www.vtpi.org
Info@vtpi.org
250-360-1560

Understanding Smart Growth Savings

Evaluating Economic Savings and Benefits of Compact Development, and How They Are Misrepresented By Critics

28 May 2015

By
Todd Litman
Victoria Transport Policy Institute



Abstract
How communities develop can have many direct and indirect impacts. Smart growth policies, which result in more compact, multimodal development, reduce per capita land consumption and the distances between common destinations, which reduces the costs of providing public infrastructure and services, improves accessibility and reduces per capita motor vehicle travel, which in turn provides economic, social and environmental benefits. This report examines these impacts. It defines *smart growth* and its alternative, *sprawl*, summarizes current research concerning their costs and benefits, investigates consumer preferences, and evaluates smart growth criticisms. This report should be useful to anybody involved in development policy analysis.

This report summarizes:

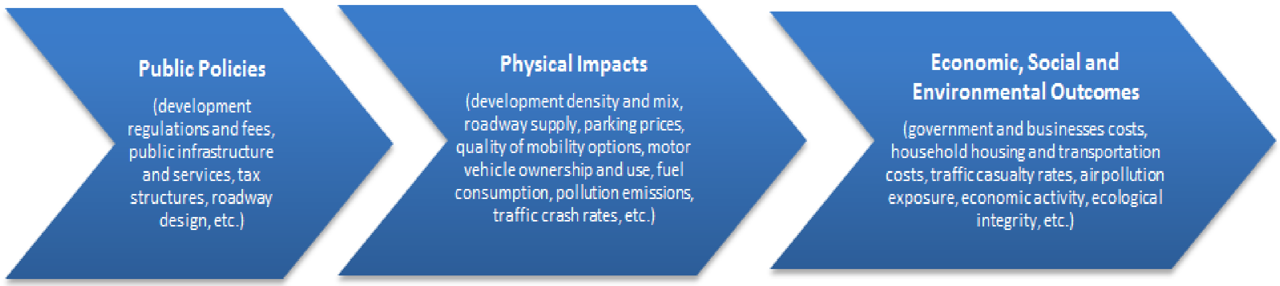
Todd Litman (2014), *Analysis of Public Policies That Unintentionally Encourage and Subsidize Urban Sprawl*, commissioned by LSE Cities (www.lsecities.net), for the Global Commission on the Economy and Climate (www.newclimateeconomy.net); at http://bit.ly/1EvGtIN.

Contents

Introduction

Home is where the heart is, and community is where the home is. As a result, there are few issues that affect people more deeply than how their community develops, since this touches their hearts. A growing body of research helps us understand the ultimate impacts of specific development policies. This information can help identify the policies that best achieve various economic, social and environmental goals:

Figure 1 **Policies, Impacts and Outcomes**



Public policies have physical impacts, which affect economic, social and environmental outcomes.

Both theoretical and empirical research described in this report indicate that *smart growth* policies that result in more compact and mixed development, and create more multimodal transportation systems, tend to provide various savings and benefits. This makes sense because such development is resource efficient; it causes residents to consume less land and energy, own fewer vehicles, require less parking, and generate less traffic congestion, traffic risk and pollution. It also tends to be more socially equitable because it expands affordable housing and transport options suitable for physically, economically and socially disadvantaged people.

In most communities, smart growth policies represent major change. Many conventional planning practices, such as restrictions on development density and minimum parking requirements, tend to favor sprawl and automobile-dependency. These policies tend to violate basic market principles, they reduce consumer sovereignty by reducing housing and transportation options, and they impose various costs that are indirect and external – imposed on other people – and therefore often overlooked by individuals making housing and transport decisions. Smart growth policies can help correct these market distortions, which increases economic efficiency and social equity.

This research has practical applications. A basic principle of good planning is that individual, short-term decisions should support long-term, strategic goals. This research can help identify ways to create truly efficient, economically successful and socially equitable communities.

This report investigates these issues. It defines smart growth and sprawl; describes various smart growth benefits and costs; examines market distortions that result in economically excessive sprawl; examines smart growth criticisms; and discusses various implications of this analysis. This information can help identify development policies that are truly optimal, considering all impacts.

Defining Smart Growth and Sprawl

Smart growth is a general term for policies that result in more compact, accessible, multimodal development, in contrast to *sprawl*, which refers to dispersed, urban fringe, automobile-dependent development, as indicated in Table 1. Comprehensive smart growth policies create *transit-oriented communities*, neighborhoods where high quality walking, cycling, public transit and carsharing services allow households to minimize their vehicle ownership and use.

Table 1 **Comparing Smart Growth and Sprawl** ("Smart Growth," VTPI 2006)

	Smart Growth	Sprawl
Density	Higher-density, clustered activities	Lower-density, dispersed activities
Growth pattern	Infill (brownfield) development	Urban fringe (greenfield) development
Land use mix	Mixed land use	Homogeneous (single-use, segregated) land uses
Scale	Human scale. Smaller buildings, blocks and roads. Designed for pedestrians	Large scale. Larger blocks, wider roads. Less detail, since people experience the landscape as motorists
Services (shops, schools, parks)	Local, distributed, smaller. Accommodates walking access.	Regional, consolidated, larger. Requires automobile access
Transport	Multi-modal. Supports walking, cycling and public transit	Automobile-oriented. Poorly suited for walking, cycling and transit
Transport connectivity	Highly connected roads, sidewalks and paths, and good connections between modes.	Poorly connected networks, with numerous dead-end streets, few paths, and inadequate connections between modes
Street design	*Complete streets* that accommodate diverse modes and activities	Streets designed to maximize motor vehicle traffic volume and speed
Planning process	Planned and coordinated between jurisdictions and stakeholders	Poorly planned, with little coordination between jurisdictions and stakeholders
Public space	Emphasis on the public realm (streets, sidewalks and public parks)	Emphasis on the private realm (yards, shopping malls, gated communities, private clubs)

This table compares smart growth and sprawl development patterns.

Smart growth is a general set of principles that can be applied in many different ways. In rural areas, it creates compact, walkable villages with a mix of single- and multi-family housing organized around a commercial center. In large cities, smart growth may create dense, urban neighborhoods with high-rise buildings organized around major transit stations. Between these is a wide range of neighborhood types, their common theme is compact and multi-modal development. In mature cities, smart growth consists primarily of incremental infill in existing neighborhoods, but in growing cities it often consists of urban expansion. Smart growth does not usually require that all residents live in high-rise apartments and forego automobile travel; excepting cities with severe constraints on expansion, a major portion of households can live in single-family or adjacent (townhouses), and many can own or share cars (Litman 2014).

Figure 2 illustrates typical examples of smart growth and sprawl (Hartzell 2013).

Figure 2 **Sprawl and Smart Growth Illustrated**

Smart Growth	Sprawl

This German town has concentrated and mixed development, with houses close to services and well-defined boundaries. A major portion of travel is by walking, cycling and public transit.	*This U.S. suburb has residential development scattered among farms. Many streets lack sidewalks and there is virtually no transit service. This results in high rates of automobile travel.*

Smart growth represents a major policy shift in most jurisdictions. During the last century, many public policies, such as those in Table 2, encouraged sprawl and automobile dependency. Although individually their impacts may seem modest and justified, they contribute to a self-reinforcing cycle of sprawl and automobile dependency, which imposes various economic, social and environmental costs (Garceau, et al. 2013; ITDP 2012). In response, many governments and professional organizations now support smart growth policies (ICMA 2014; ITE 2010; UN 2014).

Table 2 **Sprawl-Encouraging Market Distortions** (Litman 2014)

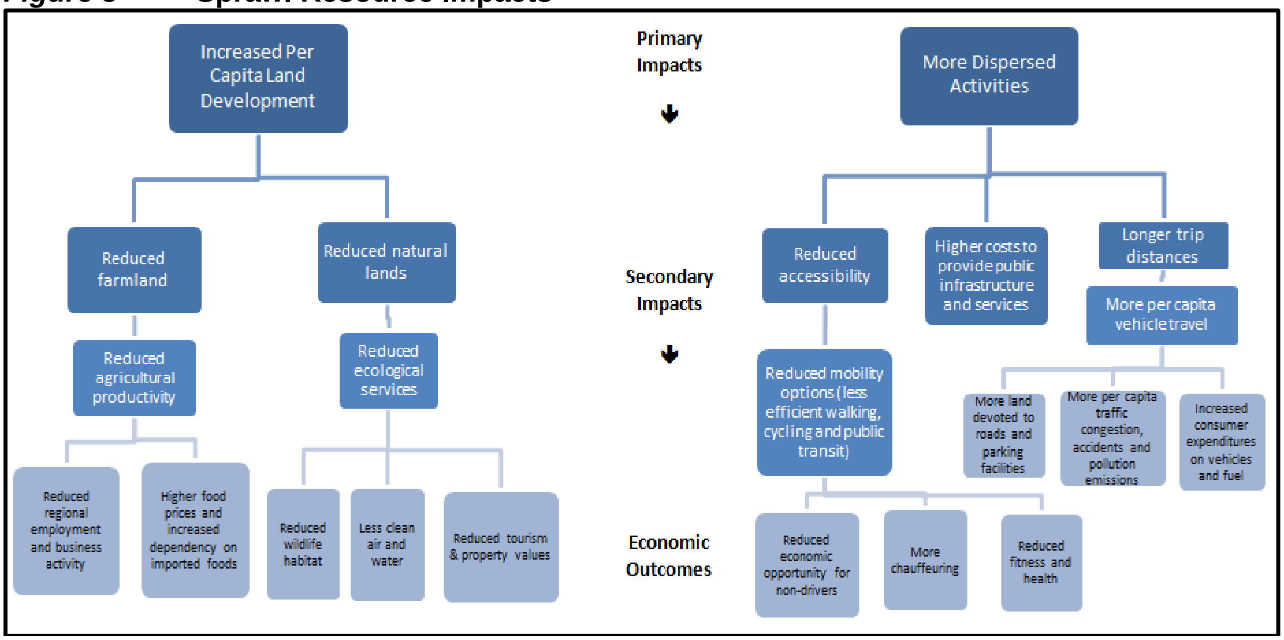
Distortions	Impacts
Restrictions on density, mix, and multi-family housing	Reduces development densities and increases housing costs.
Excessive minimum parking requirements	Reduces density, discourages infill development, and increases automobile ownership and use.
Underpriced public services to sprawled locations	Encourages sprawl and increases government costs
Tax policies that support home purchases	Encourages the purchase of larger, suburban homes
Automobile-oriented transport planning	Increases automobile travel and sprawl
Transport underpricing (roads, parking, fuel, etc.).	Encourage vehicle ownership and use

Many current policies favor sprawl and automobile transportation over compact development and resource-efficient travel modes.

Costs of Sprawl and Benefits of Smart Growth

To understand smart growth benefits it is useful to investigate their inverse, the costs of sprawl. Sprawl has two primary impacts: it increases per capita land consumption, and it disperses development which increases the distances between common destinations, and therefore the costs of providing public infrastructure and services, and the transportation costs required to access services and activities. These, in turn, impose various economic costs including reduced agricultural production and ecological services; increased infrastructure and transport costs borne by governments, businesses and households; reduced economic opportunities for disadvantaged people; more traffic congestion and accidents, higher per capita energy consumption and pollution emissions, plus reduced public fitness and health, as illustrated in Figure 3. The magnitude of these costs often depends on how they are measured: for example, sprawl tends to reduce local congestion and pollution impacts, measured in a particular area, but many of these costs shift elsewhere, so total impacts, measured per capita, often increase.

Figure 3 **Sprawl Resource Impacts**



Sprawl has two primary resource impacts: it increases per capita land development and it increases the distances between common destinations. These, in turn, impose various economic costs.

Various studies have quantified and *monetized* (measured in monetary units) many of these impacts (Bhatta 2010; Burchell and Mukherji 2003; Ewing and Hamidi 2014; NHOEP 2012). Such studies vary in scope and methods. Some only consider infrastructure (road, utility, school, etc.) costs, while others consider a wider range of public service costs (emergency response, garbage collection, school busing, etc.). Some include transport costs (vehicle costs, accidents and pollution emissions). Some include other economic, social and environmental impacts. These studies also vary in geographic scale (neighborhood, city, region and country) and how sprawl is measured. Most studies have been performed in North America, since that is where debates about sprawl are most intense and suitable data most available, but many of these economic impacts occur to some degree in most cities, so these research results are transferable to other countries, provided they are scaled to reflect regional demographic and geographic conditions.

The results of some major sprawl cost studies are summarized below:

- A major study for the Transportation Research Board (a division of the U.S. National Academy of Sciences), *The Costs of Sprawl – 2000* (Burchell, et al. 2002; Burchell and Mukherji 2003), identified the following sprawl impacts:
    - Land conversion from farm and wild lands to housing and commercial development.
    - Water and sewage infrastructure.
    - Local roads.
    - Local public services.
    - Real estate development costs.
    - Increased vehicle travel and associated costs.
    - Residents' quality of life.
    - Urban decline (negative impacts on urban communities).

  The study monetized some of these impacts and estimated the net savings if growth management were applied in the U.S. between 2000 and 2025. Under the managed growth scenario a major portion of potential rural county development is shifted to urbanized counties, densities increase 20%, and the portion of households in attached (townhouse) and multi-family (apartment) housing increases by a quarter. The analysis indicates that managed growth reduces land consumption by 21% (2.4 million acres), reduces local road lane-miles 10%, reduces annual public service costs about 10% and housing costs about 8%, saving on average $13,000 per dwelling unit, or 7.8% of total development costs. This analysis only considers relatively modest smart growth policies (most new housing continues to be single-family) and so represents a lower-bound estimate of potential smart growth savings.

- The report, *The High Costs of Sprawl: Why Building More Sustainable Communities Will Save Us Time and Money* (Environmental Defense 2013) identified various external costs of sprawl including loss of open space and farmland, higher infrastructure costs, increased driving and related health problems, increased pollution emissions, and reduced community cohesion (positive interactions among neighbors). It compares the costs of sprawl with various jurisdictions' development fees, and concludes that these fees fail to reflect the full incremental costs of sprawl, resulting in existing community taxpayer subsidizing sprawled development. It emphasizes the unfairness of these cross subsidies and external costs.

- The report, *Suburban Sprawl: Exposing Hidden Costs, Identifying Innovations* (SP 2013), compared various government costs that tend to increase with sprawl (construction and maintenance of roads, sewers, water, community centres and libraries, fire protection, policing, and school busing) with incremental tax revenues. It concluded that incremental revenues rarely cover the full incremental costs of suburban development. It also discussed various economic benefits of more compact development, including cost savings and agglomeration efficiencies, and support for social equity objectives.

- The report, *Analysis of Public Policies that Unintentionally Encourage and Subsidize Sprawl* (Litman 2014), by the Victoria Transport Policy Institute with the London School of Economic's Cities Program, quantified various economic impacts of sprawl. The study divided U.S. cities into quintiles (fifths) and estimated the additional land consumption, infrastructure and public service, transport, and health costs of more sprawled development. It estimates that sprawl's incremental costs average approximately $4,556 annual per capita, of which $2,568 is internal (borne directly by sprawl location residents) and $1,988 is external (borne by other people). The study also examined various sprawl benefits, including cheaper land, which allows households to afford more private open space (yards and gardens). However, these are mostly internal benefits and economic transfers (some people benefit but others are worse off); there are seldom significant external benefits. The study identified various market distortions that result in economically-excessive sprawl, in which total costs exceed total benefits.

- The report, *Measuring Sprawl* (Ewing and Hamidi 2014) calculated a *Sprawl Index* (although, since ratings increase with more compact development it would be more accurate to call it a *Compactness Index*) score for 221 U.S. metropolitan areas and 994 counties based on four factors: *density* (people and jobs per square mile), *mix* (combination of homes, jobs and services), *roadway connectivity* (density of road network connections) and *centricity* (the portion of jobs in major centers). The index averages 100, so scores below 100 indicate sprawl and above 100 indicate smart growth. The table below summarizes the study's key results.

Table 3 **Summary of Smart Growth Outcomes** (Ewing and Hamidi 2014)

Outcome	Impact of 10% Compactness Score Increase
Average household vehicle ownership	0.6% decline
Vehicle miles traveled	7.8% to 9.5% decline
Walking commute mode share	3.9% increase
Public transit commute mode share	11.5% increase
Average journey-to-work drive time	0.5% decline
Traffic crashes per 100,000 population	0.4% increase
Injury crash rate per 100,000 population	0.6% increase
Fatal crash rate per 100,000 population	13.8% decline
Body mass index	0.4% decline
Obesity	3.6% decline
Any physical activity	0.2% increase
Diagnosed high blood pressure	1.7% decline
Diagnosed heart disease	3.2% decline
Diagnosed diabetes	1.7% decline
Average life expectancy	0.4% increase
Upward mobility (probability a child born in the lowest income quintile reaches the top quintile by age 30)	4.1% increase
Transportation affordability	3.5% decrease in transport costs relative to income
Housing affordability	1.1% increase in housing costs relative to income.

This table summarizes various economic, health and environmental impacts from more compact development.

- A detailed study for Halifax, Nova Scotia (Stantec 2013) found that the most compact development scenario, which increased the portion of new housing located in existing urban centers from 25% to 50%, reduced infrastructure and transportation costs by about 10%, and helped achieve other social and environmental objectives including improved public fitness and health, and reduced pollution emissions.

These and other studies indicate that by increasing land consumption and travel distances, sprawl tends to increase a number of costs. Conversely, smart growth can provide various savings and benefits. Many studies only consider a subset of these effects and so do not reflect the total economic impacts.

Criticisms. Critics argued that Burchell, et al. (2002) exaggerate sprawl costs, that these costs are too small to be significant, and are offset by sprawl benefits (Cox and Utt 2004; Gordon and Richardson 2000). However, as discussed in more detail below, these critics use crude and often inappropriate evidence in their attempts to refute the costs of sprawl research, none respond to the most recent and detailed studies, and none are peer reviewed.

Specific Smart Growth Savings and Benefits

This section describes various categories of smart growth savings and benefits.

Open Space Preservation

Land is a valuable and scarce resource. We sometimes say that sprawl *consumes* land but this is not really accurate since the land still exists after development occurs, but it is changed in ways that reduce some benefits. Development displaces *open space* such as farmland, wetlands, parks and forests, and sometimes culturally significant resources such as historic sites, which provide various economic, social and environmental services including agricultural production, groundwater recharge, wildlife habitat, recreation and aesthetic values, which often support economic activities such as tourism (Banzhaf and Jawahar 2005; Harnik and Welle 2009). In addition to direct impacts, urban fringe development often has indirect impacts that disrupt farming activities, wildlife habitat, and groundwater quality on nearby properties.

Various studies have evaluated the value of open space preservation (EDRB 2007; McConnel and Walls 2005; Tagliafierro, et al. 2013). Such analysis generally indicates that undeveloped natural lands such as shorelines, forests and deserts provide the greatest ecological values. Farms provide agricultural productivity. Gardens and lawns provide modest ecological benefits since they support fewer wildlife species and often have significant fertilizer and pesticide contamination. Impervious surfaces such as buildings, parking lots and roadways provide the least environmental benefits, and they increase stormwater management costs and heat island effects (higher ambient temperatures from sunlight). These negative impacts can be reduced somewhat with design features such as rooftop gardens, street trees and pervious pavements, but this does not eliminate the value of open space preservation. Below is a ranking of external benefits of various land use types.

External Values Ranked (McConnel and Walls 2005)

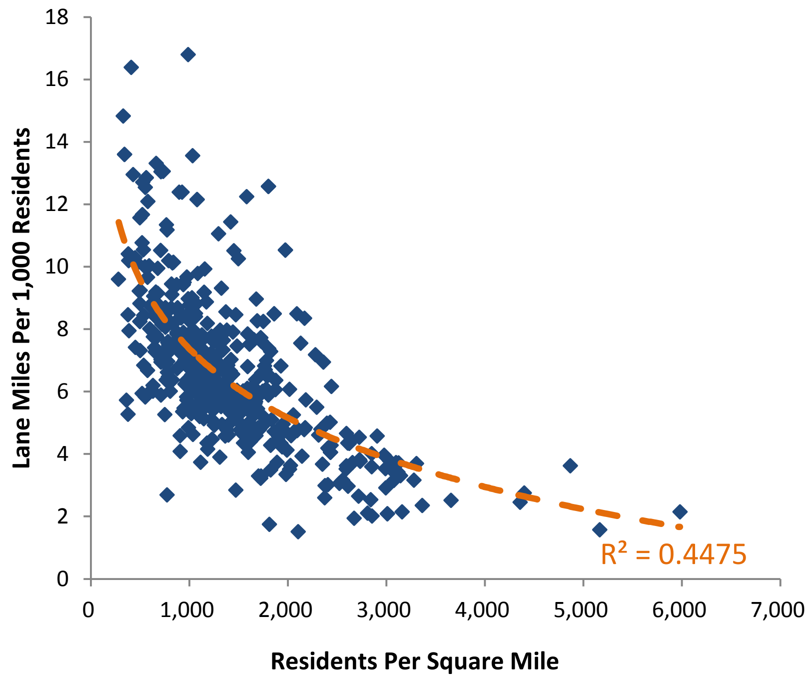
1. Shorelands and wetlands such as lake and marshes.
2. Unique natural and cultural lands such as forests, deserts and heritage sites
3. Farmlands
4. Parks and gardens
5. Lawns
6. Impervious surfaces (buildings, parking lots and roads)

Some land use types, such as shorelines, unique natural and cultural lands, and high value farmlands, provide significant external benefits that justify their preservation.

Smart growth can significantly reduce impervious surface area. It favors more compact housing types, such as small-lot single-family, townhouses and apartments which reduce land consumption. For example, 2,000 square-feet of interior space requires 500-750 square-feet of land if built using compact housing types, compared with 1,000-2,000 square feet for sprawled housing. Smart growth also reduces vehicle ownership and use, which reduces road space required per capita, and allows parking facilities to serve multiple destinations (Arrington and Sloop 2008; USEPA 2006), which together reduce total road and parking land requirements.

Figure 4 shows how per capita lane-miles decline with urban density. U.S. cities with less than 1,000 residents per square mile (approximately 1.6 residents per acre) have about 670 square feet of road space per capita, nearly three times as much as the 235 square feet in denser cities with more than 4,000 residents per square mile (approximately 6 residents per hectare). Similarly, central neighborhoods require less road space per capita than at the urban fringe.

Figure 4 **Urban Density Versus Roadway Supply** (FHWA 2012, Table HM72)



As urban densities decline, roadway supply increases. This increases per capita road construction and operating costs, hydrologic and stormwater management costs, and environmental impacts. (Each dot represents a U.S. urban region.)

Motor vehicles also require parking facilities at each destination. A typical parking space is 8-10 feet (2.4-3.0 meters) wide and 18-20 feet (5.5-6.0 meter) long, totaling 144-200 square feet (14-20 sq. meters), and off-street parking requires driveways and access lanes so typically requires 250-350 square feet (25-35 square meters) per space. Various studies indicate that there are typically between two and eight off-street parking spaces per vehicle, with lower values in smart growth communities and higher values in sprawled areas (McCahill and Garrick 2012).

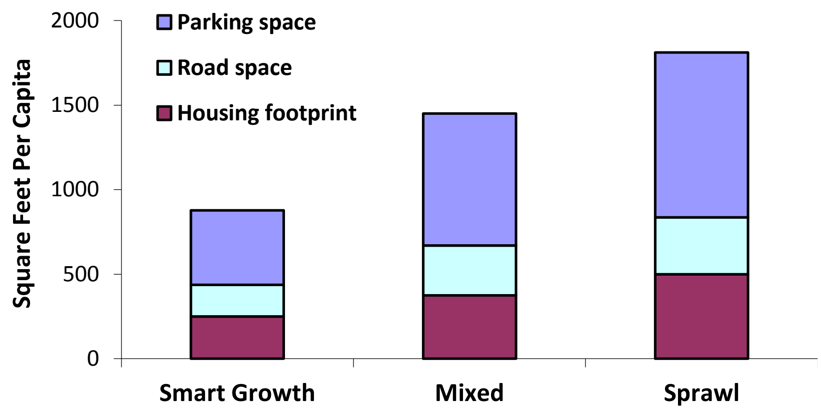
Table 4 **Per Capita Impervious Surface Area** (As Noted In Text)

	Smart Growth	Mixed	Sprawl
Vehicles per capita	0.8	0.65	0.5
Road space per vehicle (sq-ft.)	235	453	670
Off-street parking spaces per vehicle	2	4	6
Land area per parking space (sq-ft.)	275	300	325
Housing footprint per capita (sq-ft.)	250	375	500
Road and parking land area per capita (sq-ft.)	878	1,344	1,810

Smart growth requires less than half as much land for housing, roads and parking facilities as sprawl.

Table 4 and Figure 5 show that smart growth typically requires less than half as much impervious surface area, and so displaces less open space as the same amount of development with the same amount of interior space serving the same number of people in sprawled areas.

Figure 5 **Per Capita Impervious Surface Area** (As Noted In Text)



Smart growth reduces per capita impervious surface area by more than half, which preserves open space.

Reducing impervious surface area helps preserve natural hydrologic functions such as surface water flows and groundwater recharge (Arnold and Gibbons 1996). Jacob and Lopez (2009) found that stormwater runoff volumes and pollution loadings increase with development density per acre but declined per capita. Their model showed that doubling suburban densities from 4 to 8 dwelling units per acre significantly reduces pollutant loadings, and higher densities outperform almost all traditional management strategies in reducing per capita surface water contamination. Preserving natural hydrologic flows can provide various economic savings and benefits, including reduced stormwater management costs, reduced costs of providing drinking water, and support for tourism and recreation industries.

A common justification for sprawl is that it increases residents' access to nature (open space). However, smart growth generally does include open space, including local and regional parks, street trees and preserved farmlands. Although sprawl residents may have more private open space, they displace more total open space per capita, so they can be considered to *consume* nature while smart growth residents *preserve* nature, resulting in more total open space.

Criticisms. Critics claim that policies to preserve open space are unjustified, citing statistics indicating that only a small portion of total land area is urbanized and there is no overall shortage of farmland (Glans 2009; O'Toole 2008). However, this fails to account for many of the benefits provided by open space preservation.

Cities are often located in areas with high valuable farmlands and unique natural lands such as river deltas, shorelines and forests; farmlands in Idaho and Kansas are not substitutes for farmlands in California or Vermont, and environmental lands in Texas and Ohio are not substitutes for shorelines in Washington and Florida.

Sprawled development tends to disrupt far more open space than just what is urbanized, an effect called the *urban shadow*. For example, development tends to increase rural road traffic, farming noise and odor complaints, water pollution, hydrologic impacts (disruptions of ground and surface water flows), and wildlife habitat disruptions. Such impacts can be significant even if only 5-10% of land is developed (Ruby 2006).

Public Infrastructure and Service Costs

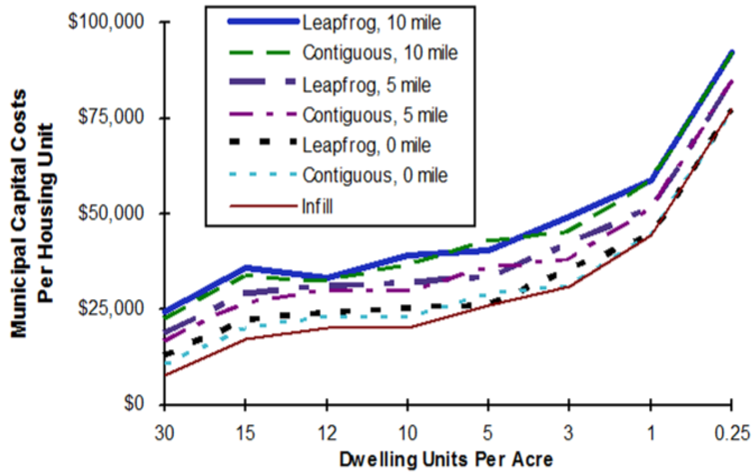
Smart growth reduces the costs of providing many types of public infrastructure and services. The reason is simple: more compact development reduces the length of roads and utility lines, and travel distances needed to provide public services such as garbage collection, policing, emergency response, and school transport, and so reduces the per capita costs of providing these services. However, some of these impacts are complex and require detailed analysis.

Rural residents traditionally provide many of their own utilities (well water, septic systems, garbage disposal, etc.), and accept lower quality public services such as unpaved roads and volunteer fire departments, but sprawl residents tend to demand urban quality services in dispersed locations, which increases their costs. Urban areas tend to have higher wages and more regulations. Infill development can increase some infrastructure costs by increasing design standards, planning requirements and brownfield remediation, but such costs are not proportionate to density; taller buildings usually have similar development mitigation requirements and brownfield remediation costs as a smaller building, so unit costs tend to decline with density.

Various studies, summarized below, have quantified these costs. These studies reflect lower-bound impacts since most only consider a subset of total public service costs and relatively modest smart growth policies, such as more compact single-family development without substantial shifts to multi-family housing.

- Burchell and Mukherji (2003) found that sprawl increases local road lane-miles 10%, annual public service costs about 10%, and housing development costs about 8%, increasing total costs an average of $13,000 per dwelling unit, or about $550 in annualized costs.
- More compact development could save Calgary, Canada about a third in capital costs and 14% in operating costs for roads, transit services, water and wastewater, emergency response, recreation services and schools (IBI 2008).
- A Charlotte, North Carolina study found that a fire station in a low-density neighborhood with disconnected streets serves one-quarter the number of households at four times the cost of an otherwise identical fire station in a more compact and connected neighborhood (CDOT 2012).
- A detailed analysis of 2,500 Spanish municipal budgets found that lower-density development increases per capita costs of providing local services (Rico and Solé-Ollé 2013). The study found that in lower density urban areas with less than 25 residents per acre, each 1% increase in urban land area per capita increases municipal costs by 0.11%. Of this, 21% is due to increased basic infrastructure costs, 17% to increased culture and sports program costs, 13% to increased housing and community development costs, 12% to increased community facilities costs, 12% to an increased general administration costs, and 6% due to increased local policing costs.
- Using data from three U.S. case studies, the study, *Smart Growth & Conventional Suburban Development: Which Costs More?* (Ford 2010) found that more compact residential development can reduce infrastructure costs by 30-50% compared with conventional suburban development.
- *Building Better Budgets: A National Examination of the Fiscal Benefits of Smart Growth Development* (SGA 2013) found that smart growth development costs one-third less for upfront infrastructure costs and saves an average of 10% of ongoing public services costs.
- Figure 6 illustrates the results of a study showing that municipal infrastructure costs tend to decline with density and are lowest for infill development.

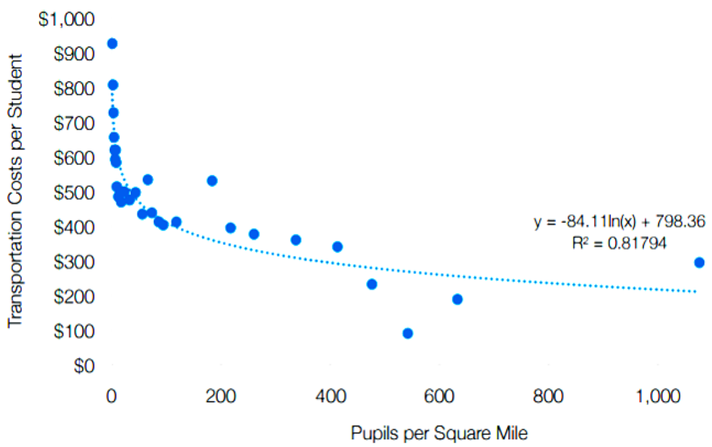
Figure 6 **Residential Service Costs** (Frank 1989)



The costs of providing public infrastructure, including roads, utilities and schools, tends to be much lower for compact, infill development, providing hundreds of dollars in annual savings per capita compared with sprawl.

Some studies have investigated how these public service costs compare with incremental tax revenues, often called *fiscal impact analysis* (Fodor 2011). A study for the City of Madison, Wisconsin investigated how municipal and school district fiscal impacts vary by development pattern (SGA and RCLCO 2015a). The analysis indicates that annual net fiscal impacts (incremental tax revenues minus incremental local government and school district costs) are $6.8 million net revenue ($203 per capita and $4,534 per acre), compared with $4.4 million ($185 per capita and $1,286 per acre) for the low density scenario. A similar study for West Des Moines, Iowa predicts that, to accommodate 9,275 new housing units, a compact development scenario designed to maximize neighborhood walkability would generate a total annual net fiscal impact of $11.2 million ($417 per capita and $17,820 per acre), about 50% more than the $7.5 million ($243 per capita and $2,700 per acre) generated by the lowest density scenario (SGA and RCLCO 2015b). Figure 7 illustrates how school transportation costs tend to decline with increased population, due to reductions in the need to provide school bus services.

Figure 7 **Transportation Costs Per Student** (SGA 2015, p. 11)



Wisconsin Department of Public Instruction data show that school transport costs are high for low-density development (under 50 school pupils per square mile) and decline with density.

Criticisms. Critics claim that smart growth increases rather than reduces public infrastructure and service costs (Gordon and Richardson 1999) or that cost savings are insignificant (Cox and Utt 2004). They cite research by Ladd (1992) which indicated that per capita public expenditures increase in higher-density counties, although that author specifically cautioned against such a conclusion due to many confounding factors that influence the relationships between county-level density and infrastructure costs:

- Larger and denser cities tend to have more business activity, which generates revenues and imposes costs, and so increases per capita government expenditures.
- Residents of lower-density, sprawled areas tend to provide more of their own services, such as water, sewage and garbage disposal, which often cost more in total than what urban residents pay. As a result, the lower local government expenditures partly reflect cost shifts rather than true savings.
- Smart growth affects density and design at a finer geographic scale than these studies analyze. Neighborhood- and site-level analyses are needed to accurately evaluate smart growth savings.
- Lower-density, more rural counties often have lower quality public services, such as unpaved roads and volunteer fire departments.
- Higher government expenditures in denser, more urbanized areas partly reflect higher wages in urban areas, so urban-rural differences are smaller when measured as a portion of income.
- Larger, denser cities tend to contain a disproportionate share of residents with special needs, such as poverty and mental illness, who require additional public services.

Cox and Utt (2004) model the relationship between density and per capita expenditures on municipal services and utilities. They found that each 1,000 increase in population per square mile is associated with per capita annual savings of $43 in municipal expenditures, plus $6 in wastewater and $4 in water supply charges, which they conclude is “miniscule” and of no practical significance. However, this county-level analysis of density does not really reflect the full impacts of smart growth policies which affect the location of development within a county, plus factors such as land use mix and transportation system design which affect the costs of providing roadway capacity, emergency services and school transportation, as documented in various studies described in this section. As a result, Cox and Utt’s analysis fails to accurately measure the true public savings that smart growth can provide.

No credible, peer-reviewed studies demonstrate that comprehensive smart growth policies fail to significantly reduce public infrastructure and service costs.

Household Affordability

Affordability refers to households' ability to purchase *basic* (or *essential*) goods such as food, housing, transportation and healthcare. Affordability is primarily an issue for lower-income households, which often struggle to afford basic goods.[1] Smart growth can affect affordability in several ways, as summarized in Table 5. It supports more affordable housing types and reduces parking and setback requirements (Ford 2009), and can reduce development fees and taxes for more compact development, reflecting the lower costs of providing public services there. It can also increase some household costs including land costs per acre, which reduces larger-lot housing affordability, and some infrastructure costs such as curbs and sidewalks.

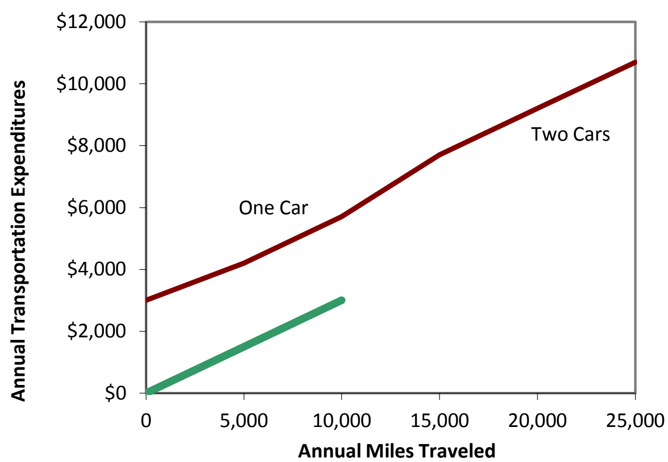
Table 5 **Smart Growth Household Affordability Impacts**

Increases Affordability	Reduces Affordability
• Allows more affordable housing types (smaller lots, townhouses, apartment, accessary dwelling units, etc.). • Reduced parking and setback requirements (reduces land requirements per housing unit) • Reduced development impact fees and taxes for compact, infill development, reflecting lower public service costs. • Reduced transport costs, particularly if it allows households to reduce their vehicle ownership.	• Urban growth boundaries can reduce developable land supply, and therefore increase larger-lot housing prices. • Increased design requirements (curbs, sidewalks, sound barriers, etc.) may increase the costs of new housing.

Smart growth tends to reduce many household costs, although it can increase others.

Smart growth can significantly reduce the need for households to own and operate automobiles, providing significant savings, as illustrated in Figure 8.

Figure 8 **Local Transportation Costs**

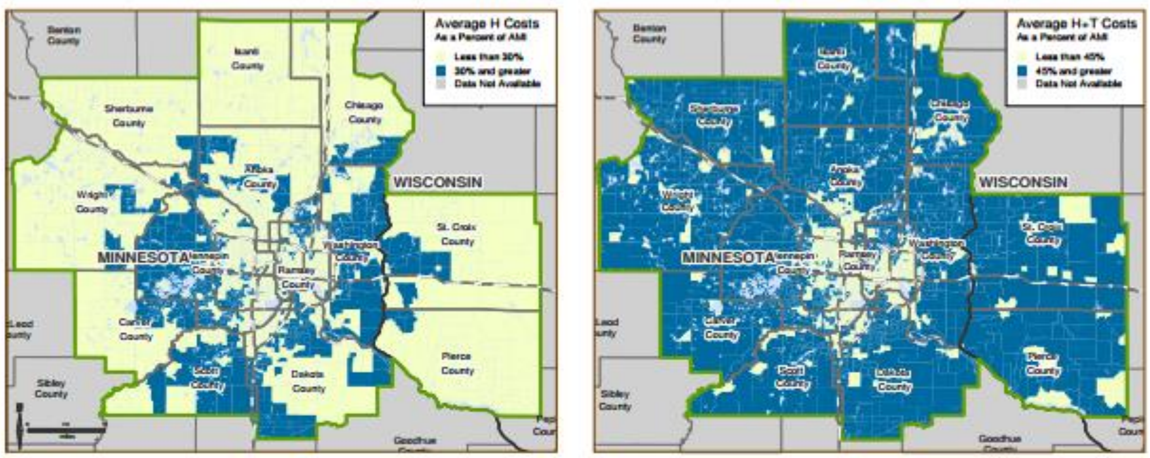


Smart growth community households can minimize their transport costs; they can generally travel less than 10,000 annual miles to local destinations (excluding longer-distance travel) using a combination of inexpensive modes including walking, cycling, public transit and occasional car rentals. Sprawl community households must travel much farther to access local services, often more than 10,000 annual miles per capita, primarily by automobile, which typically incurs about $3,000 in fixed costs plus 30¢ per mile in variable costs per vehicle.

[1] This can be important. For example, my study, *Impacts of Rail Transit on the Performance of a Transportation System* (Litman 2004) used US Bureau of Labor Statistics data to show that household transportation expenditures tend to be lower in cities with high quality transit services, indicating increased affordability. Wendell Cox challenged this conclusion using data from the *ACCRA Cost of Living Index* which compares the costs of living in cities by *top income quintile* households. If affordability is primarily concerned with cost burdens on lower-income households, ACCRA data is less relevant than BLS data.

Various studies indicate that smart growth community residents spend significantly less on transportation than in sprawled communities (CTOD and CNT 2006). Although large cities often have higher fuel prices, insurance premiums, tolls and parking fees, and residents spend more on transit and taxis, on average households tend to spend significantly less on transport overall. Although individual factors such as density, mix, connectivity, walk- and bikability, transit service quality may only have modest impacts (CARB 2010-2014), their impacts are cumulative and synergistic, so residents of compact, multimodal neighborhoods typically own 20-50% fewer vehicles and drive 20-50% fewer annual miles than in automobile-dependent areas (Arrington and Sloop 2009; Daisa and Parker 2010). Detailed analysis by Ewing and Hamidi (2014) found that each 10% increase in their compactness index is associated with a 3.5% decrease in the portion of household budgets spent on transport. The *Housing + Transportation Index* indicates that smart growth neighborhoods provide total average annual housing and transport savings that range from $1,580 in lower-priced markets such as Little Rock, up to $3,850 in higher-priced markets such as Boston (CNT 2010), equivalent to 10-20% higher incomes (Figure 9).

Figure 9 **Comprehensive Affordability Analysis** (CNT 2010)



Sprawled areas tend to have lower housing costs but higher transportation costs. Smart growth areas tend to be more affordable overall, considering total housing and transportation costs, and many smart growth policies can further increase affordability by supporting lower-priced housing development, such as allowing higher densities and reduced parking requirements.

Recent studies indicate that households in smart growth neighborhoods have lower mortgage foreclosure rates, indicating better economic resilience, that is, households are better able to respond to unexpected financial burdens such as fuel price increases, vehicle failures or income losses (NRDC 2010; Pivo 2013).

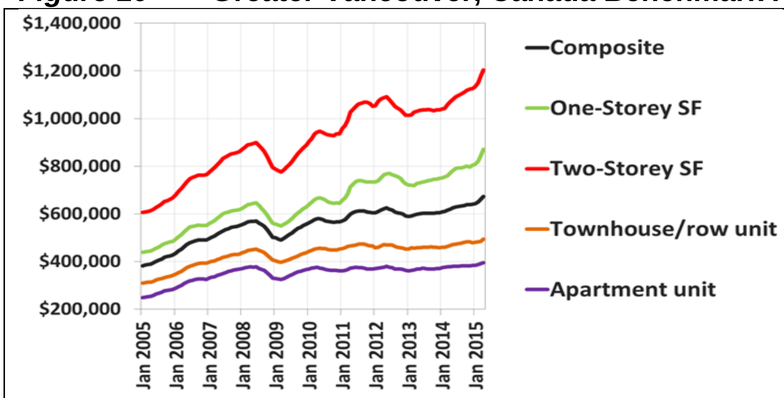
Criticisms. Critics frequently argue that smart growth increases housing prices and reduces housing affordability. However, much of their research is incomplete and biased:

- Their arguments often reflect an assumption that smart growth consists primarily of urban containment policies, which increase land prices and housing costs (Cox and Pavletich 2015; Cheshire and Vermeulen 2009). Although smart growth often does include such policies, it also includes policies that reduce land consumption per housing unit and provide other savings, as indicated in Table 5. For example, smart growth supports more compact housing types, reduced minimum parking requirements, reduced fees for infill development, plus policies that reduce transportation costs. Affordability analysis should consider all of these strategies and impacts. In many cases, the best way to maintain affordability in attractive, geographically constrained cities is to implement smart growth policies that allow more compact residential development. Affordability analysis should consider all of these impacts.

- Academic studies indicate that land use regulations increase housing costs (Manville 2010; Nelson, et al. 2002); critics jump to the conclusion that these are smart growth regulations, but in fact, the policies that most increase housing costs are sprawl-inducing regulations that limit density and require excessive parking supply, rather than smart growth policies. Lewyn and Jackson (2014) analyzed land use regulations in 25 typical jurisdictions. They found that sprawl-inducing regulations, such as density limits and minimum parking requirements, are far more common than sprawl-reducing regulations such as urban growth boundaries and density minima. Similarly, Ganong and Shoag (2012) found a positive correlation between the *Wharton Residential Land Use Regulatory Index* (WRLURI) and housing prices; critics claim this demonstrates that smart growth reduces affordability (Postrel 2012; O'Toole 2012), but Ganong and Shoag actually found that it is the sprawl-inducing restrictions on infill development that tend to increase housing prices. WRLURI ratings tends to be higher in sprawled, suburban areas than in cities, and higher in geographically constrained cities than inland cities; smart growth reduces these regulations and their costs.

- Critics' analysis often overweighs single-family housing prices and ignores or underweighs multi-family housing, which exaggerates housing prices in compact cities where multi-family housing is common (Litman 2015b). For example, the *International Housing Affordability Survey* (Cox and Pavletich 2015) ranks Vancouver, Canada as one of the world's least affordable cities, with single-house prices that have doubled during the last decade. However, multi-family housing prices increased less than inflation during most of that period, as illustrated in Figure 10, so Vancouver is relatively affordable for households that live in these compact housing types. It is impossible for Survey users to determine whether this bias applies to its analysis of all cities since, despite repeated requests, Cox and Pavletich refuse to share their data or allow peer review.

Figure 10 **Greater Vancouver, Canada Benchmark Housing Prices** (MLS 2015)



Vancouver's single-family housing prices approximately doubled during the last decade, and now average about a million dollars per house. However, apartment and townhouse prices increased less than inflation during the last seven years, indicating that Vancouver housing is relatively affordable to households that are willing to live in these compact housing types.

- Critics' research often use uses simple correlations between smart growth indicators and housing prices, ignoring confounding factors. For example, Demographia (2008) found significantly higher housing prices in smart growth cities (Boston, Portland, San Diego and Washington) than in sprawl-oriented cities (Atlanta, Dallas-Fort Worth, Indianapolis and Kansas City), but the study ignores high economic growth rates and severe geographic constraints in the smart growth cities. This confuses causes and effects: popular coastal cities tend to have higher land costs and single-family housing prices for reasons unrelated to their urban containment policies; they cannot expand significantly due to geographic constraints.

- As a public policy issue, affordability is primarily concerned with cost burdens to lower-income households, who often struggle to afford basic goods and services; many higher income households often spend a significant portion of their incomes on multiple, luxury houses, and still afford other basic goods, so that is not a problem. As a result, affordability analysis should focus on cost burdens to lower-income households, and therefore lower-priced housing and transportation options such as apartments, townhouses, and subsidized housing options. Consumer expenditure data that overweighs higher-income households, such as the ACCRA or single-family home prices, are inaccurate indicators of true affordability.

These examples illustrate how different definitions and analysis methods can result in very different conclusions about how smart growth affects affordability. The least affordable cities tend to be attractive and geographically constrained. It is infeasible for such cities to provide inexpensive, large-lot, single-family houses to every household that wants, not enough land is available due to geographic and political barriers. Critics are wrong to blame smart growth for high housing prices in such areas. On the contrary, in such conditions, smart growth policies that allow more compact and affordable development are often the most effective way to reduce housing costs, and increase overall affordability considering housing and transport costs.

Empirical evidence indicates that in the United States, smart growth tends to reduce housing affordability but this is more than offset by transportation cost savings. For example, Ewing and Hamidi (2014) found that, normalizing for other factors, each 10% increase in their compact development index is associated with a 1.1% increase in housing costs relative to income but a 3.5% decrease in transport costs relative to income, so households save more than three dollars on transportation for each additional dollar spent on housing, and *Housing + Transportation Index* analysis indicates that smart growth neighborhoods provide substantial net savings considering total housing and transportation costs (CNT 2010).

In summary, critics are wrong to conclude that smart growth necessarily reduces affordability; their evidence is incomplete and biased. Critics are correct that, by themselves, urban growth boundaries can increase unit land prices, which tends to increase housing costs and reduce household affordability unless implemented in conjunction with other smart growth policies that allow more compact development, which reduces the amount of land required per housing unit and provides other housing and transportation cost savings. In attractive, geographically constrained cities, single-family housing is often unaffordable but compact housing types are relatively affordable, so analysis results are affected by how “house” is defined and measured; since lower-income households tend to rely on compact housing types and inexpensive travel modes anyway, smart growth policies that support more townhouse and apartment development, and improve walking, cycling and public transit services tend to increase affordability in ways that critics fail to account for in their analysis.

Improved Transportation Options (Mobility for Non-Drivers)

Smart growth improves transportation options (also called transport *diversity* or *multimodalism*) by creating compact communities with good walking, cycling, public transit, carsharing (short term vehicle rentals that substitute for private vehicle ownership) and taxi services. In contrast, sprawl creates automobile-dependent communities where alternative modes are inefficient and stigmatized, as summarized in Table 6.

Table 6 **Multimodal Versus Automobile Dependent** (Boarnet 2013; Kodukula 2011)

	Multimodal	Automobile-Dependent
Planning practices	• Compact, mixed development reduces travel distances to common destinations. • Transit-oriented development increases the portion of destinations that can be reached by transit. • Significant investments in walking and cycling facilities and in public transit services. • Complete streets policies that result in multi-modal urban roadways with lower traffic speeds.	• Sprawled and separated development increases distances between destinations. • Common destinations, such as schools and commercial centers, are located on major roadways for convenient automobile access, but are difficult to access without a car. • Minimal investment in walking, cycling and public transit. • Wide roads and higher traffic speeds, which degrades walking and cycling conditions.
Impacts	• Lower vehicle ownership and use rates. • Higher rates of walking, cycling and transit use.	• High vehicle ownership and use rates: virtually all adults own a vehicle which is used for most trips. • Alternative modes are inefficient and stigmatized.

Multimodal planning creates communities with diverse travel options, so travelers can choose the most efficient mode for each trip, and non-drivers maintain high levels of accessibility.

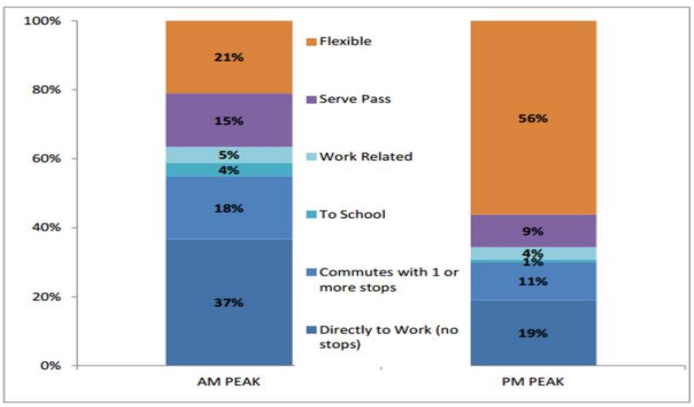
Although individual policies typically reduce only a few percent of total vehicle travel, integrated smart growth programs often reduce per capita vehicle ownership and use by 20-50% (Cervero and Arrington 2008; CARB 2010-2014). Improving transportation options tends to increase overall transport system efficiency and equity. It allows travelers to choose the most efficient mode for each trip: walking and cycling for local errands, public transit for travel on major urban corridors, and automobile travel when it is truly most cost effective overall. This benefits all community residents, and is particularly important for non-drivers, travelers who for any reason cannot or should not drive (Rodier, et al. 2010), which typically represents 20-40% of local travel demands, as indicated in the box below.

Alternative Mode (Walking, Cycling, Public Transit and Taxi Travel) Demands

- Short trips (less than a half-mile)
- Youths 10-20 years of age who lack drivers licenses (about 20% of total population)
- Seniors over 70 who do not or should not drive (5-10% of total population and increasing)
- Adults who cannot drive due to disability or lack of driver's license (5-10%)
- Households with low incomes that want to minimize transportation expenses
- Motorists who want to avoid chauffeuring non-drivers
- Drivers whose vehicle is temporarily unavailable
- Law-abiding drinkers
- Immigrants, visitors and tourists who lack a vehicle or driver's license
- People who want to walk or bike for enjoyment and health

Improving travel options and reducing per capita vehicle travel tends to benefit everybody in a community, including people who do not currently use non-automobile modes but benefit from reduced traffic and parking congestion, and reduced accident risk. It also reduces chauffeuring burdens, the time and money drivers must spend transporting family members and friends who cannot drive (Litman 2015). This travel is significant. According to the 2009 U.S. *National Household Travel Survey* (NHTS), at least 6.9% of total personal trips, 5.7% of total personal vehicle travel, 15% of morning peak, and 9.4% of afternoon peak vehicle travel, is to *serve passengers* (i.e., chauffeur) (Figure 11).

Figure 11 **Vehicle Travel in AM and PM Peak Periods** (McGuckin 2009)



Source: Author's analysis of the 2009 National Household Travel Survey

The 2009 National Household Travel Survey indicates that 15% of morning peak and 9.4% of afternoon peak travel is to "serve passengers" (i.e. chauffeur).

Since many non-drivers are physically, economically or socially disadvantaged, improving their transportation options helps achieve social equity objectives; it provides financial savings for lower-income households and improves economic opportunity for people who are poor or have disabilities. For example, Ewing and Hamidi (2014) found that children born in low-income households are much more likely to earn high incomes if they grew up in smart growth communities rather than sprawl. Investments in alternative modes ensure that non-drivers receive a fair share of public resources devoted to transportation; in most communities, 10-20% of local trips are made by walking, cycling and public transit, but most jurisdictions devote only 2-5% of their total transportation budgets to these modes.

Criticisms. Critics sometime argue that smart growth strategies do little to reduce automobile travel. They suggest that since most communities are automobile dependent, the best way to help disadvantaged people is to make automobile travel cheaper and more convenient, and to develop self-driving cars and rideshare services to provide mobility for non-drivers. These arguments fail to address the full costs of inadequate transport options, such as vehicle ownership costs and chauffeuring burdens, and therefore the benefits of improving non-drivers' accessibility. Many of the strategies critics advocate are costly and only address a small portion of these needs. For example, subsidizing vehicles for poor people can only help a portion of non-drivers, costs hundreds of dollars annually per recipient, does not improve mobility for non-drivers, and exacerbates traffic problems. Self-driving cars are unlikely to be available and affordable to lower-income households for many decades.

Congestion and Accessibility Impacts

Smart growth has mixed traffic and parking congestion impacts. Denser development tends to increase congestion *intensity* (amount that traffic speeds decline during peak periods), but by reducing travel distances, improving alternative modes, increasing connectivity and supporting demand management strategies, smart growth can reduce total per capita *congestion costs* (Cortright 2010; Litman 2013; Melia, Parkhurst and Barton 2011). Whether smart growth is considered to increase or reduce congestion depends on how this impact is measured.

For example, compact, multimodal cities such as New York, Boston and Philadelphia have more *intense* congestion, measured by the Travel Time Index, but lower *congestion costs* (fewer hours of annual delay per capita) due to lower automobile mode shares and shorter trip distances, which reduces congestion *exposure* (residents' peak period automobile travel). More sprawled, automobile-oriented cities such as Houston, Atlanta and Detroit tend to have less intense congestion but higher congestion costs. As a result, compact cities rank worse if evaluated by congestion intensity but better if evaluated by congestion costs, as shown in Table 7.

Table 7 **Congestion Rankings Change Depending On Indicators** (TTI 2013)

Congestion Intensity (Travel Time Index)	Congestion Costs (Delay Hours Per Commuter)
1. Los Angeles-Long Beach-Santa Ana CA (1.37)	1. Los Angeles-Long Beach-Santa Ana CA (44.9)
2. New York-Newark NY-NJ-CT (1.33)	2. Washington DC-VA-MD (44.3)
3. Washington DC-VA-MD (1.32)	**3. Houston TX (41.0)**
4. Boston MA-NH-RI (1.28)	**4. Atlanta GA 39.4)**
5. Houston TX (1.26)	5. San Francisco-Oakland CA (37.7)
6. Philadelphia PA-NJ-DE-MD (1.26)	6. Dallas-Fort Worth-Arlington TX (36.6)
7. Seattle WA (1.26)	**7. Miami FL (36.5)**
8. Dallas-Fort Worth-Arlington TX (1.26)	**8. Boston MA-NH-RI (36.3)**
9. Chicago IL-IN (1.25)	9. Chicago IL-IN (36.2)
10. Miami FL (1.25)	**10. Philadelphia PA-NJ-DE-MD (35.4)**
11. Atlanta GA (1.24)	11. Detroit MI (33.6)
12. San Francisco-Oakland CA (1.22)	12. Seattle WA (33.4)
13. Detroit MI (1.18)	**13. New York-Newark NY-NJ-CT (29.7)**
14. San Diego CA (1.18)	14. San Diego CA (28.0)
15. Phoenix-Mesa AZ (1.18)	15. Phoenix-Mesa AZ (26.7)

More compact urban regions (blue) tend to have more intense congestion but lower congestion costs than sprawled, auto-oriented regions (red). Rankings change depending on which indicator is used.

Congestion intensity indicators are useful for making short-term decisions, such as how best to travel across town during rush hour, but are unsuitable for strategic planning decisions that affect the quality of travel options or land use development patterns, and therefore the amount that residents must drive during peak periods. Described differently, intensity indicators reflect *mobility* (travel speed), while cost indicators reflect *accessibility* (people's overall ability to reach desired services and activities). Since accessibility is the ultimate goal of most transport activity and planning decisions often involve trade-offs between different accessibility factors, congestion cost indicators are most appropriate for identifying optimal transport system improvements. By dispersing destinations and favoring automobile-oriented transportation improvements, sprawl tends to reduce congestion intensity but increases the distances that people must travel to reach destinations. By creating more compact, mixed, multimodal communities, smart growth tends to increase overall accessibility measured as the number of destinations that can be reached in a given time period. One recent study found that in typical urban conditions, a percentage increase in development density provides ten times the increase in overall accessibility than the same increase in vehicle traffic speeds (Levine, et al. 2012).

Many smart growth strategies can help reduce congestion costs, regardless of how it is measured, as summarized in Table 8. If traffic congestion increases with development density, the most cost effective and beneficial solution is often to implement more of these smart growth policies that reduce peak period vehicle trips.

Table 8 **Smart Growth Congestion Reduction Strategies** (Litman 2013)

Smart Growth Feature	Congestion Impacts
Increased development density and mix	Increases vehicle trips within an area, but reduces trip distances and supports use of space-efficient modes, such as walking, cycling and public transit
More connected road network	Disperses traffic. Reduces trip distances. Supports space-efficient modes.
Improved transport options	Reduces total vehicle trips.
Transport demand management	Reduces total vehicle trips, particularly under congested conditions.
Parking management	Can reduce vehicle trips and support more compact development

Smart growth includes many features that can reduce traffic congestion.

Research indicates that these strategies can reduce congestion, or at least prevent it from increasing with density. A major Arizona Department of Transportation study found that households in more compact, mixed neighborhoods drive significantly less during peak periods and so experienced substantially lower congestion costs than in more sprawled, automobile-dependent areas (Kuzmyak 2012). It found that in higher-density neighborhoods residents' commute trips average seven miles and shopping trips less than three miles, compared with almost 11-mile commutes and more than four mile shopping trips in sprawled areas. Even if alternative modes only carry a minor portion of total regional travel, its mode share tends to be much higher on congested urban corridors, and so can provide significant congestion reduction impacts. For example, although Los Angeles has only 11% transit commute mode share, one study found that transit reduces regional congestion costs by 11% to 38%, and when a strike halted transit service for five weeks, average highway congestion delay increased 47% (Anderson 2013), with particularly large speed reductions on rail transit corridors (Lo and Hall 2006), indicating that higher quality service is particularly effective at reducing congestion.

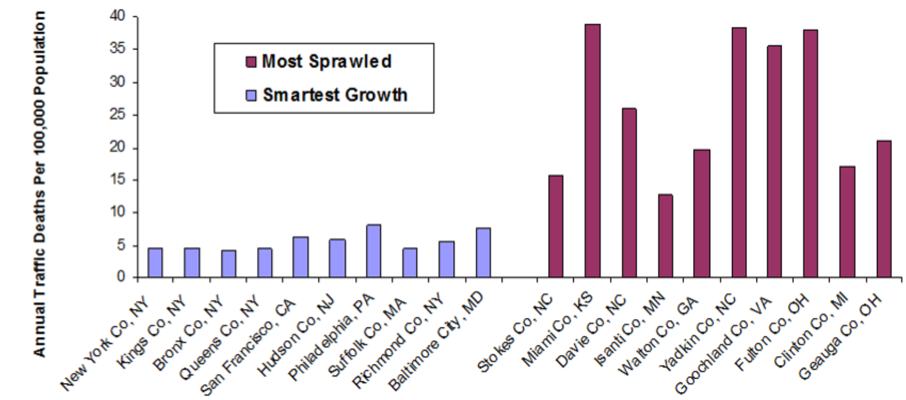
Smart growth is particularly beneficial if transportation system performance is evaluated based on the total travel time rather than just congestion delays. Although transit-oriented cities often have longer average commute duration than sprawled, automobile-dependent cities (transit travel often takes longer than the same trips made by automobile since it requires walking to and waiting for transit vehicles; and few transit routes are grade-separated so buses are delayed by congestion), sprawl increases the distances that residents must travel for other purposes, such as personal errands and chauffeuring non-drivers, and therefore the total amount of time residents spend traveling (Ewing and Hamidi 2014).

Criticisms. Critics argue that by increasing development density, smart growth increases traffic congestion. However, they only measure congestion intensity rather than total congestion delays, ignore impacts on overall accessibility (total time and money required to reach destinations), and disregard the congestion reduction impacts of smart growth strategies such as increased roadway connectivity, efficient road and parking pricing, improvements to alternative modes, and incentives to shift mode during peak periods.

Traffic Safety

Various studies using a variety of analysis methods and data sets indicate that traffic casualty rates (deaths and injuries) tend to decline with smart growth (Litman and Fitzroy 2014). Figure 12 illustrates the results of one of these studies.

Figure 12 **Annual Traffic Death Rate** (Ewing, Schieber and Zegeer 2003)



Of 280 U.S. counties analyzed, the ten with the lowest sprawl rating have about a quarter the per capita annual traffic fatality rates of the most sprawled counties.

Ewing and Hamidi (2014) found that a 10% increase in their smart growth index reduces per capita crash fatality rates 13.8%. Dumbaugh and Rae (2009) analyzed crashes in San Antonio, Texas neighborhoods. Accounting for demographic and geographic factors they found that:

- Increased vehicle travel tends to increase crash rates, with approximately 0.75% more crashes for every additional million miles of vehicle travel in a neighborhood.
- Population density is significantly associated with fewer crashes, with each additional person per net residential acre decreasing crash incidence 0.05%.
- Each additional freeway-mile in a neighborhood is associated with a 5% increase in fatal crashes, and each additional arterial mile is associated with a 20% increase in fatal crashes.
- Each additional arterial-oriented retail or commercial parcel increased crashes 1.3%, and each additional big box store increased crashes 6.6%, while pedestrian-scaled commercial uses were associated with a 2.2% reduction in crashes.
- The number of both young and older drivers were associated with increased total crashes.

Similarly, Garrick and Marshall (2011) found that in California, more compact, connected and multi-modal urban areas have about a third of the traffic fatality rates as those that are more sprawled, automobile dependent. These studies indicate that sprawl-inducing practices such as separated land uses, disconnected road networks, and higher roadway design speeds tend to increase crash casualty rates by increasing vehicle mileage and speeds. Several factors help explain why smart growth provides large safety benefits: it reduces total vehicle travel and traffic speeds, improves emergency response, and by improving travel options helps reduce higher-risk driving, by youths, seniors and drinkers. As a result, smart growth complements traffic safety strategies such as graduated driver's licenses and anti-drunk-driving campaigns.

Criticisms. Conventional traffic safety analysis generally ignores the increased traffic crashes caused by sprawl and smart growth safety benefits. Smart growth critics also ignore this issue.

Social Problems (Poverty, Crime and Mental Illness)

People who are poor and have disabilities tend to locate in compact, multimodal neighborhoods in order to have convenient access to services and economic opportunities (Glaeser, Kahn and Rappaport 2008), while sprawled, automobile-dependent areas tend to exclude disadvantaged people by limiting affordable housing and transportation. Concentrated poverty tends to increase local crime rates. In addition, some crime types are associated with commercial land uses, for example bank robberies only occur where there are banks, and bars tend to have brawls. As a result, urban neighborhoods often have higher poverty and crime rates, and associated social service cost burdens, than sprawled areas. As a result, people sometimes conclude that denser development contributes to social problems, but this confuses cause and effect; suburban policies that exclude poor people and commercial activities simply shift these problems to urban areas. There is actually no evidence that smart growth policies increase total poverty, crime or mental illness (1000 Friends 1999), on the contrary, credible research suggests that, by improving access to public services, community cohesion (positive interactions among neighbors) and economic opportunity, smart growth helps reduce total social problems.

For example, studies show that more compact and mixed development tends to increase poor residents' economic opportunity by improving access to education and employment. This is particularly important for those who lack a driver's license or automobile (Kneebone and Holmes 2015). Using *Equality of Opportunity Project* (Chetty, et. al. 2014) data, Ewing and Hamidi (2014) found that in the U.S., each 10% increase in their smart growth index is associated with a 4.1% increase in residents' upward mobility (probability of children born in the lowest income quintile reaching the top quintile by age 30).

Studies indicate that, all else being equal, crime rates tend to decline with urban density and mix, due to increased *passive surveillance* (also called *eyes on the street*) as more residents and by-passers can see and report possible threats (Litman 2014c). For example, after adjusting for socioeconomic factors such as age, employment status and income, Browning, et al. (2010) found that per capita violent crime rates decline with density in Columbus, Ohio neighborhoods, particularly in the most disadvantaged areas. Christens and Speer (2005) also found significant negative relationships between population density and per capita violent crime rates in the Nashville, Tennessee region. Hillier and Sahbaz (2006) found that robberies and burglaries decline on streets that have higher housing densities, more mixed development and more through traffic. For example, the study found that burglary rates (crimes reported per house over a five-year period) decline from 0.209 on streets with fewer than 11 dwellings, to 0.142 on streets with 50 dwellings, down to just 0.086 on streets with more than 100 dwellings.

This is not to ignore the increases in local social problems that may result from compact and mixed development that increases lower-income households and commercial activity in a neighborhood; it is important to address these risks in the planning process. However, smart growth helps reduce these problems overall, while sprawl at best shifts them to other areas, and by concentrating poverty, tends to increase total poverty, crime and isolation.

Criticisms. Critics use simple correlations between density and social problems as evidence that smart growth causes such problems (Burnett and Villarreal; O'Toole 2008), ignoring confounding factors and evidence that smart growth policies reduces poverty and crime rates.

Public Fitness and Health

Smart growth tends to increase physical fitness and health (WHO 2013). Although there are many ways to exercise, most require special time, expense and effort, which discourages their use, particularly by people who are already sedentary and overweight. One of the most effective ways to increase physical fitness in a community is to improve walking and cycling conditions, and encourage use of these modes for both recreation and utilitarian purposes (Ball, et al. 2009; CDC 2009). Research indicates that smart growth policies, including more compact, mixed development, improved walking and cycling conditions, and incentives to use public transit, increase community-wide fitness and health.

Frank, et al. (2010) measured how neighborhood walkability factors affect residents' travel activity, physical activity and fitness. They found that after normalizing for other factors:

- Adults living in the top 25% most walkable neighborhoods walk, bike and take transit 2-3 times more, and drive approximately 58% less than those in more auto-oriented areas.
- Residents living in the most walkable areas were half as likely to be overweight than those in the least walkable neighborhoods.
- Living in a Neighbourhood with at least one grocery store was associated with a nearly 1.5 times likelihood of getting sufficient physical activity, as compared to living in an area with no grocery store, and each additional grocery store within a 1-kilometer distance from an individual's residence was associated with an 11% reduction in the likelihood of being overweight.

A ten-year study of Perth, Australia residents found that their overall health improved if they moved from sprawled to more compact, walkable urban neighborhoods (Giles-Corti, et al. 2013). The study found that for every local shop, residents' physical activity increased an extra 5-6 minutes of walking per week, and for every recreational facility available such as a park or beach, residents' physical activity increased by another 21 minutes per week. Using sophisticated statistical analysis that accounts for various demographic and economic factors, Ewing and Hamidi (2014) found that smart growth significantly increases residents' lifespans; for every doubling in their Sprawl Index, life expectancy increases approximately 4%. For the average American with a life expectancy of 78 years, this translates into a three-year difference in life expectancy between people in a less compact versus a more compact county. This probably reflects the combined effects of increased physical activity and significantly lower rates of traffic fatalities, obesity, high blood pressure and diabetes.

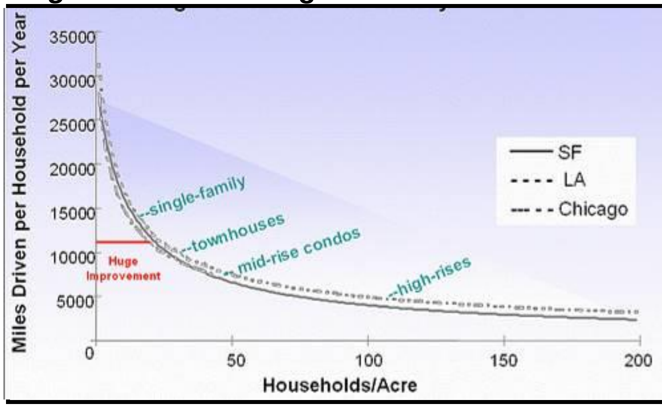
Other studies also indicate that smart growth increases overall safety and health (Lucy 2002; Myers, et al. 2013). However, increased urban densities can increase some health risks such as exposure to noise and local air pollutants. Public safety and health therefore justifies smart growth strategies that create communities where residents drive less and rely more on active modes, plus targeted strategies to reduce urban noise and air pollution emissions.

Criticisms. Critics generally argue that smart growth can provide, at most, only small health benefits, and cite statistics showing that suburban residents are healthier on average than urban residents, ignoring confounding factors such as income and age (Gordon and Richardson 2000). None refute recent research showing significant health benefits of smart growth.

Energy Consumption and Pollution Emissions

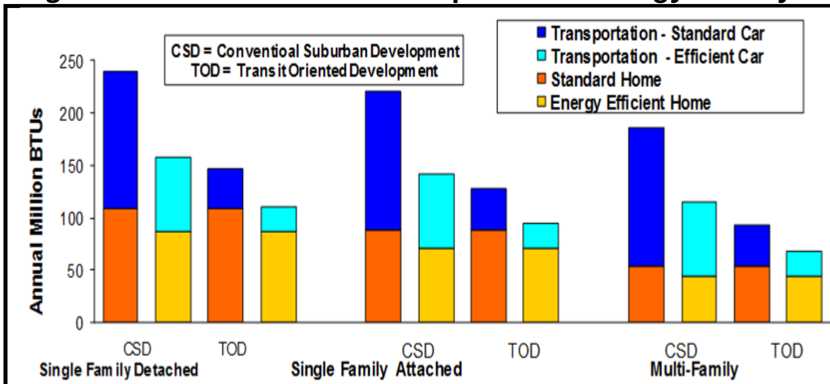
Smart growth reduces per capita energy consumption and pollution emissions by reducing infrastructure requirements, building energy use and vehicle travel (Ewing and Rong 2008; Lefèvre 2009; Litman 2014; LSE 2014). Figures 13 through 15 illustrate these impacts.

Figure 13 **Driving Versus Residential Density** (Benfield 2009)



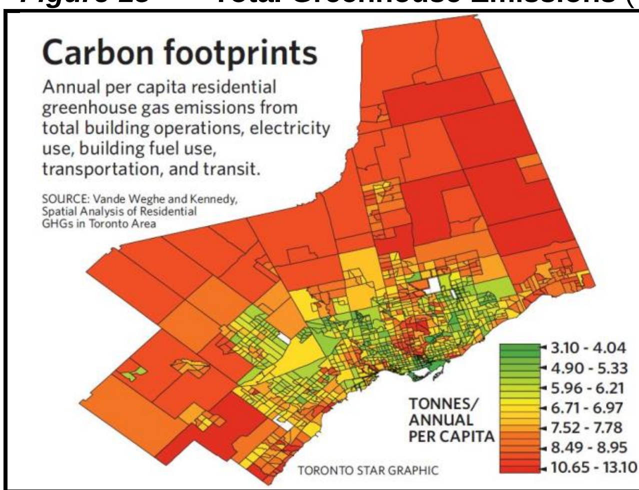
U.S. travel survey data shows that per capita vehicle travel, fuel consumption and pollution emissions decline significantly with shifts from low-density sprawl (less than 10 households per acre) to moderate urban densities (more than 25 households per acre).

Figure 14 **Household Transportation Energy Use By Location** (JRC 2011)



Housing location and type affect household energy consumption more than vehicle or home efficiency.

Figure 15 **Total Greenhouse Emissions** (VandeWeghe and Kennedy 2007)



Toronto, Canada regional data show that total per capita household greenhouse gas emissions are two or three times higher in sprawled, suburban locations than in more compact, multimodal neighborhoods.

Criticism. Critics argue that smart growth energy savings and emission reductions are small and not cost effective (Pisarski 2009). The National Association of Home Builders sponsored studies (NAHB 2010 and 2011) which it claimed demonstrates that there is no clear link between residential land use and emissions, but a review of their research reports actually indicates significant support for smart growth, as summarized in Table 9.

Table 9 **Critique of NAHB Claims** (Litman 2011)

NAHB Claims	Critique
"Higher density development will not necessarily deliver the benefits that many in the policy community ascribe to it."	This statement ignores other land use factors besides density. Researchers estimate that an integrated smart growth program can reduce future transport emissions 7-10%.
"The existing body of research demonstrates no clear link between residential land use and GHG emissions and leaves tremendous uncertainty as to the interplay of these factors."	This is untrue. Existing research clearly demonstrates links. All NAHB researchers except Fruits acknowledge that compact development significantly reduces emissions. Although uncertainty exists concerning the magnitude of some impacts, it is no greater than with other public policy issues.
"The assumption of a causal connection between density and GHG emissions is based on prevailing beliefs within the planning community and not on verifiable scientific research or analysis."	This is untrue and confuses the issue by referring only to density. Abundant theoretical and empirical evidence demonstrates causal connections between land use factors and GHG emissions. All NAHB researchers except Fruits recognize the overwhelming evidence of these connections.
"The weight of the evidence suggests that the effect of density on travel behavior is modest. In fact, doubling density results in about a 5% decrease in vehicle trips and VMT."	This is untrue and confuses the issue by referring only to density. Current research indicates that doubling density by itself reduces affected vehicle travel 5-19%, and doubling all compact development factors reduces vehicle travel 20-40%.
"The density and layout of communities have only a modest impact on peoples' transportation choices and travel behavior."	This is untrue. Many studies indicate that increasing development density, mix, connectivity and mobility options can reduce vehicle travel 20-40%, which is more than *modest*.
"New Urbanism-type street patterns have little or no impact on auto usage."	This is untrue. This was a finding of early theoretical studies but subsequent empirical studies find street connectivity to have significant impacts on travel activity.
"Policies that affect the car costs, such as increases in gas taxes or the price or availability of parking, are more effective in changing travel behavior."	This may be true, but these other policy reforms tend to be more effective and politically acceptable if implemented as part of a smart growth program.
"The decentralization of jobs lessens the ability of public transit – particularly fixed rail systems – to meet travel needs, and increases the complexity of household location decisions, reinforcing the need for auto ownership and neighborhoods that accommodate autos, and increasing VMTs."	These claims are not necessarily true, nor relevant. Smart growth helps reverse these trends, increasing the portion of homes and jobs accessible by alternative modes, and reduces non-commute travel.
"Transit availability has a small impact on auto use."	This is untrue. High quality transit with supportive policies can provide significant vehicle travel reductions, as indicated by the NAHB's own research (Liu 2007).

The National Association of Home Builders (NAHB) claims that their research demonstrates that smart growth policies do little to reduce household energy consumption and emissions, but it actually indicates the opposite; integrated smart growth programs that increase development density, mix, connectivity and transport options can reduce per capita vehicle energy consumption and emissions by 20-40%.

Economic Development

Smart growth tends to increase economic development, including productivity, business activity, property values and tax revenues (GCEC 2014; Litman 2014; Renaissance Planning Group 2012; Thompson 2013; USEPA 2013). This reflects the economic savings and benefits provided by more efficient land use, more efficient public services, improved accessibility, and agglomeration efficiencies. Table 10 summarizes some of these impacts.

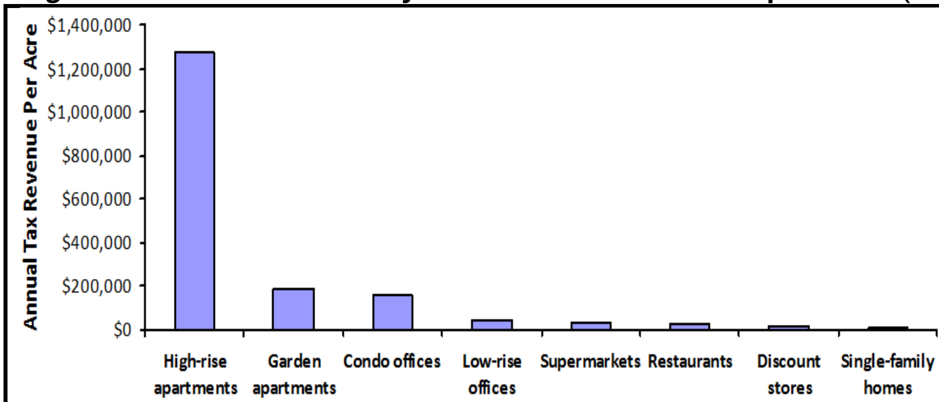
Table 10 **How Smart Growth Can Increase Economic Productivity**

Smart Growth Impact	Effects on Economic Productivity and Development
Reduced per capita land consumption	Increased agricultural productivity. Open space preservation supports tourism industry (e.g., preserving parks and shorelines)
Public infrastructure and service efficiencies	Government and utility cost savings
Reduced transportation expenditures	Shifts expenditures from vehicles and fuel to more locally produced goods, increasing regional employment and productivity
More livable communities	Attracts residents, jobs and visitors, increasing business activity
Improved mobility for non-drivers	Improves economic opportunity for disadvantaged residents, and increases the pool of potential employees for businesses
Reduced crashes and improved public health	Reduced crash damages, and reduced medical and disability costs

Smart growth tends to increase economic productivity in several ways.

More compact development tends to increase tax revenue per acre (CMAP 2014; McKeeman 2012). Figure 16 illustrates the typical revenue per acre for various land uses.

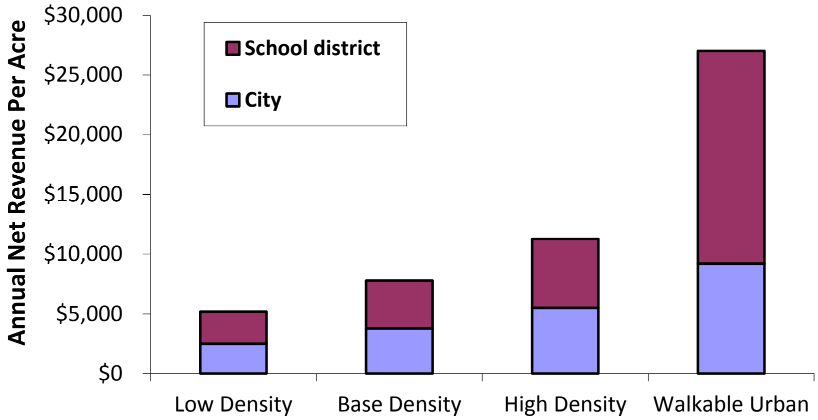
Figure 16 **Fairfax County Tax Revenue Per Developed Acre** (McKeeman 2012)



More compact development generates far more tax revenue per acre than lower-density development.

One study found that in Sarasota County, Florida, 3.4 acres of urban mixed-use development provides the same number of housing units as 30.6 acres of suburban housing, consumes about one-tenth of the land has only 57% the infrastructure costs, and provides 8.3 times as much tax return (PIP 2009). Because of these lower costs and higher revenues the study found that annual infrastructure return on investment (annual tax revenue relative to annualized public infrastructure costs) is about 35% for compact development, compared with only 2% for sprawled development, so an urban highrise repays its infrastructure costs in about three years, compared with 42 years for suburban multi-family development. As a result, more compact regional development provides more net municipal government and school district revenue per acre than lower-density sprawl (SGA and RCLCO 2015a and 2015b), as summarized in Figure 17.

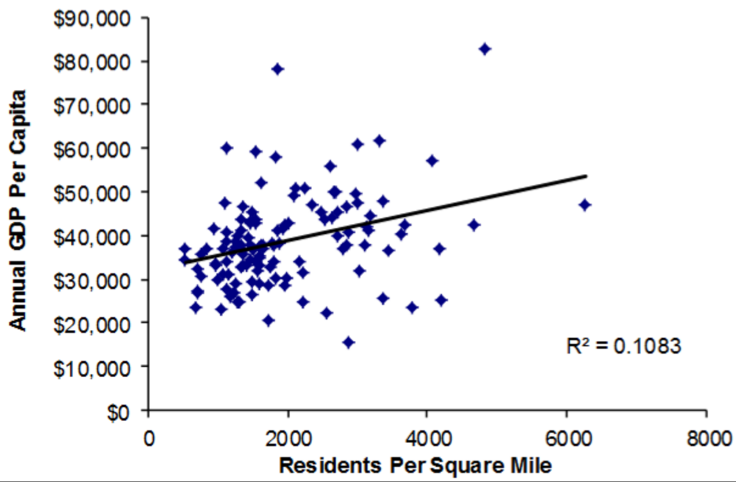
Figure 17 **Madison Tax Revenue Per Developed Acre** (SGA and RCLCO 2015b)



Smart growth development provides more net revenue (tax revenue minus incremental public service costs) per acre, and provides higher returns on infrastructure investments than sprawl.

Agglomeration efficiencies (also called *economies of agglomeration*) refers to the increased economic productivity that results from more compact development that increases accessibility and therefore the efficiencies of economic interactions (Chatman and Noland 2013; Donovan and Munro 2013; Melo, Graham, and Noland 2009; Hardesty 2013). One published study found that doubling county-level density is associated with 6% higher state-level productivity (Haughwout 2000). Similar relationships are found between cities: per capita GDP tends to increase with regional population density, as illustrated in Figure 18.

Figure 18 **Per Capita GDP and Urban Density** (BTS 2006 and BEA 2006)

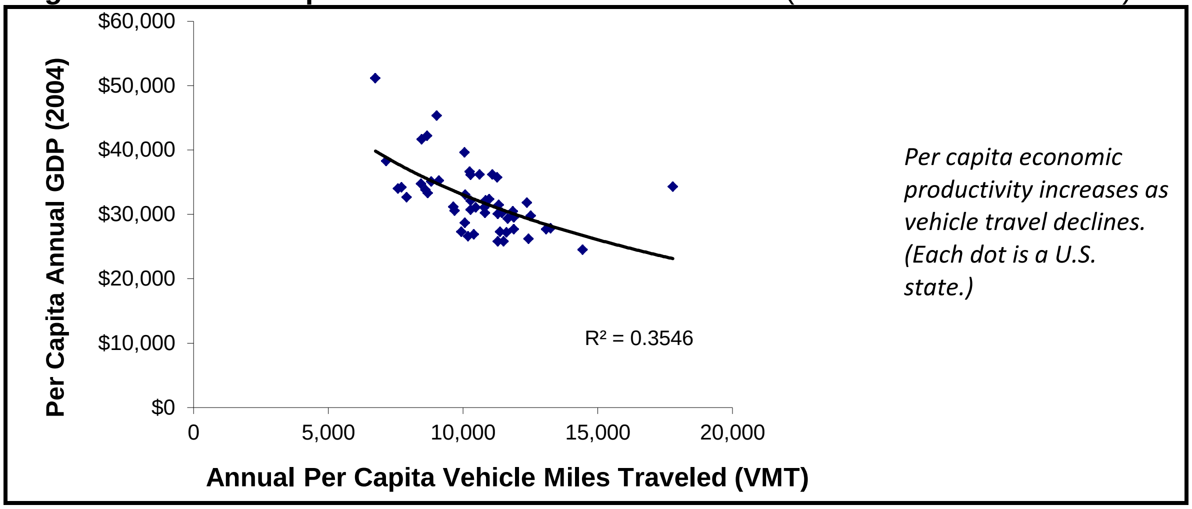


Productivity tends to increase with population density. (Each dot is a U.S. urban region.)

Glaeser and Resseger (2009) and Abel, Dey and Gabe (2011), find that this correlation is particularly strong for knowledge-based industries, which supports the hypothesis that urban density and mix help to spread knowledge. Population-weighted density, which reflects the density that urban residents experience in their neighborhood, may be a better indicator of land use productivity impacts than average regional density (Florida 2013).

Similarly, at both state and regional scales, per capita GDP tends to decline with vehicle-miles traveled (VMT) and increases with per capita transit ridership (Kooshian and Winkelman 2011) (Figure 19). This probably reflects the efficiencies of compact land use development and the transportation system efficiencies that result from a more multimodal transportation system. Talen and Koschinsky (2013) found strong correlations between neighborhood accessibility (based on WalkScores) and high income mobility (the chance that child in a low-income household will eventually earn a high income); a child born to the bottom fifth income group in a walkable neighborhood has a much better chance of becoming financially prosperous than a poor child born in a sprawled, automobile-dependent area.

Figure 19 **Per Capita GDP and VMT For U.S. States** (BTS 2006 and BEA 2006)



To the degree that smart growth policies allow more compact development in very productive urban regions, they can increase overall productivity. Hsieh and Moretti (2015) analyzed the economic impacts of restrictions on development density in Boston, New York, Seattle, San Francisco and Washington DC. They estimate that allowing more infill development in these highly productive cities could increase aggregate national economic output by 13%, more than $1 trillion annually, equivalent to several thousand dollars per worker.

Smart growth also helps increase long-term household wealth by shifting expenditures from fuel and vehicles, which depreciate in value, to housing, which tends to appreciate in value. For example, a household that spends $15,000 annually on mortgage payments and $5,000 on transport, after a decade typically accrues about $100,000 more equity (net worth) than spending $10,000 on mortgage payments and $10,000 on transport.

Criticisms. Critics cite international data showing positive relationships between per capita vehicle ownership and incomes, and examples of high income sprawled and automobile-dependent cities, such as Hartford, Connecticut (Cox 2014). However, such evidence ignores theoretical and empirical evidence that smart growth policies tend to increase productivity. Overall, more compact and multi-modal U.S. cities tend to have more per capita economic productivity, higher average incomes, and more tax revenue per acre than sprawled, automobile-dependent cities.

Smart Growth Costs and Sprawl Benefits

Comprehensive analysis should consider all impacts, so it is important to account for smart growth costs and sprawl benefits. Certainly, smart growth incurs costs, including higher land unit costs, more compact housing with less private open space (lawns and gardens), reduced privacy, and increased exposure to noise and air pollution. In many cities, urban neighborhoods have more social problems, including poverty, crime, addiction and poor schools. However, these are economic trade-offs and transfers (one group benefits at another's expense). For example, more compact development tends to reduce private open space in urban neighborhoods, but increases public parks and preserve regional open space, and the lower crime rates and better schools in sprawled neighborhoods largely results from their ability to exclude poor households, which benefits those community's residents, but concentrates poverty and associated social problems elsewhere.

Perhaps the greatest external costs of smart growth is the disruption that infill development can impose on existing urban neighborhoods, including construction noise, increased local traffic and parking congestion, reduced privacy, and the introduction of new neighbors who sometimes differ in income and culture than current residents. However, comprehensive smart growth policies can minimize and offset many of these impacts. For example, traffic and parking management strategies can reduce congestion problems. Since smart growth residents tend to drive less, increases in local traffic are offset by reductions in regional traffic compared with the same households locating in automobile-dependent, urban fringe areas.

There is little evidence that increased sprawl provides significant external benefits (more sprawled development benefits people in other communities). This is expected since rational people and businesses externalize costs and internalize benefits (Rothengatter 1991; Swiss ARE). If sprawl really did provide external benefits, developers or occupants would find ways to capture those benefits, for example, by demanding subsidies.

Criticisms. Critics often argue that sprawl has benefits that offset costs, but nearly all of the benefits they cite are direct user benefits and economic transfers, such as larger yards, increased privacy and reduced crime; I have found no credible research indicating that sprawl provides significant eternal benefits (benefits to people who live outside a sprawled area) that offset external costs.

Neighborhood associations often criticize infill development due to concerns about local impacts such as increased neighborhood traffic and parking congestion, and social problems if infill development attracts lower-income households. However, their analysis is generally limited; they consider the external impacts they would bear, but ignore benefits to the new neighborhood residents and the regional saving and benefits of infill development compared with sprawl.

Summary of Smart Growth Benefits and Costs

This analysis indicates that smart growth provides two primary resource saving: it reduces per capita land consumption, and it reduces the distances between destinations which reduces the costs of providing public infrastructure and services, improves accessibility, and reduces per capita vehicle travel. These resource cost savings, in turn, provide various economic, social and environmental benefits. Smart growth can also impose some costs. Table 11 summarizes these impacts. Some are *internal* (they directly affect the people who choose sprawled locations) and others are *external* (they affect other people). These have a mirror-image relationship with sprawl impacts: most smart growth benefits reflect costs of sprawl, and vice versa.

Table 11 **Smart Growth Costs and Benefits**

	Internal (To Smart Growth Residents)	External (To Other People)
Benefits	Increased accessibility, which reduces transportation time and money costs Improved mobility options, which increases independence and economic opportunity, particularly for non-drivers Reduced chauffeuring burdens imposed on drivers More affordable housing options (townhouses, apartments, accessary units, etc.) Reduced traffic risk Improved fitness and health	Open space preservation (farm and environmental lands) Reduced public infrastructure and service costs (roads, utilities, emergency services, etc.), and more efficient public transit services Reduced congestion and crash risk imposed on other people Reduced healthcare and disability costs Increased economic productivity and development Reduced overall crime rates Reduced fuel consumption and pollution emissions.
Costs	Higher unit land prices (dollars per acre) Less private greenspace (lawns and gardens) Less privacy More local traffic and parking congestion More local social problems (poverty, crime, etc.) More exposure to some local pollutants	Increases in some infrastructure costs such as curbs and sidewalk

Smart growth provides various benefits and costs, including some that are internal (borne by the smart growth residents) and some that are external (borne by other people). These vary depending on specific conditions.

These impacts can vary depending on conditions and perspectives. For example, smart growth tends to increase traffic congestion intensity (the reduction in speed that occurs when people drive) and pollution emission per acre, but reduces total hours of congestion delay and total emissions, because residents drive less. As a result, smart growth policies that encourage infill development may seem undesirable from a neighborhood perspective but desirable from a regional perspective.

Consumer Preferences

A key factor in this analysis is the degree that smart growth responds to consumer preferences. Although surveys indicate that, given no constraints, most consumers prefer single-family houses, they also indicate that many households want smart growth features such as accessibility, multimodalism (particularly walkability), and affordability (NAR 2013). For example, a National Association of Realtors survey (Beldon, Russonello and Stewart 2011) found:

- Nearly half of Americans (47%) would prefer to live in a city (19%) or a suburban neighborhood with a mix of houses, shops, and businesses (28%). Only one in ten (12%) say they would prefer a suburban neighborhood with houses only.
- After hearing detailed descriptions of two different types of communities, 56% of Americans select the smart growth community and 43% select the sprawl community.
- Seven times more people say the neighborhood where a house is located (88%) is a bigger consideration in deciding where to live than the size of the house (12%).
- Community factors such as high quality public schools (75%) and sidewalks and places to take walks (77%) are among the top community characteristics people consider important.
- Improving existing communities (57%) and building new developments in existing communities (32%) rates much higher than building new developments in the countryside (7%).

Consumer preferences for sprawl partly reflect social features such as perceived safety, school quality, social status and financial stability. Smart growth policies that provide these features in more compact, multimodal neighborhoods respond to consumer demands, providing the best of all worlds; smart growth benefits with houses that also reflect consumer preferences. Even people who *someday* aspire to own a single-family house often demand more compact housing options, for example, when they are young, seniors, have disabilities, may move frequently, or want to avoid the additional costs and responsibilities of single-family housing. Current demographic and economic trends are increasing demand for smart growth housing (ULI 2015).

- Millennials and seniors, both growing demographic segments, tend to prefer more compact and multimodal neighborhoods, while the number of families with young children, the segment that most prefers single-family housing, is not growing.
- Increasing health and environmental concerns are increasing demand for walkable communities.
- Improving travel options (better walking, cycling, transit, ridesharing and telecommunications) are improving demand for these modes and reducing automobile travel demands.

This is not to suggest that demand for larger-lot, single-family housing is disappearing, but North America has an abundant supply of such housing, so market studies indicate far more growth in smart growth than sprawled housing demands (Levine and Frank 2006; Nelson 2006).

Criticisms. Critics argue that most households prefer single-family dwellings, and assume that smart growth eliminates single-family housing development, and so conclude that smart growth harms consumers (Kotkin and Cox 2013). This ignores evidence of growing consumer demand for compact and affordable housing types, diversity of smart growth housing (which usually includes small-lot, single-family homes), and the large existing supply of single-family housing in most communities. It is inaccurate to claim that smart growth policies harm consumers.

Policy Implications

This analysis suggests that sprawl and automobile dependency tend to impose significant direct and external costs, and there is growing latent demand for more compact housing in multimodal neighborhoods. To the degree that this is true, smart growth policy reforms, such as those described in Table 12, increase efficiency and equity. These impacts tend to be cumulative and synergistic; for example, minimum parking requirements not only cause economically excessive parking supply (more than what consumers would choose if they paid directly for parking), they also increase land consumption, vehicle ownership and use, and demand for wider roadways, which lead to even more sprawl and automobile dependency. As a result, smart growth policy reforms can provide large savings and benefits.

Table 12 **Smart Growth Market Reforms**

Market Distortions	Smart Growth Market Reforms
Regulations prevent development of compact, affordable housing types (townhouses, multi-family, accessory units, etc.)	Reducing these regulations helps respond to consumer demands
Some households do not need a residential parking space	Eliminate minimum parking requirements and encourage property managers to unbundle parking
More compact, infill development reduces the costs of providing public infrastructure and services	Development and utility fees, and taxes should be lower for such development, reflecting their cost savings
Some households want to reduce their transportation costs and rely more on walking, cycling and public transit	Encourage compact, mixed development; improve walking, cycling and public transit, implement complete streets policies
Current planning underinvests in walking and cycling (less than their mode share	Reform planning practices to recognize the value of active modes and to invest more in these modes.
Some households want to live in urban neighborhoods, but are discouraged by inferior public services, such as schools	Improve services in urban neighborhoods so they satisfy these demands
Open space preservation provides external benefits (wildlife habitat, clean air and water, aesthetics, etc.)	Apply regulations, fees and taxes to protect open space
Automobile travel imposes external costs (parking subsidies, congestion, accident risk, air and noise pollution, etc.)	Apply regulations, fees and taxes to control these costs
Current policies result in resource inefficient development, which reduces economic productivity and development	Support smart growth policies as part of economic development strategies.

This table describes various market failures that favor sprawl over compact, multimodal development, and smart growth reforms that can increase efficient and equity.

Criticisms. Critics assume that smart growth consists mainly of urban growth boundaries intended to achieve environmental objectives (Glans 2009; Moore, Staley and Poole 2010). They ignore market-based smart growth strategies, other benefits of compact and multimodal development, growing consumer demands for such development, and existing market distortions that result in economically-excessive sprawl. Their criticism is biased and one-sided, attacking regulations that limit urban expansion but not the much larger set of regulations that support sprawl such as restrictions on development density and multi-family housing, minimum parking mandates, public expenditures on roads and parking facilities, and underpricing of public infrastructure and public service costs in sprawled locations (Lewyn and Jackson 2014).

Critiquing Criticisms

Critics seldom follow the principles of quality and credible research, such as up-to-date literature reviews, comprehensive analysis, clearly stated research questions, and peer review. Many smart growth benefit studies are performed by major research organizations including universities and the National Academy of Sciences (e.g., Burchell, et al 2002; Ewing and Hamidi 2014; Frank, et al. 2008; Litman 2014). In contrast, excepting Kotkin and Cox's 2013 four-page review article, none of the critics' publications are peer reviewed. [2]

Critics often misrepresent smart growth and consider only a small portion of total smart growth policies, impacts and outcomes, as illustrated in Table 13.

Table 13 **Critics' Scope of Analysis**

	Considered by Critics	Generally Ignored by Critics
Policies	• Urban growth boundaries • Restrictions on urban driving	• Allow smaller higher densities and more mixed development. • Allow more compact and affordable housing types (townhouses, multi-family, accessory units, lofts, etc.) • Reduced and more flexible minimum parking requirements • Lower impact and utility fees for compact, infill development • More integrated and multimodal transport planning • More efficient traffic and parking management
Impacts	• Increased density, reduced per capita land consumption	• More infill, less urban expansion • More mixed development • More affordable housing types, such as townhouses and apartments with reduced parking supply • More connected roads and paths • Reduced parking supply, more sharing of parking facilities • Improved walking, cycling, public transit and carsharing • Reduced vehicle ownership and use • More walking, cycling and public transit
Outcomes	• Farmland preservation • More efficient public services • Higher single-family housing prices • More intense traffic and parking congestion • Energy conservation and emission reductions	• Habitat preservation • Reduced public infrastructure and service costs • Reduced impervious surface and stormwater management costs • More urban greenspace • More affordable housing options • Household transportation cost savings • Reduced traffic casualty rates (deaths per captia) • Improved mobility for non-drivers, reduced chauffeuring burdens • Reduced time spent driving and less per capita congestion delay • Improved public fitness and health

Critics tend to focus on a few smart growth policies and impacts, and ignore others.

[2] Fruits (2010) published his research in the *Center for Real Estate Quarterly Journal*, which he edited, without peer review, which violates academic standards and explains why it contains numerous inaccuracies (Litman 2011).

As a result, a comprehensive smart growth program can provide far greater impacts and benefits than critics acknowledge. For example, if a 50% density increase reduces vehicle travel and associated emissions by just 5-10% (Boarnet and Handy 2014), a comprehensive smart growth program that includes increased development density, mix and transport network connectivity; improved walking, cycling, public transit and carsharing; and more efficient parking and transport management, can reduce affected residents' vehicle travel by 20-50% (CARB 2010-2014), providing much larger and more diverse benefits than critics recognize.

Similarly, Cox and Utt (2004) found that each 1,000 increase in residents per square mile is associated with $53 annual per capita savings in municipal and water utility expenditures, which they call "miniscule." However, since increased density is just one of several smart growth impacts that can affect public infrastructure and service costs (it also reduces urban expansion, road and parking facility demands, and impervious surface area; and increases the efficiency of emergency and public transit services), total savings are probably an order of magnitude greater than their analysis indicates, or $250-2,500 per resident.

Critics often use inappropriate methods to measure impacts. For example, Demographia (2008) claims to prove that smart growth causes unaffordable housing by comparing housing prices in four coastal smart growth cities with four inland sprawled cities, ignoring important factors such as higher growth rates and natural geographic constraints which tend to increase housing prices in smart growth cities. Similarly, critics claim that smart growth increases crime, but fail to account for confounding factors such as income and age; when these are considered, denser neighborhoods and larger cities are found to have lower per capita crime rates than more sprawled areas (Hillier and Sahbaz 2006; Litman 2014).

Critics misrepresent consumer demands. They argue that since consumer surveys indicate that most households prefer single-family homes, smart growth harms most households, which incorrectly assumes that smart growth eliminates single-family homes, and ignores survey data showing significant and growing consumer preferences for smart growth features such as improved access and affordability (ULI 2015).

Critics sometimes misrepresent research. For example, Fruits (2011) use outdated studies to conclude that "compact development is not a useful tool for reducing greenhouse gas emissions." He claimed that "some studies have found that more compact development is associated with greater vehicle-miles traveled," citing a 1996 paper which simply speculated that increased roadway connectivity could sometimes increase vehicle travel; subsequent empirical research disproved this idea (Litman 2011).

Some criticisms have kernels of truth but are overstated. For example, urban containment policies can increase land prices, which increases larger-lot housing prices, but critics are wrong to conclude that this necessarily reduces overall affordability since smart growth policies allow more compact and affordable housing types, and reduce transport costs. To be credible, critics must acknowledge these factors and demonstrate that comprehensive smart growth programs actually increase low-income household's total housing and transport costs. Similarly, infill development can increase local traffic and parking congestion, but other smart growth policies help reduce vehicle ownership and use, which reduce both local and regional congestion. For their claims to be credible, critics must show that comprehensive smart growth policies increase total per capita congestion costs at both local and regional scales.

Table 14 critiques typical smart growth criticisms. None withstands scrutiny.

Table 14 **Critiquing Smart Growth Criticism** (Based on Glans 2009)

Criticism	Critique
Urbanization does not threaten agricultural land. Since 1950, urban areas of more than 1,000,000 population have consumed an amount of new land equal to barely 1/10th the area taken out of agricultural production. The culprit is improved agricultural productivity, not development.	Many cities are surrounded by unique, high value farmlands, which sprawl threatens in various ways. Sprawl can disturb far more farmland than just what is classified as "urban."
There is no practical way for low-density urban areas to be redesigned to significantly increase transit and walking. Whether in America or Europe, most urban destinations are reasonably accessible only by automobile. Transit can be an effective alternative to the automobile only to dense core areas, such as the nation's largest downtowns.	In both urban and suburban areas, smart growth can create more compact, multimodal neighborhoods where residents drive less and rely more on alternative modes (FHWA 2014). Housing preference surveys indicate that many people prefer living in such neighborhoods
Large expanses of land are already protected as open space. All of the nation's urban development, in small towns and major metropolitan areas, accounts for approximately 4 percent of land (excluding Alaska).	Many cities are surrounded by unique and valuable open space, including wildlife habitat and watersheds. Sprawl can disturb far more openspace than just what is classified as "urban."
Smart growth will bring more traffic congestion and air pollution, because it will concentrate automobile traffic in a smaller geographical space. International and U.S. data shows that higher population densities are associated with greater traffic congestion and the slower, more stop-and-go traffic caused by higher densities increase air pollution.	Academic research actually shows that comprehensive smart growth policies, which increase density, mix and transport options, tend to reduce traffic congestion, energy consumption and pollution emissions (Kuzmyak 2012; Litman 2011; Ewing and Rong 2008).
Overall home ownership rates, and black home ownership rates in particular, tend to be higher where there is more sprawl. While transportation costs are greater in more sprawling urban areas, lower housing costs more than make up the difference, making the overall cost of living lower where sprawl is greater.	These claims are based on outdated research: smart growth actually allows more lower-priced housing types and increases overall affordability; higher housing costs are more than offset by transport savings (CNT 2010; NRDC 2010), and smart growth is associated with increased economic mobility (Ewing and Hamidi 2014).

Many smart growth criticisms are inaccurate. They generally cannot withstand scrutiny.

Good research is enlightening: it summarizes previous published literature on a subject, clearly describes all perspectives, defines a clearly stated research questions, provides transparent analysis, discusses issues of uncertainty and potential bias, explores how results would change with different assumptions or analysis methods, and withstands peer review. Responsible researchers answer questions from peers and share their data on request. With few exceptions, smart growth critics fail to reflect these principles, they begin with a conclusion, search for supporting evidence and ignore any contrary evidence. Their analysis is not transparent, their publications are not peer reviewed, and they seldom respond to questions from peers.

Conclusions

Smart growth involves various policies that result in more compact, multimodal development. Credible research indicates that smart growth community residents consume less land, own fewer vehicles, drive less, rely more on alternative modes, spend less on transport, have lower traffic crash casualty rates, consume less energy and produce less pollution than they would in more sprawled, automobile-dependent areas. These savings filter through the economy, increasing economic productivity and development. Smart growth can also increase some costs, including land unit costs (dollars per acre) and local traffic and parking congestion. All of these impacts should be considered when evaluating development policies.

Smart growth often provides substantial benefits, including net economic savings that total thousands of dollars annually per households, plus significant health benefits, improved mobility options for non-drivers, and external benefits including reduced traffic congestion, accident risk and pollution imposed on others. Since physically, economically and socially disadvantaged people tend to rely on affordable housing and transport options, smart growth tends to provide social equity benefits.

Many current policies tend to favor sprawl over compact development and automobile travel over alternative modes. Smart growth reforms help correct these distortions, resulting in more diverse housing and transportation options which better respond to consumer demands, more efficient pricing, and more neutral planning. These reforms provide multiple and synergistic benefits; for example, reducing parking requirements not only reduced parking facility costs, it also allows more compact development which improves accessibility and reduces vehicle ownership and use, which in turn reduce total traffic congestion, accident and pollution costs.

Although surveys indicate that most households prefer single-family housing, they also indicate significant and growing demand for smart growth features including affordability, accessibility, multimodalism, and neighborhood vibrancy. Smart growth can provide many of the features that attract consumers to sprawl, such as perceived security, good schools, status and financial stability, in more compact housing in multimodal communities, providing the best of all worlds.

Critics argue that smart growth provides minimal benefits and imposes significant costs, but their analysis is based on inaccurate definitions of smart growth and inaccurate or outdated research. For example, critics often assume that smart growth consists of just one policy (urban growth boundaries) that have just one impact (increased density), ignoring most smart growth policies and benefits. Similarly, when critics claim that smart growth reduces affordability they ignore the many strategies that reduced housing costs and provide other savings. In many cases, their criticisms justify more rather than less smart growth; for example, concerns that urban containment policies increase land prices justify more support for compact housing, and concerns that compact development increases local congestion justify more transport and parking management. Smart growth critics generally lack credibility: they do not follow the basic principles of quality research such as literature reviews, transparent analysis and peer review.

References and Information Resources

Jaison R. Abel, Ishita Dey, and Todd M. Gabe (2011), *Productivity and the Density of Human Capital*, Staff Report 440, Federal Reserve Bank of New York (www.newyorkfed.org), at www.newyorkfed.org/research/staff_reports/sr440.pdf.

Michael L. Anderson (2013), *Subways, Strikes, and Slowdowns: The Impacts of Public Transit on Traffic Congestion*, Working Paper No. 18757, National Bureau of Economic Research (www.nber.org); at www.nber.org/papers/w18757.

Chester Arnold and James Gibbons (1996), "Impervious Surface Coverage: The Emergence of a Key Environmental Indicator," *American Planning Association Journal*, Vol. 62, No. 2, (www.planning.org), Spring, pp. 243-258; at http://bit.ly/1JVtggK.

H. Spencer Banzhaf and Puja Jawahar (2005), *Public Benefits of Undeveloped Lands on Urban Outskirts: Non-Market Valuation Studies and their Role in Land Use Plans*, Resources for the Future (www.rff.org); at http://tinyurl.com/ofmptwj.

Beldon, Russonello, and Stewart (2011), *The 2011 Community Preference Survey: What Americans Are Looking for When Deciding Where To Live*, National Association of Realtors (www.realtor.org); at http://bit.ly/1Hfh1ss.

F. Kaid Benfield (2009), *Considering The Role Of Density In Smart Growth*, Switchboard; at http://switchboard.nrdc.org/blogs/kbenfield/considering_the_role_of_densit.html.

B. Bhatta (2010), *Analysis of Urban Growth and Sprawl from Remote Sensing Data*, Advances in Geographic Information Science, C Springer-Verlag Berlin Heidelberg, (DOI 10.1007/978-3-642-05299-6_2); at http://tinyurl.com/lrvclmx.

Pamela Blais (2010), *Perverse Cities: Hidden Subsidies, Wonky Policy, and Urban Sprawl*, UBC Press (www.ubcpress.ca); summarized at www.perversecities.ca.

Marlon G. Boarnet (2013), "The Declining Role Of The Automobile And The Re-Emergence Of Place In Urban Transportation: Past Will Be Prologue," *Regional Science Policy & Practice*, Vol. 5/2, June, pp. 237–253 (DOI: 10.1111/rsp3.12007).

Marlon G. Boarnet and Susan Handy (2014), *Impacts of Residential Density on Passenger Vehicle Use and Greenhouse Gas Emissions*, Policy Brief, California Air Resources Board (www.arb.ca.gov); at www.arb.ca.gov/cc/sb375/policies/density/residential_density_brief.pdf.

Robert Burchell, et al (2002), *The Costs of Sprawl – 2000*, TCRP Report 74, Transportation Research Board (www.trb.org); at http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_74-a.pdf.

Robert W. Burchell and Sahan Mukherji (2003), "Conventional Development Versus Managed Growth: The Costs of Sprawl," *American Journal of Public Health*, Vol. 93, No. 9 (www.ajph.org), Sept., pp. 1534-1540; at www.ncbi.nlm.nih.gov/pmc/articles/PMC1448006.

Robert Burchell, Anthony Downs, Barbara McCann and Sahan Mukherji (2005), *Sprawl Costs: Economic Impacts of Unchecked Development*, Island Press (www.islandpress.org).

H. Sterling Burnett and Pamela Villarreal (2004), *Smart Growth = Crime, Congestion and Poverty*, National Center for Policy Analysis (www.ncpa.org); at www.ncpa.org/pub/ba473.

CARB (2010-2014), *Impacts of Transportation and Land Use-Related Policies*, California Air Resources Board (http://arb.ca.gov/cc/sb375/policies/policies.htm).

CDOT (2012), *Effect of Connectivity on Fire Station Service Area & Capital Facilities Planning: Looking at Connectivity from an Emergency Response Perspective*, Charlotte Department of Transportation; at www.charlotteobserver.com/static/images/pdf/CNUPresentation.pdf.

Robert Cervero and G. B. Arrington (2008), "Vehicle Trip Reduction Impacts of Transit-Oriented Housing," *Journal of Public Transportation*, Vol. 11, No. 3, pp. 1-17; at www.nctr.usf.edu/jpt/pdf/JPT11-3.pdf.

Daniel G. Chatman and Robert B. Noland (2013), "Transit Service, Physical Agglomeration and Productivity in US Metropolitan Areas," *Urban Studies* (http://usj.sagepub.com).

CMAP (2014), *Fiscal & Economic Impact Analysis of Local Government Decisions* (www.cmap.illinois.gov); at http://tinyurl.com/lekvp9a.

CNT (2010), *Penny Wise, Pound Fuelish: New Measures of Housing + Transportation Affordability*, Center for Neighborhood Technology (www.cnt.org); at http://bit.ly/1GdD2vM.

Joe Cortright (2010), *Driven Apart: How Sprawl is Lengthening Our Commutes and Why Misleading Mobility Measures are Making Things Worse*, CEOs for Cities (www.ceosforcities.org); at http://bit.ly/1FkGYdj.

Wendell Cox (2014), *New Climate Report Misses Point On Us Cities*, New Geography (www.newgeography.com); at http://bit.ly/1zOpvGT.

Wendell Cox and Joshua Utt (2004), *The Costs of Sprawl Reconsidered: What the Data Really Show*, Backgrounder 1770, The Heritage Foundation (www.heritage.org).

Wendell Cox and Hugh Pavletich (2015), *Demographia International Housing Affordability Survey*, Demographia (www.demographia.com); at www.demographia.com/dhi.pdf.

CTOD and CNT (2006), *The Affordability Index: A New Tool for Measuring the True Affordability of a Housing Choice*, Center for Transit-Oriented Development and the Center for Neighborhood Technology, Brookings Institute (www.brookings.edu/metro/umi/20060127_affindex.pdf).

James M. Daisa and Terry Parker (2010), "Trip Generation Rates for Urban Infill Uses In California," *ITE Journal* (www.ite.org), Vol. 79, No. 6, June 2010, pp. 30-39.

Demographia (2008), *The Impact Of Smart Growth On Housing Affordability: An Analysis of Metropolitan Markets by Land Use Planning System*, Demographia (www.demographia.com); at www.demographia.com/dhi-us8.pdf.

Stuart Donovan and Ian Munro (2013), *Impact Of Urban Form On Transport And Economic Outcomes*, Research Report 513, NZ Transport Agency (www.nzta.govt.nz); at www.nzta.govt.nz/resources/research/reports/513/docs/513.pdf.

Reid Ewing (2013), "Mapping Mobility," *Planning*, American Planning Association (www.planning.org); at http://bit.ly/1c1GtsS.

Reid Ewing, Rolf Pendall and Don Chen (2002), *Measuring Sprawl and Its Impacts*, Smart Growth America (www.smartgrowthamerica.org).

Reid Ewing, Richard A. Schieber and Charles V. Zegeer (2003), "Urban Sprawl As A Risk Factor In Motor Vehicle Occupant And Pedestrian Fatalities," *American Journal of Public Health* (www.ajph.org).

Reid Ewing, Keith Bartholomew, Steve Winkelman, Jerry Walters and Don Chen (2007), *Growing Cooler: The Evidence on Urban Development and Climate Change*, Urban Land Institute (www.uli.org); at http://postcarboncities.net/files/SGA_GrowingCooler9-18-07small.pdf.

Reid Ewing and Fang Rong (2008), "The Impact of Urban Form on U.S. Residential Energy Use," *Housing Policy Debate*, Vol. 19, No. 1 , pp. 1-30; at http://bit.ly/1Egi6xW.

Reid Ewing and Shima Hamidi (2014), *Measuring Urban Sprawl and Validating Sprawl Measures*, Metropolitan Research Center at the University of Utah for the National Cancer Institute, the Brookings Institution and Smart Growth America (www.smartgrowthamerica.org); at www.arch.utah.edu/cgi-bin/wordpress-metroresearch.

FHWA (2014), *Nonmotorized Transportation Pilot Program: Continued Progress in Developing Walking and Bicycling Networks – May 2014 Report*, John A Volpe National Transportation Systems Center, USDOT (www.fhwa.dot.gov); at http://1.usa.gov/1KakRWU.

Richard Florida (2013), *America's Most Productive Metros: New Numbers Show The Power Of Energy And Knowledge Economies*, City Lab (www.citylab.com); at http://bit.ly/1PSigCE.

Eben Fodor (2011), *Cost of Infrastructure to Serve New Residential Development in Austin, Texas*, Fodor and Associates (www.fodorandassociates.com); at http://bit.ly/1c1GzAC.

Jonathan Ford (2009), *Smart Growth & Conventional Suburban Development: Which Costs More?* USEPA (www.epa.gov/smartgrowth/sg_business.htm); at http://bit.ly/1EN0Fud.

James Frank (1989), *The Costs of Alternative Development Patterns*, Urban Land Institute (www.uli.org).

Lawrence D. Frank, et al. (2008), "Urban Form, Travel Time, and Cost Relationships with Tour Complexity and Mode Choice," *Transportation* (www.springerlink.com), Vol. 35, pp. 37-54; summary at www.springerlink.com/content/9228326786t53047.

Eric Fruits (2011), "Compact Development And Greenhouse Gas Emissions: A Review Of Recent Research," *Center for Real Estate Quarterly Journal*, Vol. 5/1, Winter; at http://bit.ly/1GuyH7x.

Timothy Garceau, et al. (2013), "Evaluating Selected Costs Of Automobile-Oriented Transportation Systems From A Sustainability Perspective," *Research in Transportation Business & Management*, Vol. 7, July, pp. 43-53; at http://bit.ly/1GkRJgB.

GCEC (2014), "Cities: Engines of National and Global Growth," *Better Growth, Better Climate*, Global Commission on the Economy and Climate (http://newclimateeconomy.net).

Edward L. Glaeser and Matthew G. Resseger (2009), *Complementarity Between Cities And Skills*, National Bureau Of Economic Research (www.nber.org); at www.nber.org/papers/w15103.

Matthew Glans (2009), *Research & Commentary: The Failures of Smart Growth*, Hartland Institute (www.heartland.org); at http://bit.ly/1F6neXo.

Peter Gordon and Harry Richardson (2000), *Critiquing Sprawl's Critics*, Cato Foundation (www.cato.org); at www.cato.org/publications/policy-analysis/critiquing-sprawls-critics.

Larry Hardesty (2013), *Why Innovation Thrives In Cities: Double A City's Population And Its Economic Productivity Goes Up 130 Percent*, MIT News (http://newsoffice.mit.edu); at http://newsoffice.mit.edu/2013/why-innovation-thrives-in-cities-060.

Andrew F. Haughwout (2000), "The Paradox of Infrastructure Investment: Can A Productive Good Reduce Productivity?" *Brookings Review* (www.brookings.edu), Summer, pp. 40-43; at www.brookings.edu/articles/2000/summer_productivity.aspx.

Bill Hillier and Ozlem Sahbaz (2006), *High Resolution Analysis of Crime Patterns in Urban Street Networks: An Initial Statistical Sketch From An Ongoing Study Of A London Borough*, University College London; at www.spacesyntax.tudelft.nl/media/Long%20papers%20I/hilliersahbaz.pdf.

Chang-Tai Hsieh and Enrico Moretti (2015), *Why Do Cities Matter? Local Growth and Aggregate Growth*, National Bureau of Economic Research (www.nber.org); at http://bit.ly/1IIphXE. Also see, "Home Economics: Sky-High House Prices In The Most Desirable Cities Are Holding Back Growth And Jobs," *The Economist*, 4 October 2014; at http://econ.st/1qVWgtr.

IBI (2008), *Implications Of Alternative Growth Patterns On Infrastructure Costs*, Plan-It Calgary, City of Calgary (www.calgary.ca); at http://bit.ly/1zlmnQ0.

ICMA (2014), *Why Smart Growth: A Primer*, International City/County Management Association and the Smart Growth Network (www.smartgrowth.org); at http://1.usa.gov/1Juseua.

John S. Jacob and Ricardo Lopez (2009), "Is Denser Greener? An Evaluation Of Higher Density Development As An Urban Stormwater-Quality Best Management Practice," *Journal of the American Water Resources Association* , Vol. 45, No. 3, pp. 687-701; at http://bit.ly/1IlpgmG.

JRC (2011), *Location Efficiency and Housing Type—Boiling it Down to BTUs*, Jonathan Rose Companies for the U.S. Environmental Protection Agency (www.epa.gov); at www.epa.gov/smartgrowth/pdf/location_efficiency_BTU.pdf.

Elizabeth Kneebone and Natalie Holmes (2015), *The Growing Distance Between People and Jobs In Metropolitan America*, Brookings (www.brookings.edu); at http://brook.gs/1EOA8ei.

Santhosh Kodukula (2011), *Raising Automobile Dependency: How to Break the Trend?,* GIZ Sustainable Urban Transport Project (www.sutp.org); at http://bit.ly/1dnJqWf.

Chuck Kooshian and Steve Winkelman (2011), *Growing Wealthier: Smart Growth, Climate Change and Prosperity*, Center for Clean Air Policy (www.ccap.org); at www.growingwealthier.info.

Joel Kotkin and Wendell Cox (2013), "The Future of the Affluent American City," *CityScape*, Vol. 15, No. 3, pp. 203-207; at www.huduser.org/portal/periodicals/cityscpe/vol15num3/ch14.pdf.

J. Richard Kuzmyak (2012), *Land Use and Traffic Congestion*, Report 618, Arizona Department of Transportation (www.azdot.gov); at http://bit.ly/1FpI0om.

Helen Ladd (1992), "Population Growth, Density and the Costs of Providing Services," *Urban Studies*, Vol. 29, No. 2, pp. 273-295.

Benoit Lefèvre (2009), "Urban Transport Energy Consumption: Determinants and Strategies for its Reduction. An Analysis of the Literature," *SAPIENS* (Surveys and Perspectives Integrating Environment & Society); Vol. 2, No. 3; http://sapiens.revues.org/914.

Jonathan Levine (2006), *Zoned Out: Regulation, Markets and Choices in Transportation and Metropolitan Land Use*, Resources for the Future (www.rff.org).

Jonathan Levine and Lawrence Frank (2007), "Transportation and Land Use Preferences and Residents' Neighborhood Choices: The Sufficiency of Compact Development In The Atlanta Region," *Transportation*, Vol. 34, No. 2, pp. 255-274.

Michael Lewyn and Kristoffer Jackson (2014), *How Often Do Cities Mandate Smart Growth or Green Building?* Mercatus Center (www.mercatus.org), George Mason University; at http://bit.ly/1E44vKc.

Todd Litman (2004), "Impacts of Rail Transit on the Performance of a Transportation System," *Transportation Research Record 1930*, Transportation Research Board (www.trb.org), pp. 23-29; at www.vtpi.org/railben.pdf.

Todd Litman (2006), *Smart Growth Reforms*, VTPI (www.vtpi.org); at www.vtpi.org/smart_growth_reforms.pdf.

Todd Litman (2009), *Where We Want To Be: Home Location Preferences And Their Implications For Smart Growth*, Victoria Transport Policy Institute (www.vtpi.org); at www.vtpi.org/sgcp.pdf.

Todd Litman (2011), "Can Smart Growth Policies Conserve Energy and Reduce Emissions?" Portland State University's *Center for Real Estate Quarterly*, Vol. 5, No. 2, Spring, pp. 21-30; at www.vtpi.org/REQJ.pdf. Also see, *Critique of the National Association of Home Builders' Research On Land Use Emission Reduction Impacts* (www.vtpi.org/NAHBcritique.pdf).

Todd Litman (2012), *Evaluating Criticism of Smart Growth*, VTPI (www.vtpi.org); at www.vtpi.org/sgcritics.pdf.

Todd Litman (2013), "Smarter Congestion Relief In Asian Cities: Win-Win Solutions To Urban Transport Problems," *Transport and Communications Bulletin for Asia and the Pacific*, United Nation's Economic and Social Commission for Asia and the Pacific (www.unescap.org), No. 82, pp. 1-18; at www.unescap.org/ttdw/Publications/TPTS_pubs/bulletin82/b82_Chapter1.pdf. Also see, *Congestion Evaluation Best Practices*, Paper 12, International Transportation Economic Development Conference, 9-11 April 2014, Dallas, Texas; at www.vtpi.org/ITED_congestion.pdf.

Todd Litman (2014), *Analysis of Public Policies That Unintentionally Encourage and Subsidize Urban Sprawl*, Victoria Transport Policy Institute (www.vtpi.org), LSE Cities (www.lsecities.net), for the Global Commission on the Economy and Climate (www.newclimateeconomy.net); at http://bit.ly/1EvGtIN.

Todd Litman (2015), *Evaluating Household Chauffeuring Burdens: Understanding Direct and Indirect Costs of Transporting Non-Drivers*, Transportation Research Board Annual Meeting; at www.vtpi.org/chauffeuring.pdf.

Todd Litman (2015b), *More Critique of Demographia's International Housing Affordability Survey*, Planetizen (www.planetizen.com); at www.planetizen.com/node/73400).

Todd Litman and Steven Fitzroy (2014), *Safe Travels: Evaluating Mobility Management Traffic Safety Impacts*, Victoria Transport Policy Institute (www.vtpi.org); at www.vtpi.org/safetrav.pdf.

Shih-Che Lo and Randolph W. Hall (2006), "Effects of the Los Angeles Transit Strike On Highway Congestion," *Transportation Research A*, Vol. 40, No. 10 (www.elsevier.com/locate/tra), December 2006, pp. 903-917; summary at http://bit.ly/1PuCcjV.

LSE Cities (2014), *Better Growth, Better Climate*, *New Climate Economy* (http://newclimateeconomy.net); at http://newclimateeconomy.report.

William Lucy (2002), *Danger in Exurbia: Outer Suburbs More Dangerous Than Cities,* University of Virginia (www.virginia.edu); summary at http://bit.ly/1Ilpme2.

James M. McElfish (2007), *Ten Things Wrong With Sprawl*, Environmental Law Institute (www.elistore.org/Data/products/d17__02.pdf).

Nancy McGuckin (2009), *Mandatory Travel During Peak Period*, Travel Behavior (http://travelbehavior.us); at http://bit.ly/1JuspFK.

Alanna McKeeman (2012), *Land Use, Municipal Revenue Impacts, and Land Consumption*, Virginia Tech; at www.baconsrebellion.com/PDFs/2013/02/McKeeman.pdf.

Evert J. Meijers and Martijn J. Burger (2009), *Urban Spatial Structure and Labor Productivity in U.S. Metropolitan Areas*, presented 'Understanding and Shaping Regions: Spatial, Social and Economic Futures', Leuven, Belgium, April 6-8; at http://bit.ly/1elyfxr.

Steve Melia, Graham Parkhurst and Hugh Barton (2011), "The Paradox of Intensification," *Transport Policy*, Vol. 18, No. 1, pp. 46-52 (http://bit.ly/1HA76Ax); at http://bit.ly/1JVuicw.

Patricia C. Melo, Daniel J. Graham, and Robert B. Noland (2009), "A Meta-Analysis Of Estimates Of Urban Agglomeration Economies," *Regional Science and Urban Economics*, Vol. 39/3, May, pp. 332-342; at www.sciencedirect.com/science/article/pii/S0166046208001269.

Joseph Minicozzi (2012), *The Smart Math of Mixed-Use Development*, Planetizen (www.planetizen.com); at www.planetizen.com/node/53922.

MLS (2015), *HPI Benchmark Housing Price: Greater Vancouver*, Real Estate Board of Greater Vancouver (www.rebgv.org); at http://creastats.crea.ca/natl/images/natl_chartC03_hi-res_en.png.

Adrian T. Moore, Samuel R. Staley and Robert W. Poole Jr. (2010), "The Role Of VMT Reduction In Meeting Climate Change Policy Goals," Transportation Research A, Vol. 44, pp. 565–574; at http://ntl.bts.gov/lib/35000/35200/35297/TransportationResearchPart_A2.pdf.

Steve Mouzon (2011), "The Costs of Sprawl," *The Original Green* (www.originalgreen.org); at www.originalgreen.org/OG/Blog/Entries/2011/3/8_Costs_of_Sprawl_-_Part_1.html.

Sage R. Myers, et al. (2013), "Safety in Numbers: Are Major Cities the Safest Places in the United States?" *Annals of Emergency Medicine*, American College of Emergency Physicians (http://dx.doi.org/10.1016/j.annemergmed.2013.05.030); at http://bit.ly/1B8Rlvz.

NAHB (2010), *Climate Change, Density and Development: Better Understanding the Effects of Our Choices*, National Association of Home Builders (www.nahb.org); at http://bit.ly/1ETNUcK.

NAHB (2011), *Climate Change: Research Documents*, National Association of Home Builders (www.nahb.org); at www.nahb.org/reference_list.aspx?sectionID=2003.

NAR (2013), *National Community Preference Survey*, National Association of Realtors (www.realtor.org); at http://bit.ly/S7p1tj.

Arthur C. Nelson (2006), "Leadership in a New Era," *Journal of the American Planning Association*, Vol. 72, No. 4 (www.planning.org); at http://bit.ly/1KgQBg3.

NHOEP (2012), *Evaluating The Fiscal Impacts Of Development*, New Hampshire Office of Energy and Planning (www.costofsprawl.org).

NRDC (2010), *Reducing Foreclosures and Environmental Impacts through Location-Efficient Neighborhood Design*, Natural Resources Defense Council (www.nrdc.org); at www.nrdc.org/energy/files/LocationEfficiency4pgr.pdf.

OEP (2012), *Evaluating The Fiscal Impacts Of Development, Part I - Final Report*, New Hampshire Office of Energy and Planning (www.nh.gov/oep); at http://bit.ly/1Ahs5bo.

Randal O'Toole (2008), "Urban Sprawl and Smart Growth," *A Breath of Fresh Air*, Fraser Institute (www.fraserinstitute.org); at http://bit.ly/1QVoZOq.

Randal O'Toole (2012), *Yes, Land-Use Regulation Does Increase Income Inequality*, Cato Institute (www.cato-at-liberty.org); at http://bit.ly/1ejkZJz.

PIP (2009), *Smart Growth: Making the Financial Case*, Public Interest Projects, Presentation to the Sarasota County Board of County Commissioners; at www.box.net/shared/o4a47iy5th.

Alan Pisarski (2009), *ULI Moving Cooler Report: Greenhouse Gases, Exaggerations And Misdirections*, New Geography (www.newgeography.com); at http://bit.ly/1cLFMEt.

Gary Pivo (2013), *The Effect Of Transportation, Location, And Affordability Related Sustainability Features On Mortgage Default Prediction And Risk In Multifamily Rental Housing*, University of Arizona for Fannie Mae (www.fanniemae.com); at http://bit.ly/1FJ9FCR.

Renaissance Planning Group (2012), *Smart Growth And Economic Success: Benefits For Real Estate Developers, Investors, Businesses, And Local Governments*, U.S. Environmental Protection Agency (www.epa.gov); at http://1.usa.gov/1cSFSdF.

Caroline Rodier, John E. Abraham, Brenda N. Dix and John D. Hunt (2010), *Equity Analysis of Land Use and Transport Plans Using an Integrated Spatial Model*, Report 09-08, Mineta Transportation Institute (www.transweb.sjsu.edu); at http://tinyurl.com/mew7ns4.

Emily Ruby (2006), *How Urbanization Affects the Water Cycle*, California Water and Land Use Partnership (www.coastal.ca.gov); at www.coastal.ca.gov/nps/watercyclefacts.pdf.

SGA (2014), *Measuring Sprawl*, Smart Growth America (www.smartgrowthamerica.org); at www.smartgrowthamerica.org/documents/measuring-sprawl-2014.pdf.

SGA and RCLCO (2015a), *The Fiscal Implications for Madison, Wisconsin*, Smart Growth America (www.smartgrowthamerica.org); at http://bit.ly/1PSiARH.

SGA and RCLCO (2015b), *The Fiscal Implications for West Des Moines , Iowa*, Smart Growth America (www.smartgrowthamerica.org); at http://bit.ly/1PC1wVp.

Stantec (2013), *Quantifying the Costs and Benefits to HRM, Residents and the Environment of Alternate Growth Scenarios*, Halifax Regional Municipality (www.halifax.ca); at www.halifax.ca/boardscom/documents/HRMGrowthScenariosFinalReportApril292013.pdf.

Strategic Economics (2013), *Fiscal Impact Analysis Of Three Development Scenarios In Nashville-Davidson County, TN*, Smart Growth America (www.smartgrowthamerica.org); at www.smartgrowthamerica.org/documents/fiscal-analysis-of-nashville-development.pdf.

Carolina Tagliafierro, et al. (2013), "Landscape Economic Valuation By Integrating Landscape Ecology Into Landscape Economics," *Environmental Science & Policy*, Vol. 32, pp. 26-36; www.sciencedirect.com/science/article/pii/S1462901112002286.

Emily Talen and Julia Koschinsky (2013), *Equality of Opportunity Project* (EOP), Arizona State University; at www.equality-of-opportunity.org.

David Thompson (2013), *Suburban Sprawl: Exposing Hidden Costs, Identifying Innovations*, Sustainable Prosperity (www.sustainableprosperity.ca); at http://bit.ly/1iKsf2v.

ULI (2015), *America in 2015:* A ULI Survey of Views on Housing, Transportation, and Community, Urban Land Institute (www.uli.org); at http://on.uli.org/1KY7oC9.

USEPA (2013), *Smart Growth and Economic Success: The Business Case*, U.S. Environmental Protection Agency (www.epa.gov); at www.epa.gov/smartgrowth/economic_success.htm.

VTPI (2006), *Online TDM Encyclopedia*, Victoria Transport Policy Institute (www.vtpi.org).

www.vtpi.org/sg_save.pdf