SUSTAINABLE URBAN REDEVELOPMENT AND CLIMATE CHANGE

The Dual Benefits of Energy-Efficient Buildings in Energy-Efficient Locations

For the Congressional Briefing
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2253 Rayburn House Office Building
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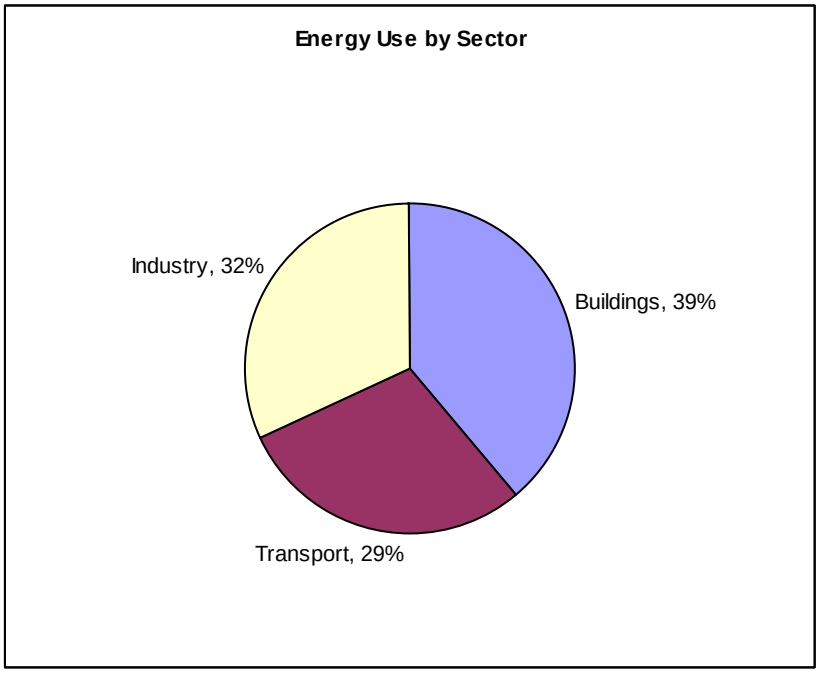
Introduction/Framing the Issue

Urban redevelopment programs, including transit-oriented development, historic preservation, and brownfields redevelopment, produce well-documented benefits: revitalizing neighborhoods, restoring historic buildings, bringing back jobs, cleaning up abandoned factories, and converting eyesores into assets. This paper explores the further potential for these urban redevelopment programs to also serve as an element of energy conservation and climate change strategies.

The authors are using the term "sustainable urban redevelopment" as a generic term to describe development that is green and energy-efficient both internally within the building envelope and externally, in that there are energy savings by virtue of the project location and its relationship to the city. This dual benefit is key.

The chart at the right functions to frame the potential for urban infill projects to impact the energy sector. Infill/ redevelopment activities can significantly impact two of the three sectors. If the project is green/energy efficient, it impacts building-related energy demands. If the project is also well-located vis-à-vis the urban context, it can also reduce the energy demand in the transportation sector. It is this dual benefit of sustainable urban redevelopment that holds great potential as an energy/climate solution.



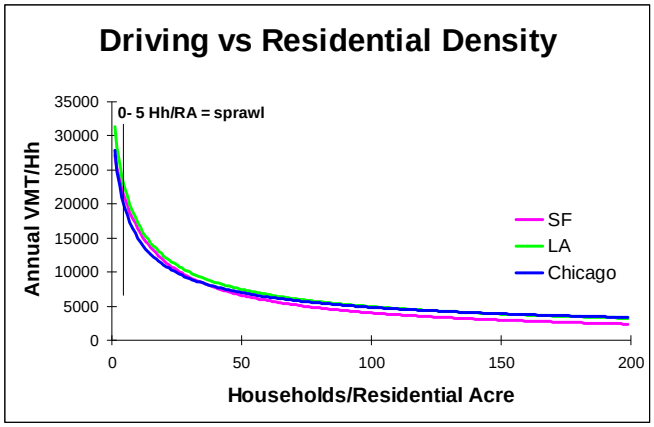
Source: U.S. Department of Energy, Energy Information Administration

Urban Infill/Compact Development and VMT

Transportation accounts for 29 percent of total U.S. energy demands. Current energy policies, as well as most proposed strategies for addressing greenhouse gases (GHGs), concentrate on fuel efficiency and alternative fuels as the primary mechanisms to conserve energy and reduce GHGs. However, projected increases in vehicle miles traveled (VMT) due to continued population growth and sprawling development patterns are likely to more than counterbalance the foreseeable gains attributable to fuel efficiency and expanded use of alternative fuels. Therefore, it is critical for both energy and climate policy to address where and how our regions grow and develop.

A recent report released by Urban Land Institute (ULI) documents that compact urban development, as an alternative to sprawl, could reduce VMT by 20 to 40 percent.[1] Factors that determine the greater and lesser VMT savings attributable to urban compact development are:

- Density of jobs and households
- Location in proximity to city center
- Mix of uses/internal design
- Degree of connection to the existing street network
- Access to transit



Another study reviewed the evidence of the relationship between density and VMT and found that any doubling of density corresponds to lowering of VMT by about 25 percent. The authors also compared highly dense North Beach in San Francisco (100 households/residential acre) to low density suburban San Ramon (three households/ residential acre) and found that North Beach reduced VMTs by 75 percent.[2]

Other studies have come to similar conclusions.[3] Case studies of brownfields projects have shown similar (20 to 40 percent) VMT reductions in Atlanta,[4] Baltimore, and Dallas.[5]

Transit-oriented Development. Neighborhoods that are classified as "transit zones" have also been linked to 20 to 40 percent lower automobile ownership rates, as well as non-auto commute mode splits that are two to four times higher than regional averages.[6] In the San Francisco Bay Area, VMT for households living within 1/2-mile of transit is half that of families living in suburban locations more than 1-mile from rail or ferry stops.[7] An average American family spends 19% of its

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[1] Urban Land Institute, Smart Growth America, the Center for Clean Air Policy, and the National Center for Smart Growth, "Growing Cooler: Evidence on Urban Development and Climate Change," Washington, D.C. January 2008 http://www.smartgrowthamerica.org/gcindex.html

[2] "Location Efficiency: Neighborhood and Socio-Economic Characteristics Determine Auto Ownership and Use," John Holtzclaw,* Robert Clear, Hank Dittmar, David Goldstein and Peter Haas, *Transportation Planning and Technology*, Vol. 25(1), pp 1-27, March 2002.

[3] Some of the studies include Pew Center on Global Climate Change, "Towards a Climate-Friendly Built Environment," Pew Report; Kris Wernstedt, "Overview of Existing Studies on Community Impacts of Land Reuse," National Center for Environmental Economics, 2004; The Funders Network and the Environmental and Energy Study Institute, "Energy and Smart Growth – It's About How and Where We Build" Larry King, "Sprawl and Public Health," *Public Health Reports*, May-June 2002.- http://www.cdc.gov/healthyplaces/articles/Urban%20Sprawl%20and%20Public%20Health%20-%20PHR.pdf .

[4] U.S. Environmental Protection Agency, "Atlantic Steel Redevelopment," Washington, D.C., 2006, http://www.epa.gov/innovation/collaboration/atlanticsteel.pdf

[5] "Clean Air/Brownfields Report" U.S. Conference of Mayors, December 2001.

[6] Reconnecting America, "Transit-Oriented Development Decision-Making: One Size Does Not Fit All," presentation to the New Partners for Smart Growth Conference, 2008. (see chart included in appendix)

[7] Metropolitan Transportation Commission. New Places, New Choices: Transit-Oriented Development in the San Francisco Bay Area. November, 2006.

income on transportation, but, for households in "transit-rich neighborhoods," the percentage drops to 9%.[8] Transit prevents the emissions of an estimated 16.6 million metric tonnes of GHG emissions from private vehicles annually.[9]

Measuring VMT reduction and "Location Efficiency." The science of predicting VMT reduction and measuring "energy location efficiency" is advancing rapidly. Models include: PLACES3S; Place Matters; EPA Smart Growth Index, and the Brookings Institution's www.walkscore.com. Just as certain governmental development incentives are being tied to the US Green Building Council's LEED (or other green building rating systems), parallel smart growth and climate objectives would be served by tying development incentives to carefully measured energy location efficiency.

Buildings and Energy

Green Buildings. Buildings make up about 39 percent of energy demands. Green buildings represent one obvious potential source of energy savings. One post-construction analysis of 125 green buildings concluded that LEED-certified buildings save an average of 25 to 30 percent in energy demands.[10]

Density and Energy Efficiency. As discussed above, density factors heavily into VMTs and transportation-related energy savings, but it also results in energy savings within the building envelope due to fewer exposed surfaces. Two studies found that energy use in multi-family buildings averages almost 50 percent less than single-family detached units.[11] The authors of the ULI "Growing Cooler" report concluded that after controlling for socio-economic variables, multi-family/compact development uses about 20 percent less energy than comparable single-family detached units.[12]

Building Preservation and Energy. Redevelopment often involves rehabilitating existing buildings, which takes less energy than new construction. According to the National Trust for Historic Preservation, it takes 40 to 65 years for a green, energy-efficient new office building to recover the energy lost in demolishing an existing building and building a new one. This finding is based on a calculation of the embodied energy that has been invested in a building over time (the energy needed to extract resource, manufacture building materials, and construct a building), as well as the additional energy needed to construct a new, green building.

Alternative Energy Production. Many green buildings incorporate energy production features, such as solar panels or wind energy. These features not only reduce emissions from fossil fuel-

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[8] Reconnecting America, Center for Transit-Oriented Development. "Realizing the Potential - Expanding Housing Opportunities Near Transit," April 2007

[9] Davis, Todd and Hale, Monica "Public Transportation's Contribution to U.S. Greenhouse Gas Reduction". September 2007.

[10] Greenbuild, "LEED Delivers on Predicted Energy Savings " (survey of 125 LEED-certified buildings)

[11] Naomi Friedman, "Connecting Energy and Smart Growth," Environmental and Energy Study Institute presentation, 2006; and Robin K. Vieira and Danny S. Parker, "Energy Use in Attached and Detached Residential Developments: Survey Result," http://www.fsec.ucf.edu/en/publications/html/FSEC-cr-381-91/ Florida Solar Energy Center, 2007

[12] Urban Land Institute, Smart Growth America, the Center for Clean Air Policy, and the National Center for Smart Growth, "Growing Cooler: Evidence on Urban Development and Climate Change," Washington, D.C., January 2008 http://www.smartgrowthamerica.org/gcindex.html

based energy systems, but also create jobs in industry, installation, and maintenance throughout the country. While still in its nascent stages in this country, the renewable energy and energy efficiency sectors accounted for an estimated $970 billion in revenues and 8.5 million jobs in 2006 alone.[13] Brownfields projects that have also incorporated energy production features have been catalogued on the Northeast-Midwest website: http://www.nemw.org/brownfields.htm#sustain.

Site-related Energy Savings

Although site-related factors have not been adequately quantified, there may be further energy savings associated with sustainable urban redevelopment, including;

- There is less "line-loss" in distributing electricity to dense urban areas than to spread suburban areas.
- Less energy is spent in building and maintaining infrastructure for urban projects than suburban sprawl projects.
- Some urban projects are served by waste-to-energy plants or district heating systems that also lower GHGs.
- An indirect benefit of urban redevelopment is the retention of greenfield "carbon sinks."

Adding up the Energy Savings

If a redevelopment project involves proximity to transit, dense mixed use, and "connectedness," as well as green/energy efficient features, the total energy savings (relative to conventional construction on a greenfields site) would be at least 30 percent, with a potential to exceed 50 percent.

Policy Implications – Current Legislation

The co-sponsors of the briefing recommend that Congress consider a number of measures to support sustainable urban redevelopment, as follows:

- ***Use Cap-and-Trade Climate Revenues to Encourage Sustainable Redevelopment.*** Authorize climate change/cap-and-trade revenues to encourage sustainable urban redevelopment and greater transportation choices, which is addressed in Congressman Ed Markey's iCAP bill and Congressman Lloyd Doggett and Earl Blumenauer's cap-and-trade legislation. $8 billion dollars is recommended annually to fund both transportation choices and smart growth, including redevelopment. Recommended policy for eligible uses of funds to support sustainable urban redevelopment:

  > *Funding for planning and implementation of mixed-use infill, brownfields, historic preservation, and transit-oriented development, consistent with current federal funding authorities and linked to requirements for buildings to be high performance and that the development is projected to reduce VMTs.*

- ***Re-authorize the EPA Brownfields Program.*** Support Johnson-Oberstar Brownfields Reauthorization Bill (H.R. 5336) with modifications, as follows:

[13] American Solar Energy Society. "Renewable Energy and Energy Efficiency: Economic Drivers for the 21st Century". 2007.

- Authorization level increased to $600 million at the end of the next five years;
- Establish a "Pilot Program for Sustainable and Alternative Energy Reuse of Brownfields;"
- Higher ceilings for cleanup grants and other measures to expedite cleanups;
- Strengthen the funding criteria to reflect greater emphasis on green buildings.

- ***Improve Rehabilitation Tax Credit***. Support Reps. Stephanie Tubbs Jones and Phil English's Community Restoration and Revitalization Act –(H.R. 1043), a bipartisan bill that would improve the existing historic preservation tax credit (rehab credit) for the restoration and rehabilitation of the nation's vacant and underutilized historic buildings. The Community Restoration and Revitalization Act is a package of amendments that would further the mission of the rehab credit by spurring greater investments in smaller commercial projects and Main Street commercial properties in older neighborhoods – particularly where there is a critical need for affordable housing and community revitalization. A key aspect of the bill highlights the usefulness of creating affordable rental housing in historic buildings. The law allows the rehab credit to be "paired" with the Low-Income Housing Tax Credit in certain projects.

- ***Adopt Brownfields Tax Credit.*** Support HR 3080 – America's Brownfield Cleanup Act (Brownfields Tax Credit - Turner, R-OH). The bill would establish an income tax credit for up to 50% of qualified remediation expenditures. There would be a $1 billion cap on the program and credits would be distributed to states proportionately to population. Recommend consideration of eligibility or funding criteria to tie the program to green buildings and energy efficient locations.

- ***Adopt Location Efficient Mortgages.*** Support Congressman Perlmutter's GREEN Act, which would encourage the creation of location efficient mortgages that help people afford housing near good public transportation.

- ***Support the Choices for Gas Relief Act of 2008.*** Support legislation recently introduced by Congressman Earl Blumenauer that provides funding for transit, pedestrian and bike infrastructure (which helps support urban redevelopment), and sets goals for location efficiency mortgages and initiates a grant program to assist states in constructing, preserving, or acquiring affordable housing that is close to transit, helping low-income consumers save transportation costs.

Policy Implications - Future Legislation

- ***Support reform for next year's Surface Transportation bill***: Federal transportation language has historically discriminated against urban redevelopment, making it easier to build new road networks than maintain and improve the older road and transit systems that exist in most urban areas. Additionally, our federal transportation spending is disproportionately skewed towards roads (80 percent of the spending) instead of public transportation. A recently launched coalition of groups called Transportation for America, which includes Smart Growth America and Reconnecting America, is pushing for significant changes in this legislation, including a greater emphasis on maintaining our current infrastructure, providing more affordable transportation choices for people, spending

taxpayer dollars in a more accountable manner, and ensuring transportation policy is better coordinated with development, housing, and other relevant policies.

- ***Incentives for Greening Existing Buildings.*** Support legislation that promotes the greening of existing buildings through the establishment of a tax credits for green retrofits, loan guarantees, and/or other incentives that directly addresses the market barriers that prevent individuals and business owners from greening their buildings

Appendices

Appendix 1. Projects Presented in this Briefing

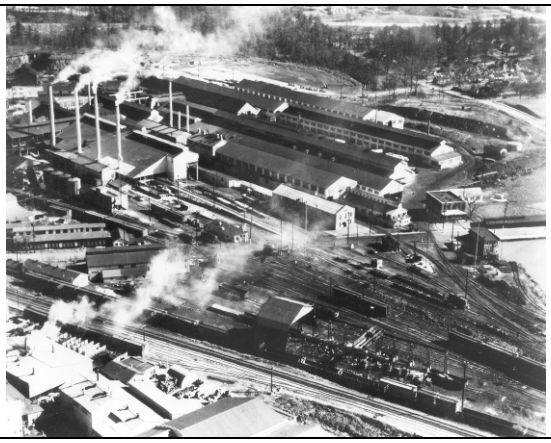
Appendix 2. Speaker Bios

Appendix 3. Transit, Biking, Walking to Work, Transit Zones vs. Region

Appendix 4. Sustainable Urban Redevelopment and Climate Change, by the Numbers

Appendix 1 – Projects Presented in Briefing

Atlantic Station

	
Atlantic Steel	*Atlantic Station*

The Atlantic Station® community is a 138-acre environmental redevelopment and reclamation of the former Atlantic Steel Mill in Midtown Atlanta being developed by AIG Global Real Estate Investment Corp. and Atlanta-based Jacoby Development, Inc. (JDI).

Project Description. In 1997, Jacoby Development initiated plans to redevelop the 100-year-old Atlantic Steel Mill—creating the largest urban brownfield redevelopment in the U.S. The property is already a national model for smart growth and new urbanism. A joint venture between AIG Global Real Estate Investment Corp. and Atlanta-based JDI, the Atlantic Station community represents $2 billion in new construction.

The total redevelopment will provide:

- Six million square feet of class A LEED certified office space
- 3,000 - 5,000 residential units (for-sale and for-rent)
- Two million square feet of retail and entertainment space,
- 1,000 hotel rooms
- 11 acres of public parks

VMT Reduction/Energy-Efficient Location. The complex was designed so people can leave their cars parked. To support mass transit use and decrease single occupancy vehicle travel, the Atlantic Station neighborhood operates a clean-fueled, rubber-tired transit shuttle system that circulates between the Arts Center MARTA station and the Atlantic Station community. The shuttle carries 60,000 people a month to and from a nearby transit site. There is also a dedicated lane, and a commuter café, intended as a hub from which people can find out about mass transit, car- and bike-sharing, and other commuting options. Additionally, space is reserved for light rail service, should funding allow the BeltLine to be expanded there. The project has also started a "Go Carless" campaign to encourage car-dependent Atlantans to consider the advantages of living working and playing in a walkable, transit-friendly community.

1. ***Results of VMT studies*** –

- Average daily vehicle miles traveled (VMT) per resident of the site – **8.6 miles**
- Average daily vehicle miles traveled (VMT) per employee of the site – **12.0 miles**
- Individuals residing in ARC's 20-county modeling domain travel an average of **32.4 miles** per day. Employed residents travel, on average, **18.85 miles per day**.

Green Buildings. The project involves 8 million square feet of space that has been with USGBC's LEED program. Thus far, two certifications, one gold and one silver, have been received.

Portland Armory

Built in 1891, the Portland Armory is listed on the National Register of Historic Places. During the twentieth century, this half-block fortress (located between 10th and 11th Avenue in the Pearl District) was inhabited by the First Regiment Militia, a mustering place for foreign wars, the backdrop for a President's oration, and host to many sporting events. It is now under construction to become the home of Network member with two theaters and an open gathering place for the community. While turning an armory into an arts and community hub is ambitious, equally challenging is the attempt to renovate the building to the highest LEED standards. An overarching challenge is to balance sustainable design with historic sensitivity, and the needs of visitors, theater patrons, and professionals. As an example, natural daylighting is common in many LEED buildings, but the Armory's fortress design and theater use limit this opportunity. The solution is to use multiple small skylights to bathe top floor workspaces in natural light, augmented by auto-dimmed electric lighting.

Water use. For water efficiency a multi-tiered capture and conservation effort is in development, including collecting rainwater from the Armory's roof in a 30,000 gallon cistern. High efficiency fixtures will be used throughout the building along with some dual flush toilets. Such rain capture and reuse will reduce impact on the municipal water and sewer systems and local watersheds.

Energy Use. Energy efficiency is a major driver for the LEED standards. Energy saving techniques are planned to use at least 35% less energy than code, meaning that this 19th century building will

use far less power than most new construction, yet will be healthier and more comfortable. The heating system will distribute heat from high-efficiency condensing boilers via radiant, in-floor coils. Water cooling will be performed at the Brewery Blocks' chilling plant, a centralized, non-CFC solution that not only protects the atmosphere but serves several buildings in the area. Air cooling will be achieved by an under-floor, displacement ventilation system which enhances comfort and reduces noise and unsightly ducting.

VMT Reduction. Aside from energy-efficiency within the building, the site is also an energy-efficient location. A former brownfields site put back to productive reuse, the site is adjacent to a streetcar line, five blocks from a light rail line, and an easy walk from many downtown and near downtown businesses and residences. The "Walk Score' for the site is 100.

The goal is that the Armory will be a celebration of the Portland community's commitment to sustainability. As many as 50,000 people visit the Natural Capital Center each year, a nearby LEED Gold historic building. And many will come to the Armory to experience and learn from a healthy, comfortable, and entertaining building, which just happens to be one hundred years old.

Sustainable Development Projects of Arcadia Land Development

Downtown Albuquerque, NM--Century Theater Block

At the gateway into downtown Albuquerque, the Century Theatre Block is a 110,000 sq foot, 14-plex movie theater, office and retail project that catalyzed the redevelopment of downtown. It is across the street from the commuter and Amtrak train station and from the bus rapid transit hub.

Suburban Philadelphia TOD

This transit-oriented development condominium project at Haverford train station in Lower Merion Township on the Philadelphia Main Line is a 42-unit luxury project which will be the first project of its kind. It is hoped that additional high density development can be sparked in the immediate area to create a regionally significant, walkable urban place.

Suburban San Francisco TOD

The transit-oriented conversion of a 14-acre strip center at a San Mateo (CA) Caltrain station, south of San Francisco, is a model of what future TOD development should be in the US. It converts a 200,000 square foot strip center into a 1,000,000 square foot retail, residential and office walkable urban development.

Appendix 2 – Speaker Bios

Brian M. Leary

Since joining Atlantic Station in 1997 as Vice President for Design and Retail, Brian Leary has developed the master plan into a national model for smart growth and new urbanism. Leary successfully negotiated with the U.S. Environmental Protection Agency for Atlantic Station and the new 17th Street multi-modal bridge to become the first Project XL and transportation control measure of its kind in the United States.

Prior to joining the Atlantic Steel redevelopment team, Leary worked for Central Atlanta Progress (CAP). With CAP and COPA, Inc., the non-profit development arm for the Centennial Olympic Park area, Leary helped with the continued implementation of the Westside Tax Allocation District (TAD), Centennial Park area special public interest (SPI) overlay zoning district and expansion of the Downtown Improvement District (DID).

Leary is a graduate of Georgia Tech's College of Architecture with an undergraduate degree in architecture and a master's degree in City Planning. While focusing on transportation and land development in graduate school, he worked with Catherine Ross, Ph.D. (now Executive Director of the Georgia Regional Transportation Authority) and her consulting firm. Before graduating, he finished his thesis outlining a redevelopment plan for the Atlantic Steel property that would provide a national model for smart growth and brownfield remediation through the creation of a 24-hour, live-work-play community.

Leary has spoken to groups across the United States outlining not only the consequences of sprawl and its inefficient use of resources, but also growth through sustainable development practices. He has presented to the Congress for New Urbanism, National Partners for Smart Growth, Real Estate Roundtable, Urban Land Institute, and the President's National Town Meeting on Sustainability. In April of 1999, his article, "Steel Away" which outlined the past, present and future of the Atlantic Steel property was published in Urban Land magazine.

Leary is a member of the Urban Land Institute (ULI), Congress for New Urbanism, International Council of Shopping Centers (ICSC) and the Home Park Community Improvement Association. He is an alumni advisor to Georgia Tech and sits on the Atlanta Streetcar Advisory Board, the Board of PEDS, the Board of Georgian's for Transportation Alternatives, the Inner City, Environmental and Brownfield Committees of ULI's Atlanta District and the Midtown Alliance Transportation Committee.

Ralph DiNola

A principal with Green Building Services, Ralph brings over 15 years of green building and design expertise to his consulting work. He is widely recognized for his ability to deliver high level green building strategies and forge effective working relationships among members of national and international project teams. Ralph is a nationally recognized facilitator who leads trainings, eco-charrettes and workshops on sustainability and green building strategies. As a member of the USGBC's LEED faculty, he also leads workshops on the LEED Green Building Rating System. Ralph is on the Board of Directors of the Cascadia Green Building Council and a member of the USGBC's LEED for Retail Committee.

Christopher B. Leinberger

Chris Leinberger is a land use strategist, developer, teacher, researcher, consultant and author, focusing on implementing what he refers to as "walkable urbanism" in the building of the built environment. He is a founding partner of Arcadia Land Company, a progressive real estate development firm which has had or currently has New Urbanism and transit-oriented developments (TOD) projects in Independence, Missouri, downtown Albuquerque and the Philadelphia metropolitan area. He is a Visiting Fellow at The Brookings Institution in Washington, DC, and a Professor of Practice and Director of the Graduate Real Estate Program at the University of Michigan. Chris has written award-winning articles for publications such as the *Atlantic Monthly*, *Wall Street Journal*, *Urban Land* magazine, among others, and is the author or has contributed chapters to eight books. He has been profiled by national broadcast and print media such as CNN, Today Show, NBC, ABC, National Public Radio, Progressive Architecture, among others. Chris is a graduate of Swarthmore College and Harvard Business School. His most recent book is *The Option of Urbanism; Investing in a New American Dream* (Island Press) and most recent national article is "The Next Slum?", which appeared in the March, 2008, *Atlantic Monthly*.

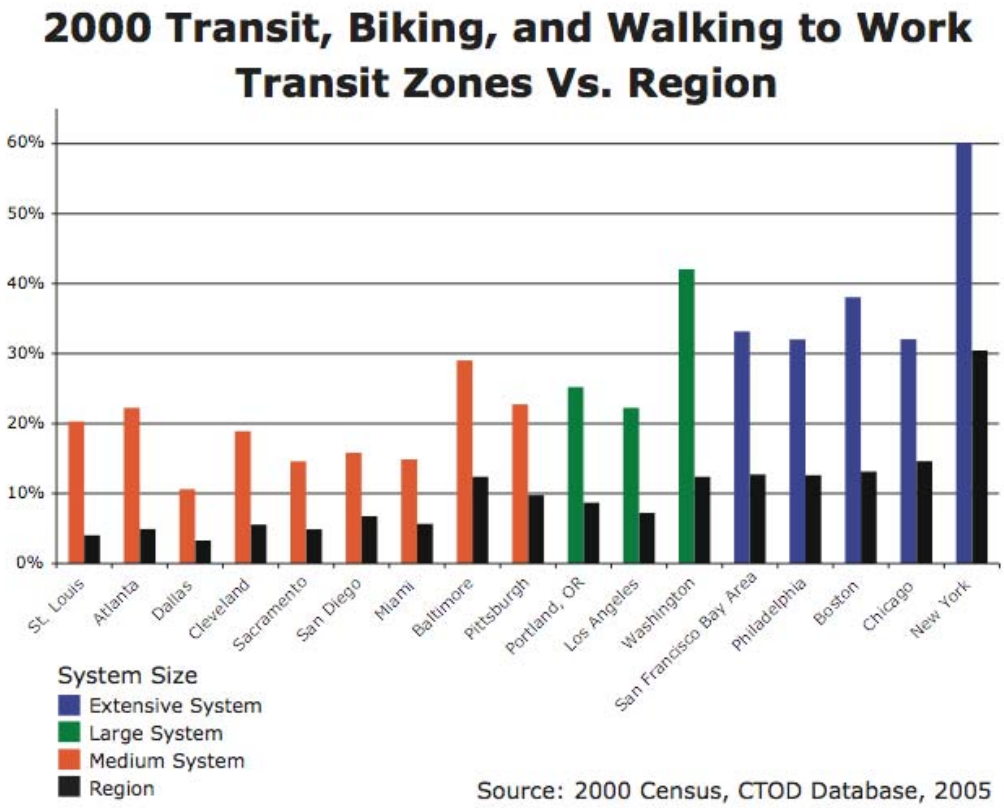
For further information, go to:
www.arcadialand.com
www.cleinberger.com
www.brookings.edu/walkableurbanism
www.tcaup.umich.edu/realestate/

Geoff Anderson

Mr. Anderson is the President and CEO of Smart Growth America. Geoff came to his current position in January 2008 after 13 years at the US EPA where he headed the Agency's Smart Growth Program. During his tenure at EPA, he was instrumental in creating the Agency's Smart Growth program, he helped to found the Smart Growth Network, the New Partners for Smart Growth Conference, and the popular web site smartgrowth.org. In addition, he provided seed funding for and helped to catalyze the creation of the National Vacant Properties Campaign, The LEED for Neighborhood Development Certification program, and the Governors' Institute for Community Design.

He has co-authored numerous publications including: This Is Smart Growth, Getting to Smart Growth Volumes 1 and 2, Protecting Water Resources with Higher Density Development, The Transportation and Environmental Impacts of Infill vs. Greenfield Development and many others. His work also included direct technical assistance, helping with smart growth implementation in communities nationwide including Cheyenne, WY, Prince George's County, MD, and the flagship smart growth project Atlantic Station in Atlanta, Ga. Geoff received a Masters Degree from Duke University's Nicholas School of the Environment with a concentration in Resource Economics and Policy.

Appendix 3


2000 Transit, Biking, and Walking to Work
Transit Zones Vs. Region
60%
50%
40%
30%
20%
10%
0%
St. Louis
Atlanta
Dallas
Cleveland
Sacramento
San Diego
Miami
Baltimore
Pittsburgh
Portland, OR
Los Angeles
Washington
San Francisco Bay Area
Philadelphia
Boston
Chicago
New York
System Size
Extensive System
Large System
Medium System
Region
Source: 2000 Census, CTOD Database, 2005

Appendix 4

Sustainable Urban Redevelopment and Climate Change – By the Numbers[i]

Smart Growth and Vehicle Miles Traveled (VMT)	**Percentages and metric tons of CO_2**
o The percentage of energy demands accounted for by transportation	29%
o Total CO_2 accounted for by transportation	1,729 million tons
o The percentage growth of greenhouse gas (GHG) emissions from mobile sources from 1990 to 2004	29%
o If fuel efficiency/CAFE standards are increased by 40% (to 35 MPG), but VMTs continue rising at 2% annually, what will happen to GHGs? [ii]	GHGs increase 12% by 2030
o The 10 most "compact" metropolitan areas (example: Portland) reduce average per person VMTs relative to the 10 most "sprawling" metropolitan areas (example: Atlanta) by:[2]	25%
o "Compact urban development" (with density 2-3 times typical suburban density) reduces VMT compared to sprawl development patterns by: [2]	20% – 40%
o If 60 percent of new growth by 2050 is accommodated in "compact urban development," travel-related greenhouse gas emissions would be cut by: [2]	7% - 10% or 85 million tons
o For a typical office building, the energy used in employee access exceeds the energy used in the building by:[iii]	30%
o ***At the individual level,*** moving from the suburbs to an urban compact neighborhood is equivalent to driving a hybrid.	
▪ Hybrid fuel efficiency saves CO_2 relative to average vehicle fuel efficiency	2 tons
▪ Urban compact neighborhood saves CO_2 via lower VMTs	2.1 tons
Buildings – Energy-Efficiency and Density	
o The percentage U.S. CO_2 emissions accounted for by buildings[iv]	39%
o Total CO_2 accounted for by buildings	2,290 million tons
o The percentage reduction in energy use of LEED-certified buildings, compared to non-LEED buildings[v]	25% - 30%
o The percentage reduction in energy used by households in multi-family dwellings compared to single-family detached dwellings[vi]	50%
▪ If income and DU size are held constant, the percentage reduction is[2]	20%
o ***At the individual level,*** if you moved from a single-family detached house to a green multi-family condo or apartment of the same size, you would be reducing your structure-related GHGs by about	42% or 4.8 tons
Public Transportation[vii]	
o Net carbon dioxide saved from public transportation (CO_2 emissions from personal vehicles if no transit service less emissions from public transport)	3.9 million tons
o Additional carbon dioxide saved from transit-reduced congestion	3.0 million tons
o Total carbon dioxide savings from public transportation	6.9 million tons
o An average American family spends 19% of its income on transportation, but, for households in "transit-rich neighborhoods," the percentage drops to[viii]	9%
o ***At the individual level,*** if an individual commuting 20 miles switched from automobile to transit, that would save	2.2 tons
Infrastructure	
o One study concluded that it takes less energy to build and maintain infrastructure for urban infill relative to suburban development by a factor of [ix]	25%
Distributed Energy – Waste-to-Energy Plants	
o CO_2 emissions saved by one 1,500-ton-per-day waste-to-energy facility[x]	270,000 tons

[i] Source unless otherwise specified: U.S. Department of Energy, Energy Information Administration, and Northeast-Midwest Institute.

[ii] Urban Land Institute, Smart Growth America, the Center for Clean Air Policy, and the National Center for Smart Growth, "Growing Cooler: The Evidence on Urban Development and Climate Change," Washington, D.C., January 2008, http://www.smartgrowthamerica.org/gcindex.html

[iii] Alex Wilson, "Driving to Green Buildings," Environmental Building News, September 2007

[iv] U.S. Department of Energy, Buildings and Energy Data Book, 2007

[v] Greenbuild, "LEED Delivers on Predicted Energy Savings " (survey of 125 LEED certified buildings)

[vi] Naomi Freeman, "Connecting Energy and Smart Growth," Environmental and Energy Study Institute presentation, 2006. Also: Robin K. Vieira and Danny S. Parker, "Energy Use in Attached and Detached Residential Developments: Survey Result," http://www.fsec.ucf.edu/en/publications/html/FSEC-cr-381-91/

[vii] SAIC, "Public Transportation's Contribution to Greenhouse Gas Reduction," September 2007

[viii] Reconnecting America, Center for Transit-Oriented Development. "Realizing the Potential - Expanding Housing Opportunities Near Transit," April 2007

[ix] California Energy Commission, PLACE^{3}S, 1996

[x] http://www.dec.ny.gov/chemical/8979.html