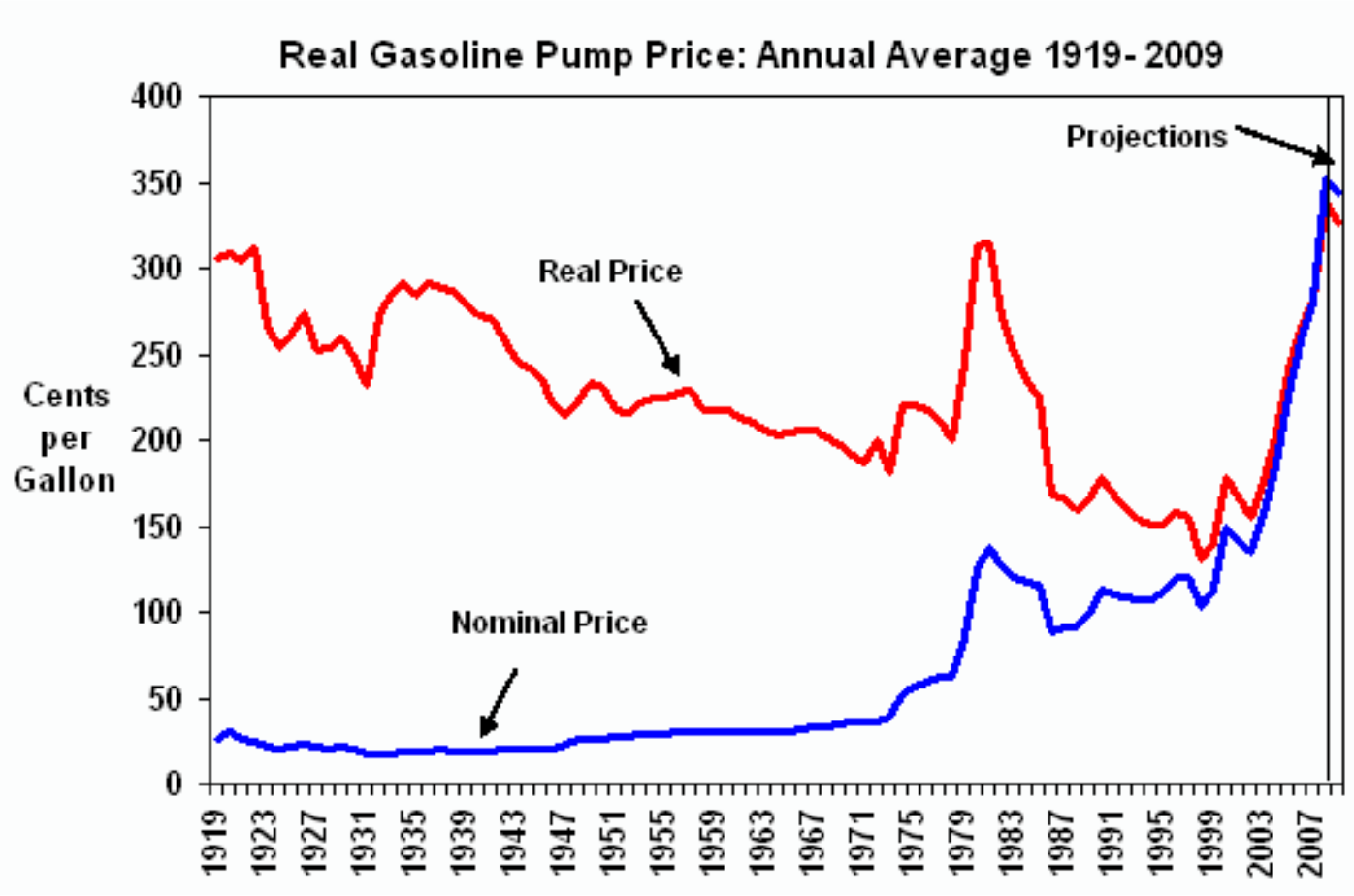


Decline in Households with Kids

Household	1960	2000	2025
With Children	48%	33%	28%
Without Children	52%	67%	72%
Single	*13%*	*26%*	*28%*

Source: Census for 1960 and 2000, 2025 adapted from Martha Farnsworth Riche, How Changes in the Nation's Age and Household Structure Will Reshape Housing Demand in the 21st Century, HUD (2003).

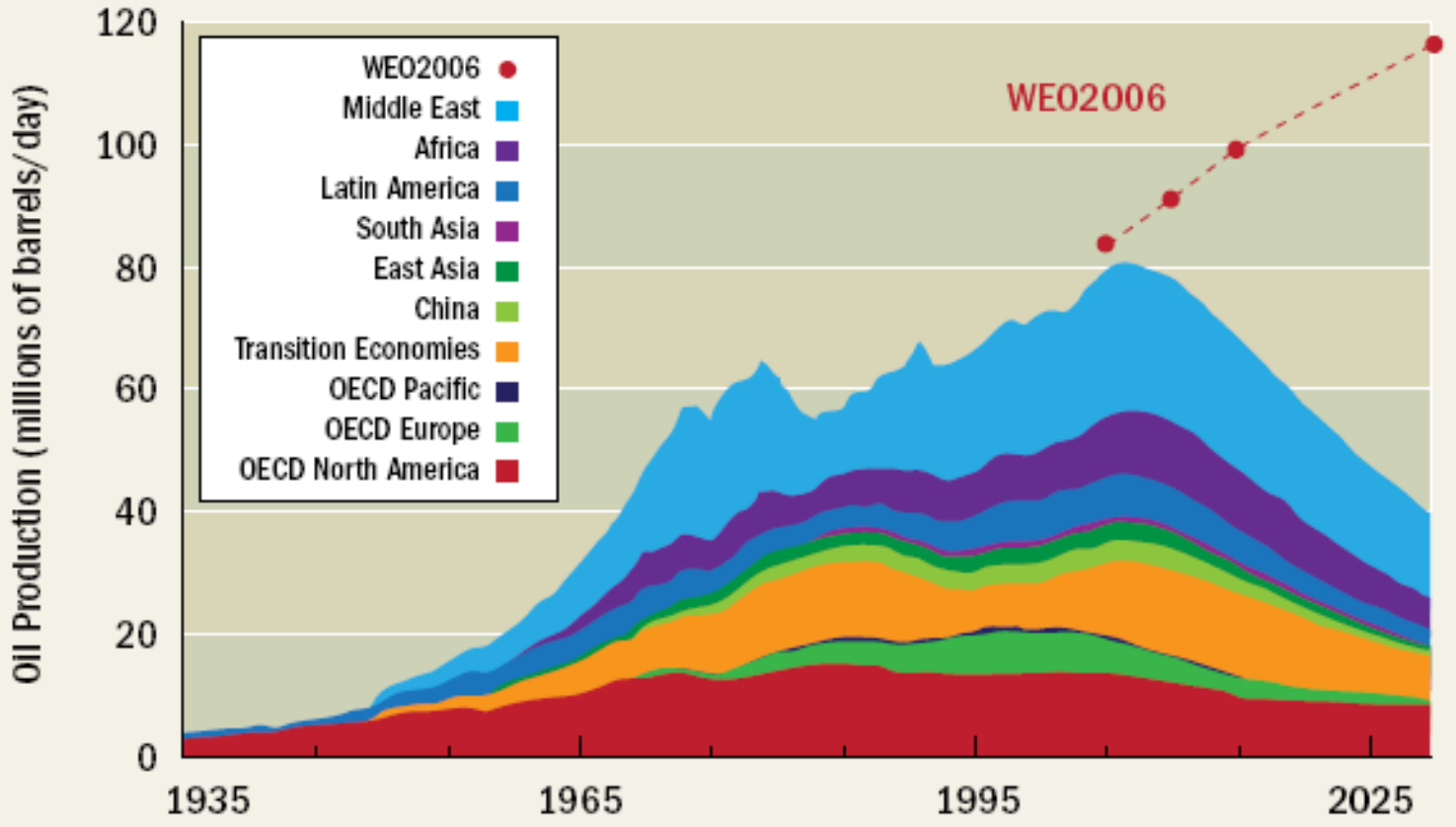
Gas Price Bubble?



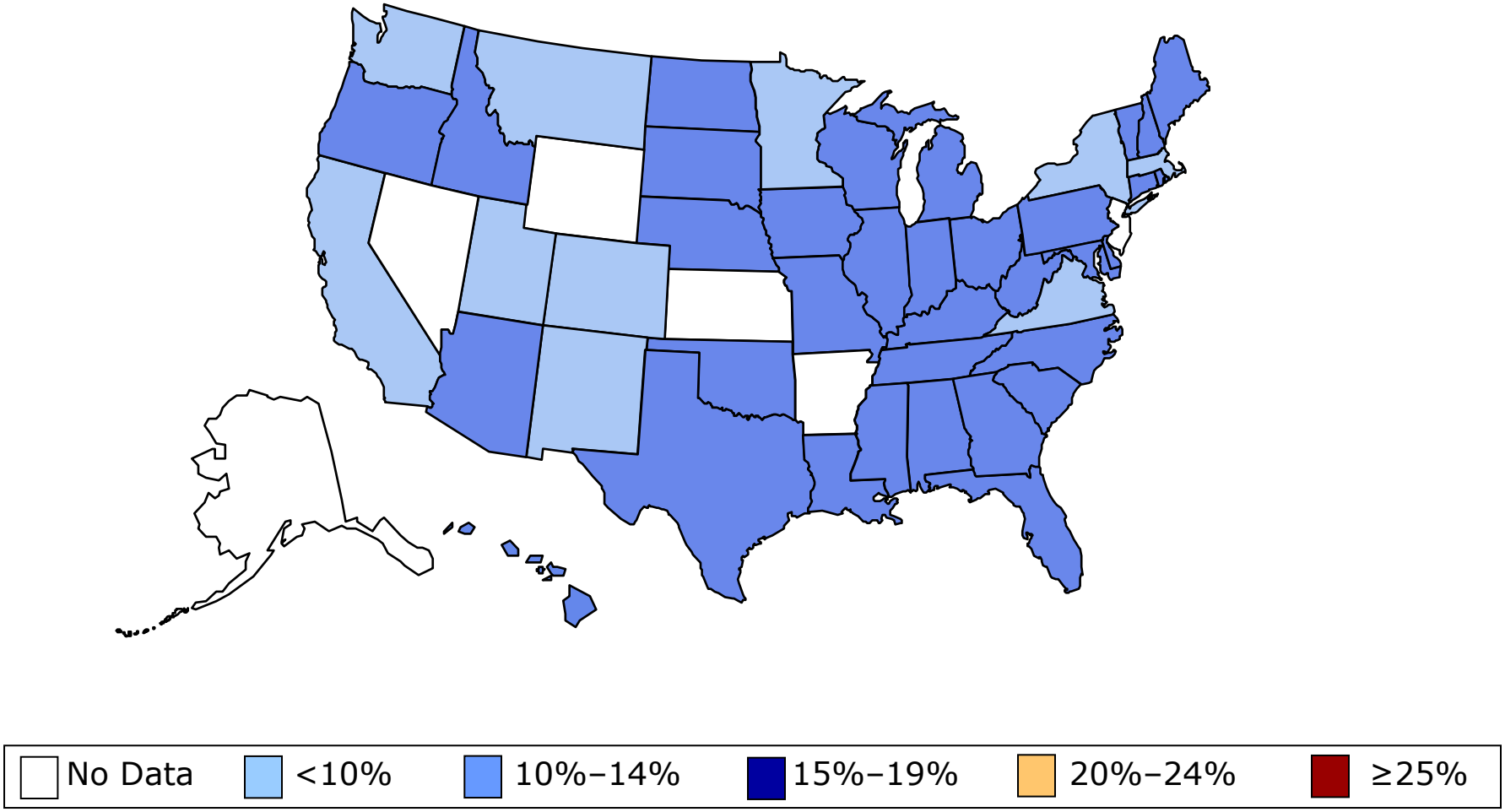
Peak Oil

FIGURE 1-6

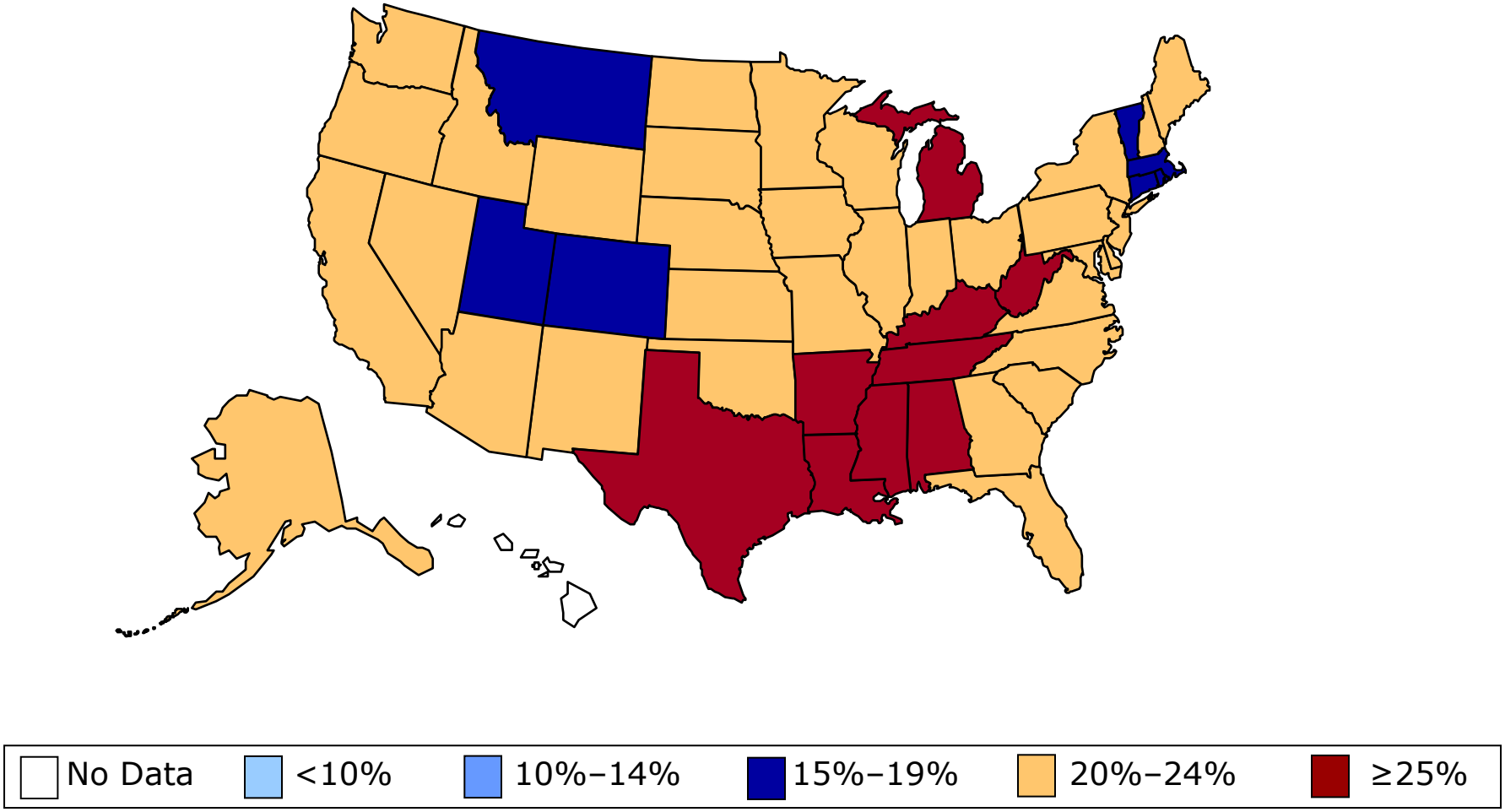
World Oil Production in the Best and Worst Cases*



Obesity Trends Among U.S. Adults
1990



Obesity Trends Among U.S. Adults 2004

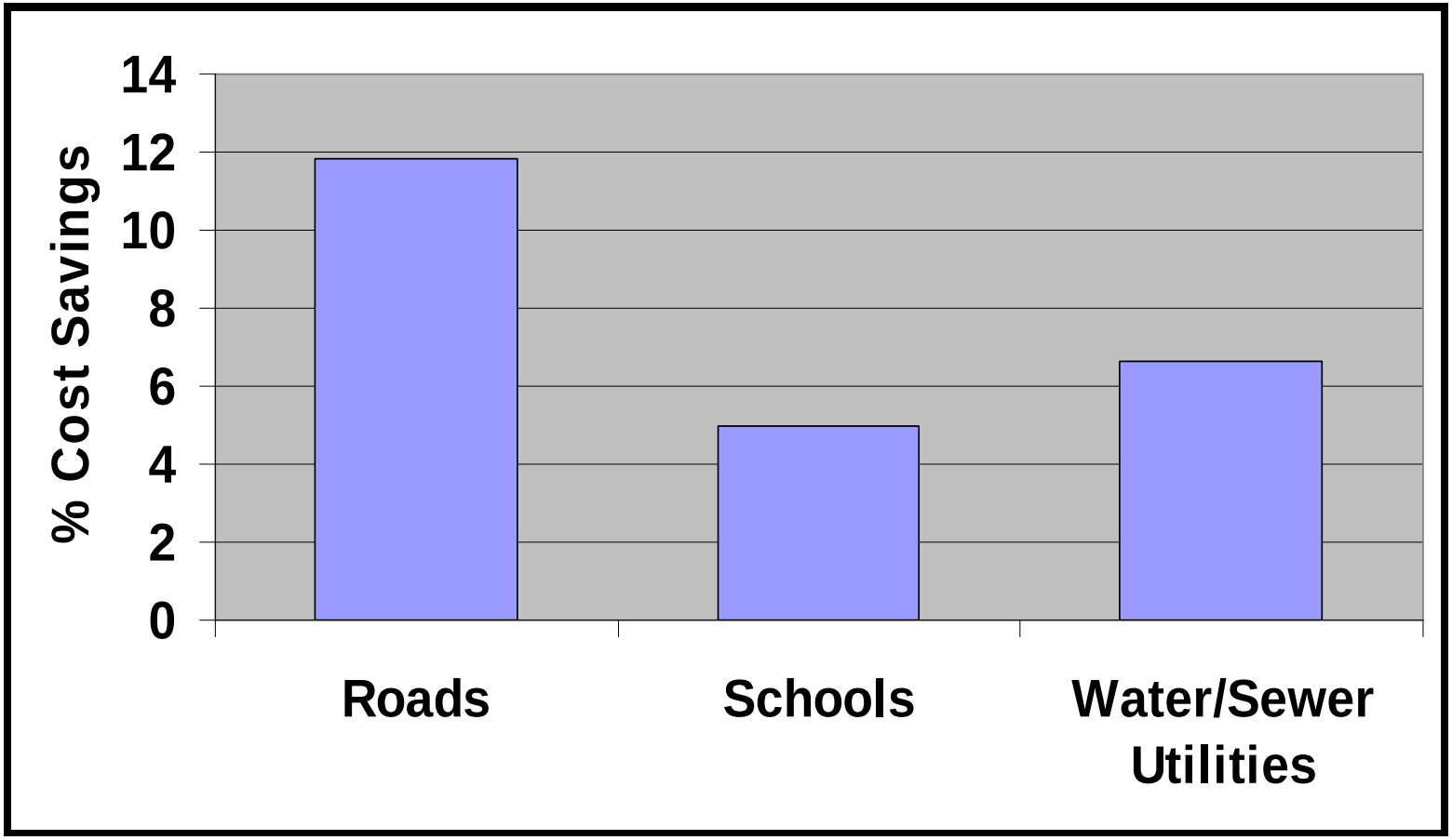


ASCE's Infra Report Card 2001

System	Grade	Comments
Roads	D+	27% of freeways congested
Bridges	C	29% structurally deficient/obsolete
Transit	C-	Ridership up, Spending not
Wastewater	D	$12 billion annual shortfall
Solid Waste	C+	Amounts of SW on the decline
Hazardous Waste	D+	Backlog of SF sites on the rise
Drinking Water	D	$11 billion annual shortfall
Dams	D	Over 2,100 unsafe dams in US
Aviation	D	Air traffic up 37%, Capacity up 1%
Energy	D+	Capacity lags behind demand
Schools	D-	75% of school buildings inadequate
OVERALL	D+	

TOTAL 5 YEAR INVESTMENT NEED: *$1.3 TRILLION*

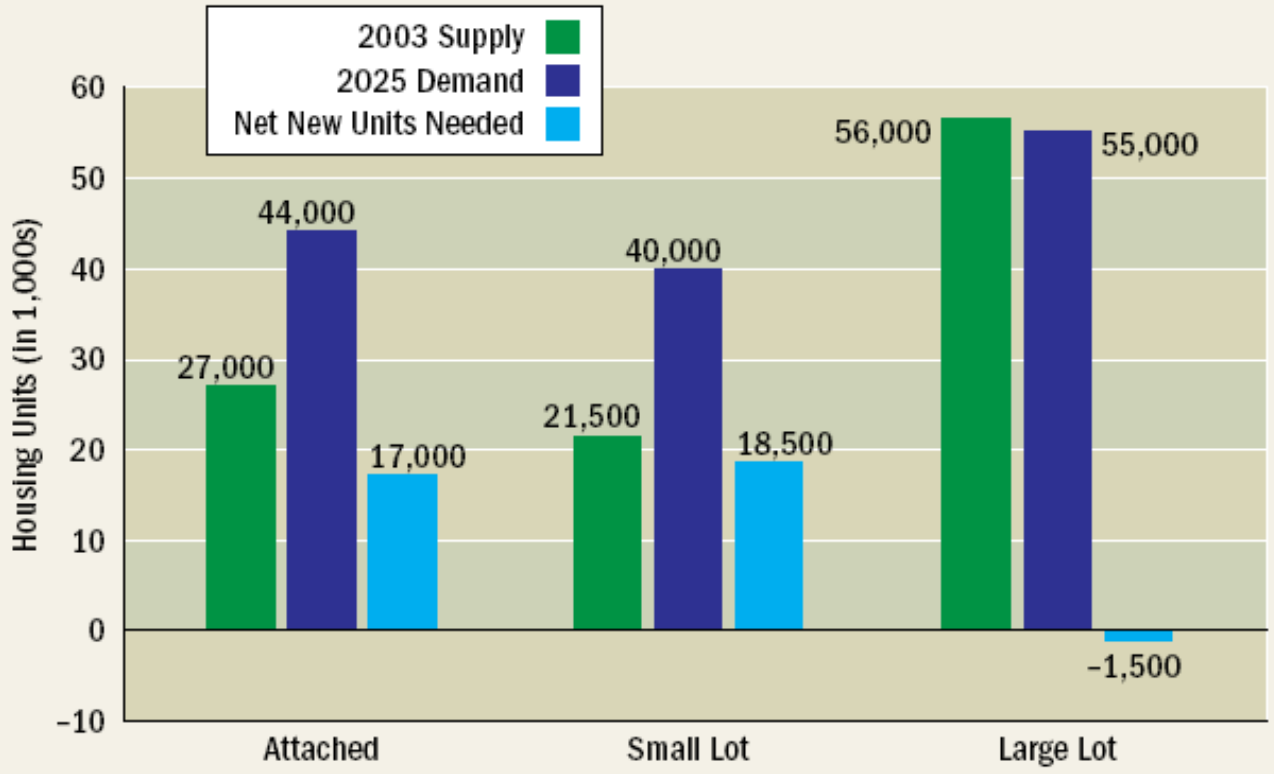
Savings with Compact Development



Enough of the Big Stuff Already

FIGURE 1-5

2003 Housing Supply versus 2025 Housing Demand



SOURCE: A.C. Nelson. "Leadership in a New Era." *Journal of the American Planning Association.* Vol. 72, Issue 4, 2006, pp. 393–407.

Chapter 3

Perfect Storm in Climate Policy

Major U.S. Corporations and Environmental Groups Band Together to Form the USCAP

2,500 Top Climate Scientists (IPCC) Project Catastrophic Consequences

Supreme Court Rules that EPA Has Power and Duty to Act on Greenhouse Gases

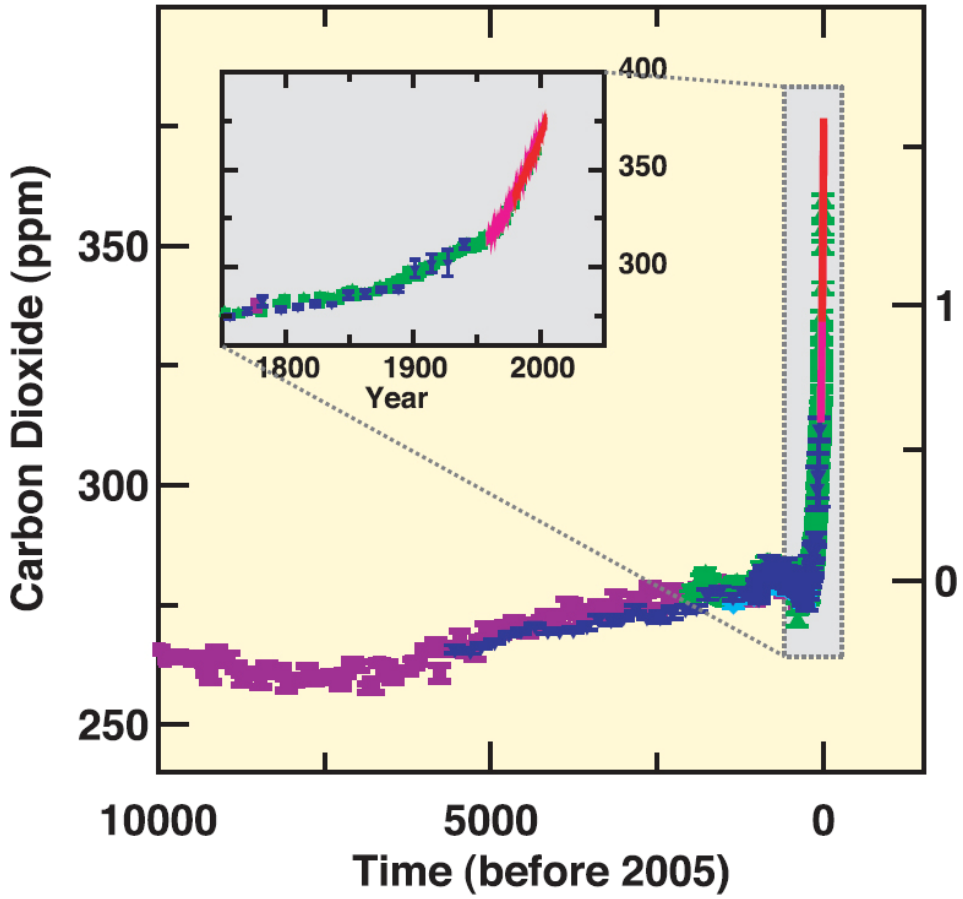
Russian Mini-Submarines Plant Flag under the North Pole, Precipitating an Artic Land Grab

Synthesis Report

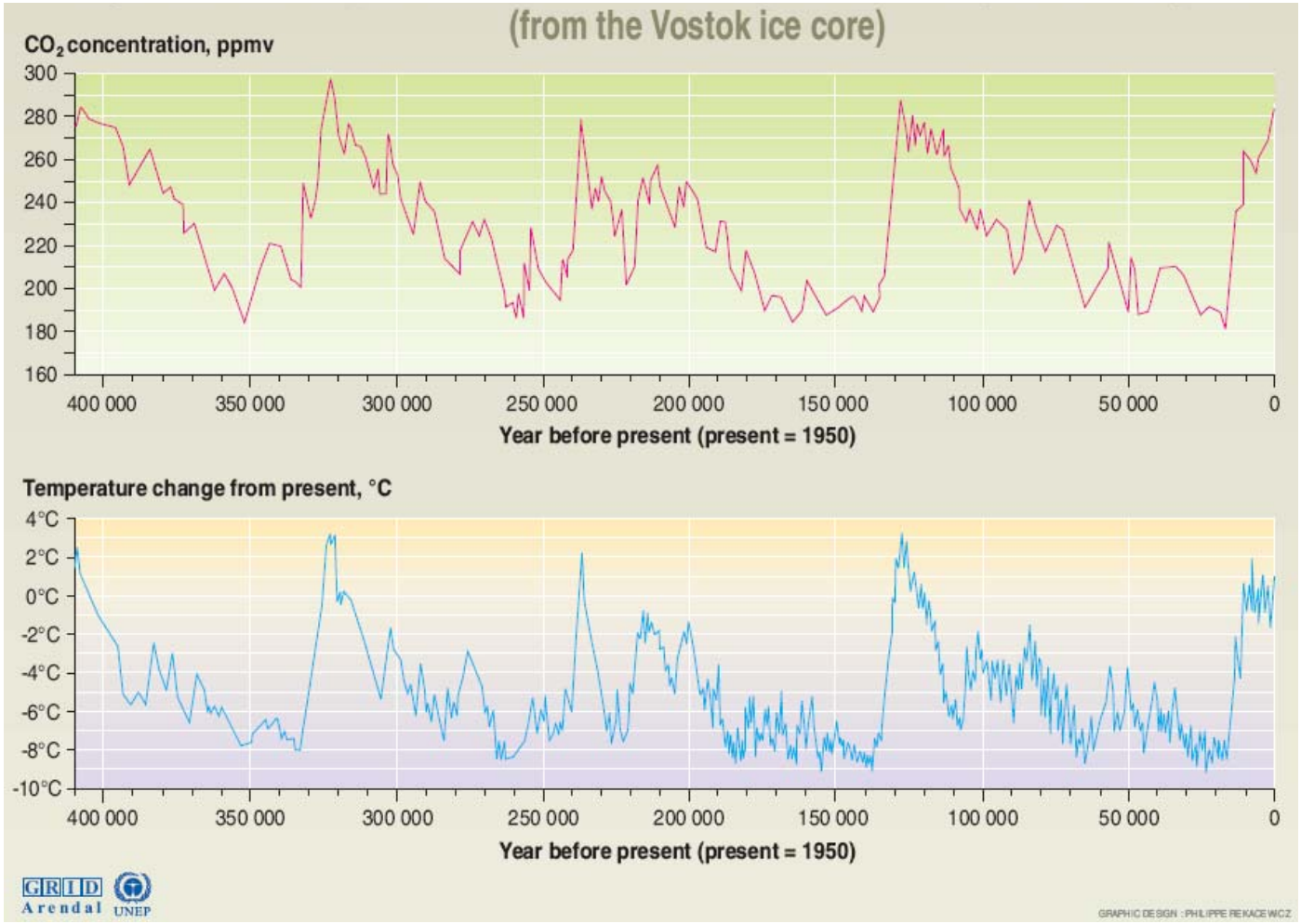
An Assessment of the Intergovernmental Panel on Climate Change

This underlying report, adopted section by section at IPCC Plenary XXVII (Valencia, Spain, 12-17 November 2007), represents the formally agreed statement of the IPCC concerning key findings and uncertainties contained in the Working Group contributions to the Fourth Assessment Report.

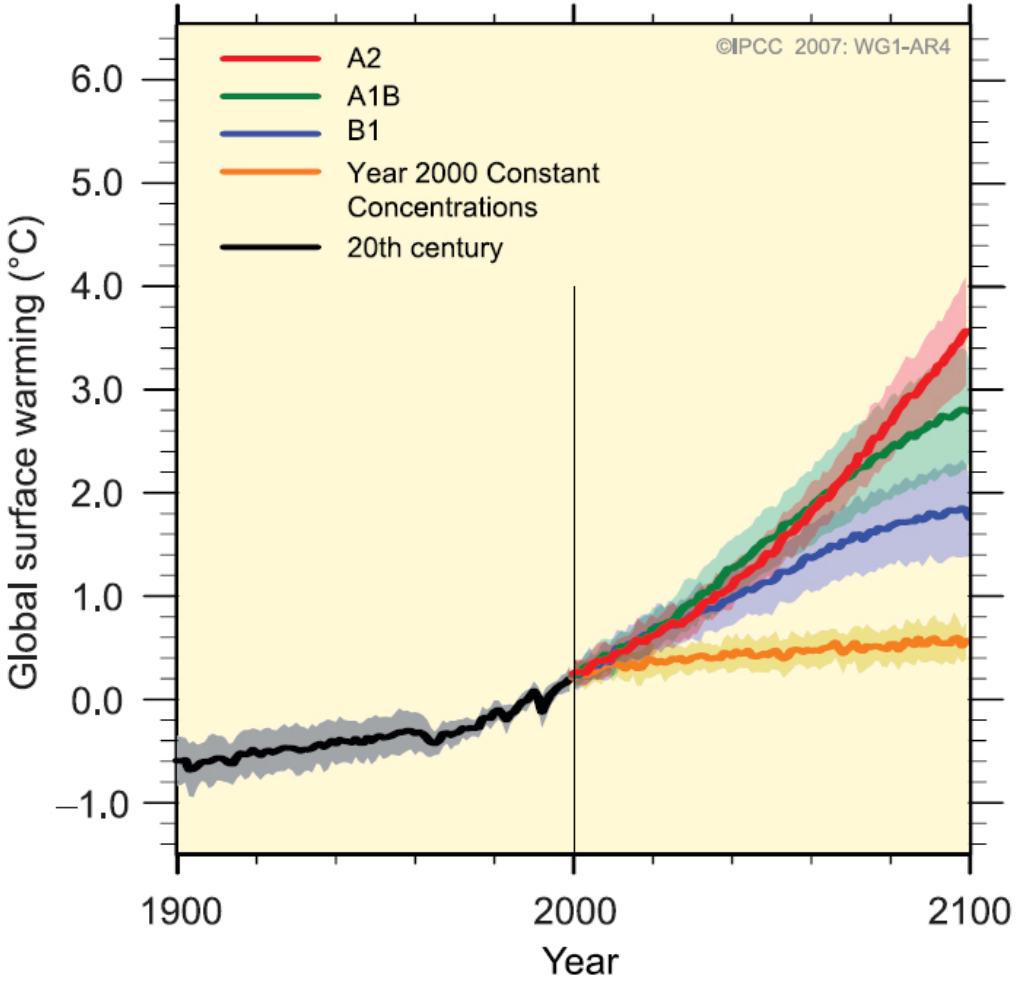
Unprecedented CO_2 Rise



Temperature vs. CO_2 for 400,000 Years



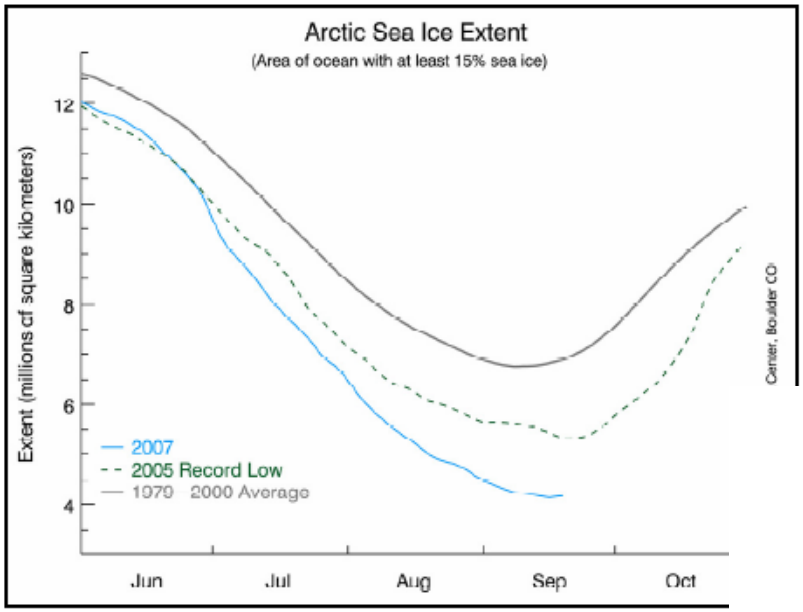
Global Warming Forecasts

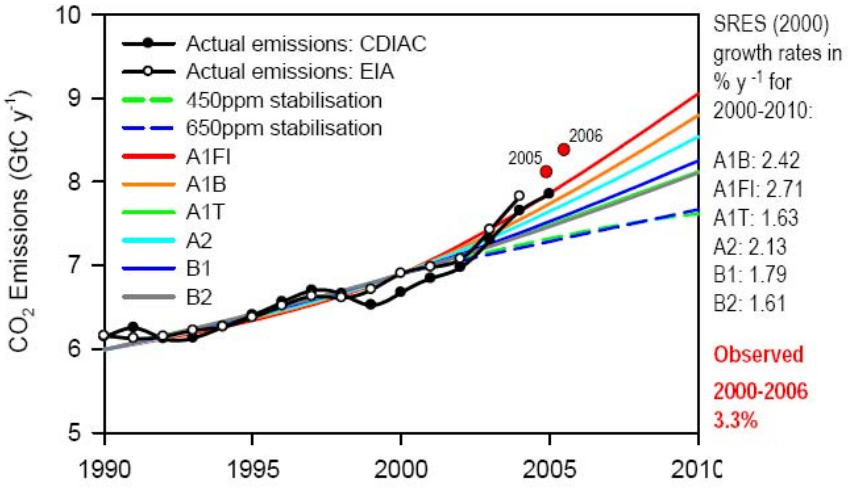


Climate Change Impacts at 2 to 3°C

- More than 1/3 of species at risk of extinction (corals, polar bears…)
- Amazon rainforest & Great Lakes ecosystem at risk of collapse
- Hundreds of millions displaced from coastal areas, at risk of hunger
- Partial deglaciation of Greenland Ice Sheet expected to begin: sea level to increase 4-6 meters over centuries to millennia

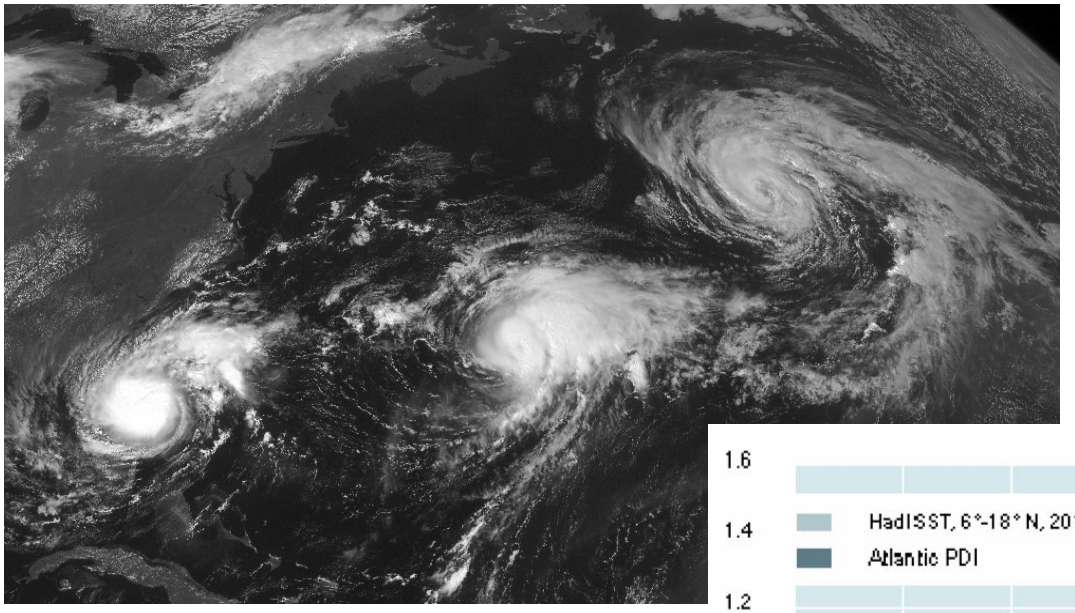
Accelerating



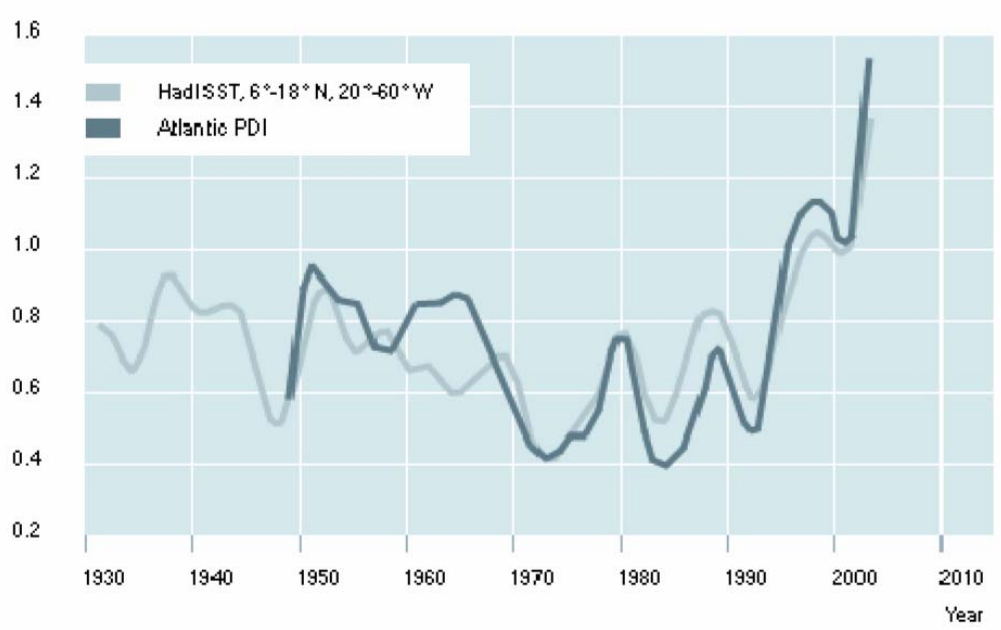


Raupach et al. 2007, PNAS

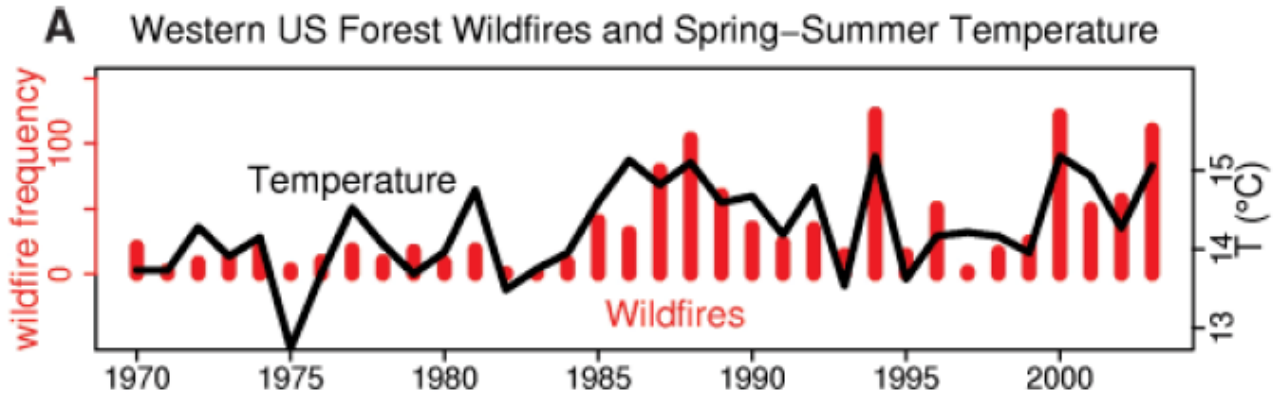
Global Warming Fingerprints



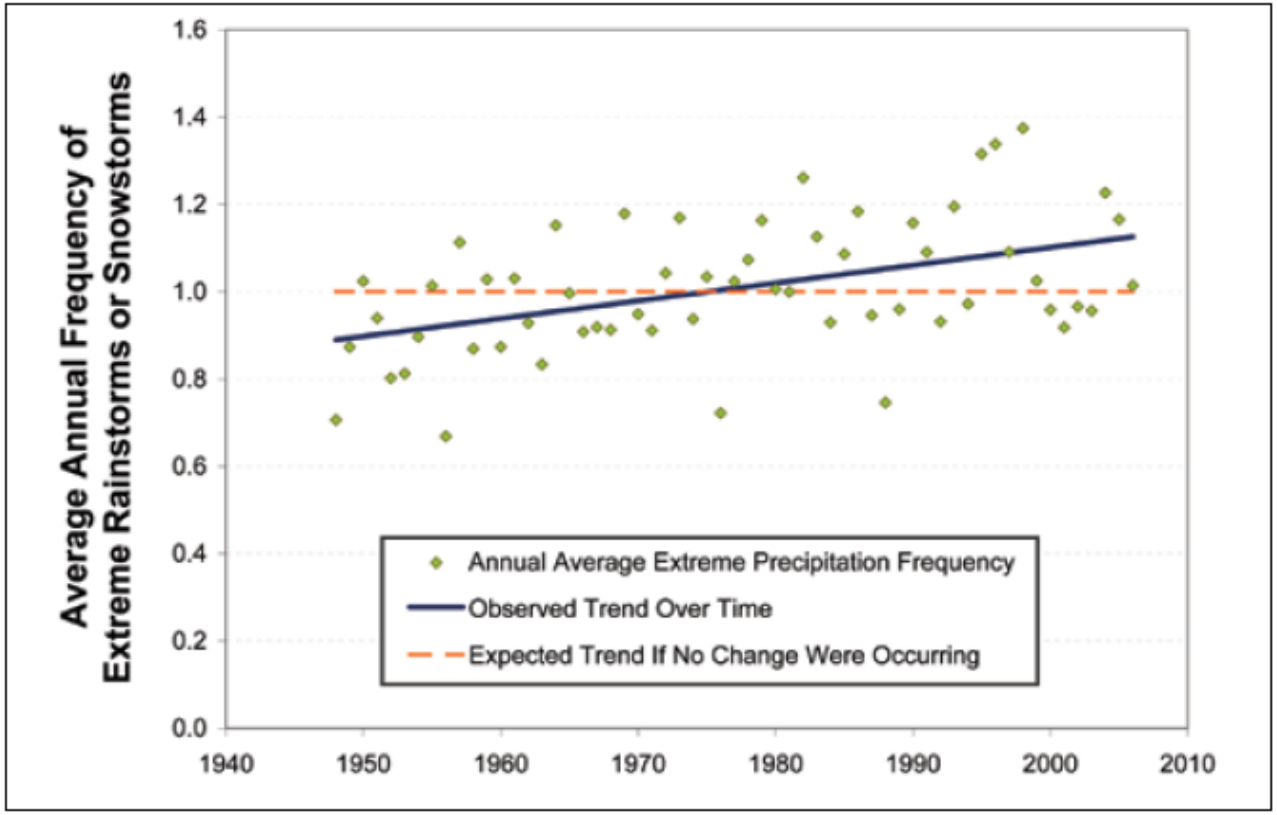
Hurricanes Ophelia, Nate, and Maria were among 15 hurricanes that raged across the Atlantic, Gulf of Mexico, and Caribbean in 2005.



Global Warming Fingerprints



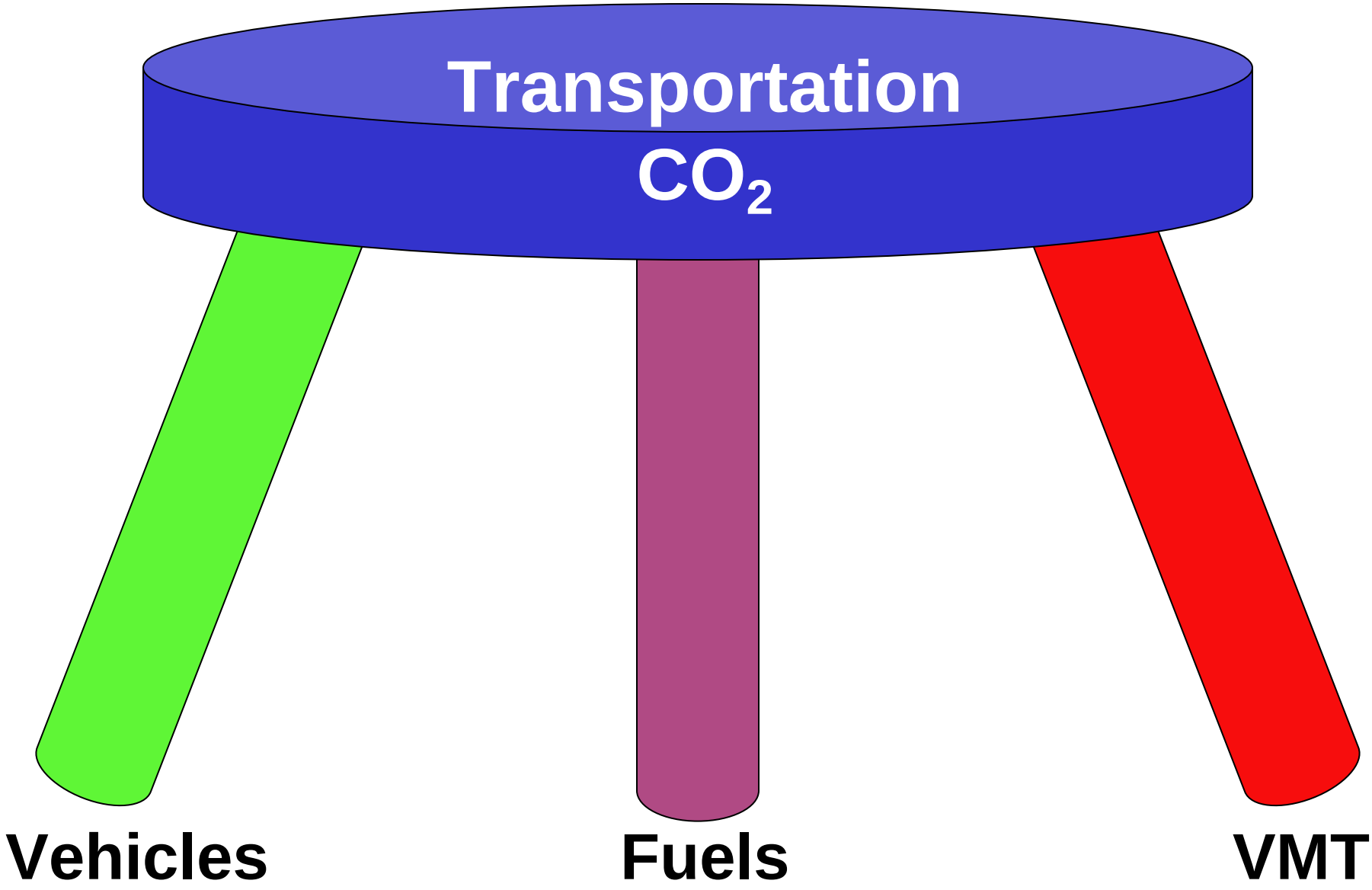
Global Warming Fingerprints



J. Madsen and E. Figdor, *When It Rains, It Pours: Global Warming and the Rising Frequency of Extreme Precipitation in the United States,* Environment America Research & Policy Center, December 2007.
http://www.environmentamerica.org/uploads/oy/ws/oywshWAwZy-EXPsabQKd4A/When-It-Rains-It-Pours----US---WEB.pdf

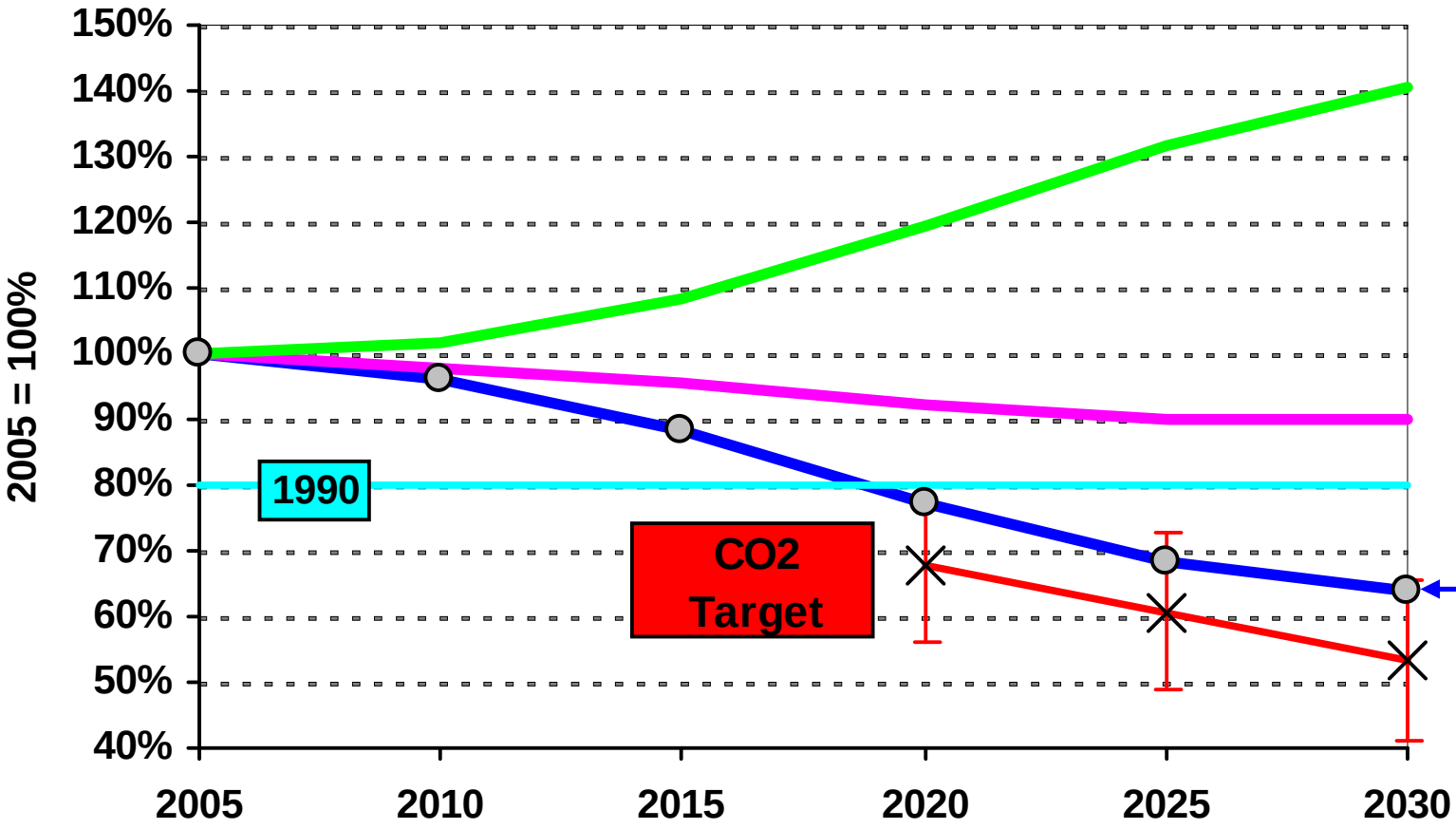
US must cut Greenhouse Gases 60-80% below 1990 levels by 2050

- **15-30% below 1990 by 2020 to keep on track**
  - US GHGs now 20% above 1990 levels
  - Not easy, but possible
  - Delayed action means higher risks and costs
- Transportation about 1/3 of US CO2 emissions, and growing fastest
- **Major reductions will be needed in all sectors**
  - Other sectors (electricity, industry) unable to overcompensate for transportation



Center for Clean Air Policy

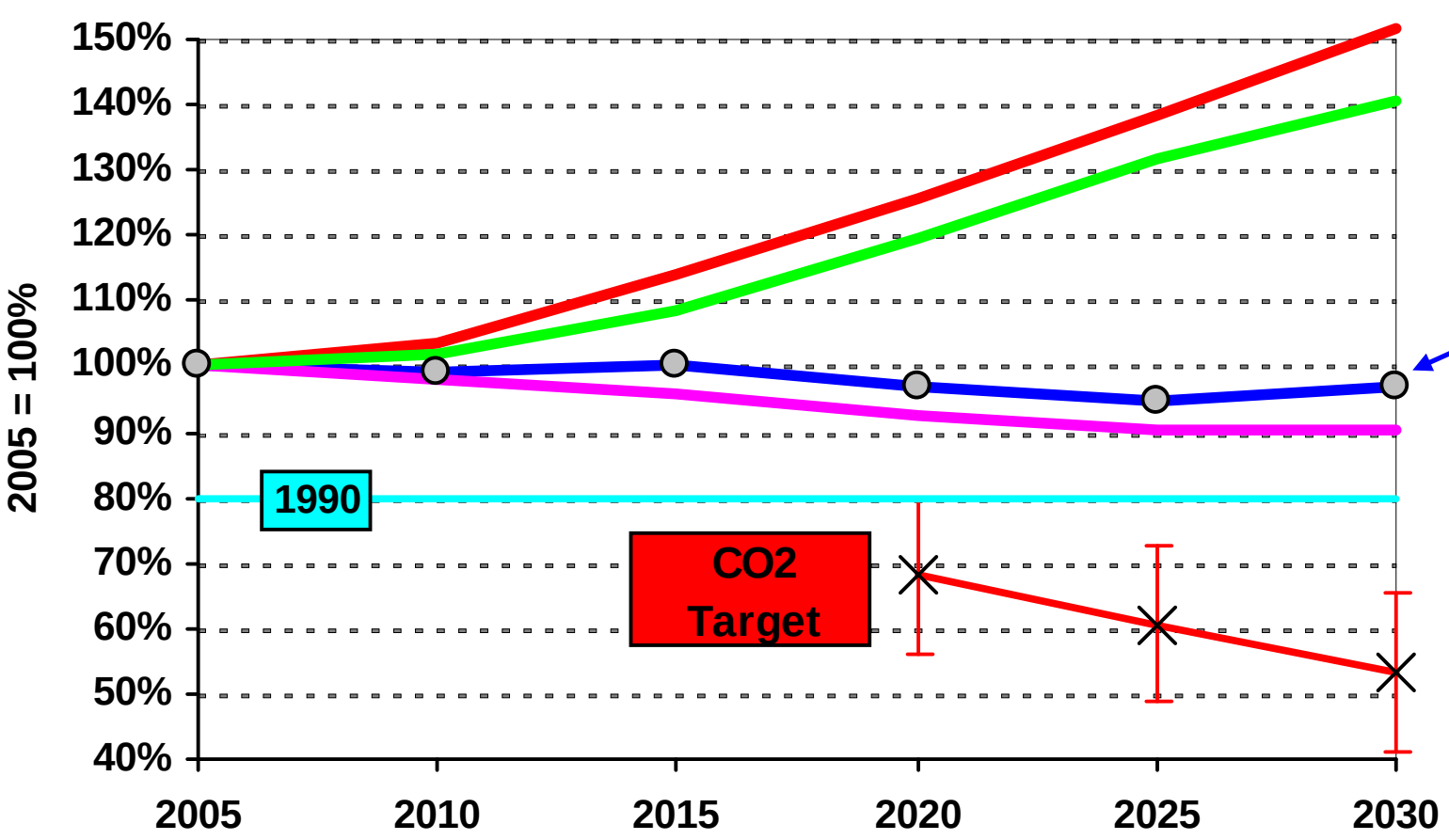
Energy Bill: CAFE & -10% Fuel GHG by 2025



Center for Clean Air Policy

Source: S. Winkelman based on EIA AEO 2008 (revised), HR6 and sources cited in *Growing Cooler* .

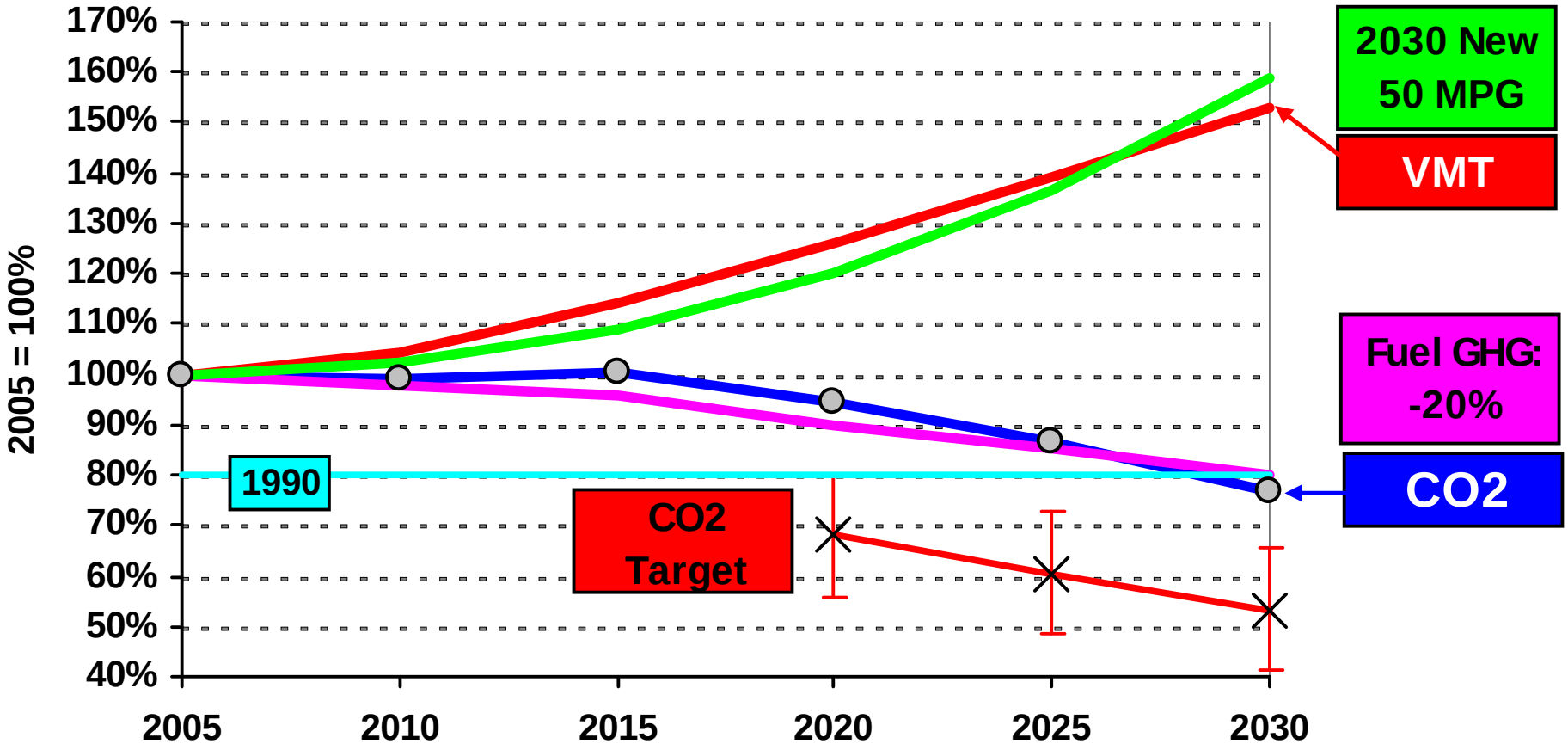
VMT Growth to Wipe Out Energy Bill Savings



Source: S. Winkelman based on EIA AEO 2008 (revised), HR6 and sources cited in *Growing Cooler* .

Center for Clean Air Policy

Aggressive Case: 50 mpg in 2030 & -20% Fuel GHG



Center for Clean Air Policy

Source: S. Winkelman based on EIA AEO 2008 (revised), HR6, stock model calculations and sources cited in *Growing Cooler* .

Chapter 4

Main Questions Addressed

1. What reduction in vehicle miles traveled (VMT) is possible in the United States with compact development rather than continuing urban sprawl?

2. What reduction in CO_2 emissions will accompany such a reduction in VMT?

3. What policy changes will be required to shift the dominant land development pattern from sprawl to compact development?

We have been studying sprawl for a long time

So when EPA asked these questions, we could draw on a lot of research

Four Literatures – Core of ULI Book

- Aggregate travel studies
- Disaggregate travel studies
- Regional simulation studies
- Project simulation studies

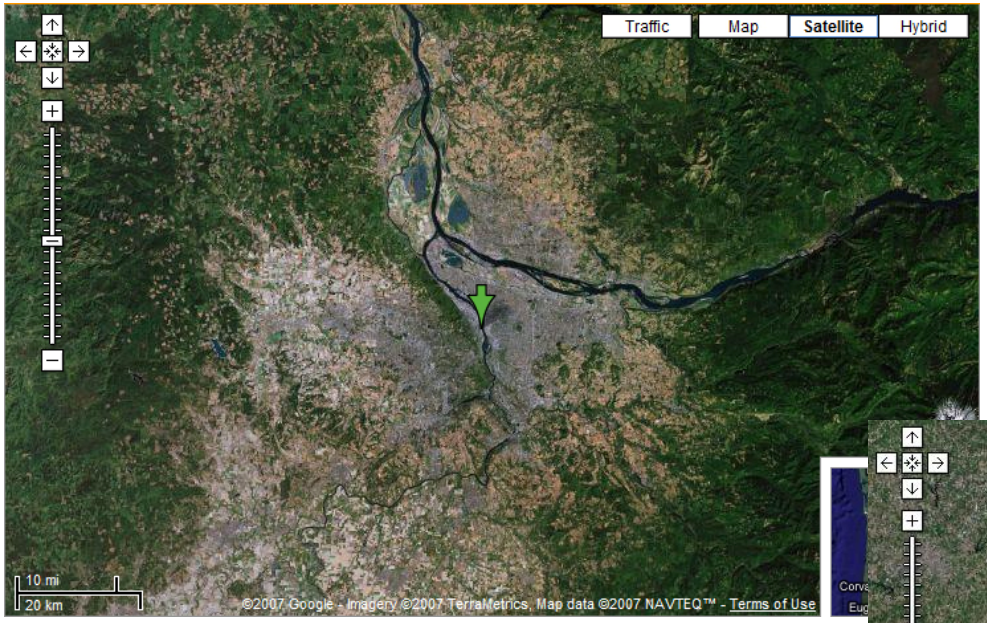
Low Density

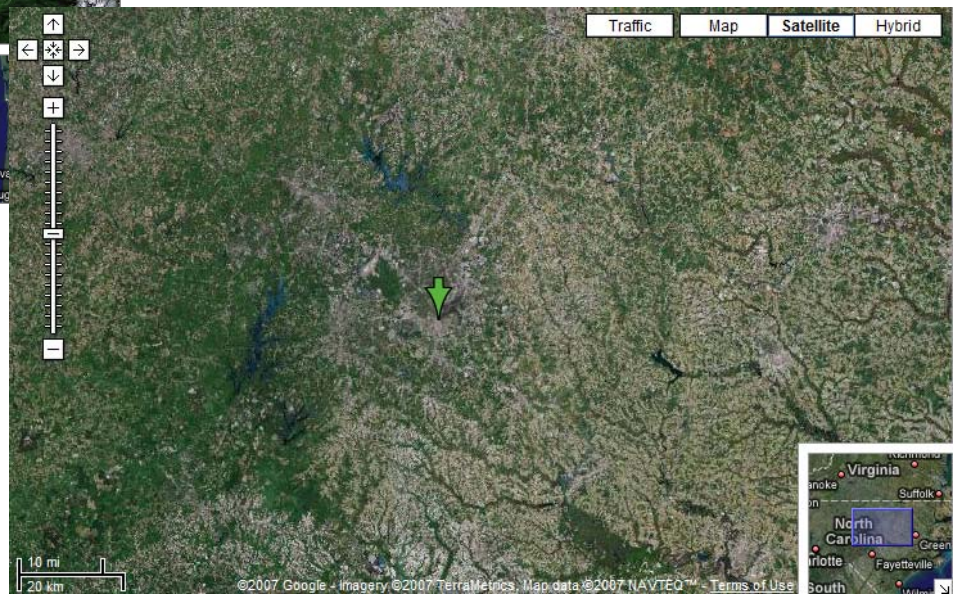
Single Use

Strips

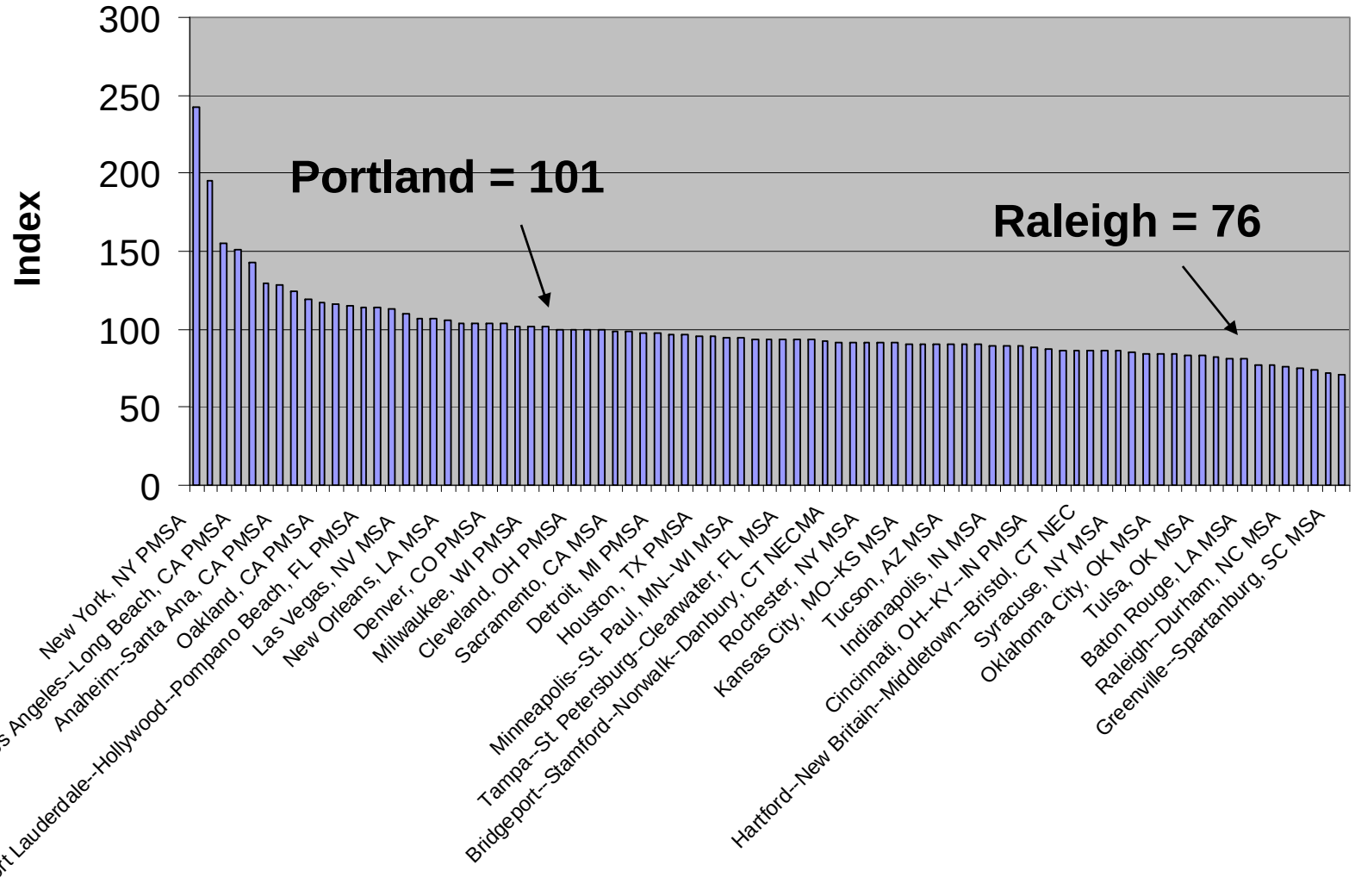
Sparse Network

Portland vs. Raleigh

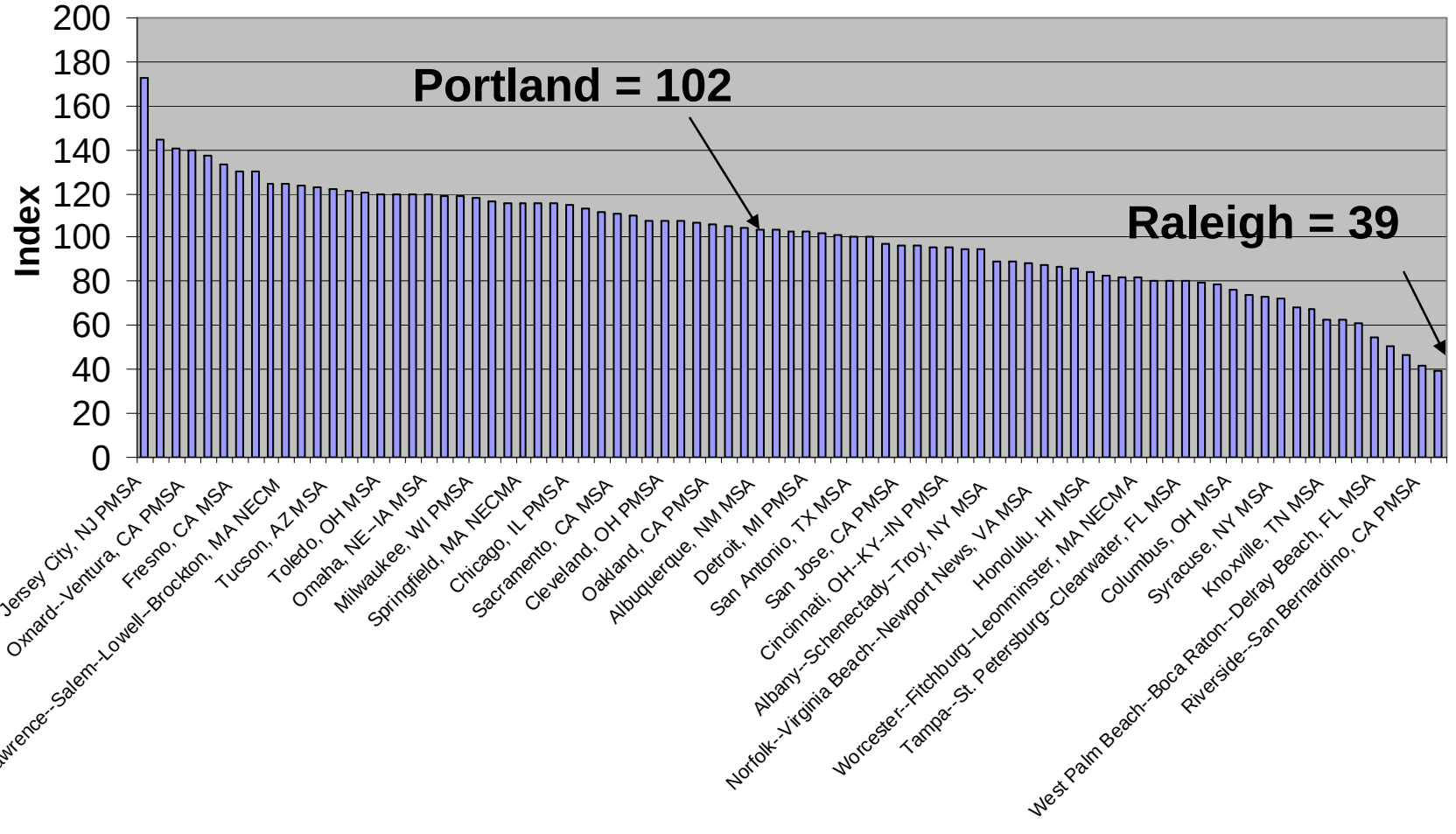




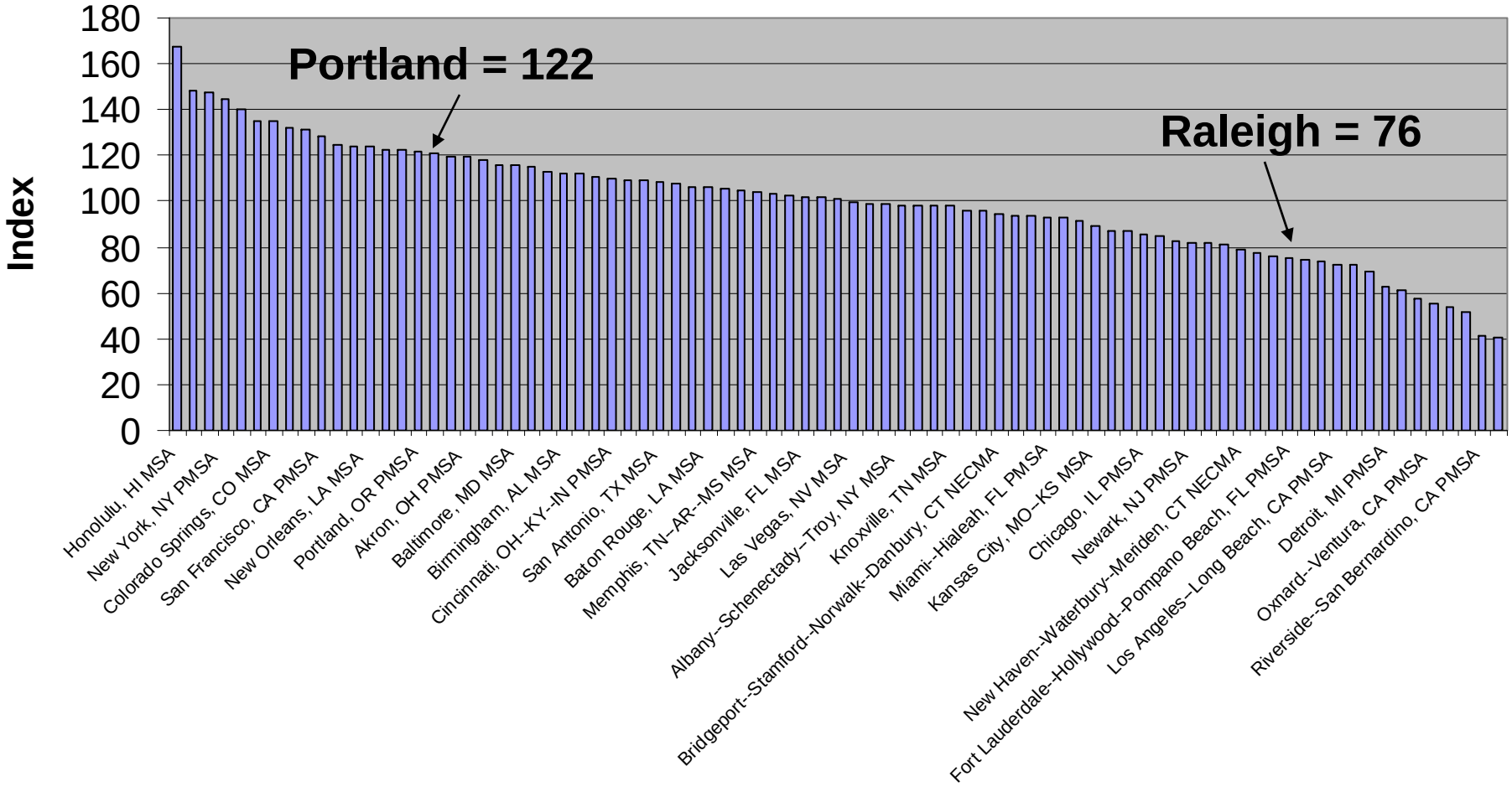
Density Factor



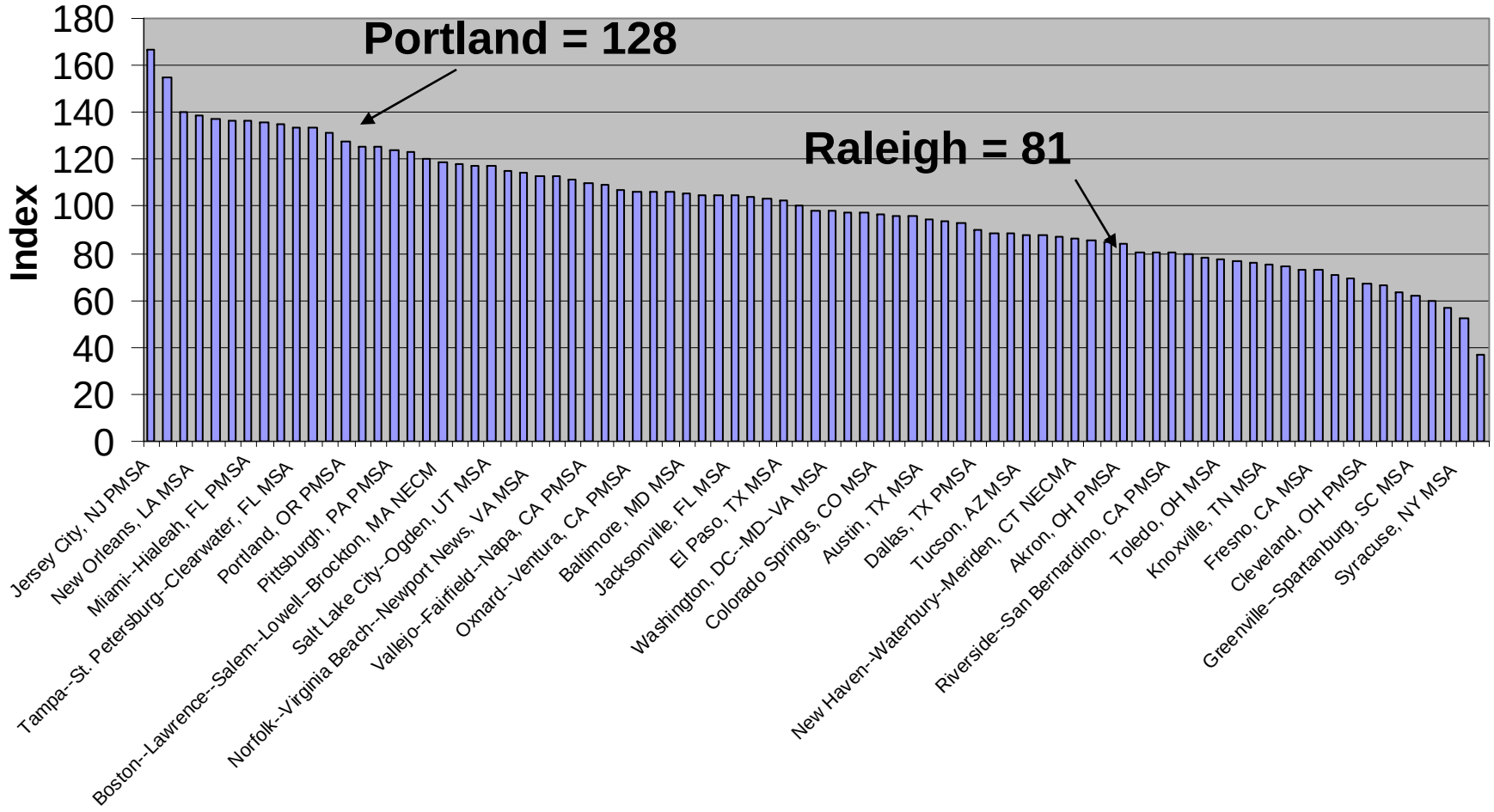
Mix Factor


Index
200
180
160
140
120
100
80
60
40
20
0
Portland = 102
Raleigh = 39
Jersey City, NJ PMSA
Oxnard--Ventura, CA PMSA
Fresno, CA MSA
Boston--Lawrence--Salem--Lowell--Brockton, MA NECM
Tucson, AZ MSA
Toledo, OH MSA
Omaha, NE--IA MSA
Milwaukee, WI PMSA
Springfield, MA NECMA
Chicago, IL PMSA
Sacramento, CA MSA
Cleveland, OH PMSA
Oakland, CA PMSA
Albuquerque, NM MSA
Detroit, MI PMSA
San Antonio, TX MSA
San Jose, CA PMSA
Cincinnati, OH--KY--IN PMSA
Albany--Schenectady--Troy, NY MSA
Norfolk--Virginia Beach--Newport News, VA MSA
Honolulu, HI MSA
Worcester--Fitchburg--Leonminster, MA NECMA
Tampa--St. Petersburg--Clearwater, FL MSA
Columbus, OH MSA
Syracuse, NY MSA
Knoxville, TN MSA
West Palm Beach--Boca Raton--Delray Beach, FL MSA
Riverside--San Bernardino, CA PMSA

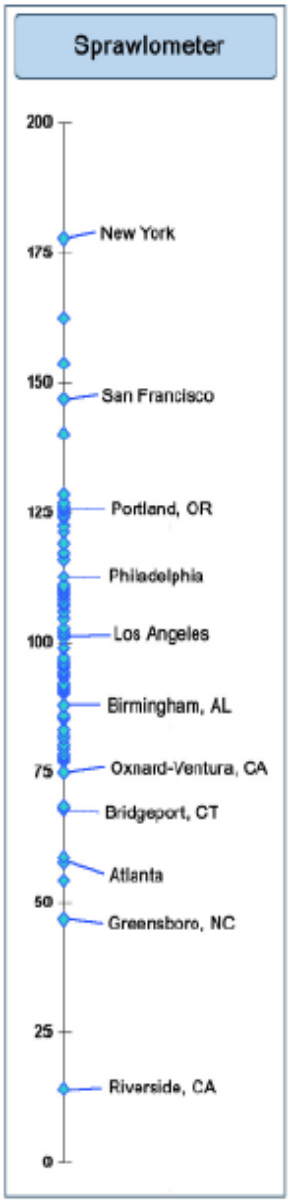
Centers Factor

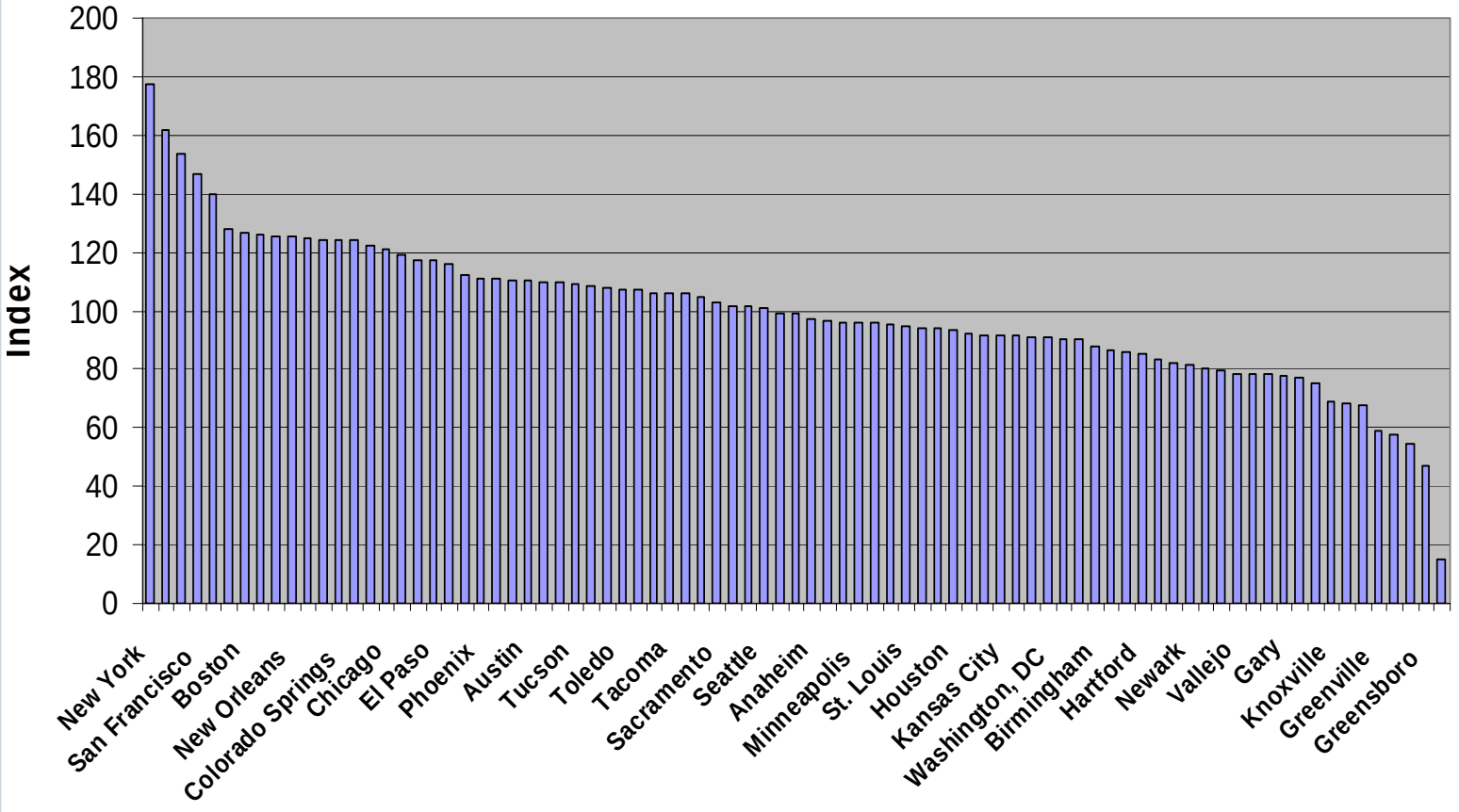


Streets Factors

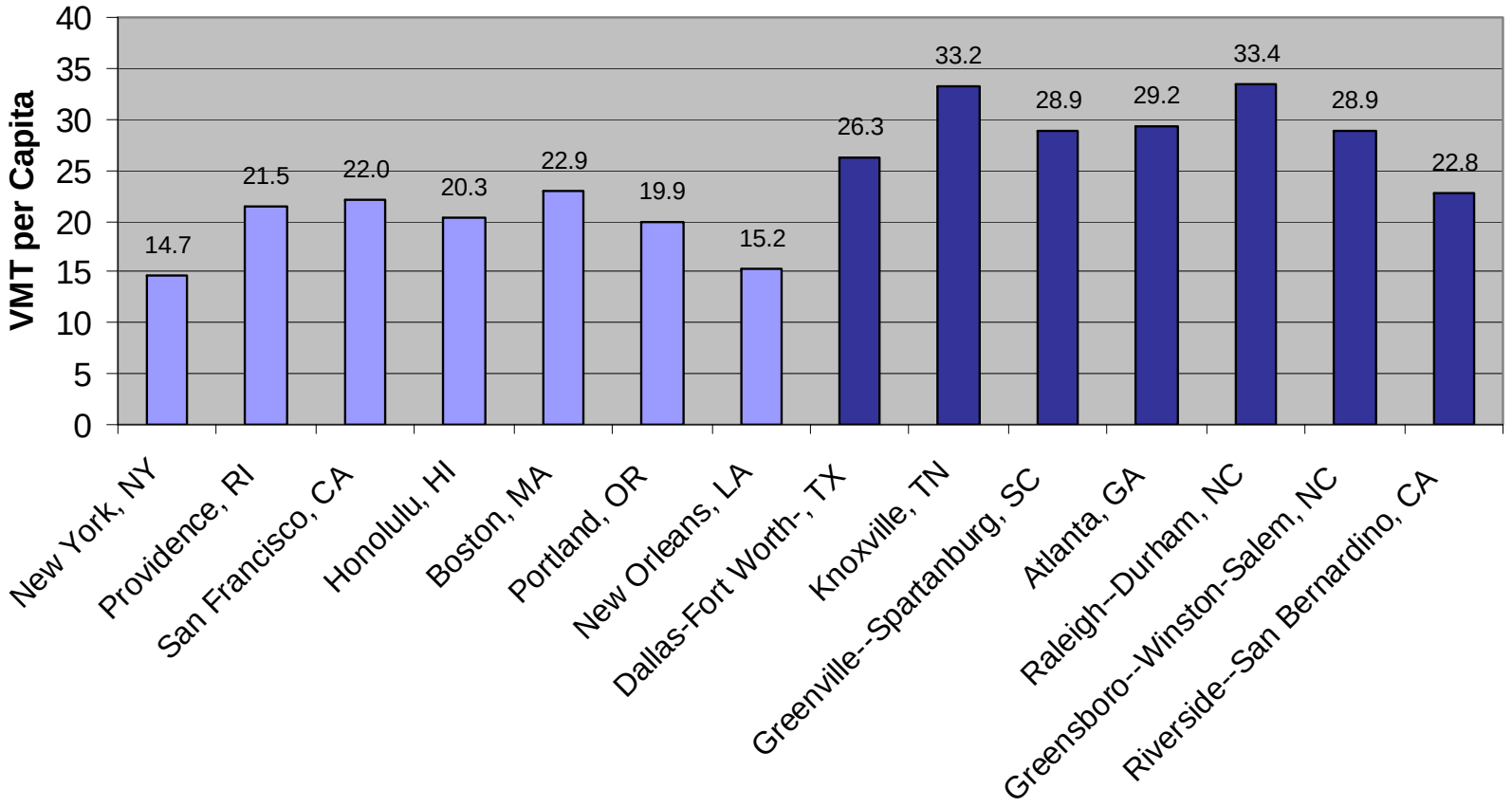


Overall Index

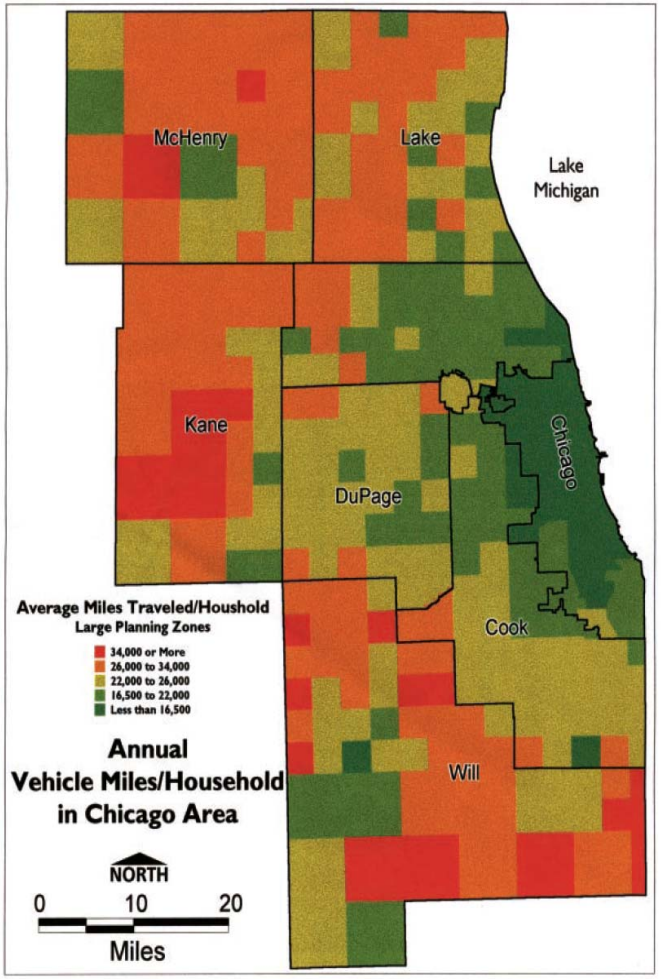




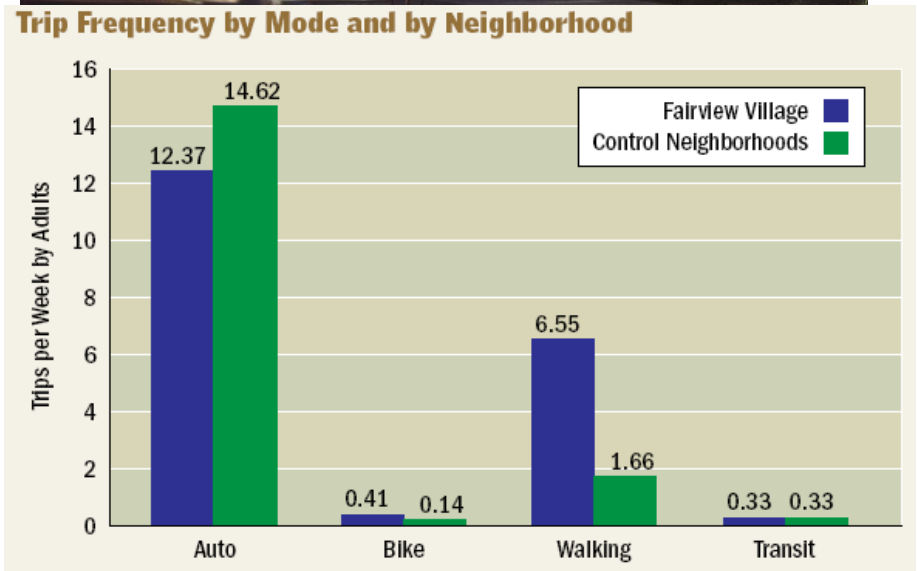
35% Less VMT with Compact Development

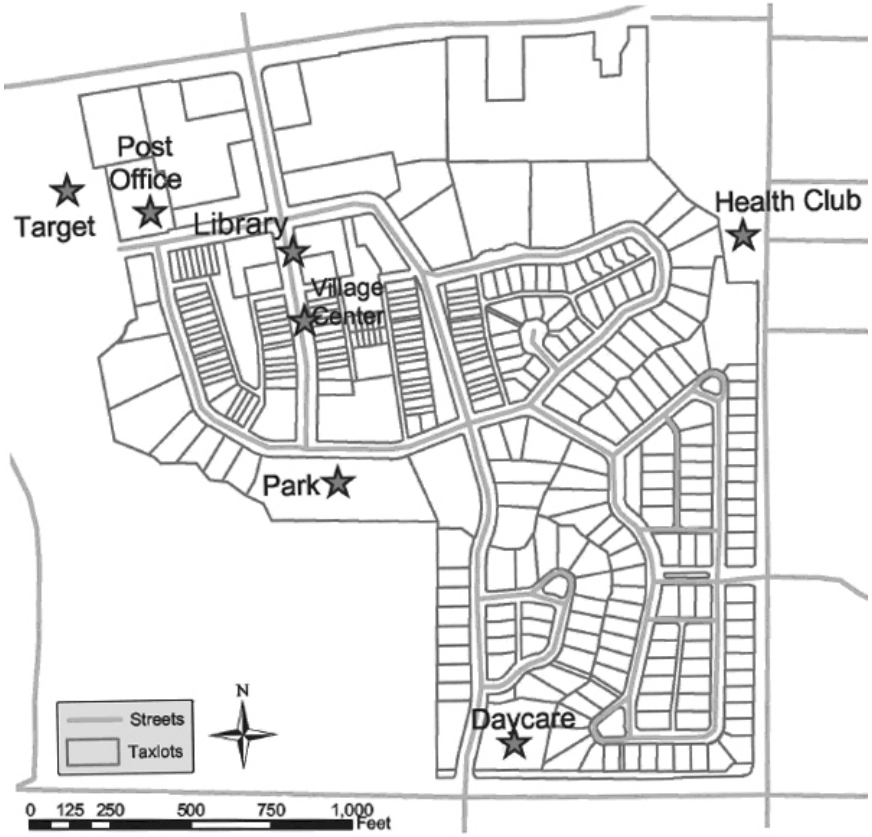


Disaggregate Travel Studies

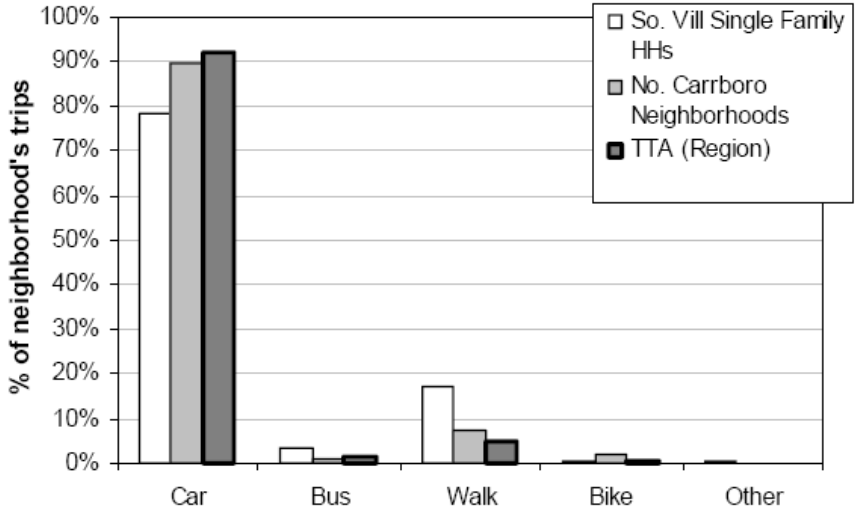


Fairview Village (20% Lower)

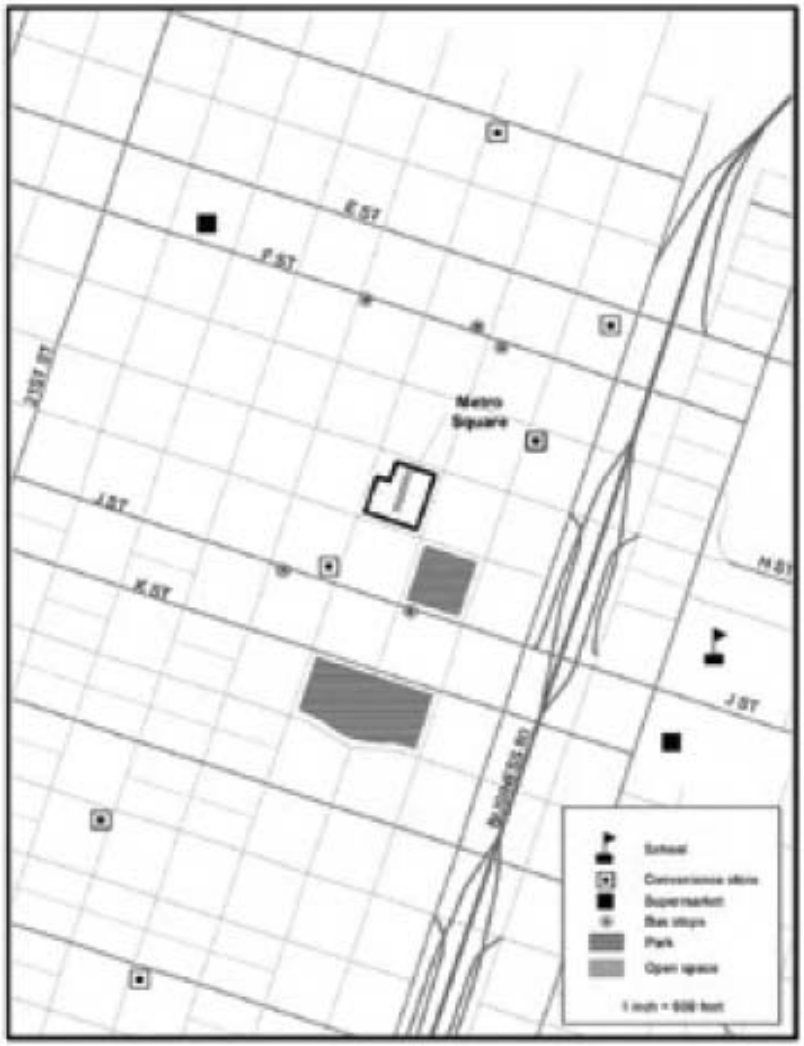




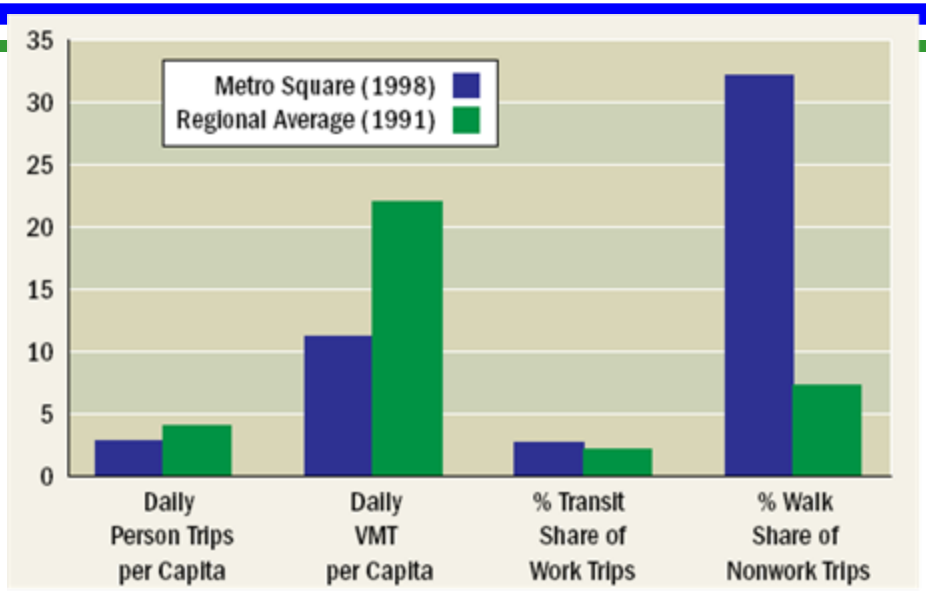
Southern Village (40% lower)



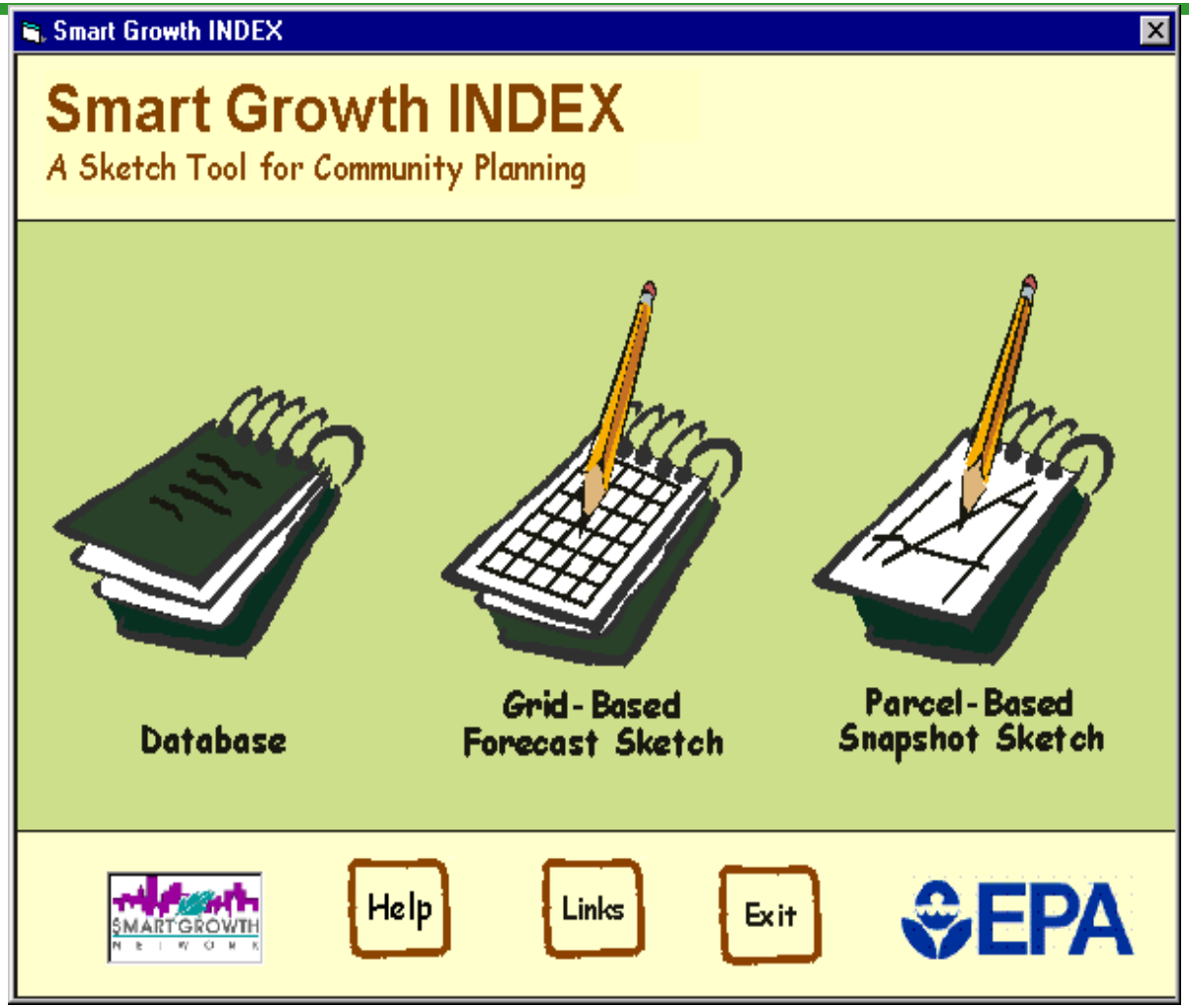
Metro Square (50% lower)



NATURAL RESOURCES DEFENSE COUNCIL



Smart Growth Index Model

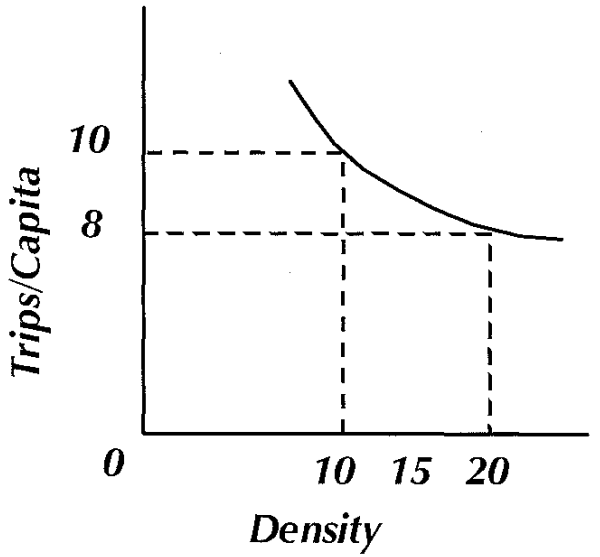


Elasticities

Convenient Way of Summarizing Relationships

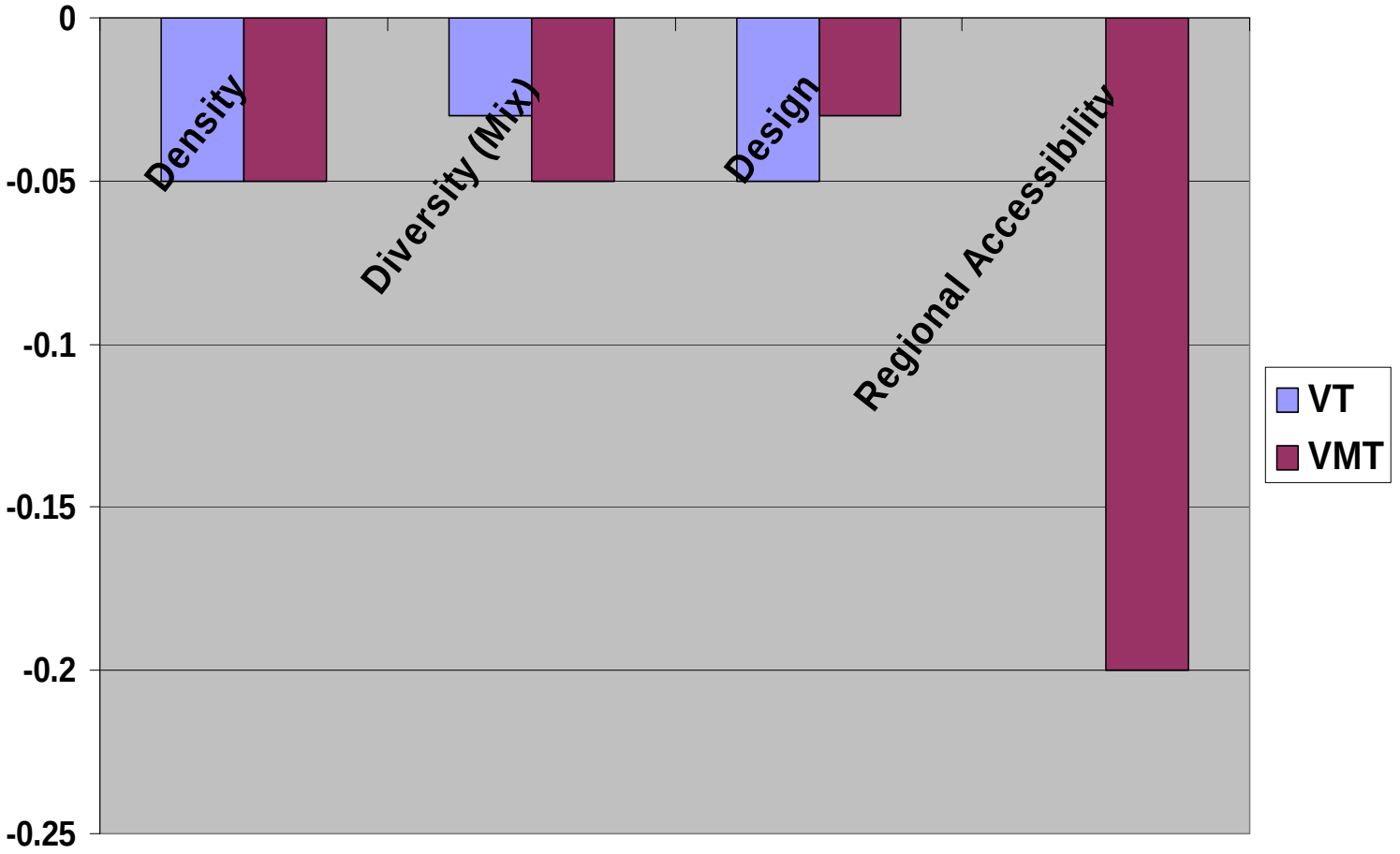
Dimensionless So Perhaps Transferable

$$\text{Travel–Land Use Elasticity} = \frac{\%\ \Delta\ \text{Travel Demand}}{\%\ \Delta\ \text{Land Use}}$$



$$\frac{\frac{8-10}{8}}{\frac{20-10}{20}} = \frac{-0.4}{0.5} = -0.8$$

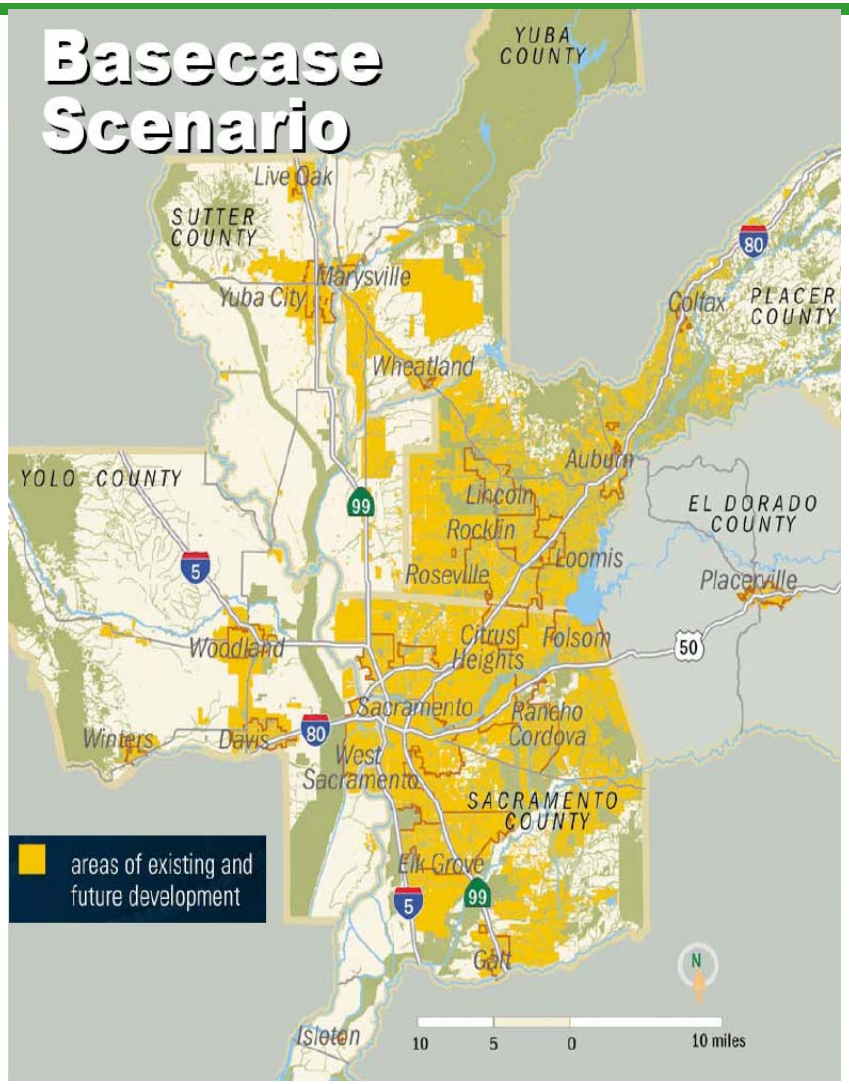
1/3 Reduction in VMT

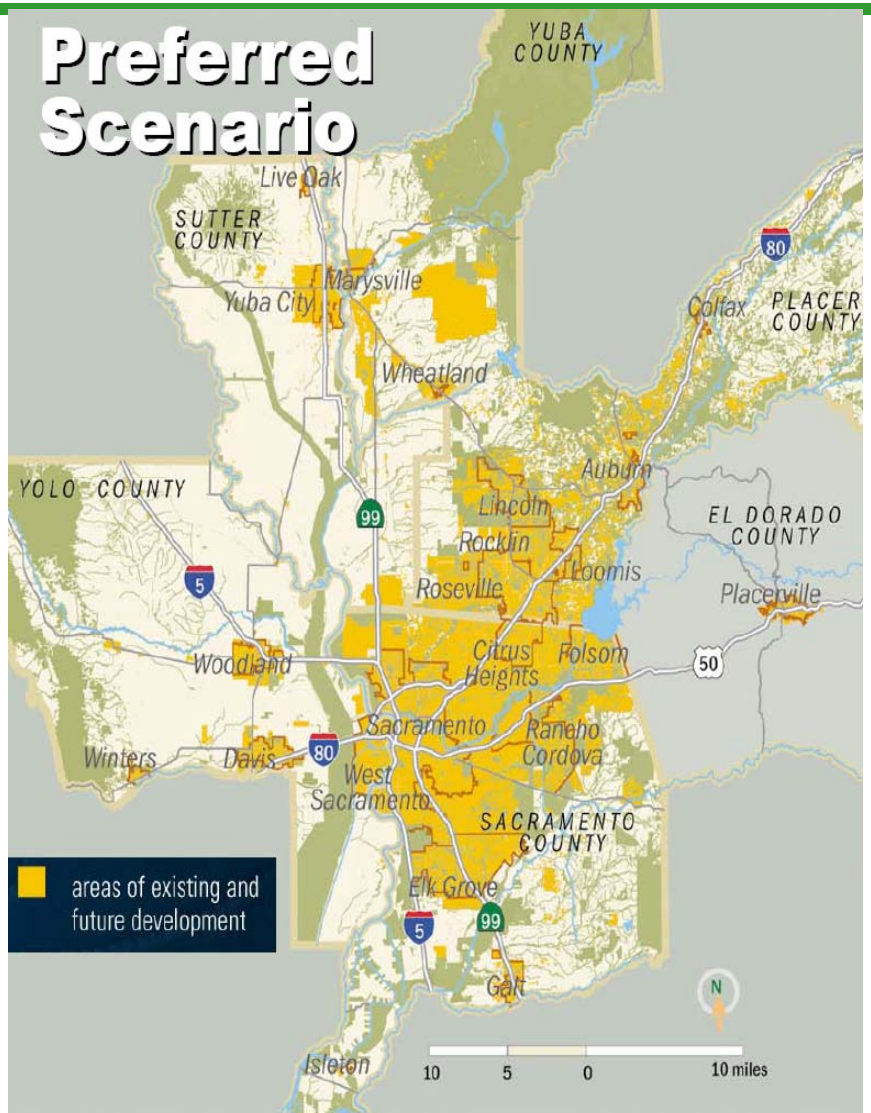


Two Studies Underway

- Meta Analysis of the 100+ studies
- Analysis of Travel Characteristics of Mix-Use Developments
  - » Portland, Houston, Sacramento, Boston, Seattle, Atlanta

Regional Simulations



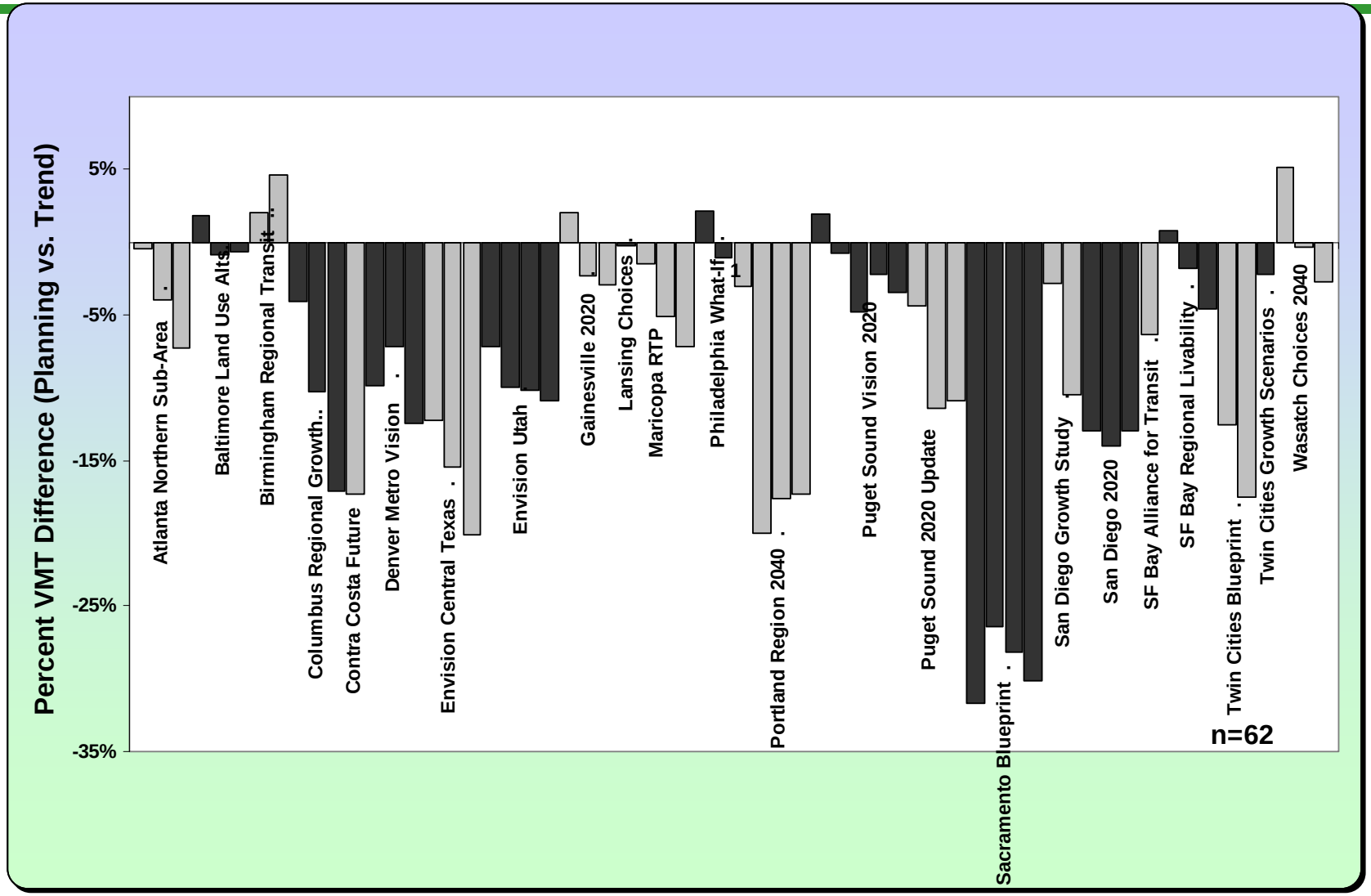


Simulation Results

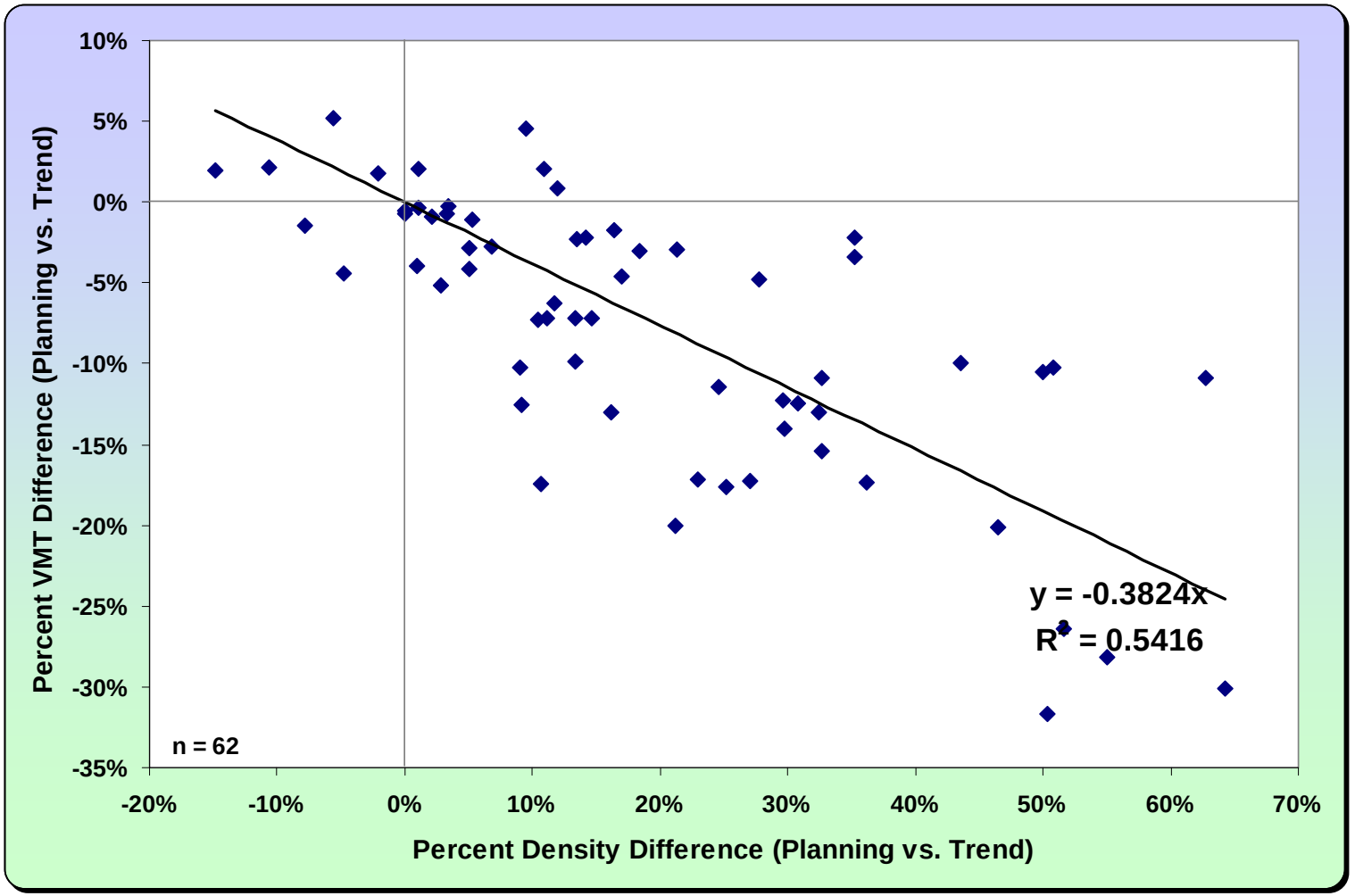
26% reduction in VMT by 2050

15% reduction in CO_2 by 2050

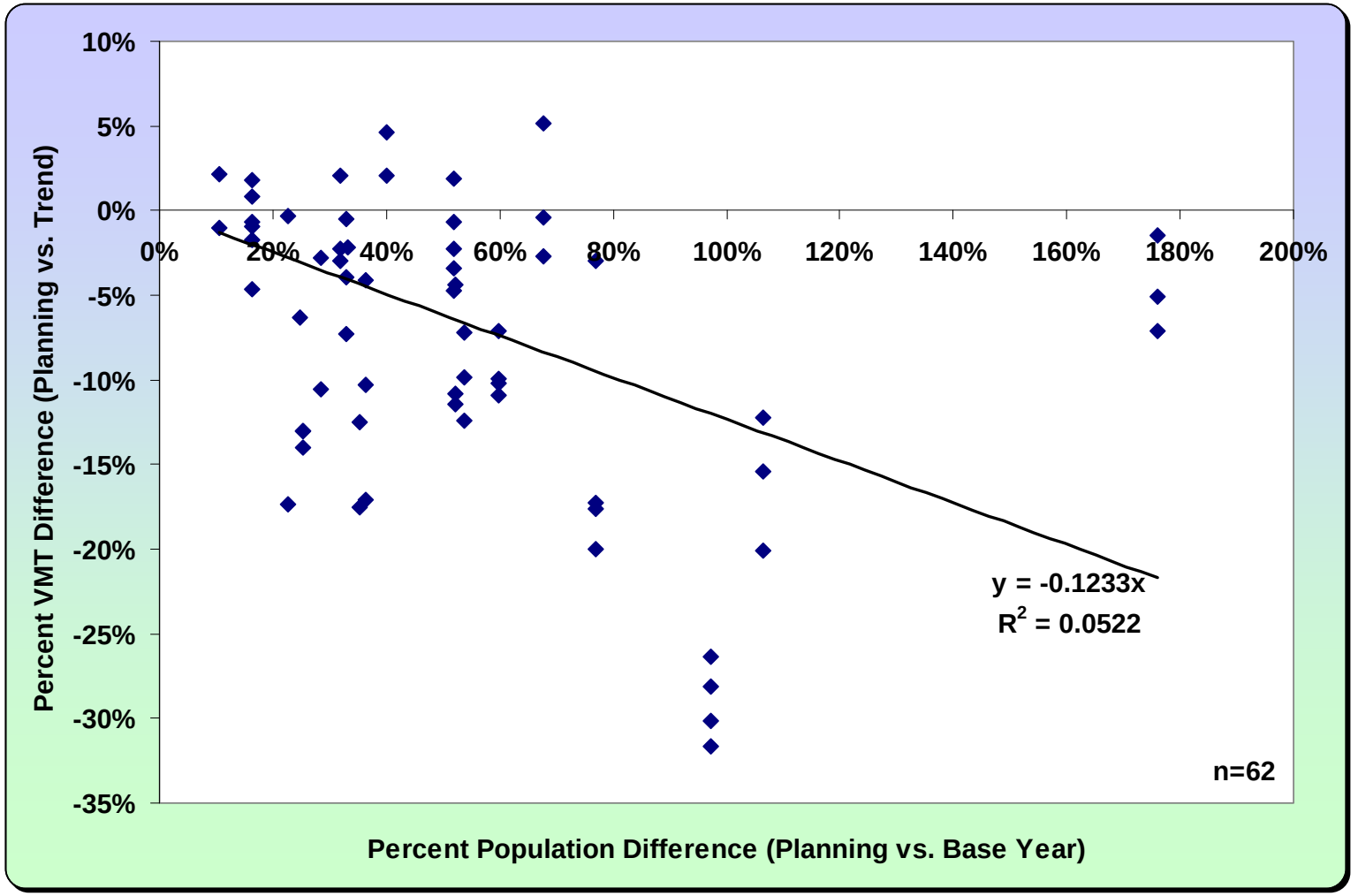
Big Variation



Variation with Density



Variation with Growth



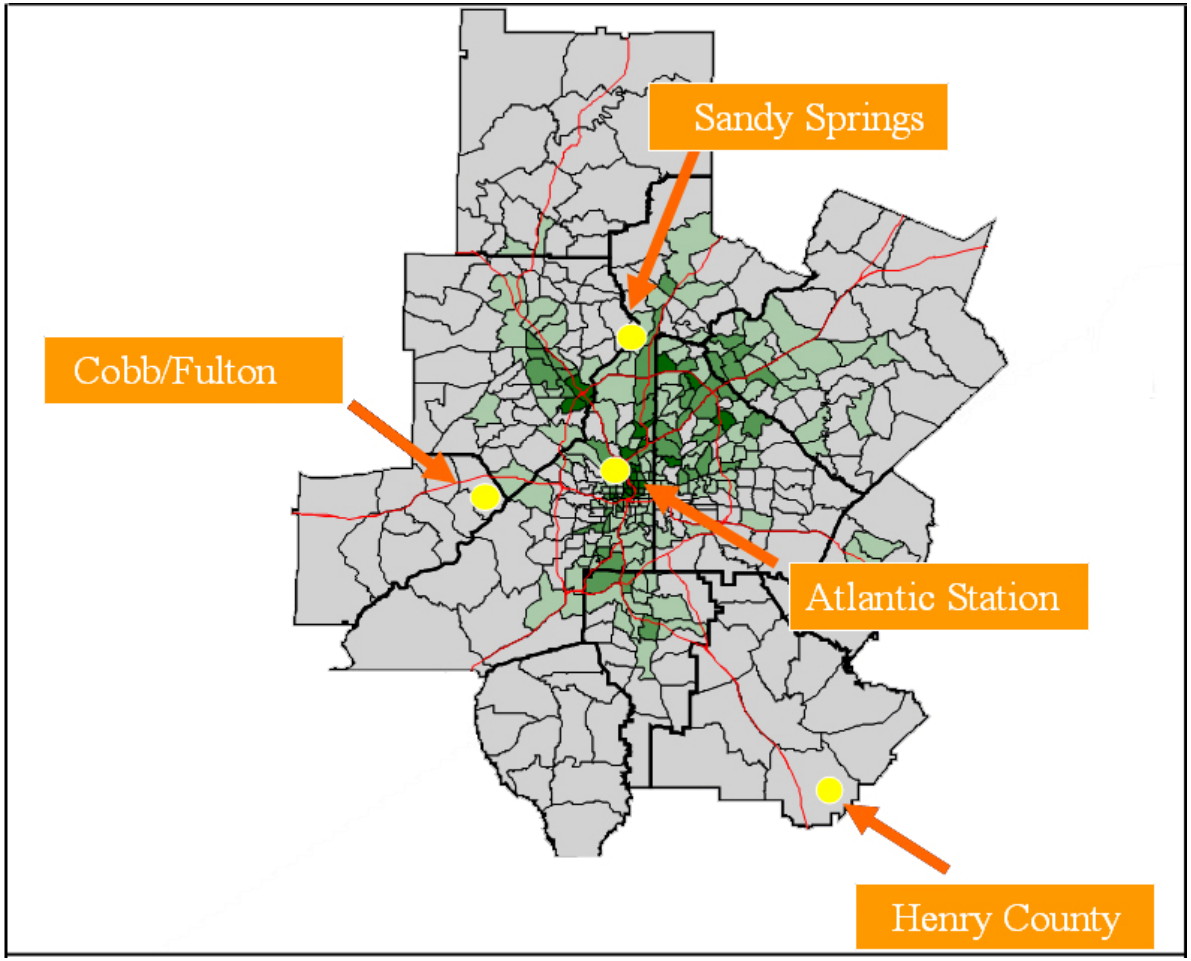
Best-Fit Model of VMT Reduction

	Coefficient	t	P
Difference in density (% above trend)	–0.074	–1.48	0.15
Development centralized	–1.50	–2.13	0.037
Land uses mixed	–4.64	–2.15	0.036
Population growth increment (% above base)	–0.068	–2.02	0.056
Transportation coordinated	–2.12	–1.01	0.33

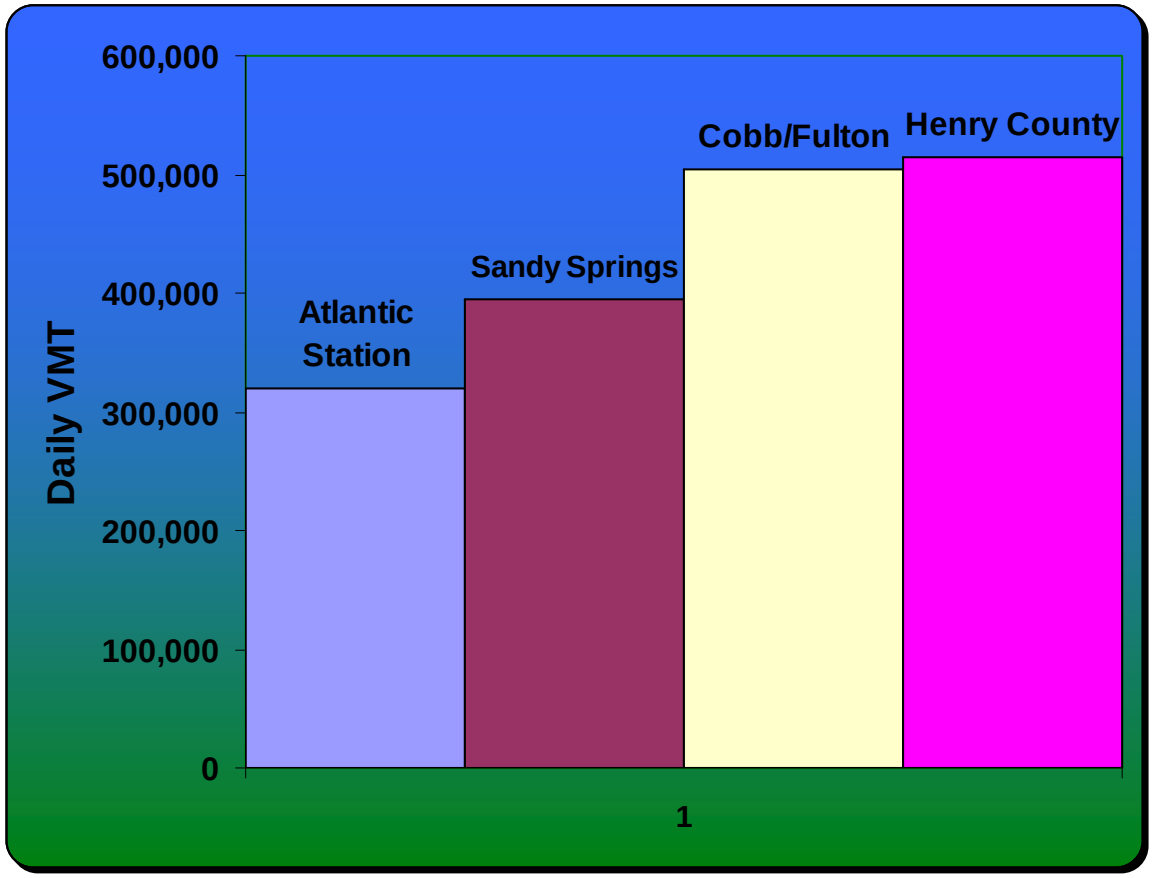
Results

A smart growth development plan that increases average regional density by 50 percent in 2050, emphasizes infill, mixes land uses to a high degree, and has coordinated transportation investments, it would be expected to reduce regional VMT by about 17 percent over 43 years at an average metropolitan growth rate of 1.3 percent annually

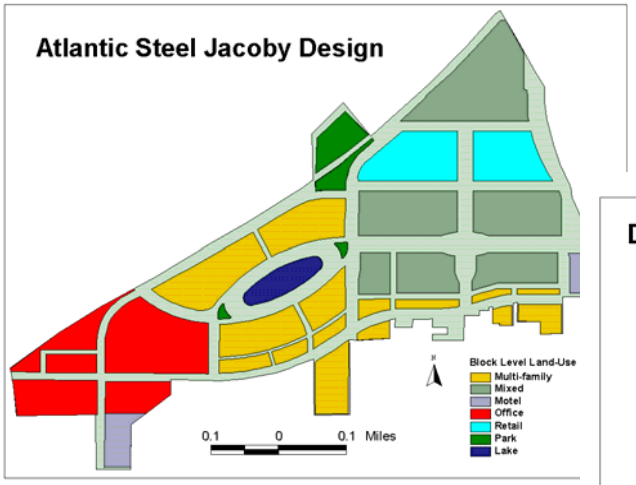
Atlantic Station vs. Henry County

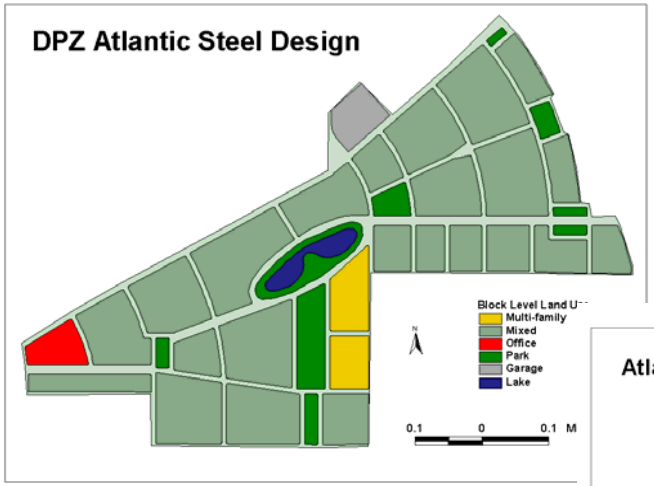


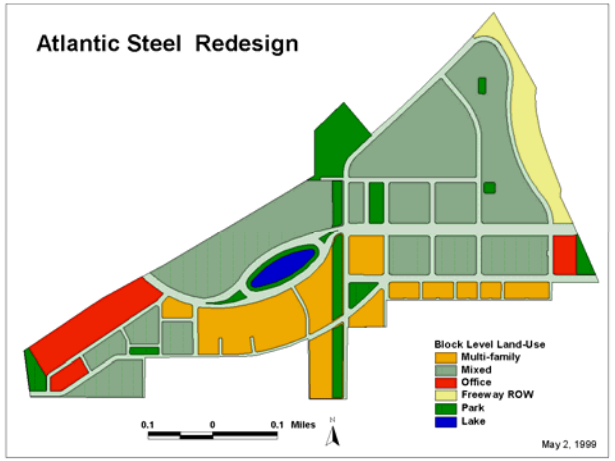
1/3 Savings Due to Regional Accessibility



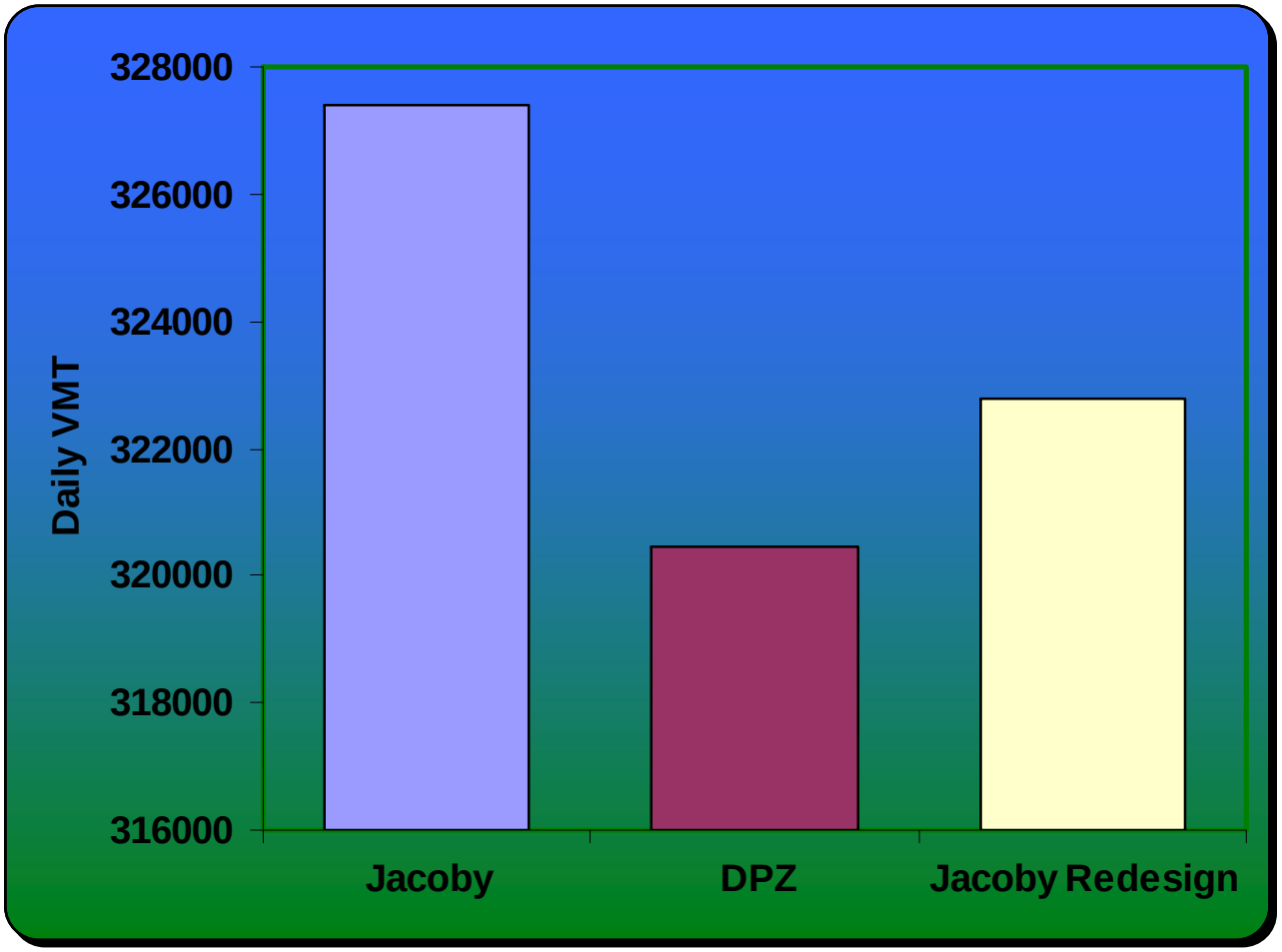
Alternative Site Plan Comparison







2% Savings Due to Site Design

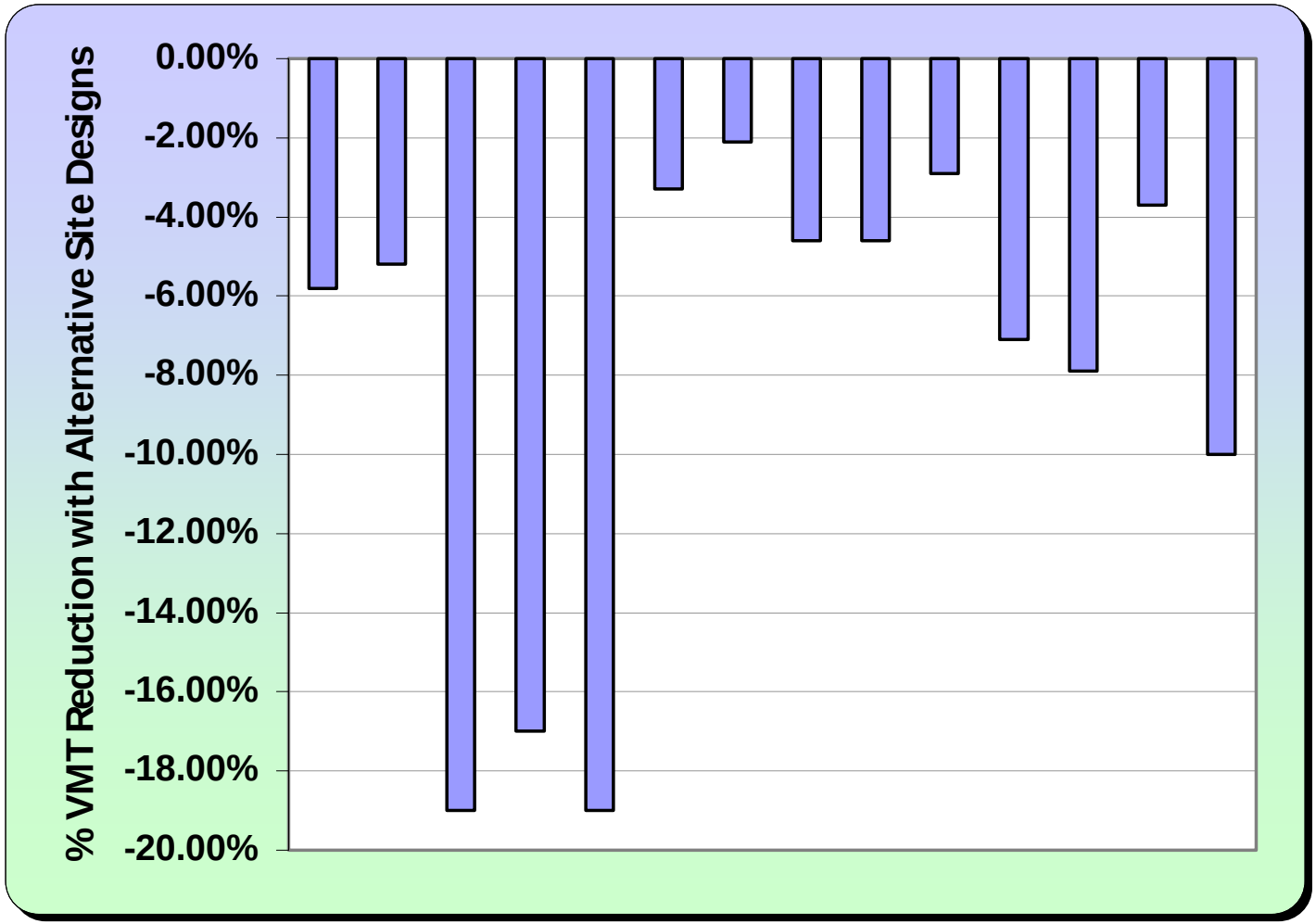


Thriving Community

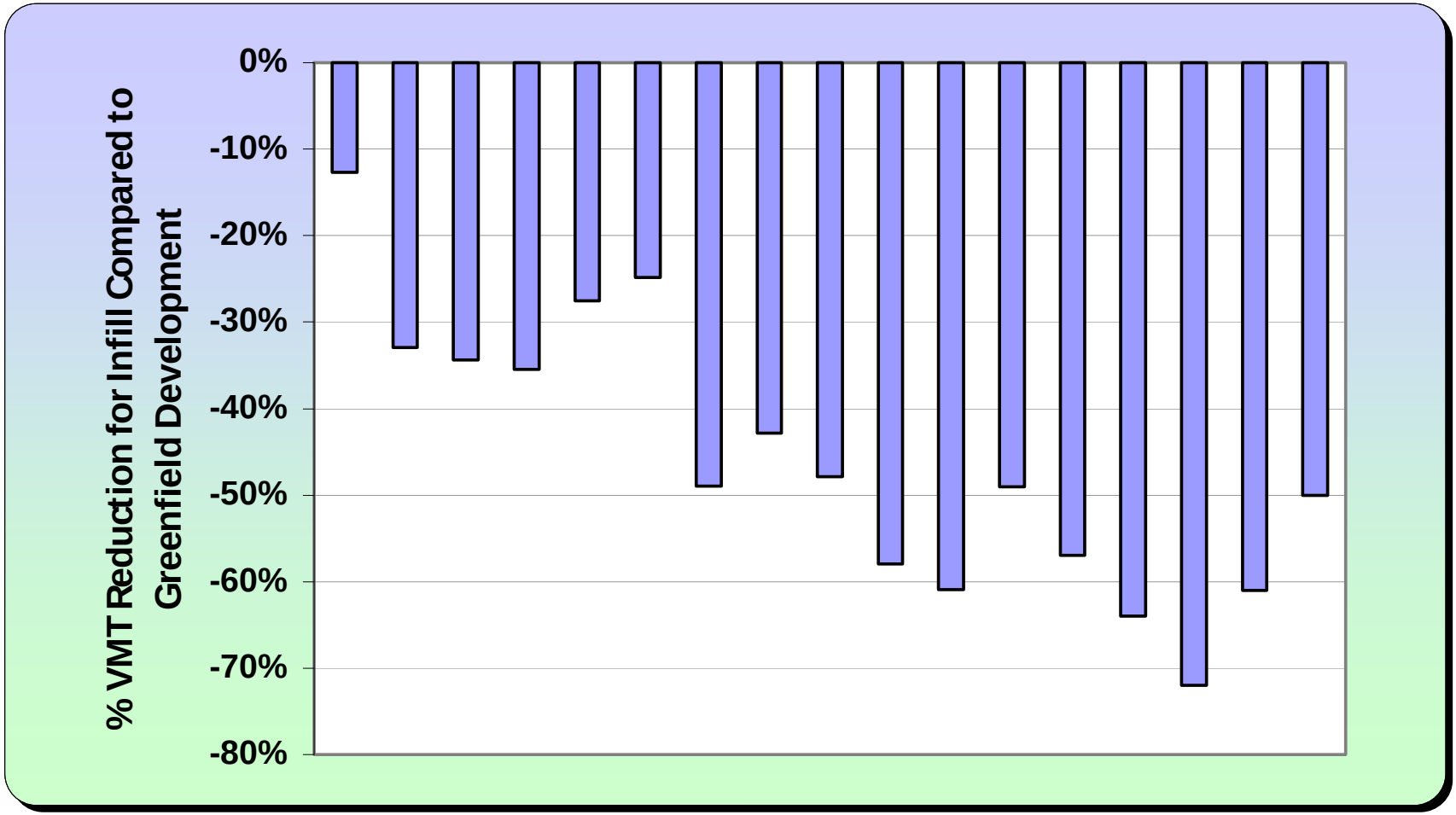
Actual Results Are Better

- 8 VMT per Day for Residents
- 11 VMT per Day for Employees

Effect of Site Design Alone on VMT



Effect of Regional Location and Site Design on VMT



Answer to 1st Question

20-40% VMT Reduction for Each Increment of Compact Development

Doing the Math through 2050

60-90% Compact

x

67% New Development

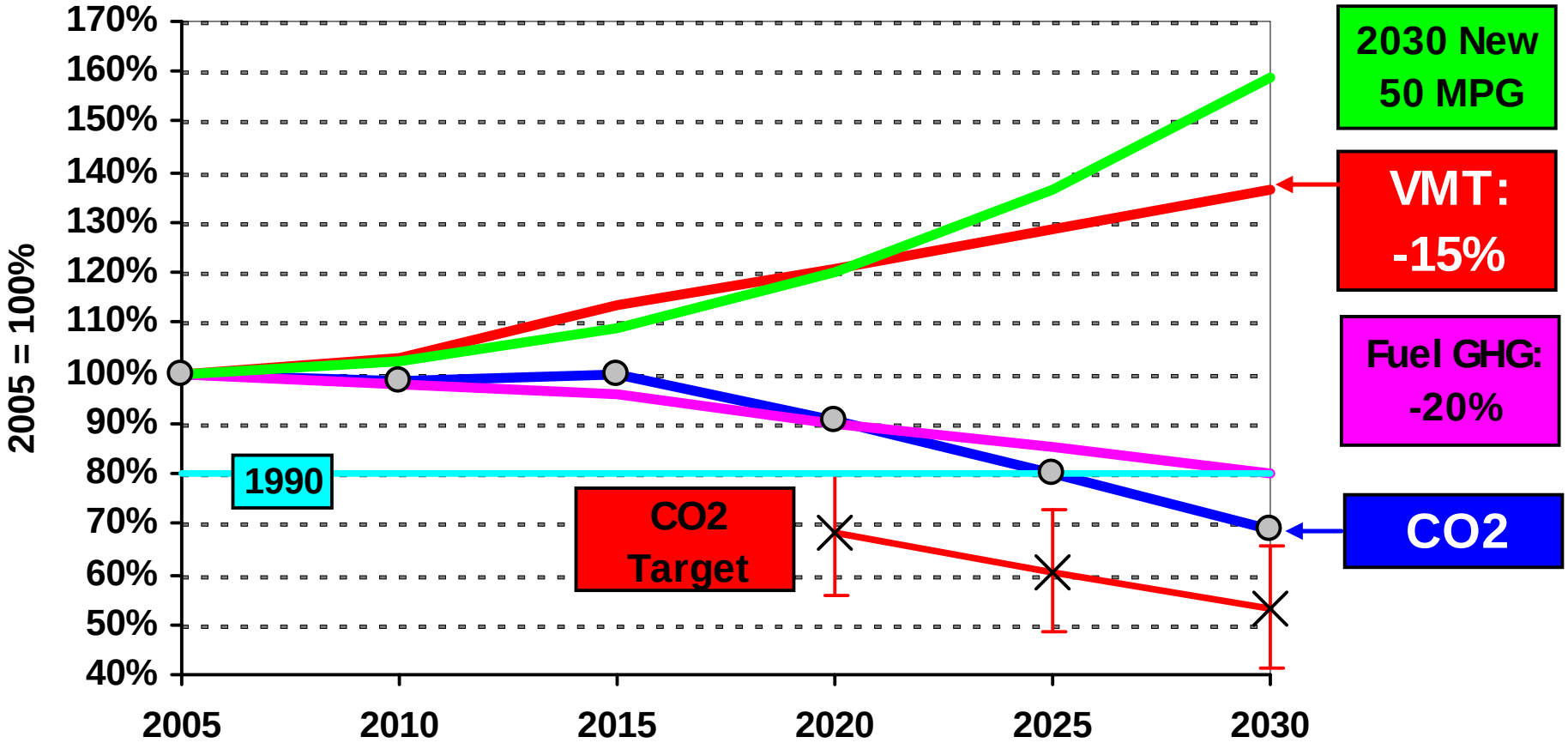
x

30% VMT Reduction

=

12-18% Reduction in Metropolitan VMT

Add Smart Growth -15% VMT → 2030 CO_2 is 14% below 1990



Source: S. Winkelman based on EIA AEO 2008 (revised), HR6, stock model calculations and sources cited in *Growing Cooler* .

Center for Clean Air Policy

Chapter 5

Residential Self Selection

Big Caveat

"If researchers do not properly account for the choice of neighborhood, their empirical results will be biased in the sense that features of the built environment may appear to influence activity more than they in fact do. (Indeed, this single potential source of statistical bias casts doubt on the majority of studies on the topic to date.)"

Transportation Research Board/Institute of Medicine (2005)

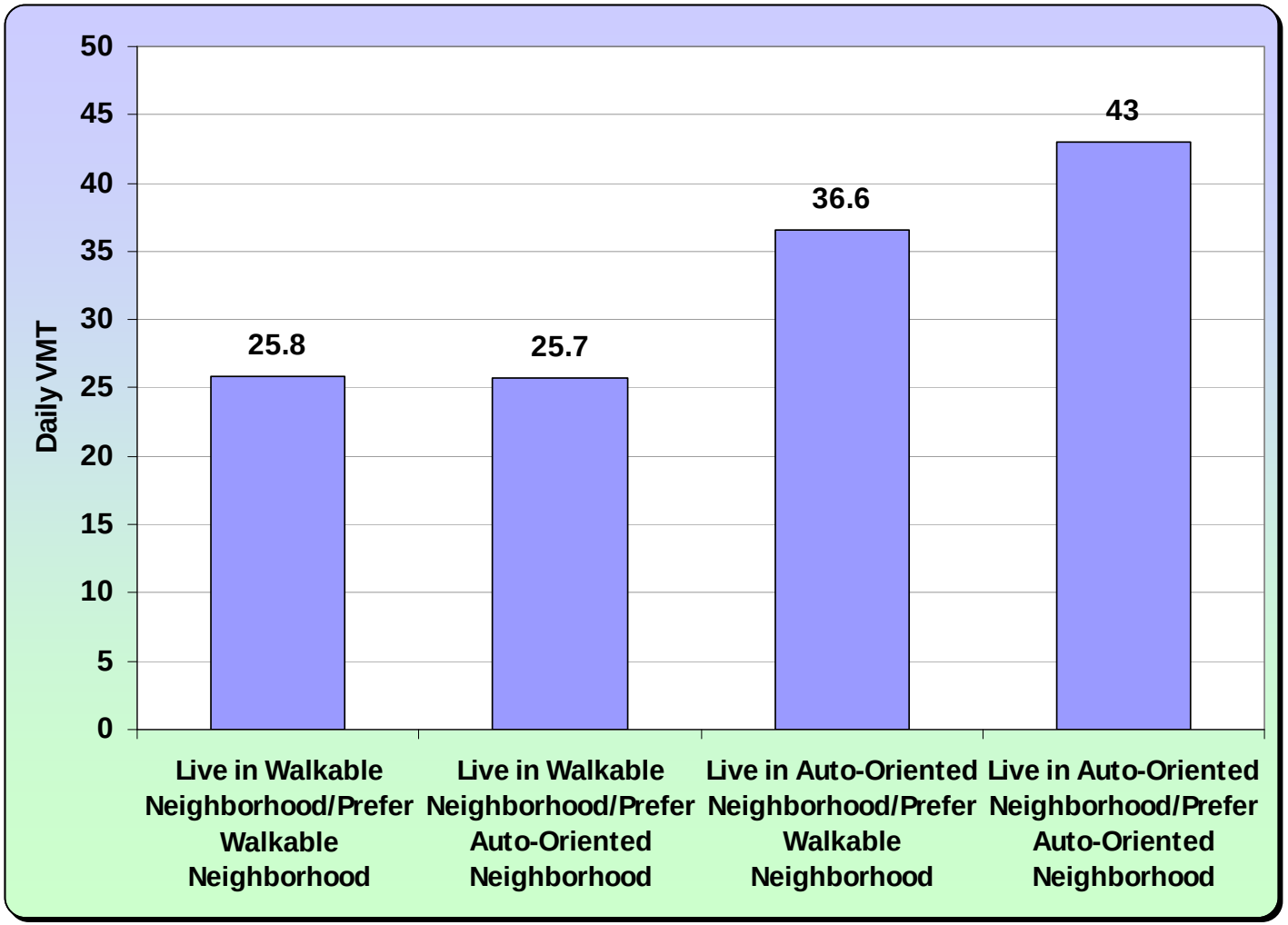
Competing Paradigms

Environmental Determinism

vs.

Self-Selection

Effect of the Environment Regardless of Preferences



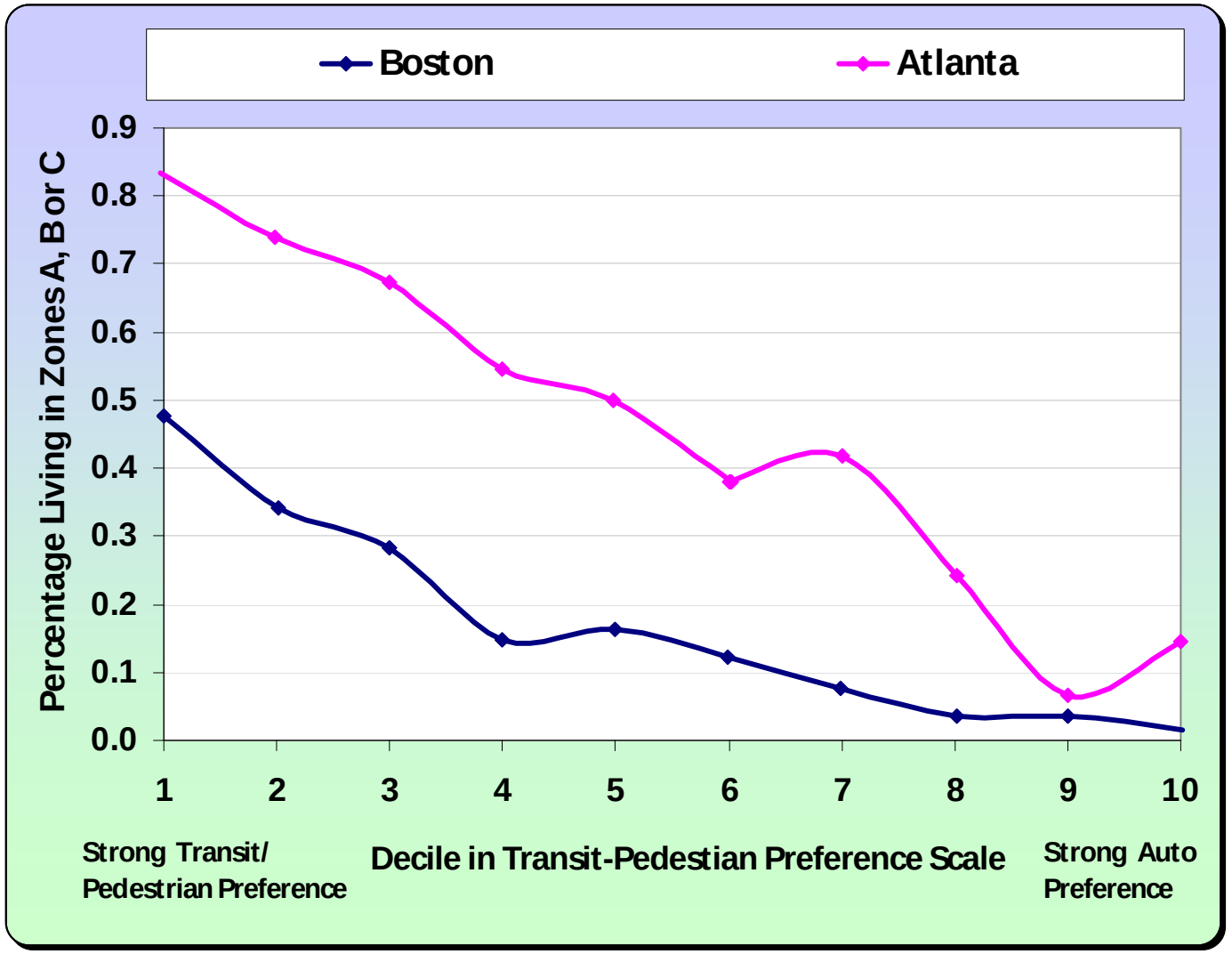
Weight of Evidence

"Virtually every quantitative study reviewed for this work, after controlling for self-selection through one of the various ways discussed above, found a statistically significant influence of one or more built environment measures on the travel behavior variable of interest"

Cao, Mokhtarian, and Handy (2006)

The Built Environment May Matter in Any Case…

Walkable, Transit-Oriented Development Is Undersupplied



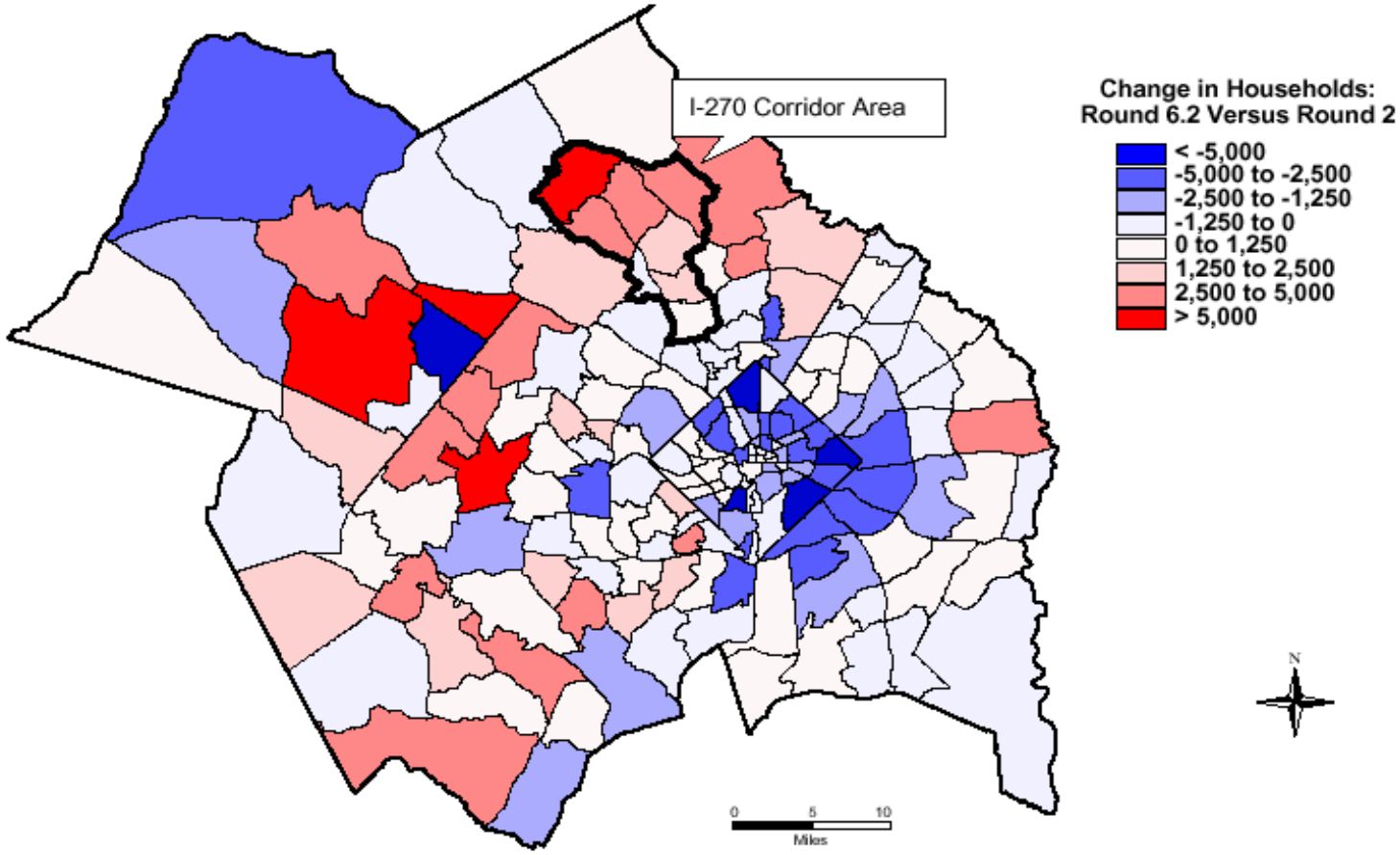
Effect of New Compact Development on Regional VMT

	Self Selection Dominates	Environmental Determinism Dominates
Walkable, transit-oriented places undersupplied at present	VMT decreases	VMT decreases
Walkable, transit-oriented place adequately supplied at present	VMT stays the same	VMT decreases

Chapter 6

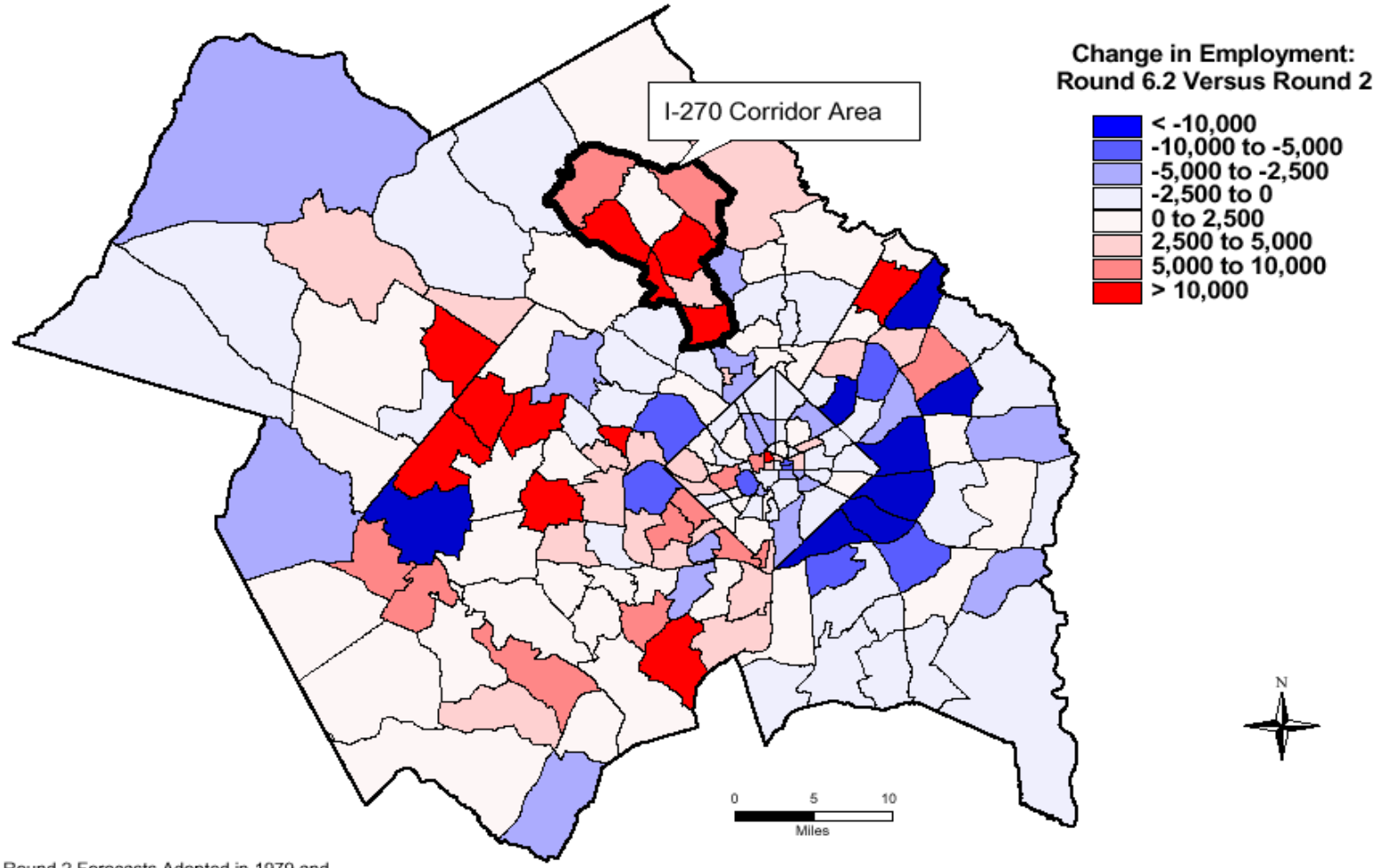
Induced Travel and Induced Development

Difference Between Actual and Forecasted Households (2000)



* Round 2 Forecasts Adopted in 1979 and
Round 6.2 Forecasts Adopted in 2000

Difference Between Actual and Forecasted Employment (2000)

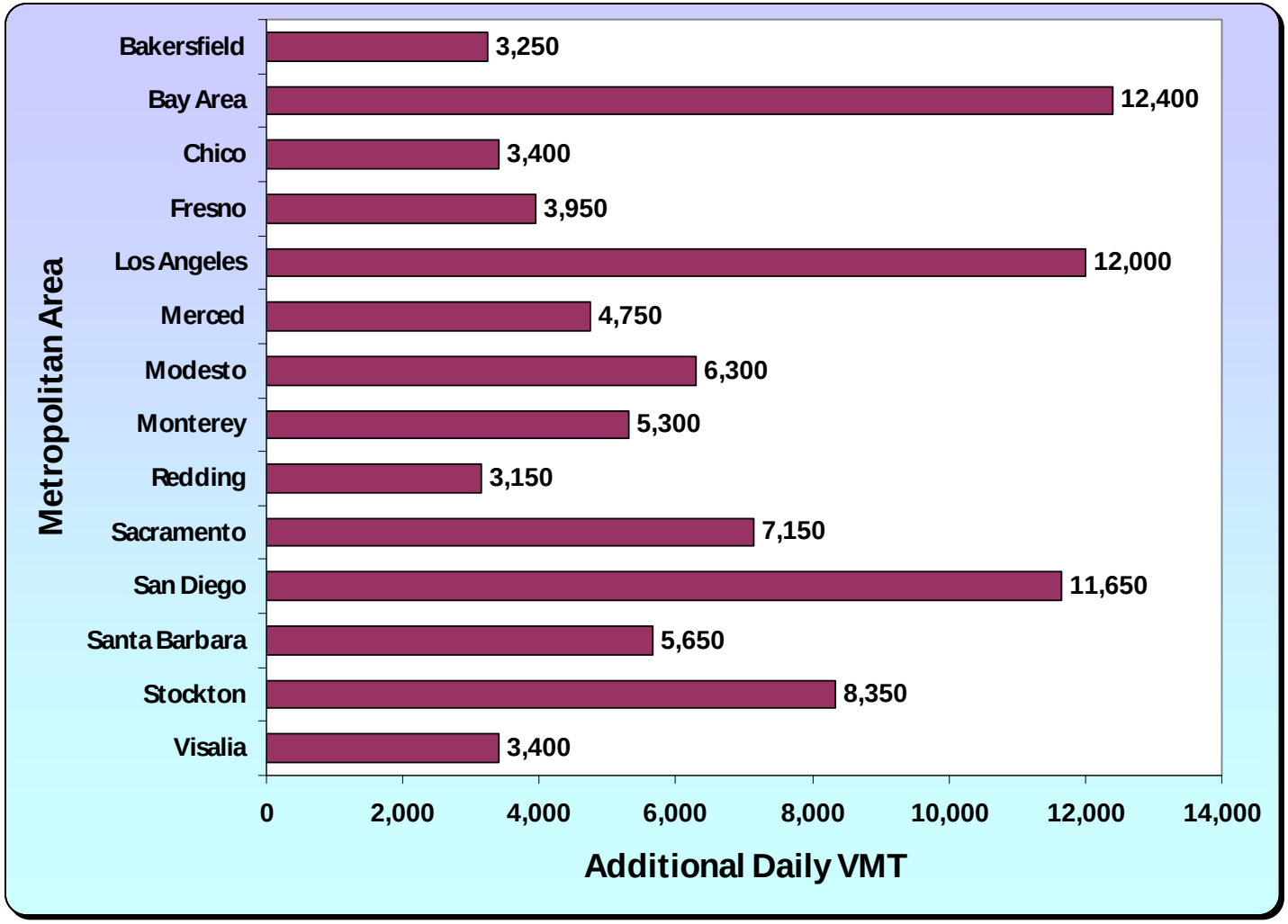


* Round 2 Forecasts Adopted in 1979 and Round 6.2 Forecasts Adopted in 2000

Elasticities of VMT with Respect to Capacity

	Facility-Specific Studies	Areawide Studies
Short-term	0	0.4
Medium-term	0.27	NA
Long-term	0.63	0.73

VMT Increases with Congestion



What We Know about Induced Development

- Highway investment patterns tend to favor suburbs over central cities, and thereby contribute to decentralization and low-density development.
- The induced development impacts of interstate-quality highways are wider and deeper than those of lesser highways and streets.
- It takes many years after construction for development to adjust to a new land use/transportation equilibrium.
- The induced development impacts of major highways extend out at least one mile, and probably farther.

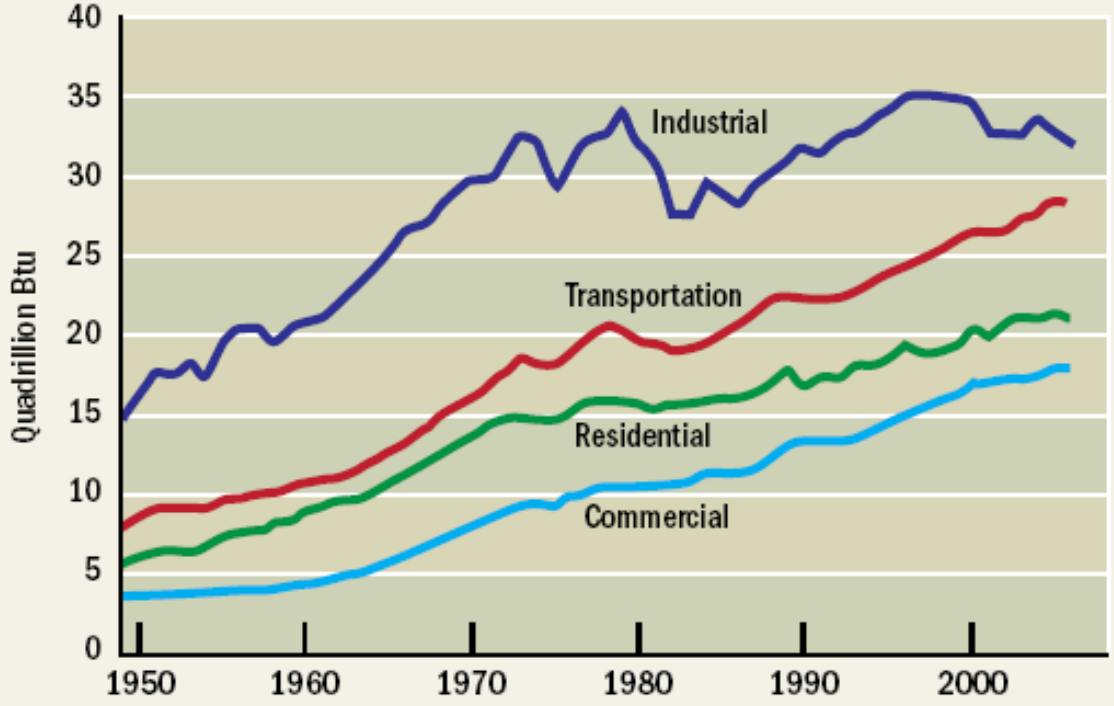
Chapter 7

Residential Energy and CO_2

U.S. Energy Use by End-Use Sector

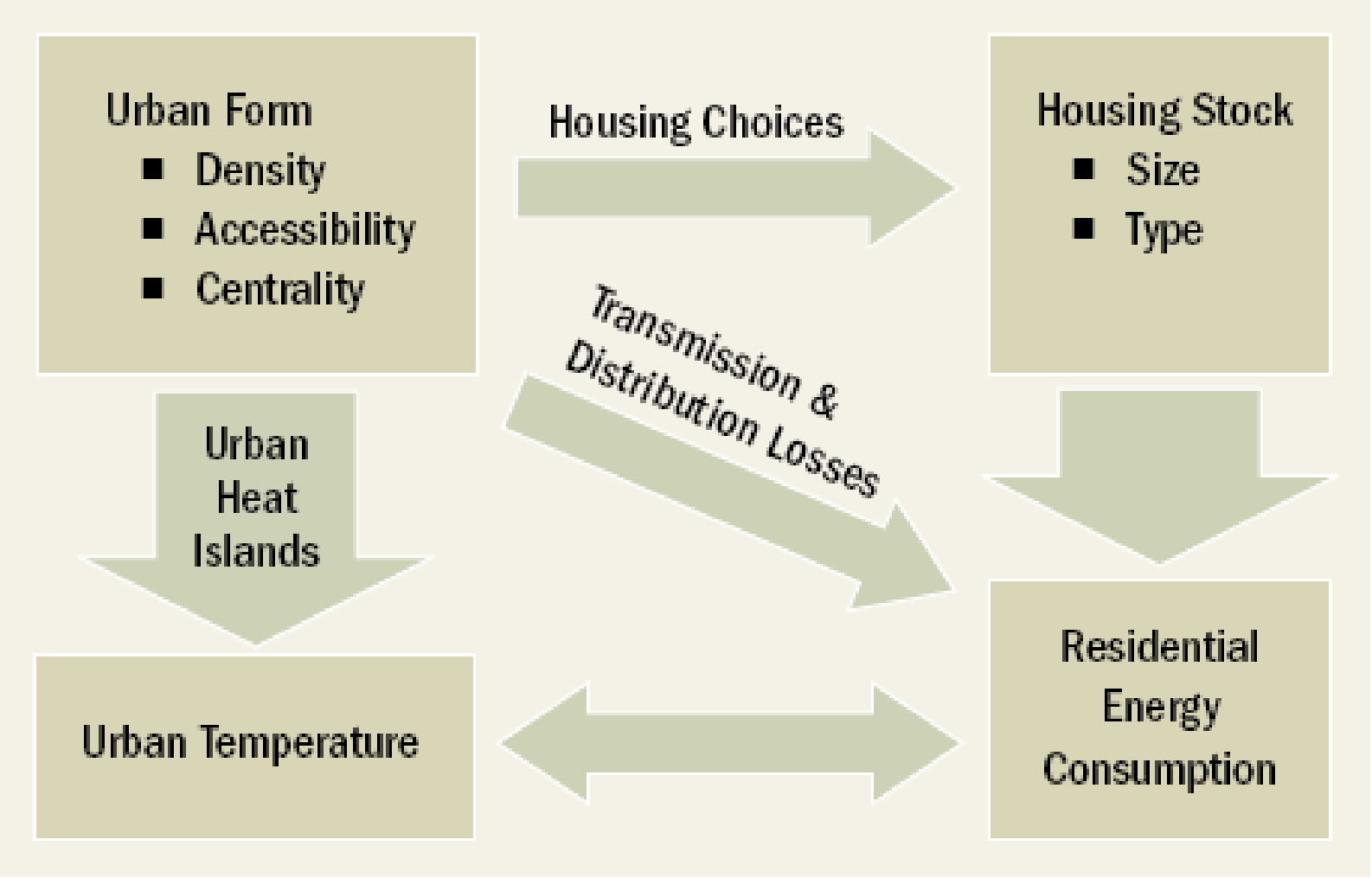
FIGURE 7-1

Total U.S. Energy Use by End-Use Sector, 1949 to 2005



SOURCE: Energy Information Administration, *Annual Energy Review 2006*, Washington, D.C., 2007.

Causal Pathways



Built Environment is Part of Reason

- House Size
  - » 1,000 square feet in San Francisco County
  - » 2,300 square feet in Waukesha County
- House Type
  - » 99 percent multifamily in New York County
  - » 0.6 percent in New Kent County, Virginia

Chapter 8

What Would It Take?

- What would it take to reach the 2030 CO2 reduction target of 33 percent below 1990 levels?
- Will compact development with supportive transportation policies be enough?
- If not, how much VMT reduction must be achieved through pricing, and what price changes would be required?

Urban VMT Reduction

	Elasticities of VMT with Respect to Policy Variables	Change in Annual Growth Rates of Policy Variables (% above/below Trend)	Effect on Annual VMT Growth Rate (% below Trend)
Population density	–0.30	1	–7.7%
Highway lane miles	0.55	–1	–11.4%
Transit revenue miles	–0.06	2.5	–4.6%
Real fuel price	–0.17	2.7	–14.4%

Compact Development

+

Transit

+

Road Pricing

-

Highway Expansion

=

38% VMT reduction by 2030

Chapter 9

Policy and Program Recommendations

Federal Policy Recommendations

- Require Transportation Conformity for Greenhouse Gases
- Use Cap-and-Trade (or Carbon Tax) Revenues to Promote Infill Development
- Enact "Green-TEA" Transportation Legislation that *Shifts Funding and Makes GHG Reduction a Priority*

Federal Policy Recommendations

- Provide Funding Directly to Metropolitan Planning Organizations *with Incentives*
- Develop a National Blueprint Planning Process that Encourages Transportation Choices and Land Use Change
- Create a New Program to Provide Funding to "Rewrite the Rules" *subject to Guidelines*

State Policy Recommendations

- Adopt and Suballocate VMT Reduction Targets
- Align State Spending with Climate and Smart Growth Goals
- Adopt a Statewide “Complete Streets” Policy and Funding Program
- Require Analysis of GHG Emissions as Part of Planning Approvals

Regional Policy Recommendations

- Give Funding Priority to Compact, Transit-Served Areas
- Redirect Transportation Funds from Road Expansion to Transit and Bike-Ped
- Establish a Regional Transfer of Development Rights Program
- Create a Carbon Impact Fee for New Development
- Use Scenario Planning to Evaluate Growth Options

Local Policy Recommendations

- Develop a Local Climate Action Plan
- Favor Smart Growth Projects in the Approval Process
- Reform the Rules of Development
- Adopt Pedestrian-Friendly Site and Building Design Standards
- Provide Workforce Housing Near Jobs

California Model

Recognition

- Technology Won't Get Us There
- Urban Development Makes a Difference (CAT's 10 MMTCO2e)
- Smart Growth Can Produce Measurable Results (Haagen Smit Conference)

AB 32 – Global Warming Solutions Act of 2006

- Statewide GHG Emissions Limit (1990 Levels by 2020)
- Annual Reporting, Monitoring, and Verification of GHG Emissions
- Scoping Plan of Maximum TF and CE Measures by 2009
- Enforceable Regulations by 2010
- Reimbursement for Local Agencies

AB 375

- GHG Budgets for Regions
- Regional Preferred Growth Scenarios
- Travel Model Enhancements
- Environmental Streamlining for Smart Growth Projects

Regional Agencies

- Capacity Building
- Regional Blueprint Planning
- Compliance with GHG Budgets
- Performance-Based Project Funding

Localities

- Climate Action Plans
- Subregional GHG Targets
- Zoning Reforms

CARB Scoping Plan

- 2 mm tons by 2020 with smart growth
- Our reanalysis

Additional Measures

- Keying of State Funding to GHG Goals
- Indirect Source Rule for Projects Inconsistent with Plan
- Technical and Financial Support for Good Planning

Issues

- Role of Regions/Suballocations
- Voluntary or Mandatory/Carrots or Sticks
- GHG or VMT Targets

It is a Choice

"The task of holding global emissions constant would be out of reach, were it not for the fact that all the driving and flying in 2056 will be in vehicles not yet designed, most of the buildings that will be around then are not yet built, the locations of many of the communities that will contain these buildings and determine their inhabitants' commuting patterns have not yet been chosen"

Socolow and Pacala 2006

Climate Change in Its Proper Perspective