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Understanding Smart Growth Savings

Evaluating Economic Savings and Benefits of Compact Development

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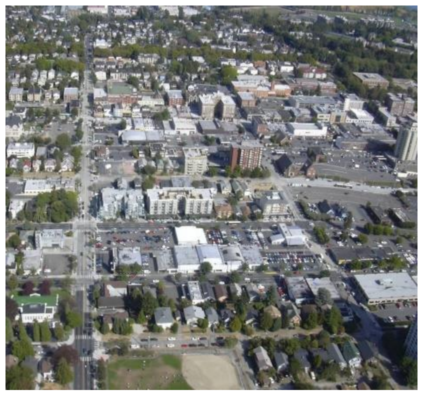
By
Todd Litman
Victoria Transport Policy Institute



Abstract

How communities develop can have many direct and indirect impacts. Smart Growth policies create more compact, multi-modal development which reduces per capita land consumption and the distances between destinations. This, in turn, reduces the costs of providing public infrastructure and services, improves accessibility, and reduces motor vehicle travel, which provides many 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 https://bit.ly/2QqPhzc.

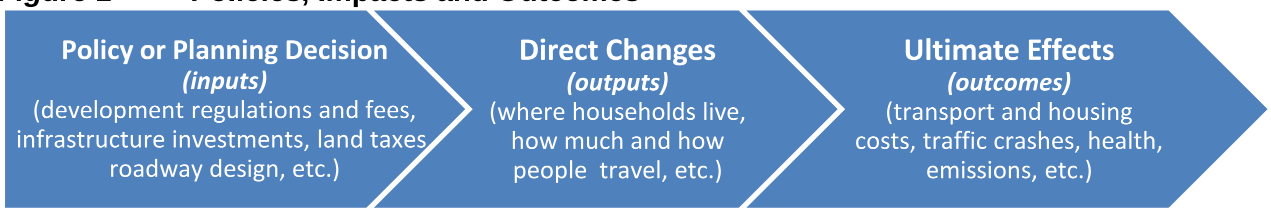
Smart Growth supports compact and efficient building types, such as housing over retail.

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 their community's development pattern, since this touches their hearts. New research helps us understand how specific development policies, such as development regulations, public infrastructure investments, land taxes and roadway design affect economic, social and environmental goals such as transportation and housing costs, crashes, public fitness and health, and emissions.

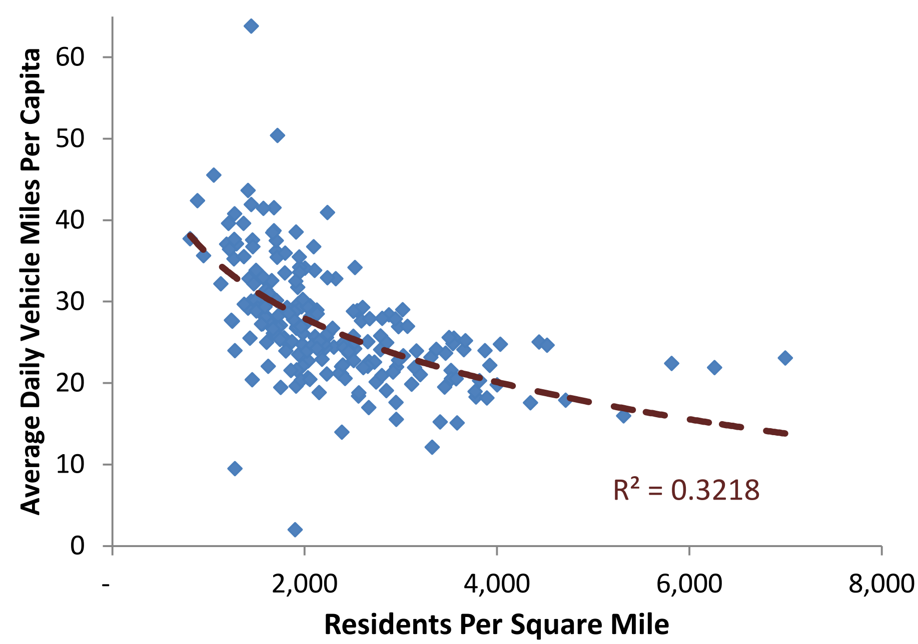
Figure 1 **Policies, Impacts and Outcomes**



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 development and more multimodal transportation systems provide significant savings and benefits. This makes sense because such development is resource efficient; residents consume less land and energy, own fewer vehicles, drive less, require less road and parking infrastructure, and generate less traffic costs. It also tends to be more socially equitable because it expands affordable housing and transport options suitable for physically, economically and socially disadvantaged people.

Figure 2 **Per Capita Vehicle-Miles Versus Population Density** (FHWA 2018, Table HM72)



Per capita vehicle travel tends to decline with urban population density. The largest declines result from increases from low (less than 2,000 residents per square mile, or about 3 per acre) to moderate densities (more than 4,000 residents per square mile or more than 6 per acre).

This actually reflects more than just density. Higher densities are also associated with more mixed development and more multimodal transportation systems.

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 distortions, increasing 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	Sprawl
Growth pattern	Mostly infill (brownfield) development.	Mostly urban fringe (greenfield) development.
Density	Higher-density, clustered activities.	Lower-density, dispersed activities.
Land use mix	Mixed land use.	Homogeneous (single-use, segregated) land uses.
Scale	Human scale. Smaller blocks and roads, more local services, for pedestrian access	Large scale. Larger blocks, wider roads, more regional services, assuming automobile access.
Services (shops, schools, parks)	Local, distributed, smaller. Accommodates walking access.	Regional, consolidated, larger. Requires automobile access.
Housing types	Diverse, including compact housing types such as townhouses an d apartments.	Primarily single-family housing.
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 intermodal connections.
Parking supply	Lower parking supply, higher parking prices	Parking facilities are abundant and usually unpriced
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 set of general principles that can be applied in many 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 transit stations (Prince's Foundation 2020; SGN 2011). 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 infill in existing neighborhoods, but in growing cities it can consist 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 geographic constraints, a major portion of households can live in single-family or adjacent (townhouses), and many can own or share cars (Litman 2014).

The figures below illustrate typical examples of Smart Growth and sprawl (Hartzell 2013).

Figure 3 **Sprawl and Smart Growth Illustrated**

Smart Growth

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.

Sprawl

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. During the last century, many public policies encouraged sprawl and automobile dependency (Table 2).

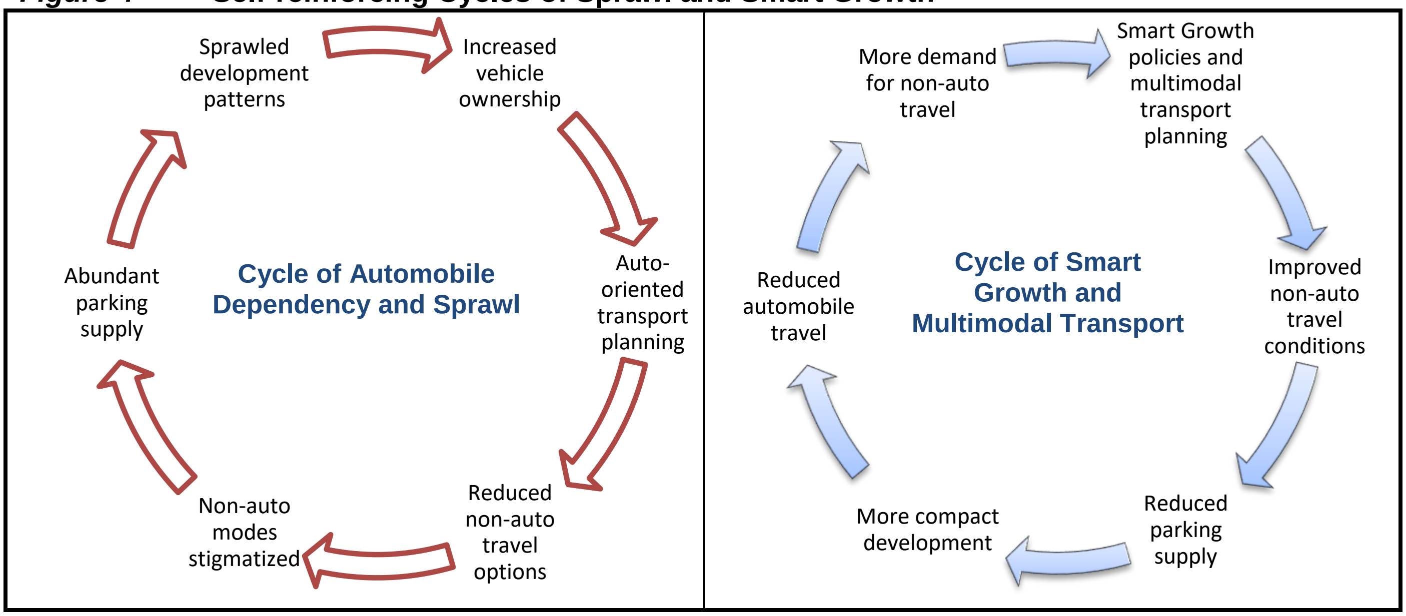
Table 2 **Sprawl-Encouraging Market Distortions** (Litman 2014)

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, multimodal development.

Together 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), which create a virtuous cycle of more compact development and more multimodal transportation systems. Although individual policies may seem to have modest impacts, their effects are cumulative and synergistic (total impacts are greater than the sum of their individual impacts) so an integrated program that allows more compact development, reduces parking minimums, and improves non-auto travel can have large impacts and benefits.

Figure 4 **Self-reinforcing Cycles of Sprawl and Smart Growth**



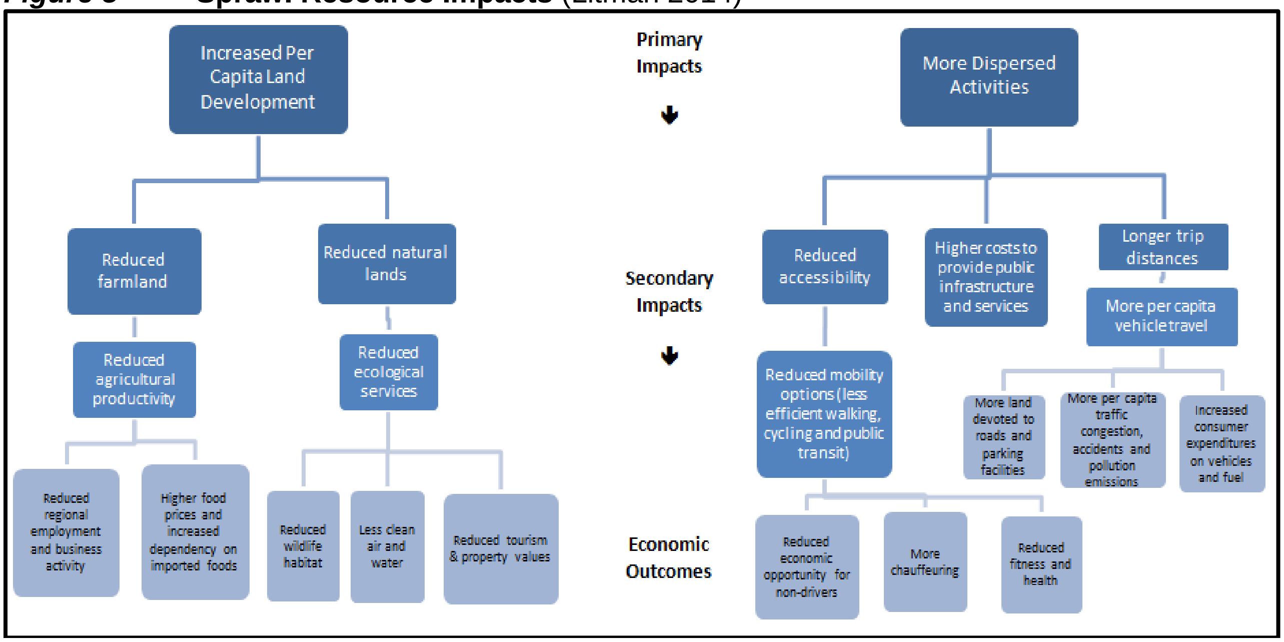
Many current public policies contribute to a self-reinforcing cycle of automobile dependency and sprawl. Smart Growth development policies support a self-reinforcing cycle of compact development and multimodal transportation planning.

New analysis tools, such as the **Housing and Transportation Affordability Index** (https://htaindex.cnt.org), **Smart Location Mapping** (www.epa.gov/smartgrowth/smart-location-mapping), and **Street Smart** (www.thinkstreetsmart.org) provide practical guidance for evaluating multimodal accessibility, and therefore for measuring Smart Growth impacts (Sundquist, McCahill and Brenneis 2021).

Sprawl Costs and Smart Growth Benefits

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 travel 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 productivity, 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 below. 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 5 **Sprawl Resource Impacts** (Litman 2014)



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) these impacts (Ahlfeldt and Pietrostefani 2017 and 2019; Borys 2017; Burchell and Mukherji 2003; Ewing and Hamidi 2014; FBCI and SGA 2021; Litman 2014; NCE 2018; NHOEP 2012). These 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.

Major sprawl cost studies are summarized below:

- The British Columbia *Community Lifecycle Infrastructure Costing Tool* (https://tinyurl.com/2c8efrvt) estimates the lifecycle costs of different development patterns considering density, location, design, and other factors.

- The report, *The High Costs of Sprawl* (Environmental Defense 2013) identified various external costs of sprawl including greater open space and farmland losses, infrastructure costs, driving, health problems and pollution emissions. It concluded that most development fees fail to reflect the full incremental costs of sprawl, resulting in taxpayers subsidizing sprawled development. It argues that these subsidies and external costs are unfair.

- *El Costo de la Expansión Urbana en México* (*The Cost of Urban Expansion in Mexico*) calculated the additional housing, infrastructure and transportation costs of auto-dependent, urban fringe development (Zubicaray, et al. 2021). If found that sprawl costs exceed 1% of Mexico's annual GDP, and are unfair to lower-income workers who experience less access to jobs and service, and higher transport costs. The researchers conclude that the current development model is not financially sustainable, and recommend reforms to achieve economic and social goals.

- *The Costs of Sprawl – 2000* (Burchell, et al. 2002; Burchell and Mukherji 2003), for the Transportation Research Board (a division of the U.S. National Academy of Sciences) evaluated the following sprawl impacts:
  - Urban development of farm and wild lands.
  - Water and sewage infrastructure.
  - Local road and public services costs
  - Increased vehicle travel and associated costs.
  - Residents' quality of life.
  - Real estate development costs.

  This study monetized some impacts and estimated the potential net savings of growth management. A managed growth scenario shifts development from rural to urbanized counties, increases densities 20%, and the portion of households in attached (townhouse) and multi-family (apartment) by 25%. This would reduce land consumption 21%, local road lane-miles 10%, 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 policies (most new housing would still be single-family) and so represents lower-bound Smart Growth savings.

- The report, *Suburban Sprawl: Exposing Hidden Costs, Identifying Innovations* (SP 2013), compared public costs that tend to increase with sprawl (construction and maintenance of roads, sewers, water, community centers, fire protection, policing, and school busing) with tax revenues. It concluded that incremental revenues rarely cover the full incremental costs. It also discussed various economic and social benefits of more compact development.

- *Analysis of Public Policies that Unintentionally Encourage and Subsidize Sprawl* (Litman 2014), for the London School of Economic's Cities Program, quantified various economic impacts of sprawl. It divided U.S. cities into density quintiles (fifths) and estimated the additional land consumption, public service, transport, and health costs of 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 identified various market distortions that increase sprawl.

- *Zoned In: Economic Benefits & Shared Prosperity with Form-Based Codes*, a major study by the Form-Based Codes Institute and Smart Growth America, uses qualitative and quantitative analyses, including trends in land values, tax revenues, rents, and demographics, to assess how form-based codes, which support more compact, multimodal development, affect communities' economic performance. The results indicate that by supporting Smart Growth development, form-based codes tend to improve economic outcomes, and provide positive equity impacts.

- Using fine-grained travel data generated by mobile telephones, Tomer, Kane and Vey (2020) found that average trip distances vary from less than 4 miles in older, more compact and multi-modal urban neighborhoods to more than 10 miles in sprawled, automobile-dependent locations.

- A detailed academic study by Talen and Koschinsky (2014) found that residents of compact, walkable, diverse neighborhoods benefit from improved health, safety and community cohesion.

- The report, *Rationale for Smart Growth Fiscal Impact Analysis and Model Fiscal Impact Assessment Ordinance* (Nelson, Nicholas and Juergensmeyer 2022), provides detailed guidance for calculating the incremental costs of sprawled development, and for incorporating this information into public policies.

- Ewing and Hamidi's 2014 report, *Measuring Sprawl*, calculated a compactness index score for 221 U.S. metropolitan areas and 994 counties reflecting 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 table below summarizes their 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 and injuries per 100,000 population	0.4% to 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*	4.1% increase
Transportation affordability	3.5% lower transport costs relative to income
Housing affordability	1.1% higher housing costs relative to income.

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

** Upward mobility refers to the probability that a child born in the lowest income quintile reaches the top quintile by age 30.*

- A detailed study for Halifax, Nova Scotia (Stantec 2013) found that a compact development scenario that increased the portion of new housing located in existing urban centers from 25% to 50% reduced infrastructure and transportation costs approximately 10%, and helped improve public health and reduced pollution emissions.
- Ahlfeldt and Pietrostefani 's (2017 and 2019) analysis of 300 academic papers concerning urban form impacts found that 69% identify positive effects associated with compact urban form: over 70% attribute positive effects of economic density (the number of people living or working in an area), 58% attribute positive effects to land use mix, and 56% attribute benefits to urban density. They also identify congestion, health, and well-being costs that can result from higher urban densities, and so recommend mitigation policies that maximize benefits and minimize costs, to ensure efficient and equitable access to housing, services, and jobs in compact cities.
- The report, *Urban Land Use Reform: The Missing Key to Climate Action* (Holland, et al. 2023) analyzed the impacts of Smart Growth development policies (upzoning, reduced parking mandates, faster project approvals, etc.) on three typical North American cities: Austin, Texas, Charlotte, North Carolina and Denver, Colorado. The table below summarizes the results.

Table 5 **Smart Growth Policy Impacts** (Holland, et al. 2023)

	Austin	Charlotte	Denver	Average
Vehicle travel reductions	12%	8%	13%	11%
Building energy savings	16%	4%	7%	9%
Reduced per capita water consumption	17%	12%	10%	13%
Reduced per capita land consumption	53%	69%	82%	68%
Greenhouse gas emission reductions	14%	5%	8%	9%
Carbon sequestration (1,000 annual tonnes)	200	33	48	94

Smart Growth development policies can provide significant reductions in vehicle travel, building energy, water and land consumption, greenhouse emissions, and more greenhouse gas sequestration due to greenspace preservation.

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 overlook some impacts.

Criticisms. Critics argued that some studies exaggerate sprawl costs, and any costs 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.

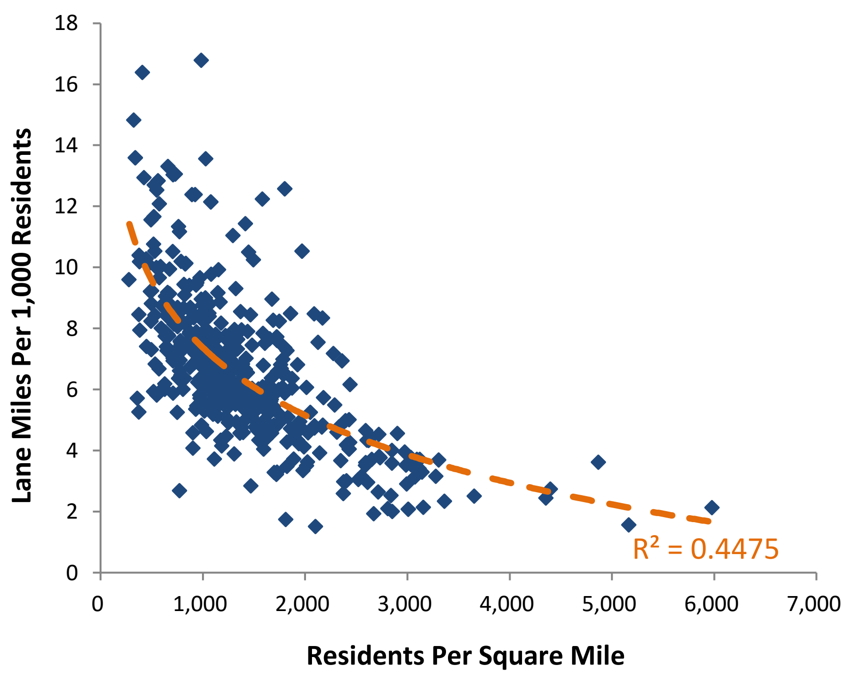
Specific Smart Growth Savings and Benefits
This section describes various categories of Smart Growth savings and benefits.

Open Space Preservation
Land is a scarce and valuable resource. Development often displaces and disturbs *open space* such as farmland, wetlands, parks, forests, and culturally significant 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 (Harnik and Welle 2009; Hawkes 2016; Weller 2018). In addition to direct impacts, development often has indirect impacts, called the *urban shadow*, that disrupt farming activities, wildlife habitat, and groundwater quality on nearby properties.

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), which together reduce total road and parking land requirements.

The figure below 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 6 **Urban Density Versus Roadway Supply** (FHWA 2012, Table HM72)



As urban densities increase, roadway supply declines. This reduces 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). By reducing per capita vehicle travel and allowing more sharing of parking facilities, Smart Growth can significantly reduce per capita pavement area (Litman 2019).

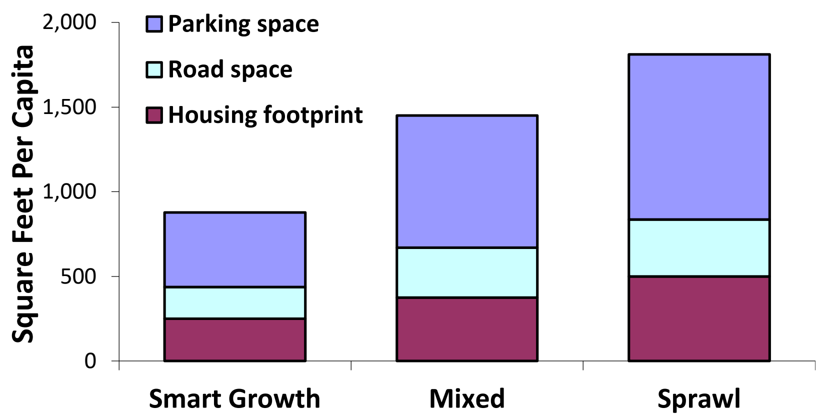
Table 6 **Per Capita Impervious Surface Area** (As Noted In Text)

	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 7 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 7 **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. They estimate that doubling suburban densities from 4 to 8 dwelling units per acre significantly reduces pollutant loadings, and higher densities outperform most 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.

Analysis by Sorensen, et al. (2018) found that, between 1992 and 2012, 62% of all U.S. urban development occurring on farmland, and expanding urban areas accounted for 59% of U.S. farmland losses. Of this, low-density residential development, with new houses built on one- to 20-acre parcels, accounted for 41% of these losses. 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.

Analysis by researchers Bigelow, Lewis and Mihiar (2022) measured factors that affect urban expansion into undeveloped areas in the U.S. They found that urbanization of undeveloped urban fringe lands was four times higher between 1980 and 2000 than during the 2000–2015 period, despite relatively constant population growth. They estimate that the widespread shift in land development rates preserved 7 million acres, roughly half of which would have come from conversions of forested lands. Their analysis concludes that increase in in urban fringe development during the last two decades of the 20th century was driven by declining real gas prices (an important component of commuting costs) and, to a lesser extent, rising incomes. Since 2000, however, income growth has been stagnant while gas prices have risen sharply, and we find that the latter has played a larger role in shaping the recent shift towards denser development. They conclude that this indicates how transportation policies can affect forest and agricultural land displacement.

Some studies have valued open space (EDRG 2007; McConnel and Walls 2005; Tagliafierro, et al. 2013). The box below ranks the external benefits of various land uses. Impervious surfaces such as buildings, parking lots and roadways generally provide the least environmental benefits, and they increase stormwater management costs and heat island effects (higher ambient temperatures from sunlight).

External Values Ranked (McConnel and Walls 2005) Shorelands and wetlands such as lake and marshes. Unique natural and cultural lands such as forests, deserts and heritage sites Farmlands Parks and gardens Lawns 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.*

Table 7 summarizes one estimate of various economic, social and environmental values of openspace in Washington State's Puget Sound region. Many are indirect, and so tend to be undervalued by stakeholders. For example, area residents may be unaware that openspace reduces disaster risks, maintains water quality and supports local industries.

Table 7 **Puget Sound Openspace Values** (Chadsey, Christin and Fletcher 2015)

	Low Range		High Range	
	Total (m)	**Per Acre**	**Total (m)**	**Per Acre**
Aesthetic (perceived beauty and higher property values)	$2,294	$655	$9,510	$2,717
Air quality protection	$422	$121	$529	$151
Food production (farm and aquaculture)	$13	$4	$86	$25
Shelter (wildlife habitat)	$74	$21	$111	$32
Water quality and percolation	$63	$18	$1,925	$550
Health (exercise and mental health)	$41	$12	$50	$14
Play (outdoor recreation and related industries)	$2,633	$752	$4,133	$1,181
Disaster mitigation (e.g., flood protection)	$1,860	$532	$4,194	$1,199
Raw materials (lumber, stone, etc.)	$23	$7	$155	$44
Waste and pollution transformation	$4,034	$1,153	$4,569	$1,306
Totals	*$11,458*	*$3,274*	*$25,264*	*$7,219*

This study indicates that openspace provides diverse economic, social and environmental benefits.

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.

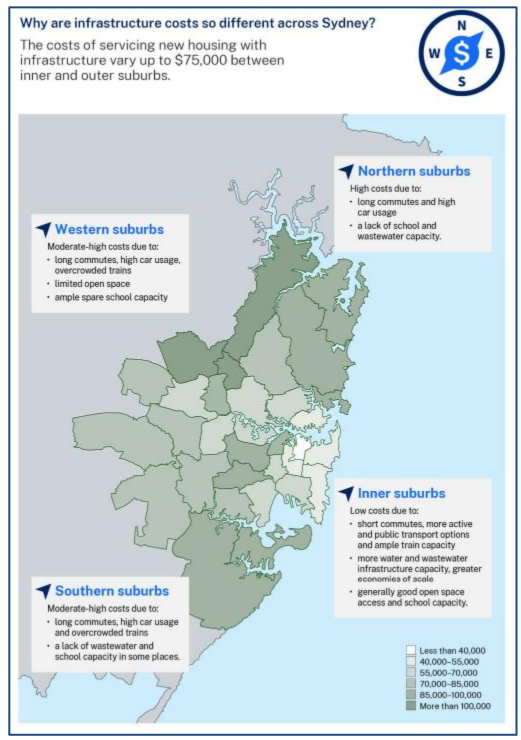
Cities are often located in areas with high valuable farmlands and unique natural lands such as river deltas, shorelines and forests; farmlands in Idaho and Kansas are not substitutes for farmlands in California or Vermont, and environmental lands in Texas and Ohio are not substitutes for shorelines 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. 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 accept lower public service quality, such as unpaved roads and volunteer fire departments, and provide many of their own utilities (well water, septic systems, garbage disposal, etc.), but sprawl tends to attract residents who demand urban quality services in dispersed locations, despite higher costs. 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 costs and relatively modest Smart Growth policies, such as more compact single-family development without substantial shifts to multi-family housing.



- A study by the New South Wales Productivity Commission, *Building More Homes Where Infrastructure Costs Less* (NSW 2023) calculated that in Sydney, public infrastructure costs per home vary from less than $40,000 in central neighborhoods to more than $100,000 in outer suburbs, as illustrated to the right, so infill infrastructure typically costs approximately $40,000 less per property than greenfield, reflecting lower unit costs for transport, utilities, education, health care and emergency services.

- A study by Mattson (2021) found that the construction and operating costs of municipal streets and highways, emergency services (expect police operations), parks and recreation, water, sewage and solid waste management tend to decline with density.

- Goodman (2019) analyzed separately the effects of development density and sprawl on the costs of providing public services. The study found that increased density slightly increases some public costs, but this effect is small compared with the costs of sprawl, which increases per capita costs for education, fire services, police protection, and sewerage. Increasing a city's density from the 25th to the 50th percentile ranking increases annual per capita expenditures by $5, but reducing its sprawl ranking from the 50th to the 25th percentile reduces per capita annual expenditures by $61.

- *Building Better Budgets: A National Examination of the Fiscal Benefits of Smart Growth* (SGA 2013) found that Smart Growth development typically reduces public infrastructure construction costs by a third and ongoing public services costs by 10%.

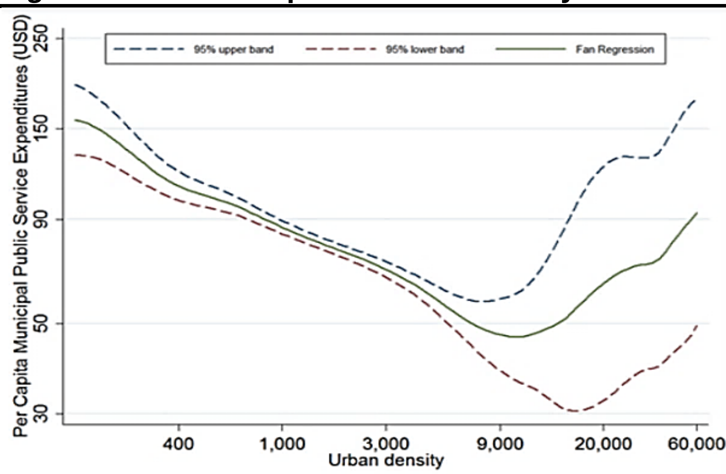
- Burchell and Mukherji (2003) found that sprawl increases local road lane-miles 10%, annual public service costs about 10%, and housing development costs about 8%, increasing total costs an average of $13,000 per dwelling unit, or about $550 in annualized costs.

- A Charlotte, North Carolina study found that neighborhoods with low densities and disconnected streets require four times the number of fire stations at four times the cost compared with more compact and connected neighborhoods (CDOT 2012).

- Fernández-Aracil and Ortuño-Padilla (2016) found that each 1% increase in compact population is associated with a 0.217% per capita decrease in public service costs in Spanish urban areas.

- Analyzing municipal budgets in 8,600 municipalities of Brazil, Chile, Ecuador and Mexico, de Duren and Compeán (2015) found that low-density development approximately triples per capita expenditures on public service, with the greatest efficiencies at approximately 90 residents per hectare (figure below). This justifies policies that encourage densification, particularly in medium-sized cities.

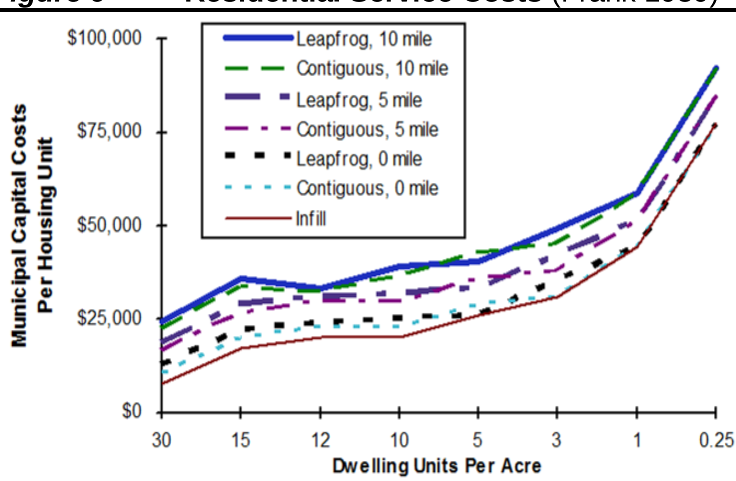
Figure 8 **Municipal Service Costs By Urban Density** (de Duren and Compeán 2015)



All else being equal, the annual costs of providing public water, sewage, garbage collection by municipal governments in Brazil, Chile, Ecuador, and Mexico range from more than $150 in very low density areas to about $50 per capita.

- 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 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.
- Figure 8 illustrates the results of a study showing that municipal infrastructure costs tend to decline with density and are lowest for infill development.

Figure 9 **Residential Service Costs** (Frank 1989)



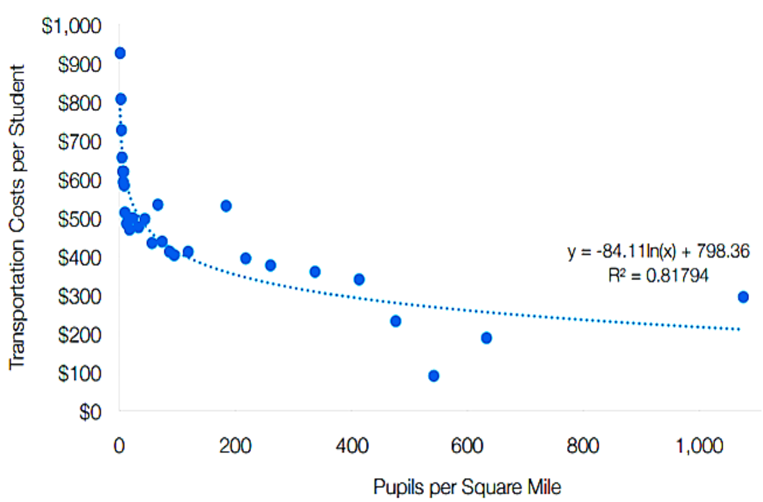
The costs of providing public infrastructure, including roads, utilities and schools, tends to be much lower for compact, infill development, providing hundreds of dollars in annual savings per capita compared with sprawl.

The City of Calgary (2016) developed cost-based development fees using detailed and transparent accounting of infrastructure costs, such as new water and sewage lines, roadway improvements and other public services. The resulting fees are significantly higher in sprawled locations to reflect the higher costs of providing public infrastructure and services there. Fees range from $2,593 per multi-unit unit, $6,267 for a single family home, and $422,073 to $464,777 per hectare in suburban areas.

Fiscal impact analysis evaluates how the incremental public service of development compare with their incremental tax revenues (Fodor 2011). The report, *Rationale for Smart Growth Fiscal Impact Analysis and Model Fiscal Impact Assessment Ordinance* (Nelson, Nicholas and Juergensmeyer 2022) provides guidance for calculating fiscal impacts of a particular development, taking into account Smart Growth related geographic and design factors that affect public costs.

A study for the City of Madison, Wisconsin investigated how these 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). The figure below illustrates how school transportation costs tend to decline with increased population, due to reductions in the need to provide school bus services.

Figure 10 **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.
- Sprawled area households 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, and their public services are often lower quality, such as unpaved roads and volunteer fire departments. 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.
- 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, their 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 and Resilience

Affordability refers to households' ability to purchase *basic* (or *essential*) goods such as food, housing, transportation and healthcare. Economic resilience refers to households' ability to respond to unexpected financial stresses. Affordability and resilience are primarily issues for lower-income households, which often struggle to afford basic goods and pay bills. Smart Growth can affect affordability in several ways, as summarized in Table 8. 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. By increasing retail agglomeration efficiencies and competition, larger and more connected urban development tends to reduce consumer costs (Handbury and Weinstein 2014). It can also increase some household costs including land prices and some infrastructure costs such as curbs and sidewalks.

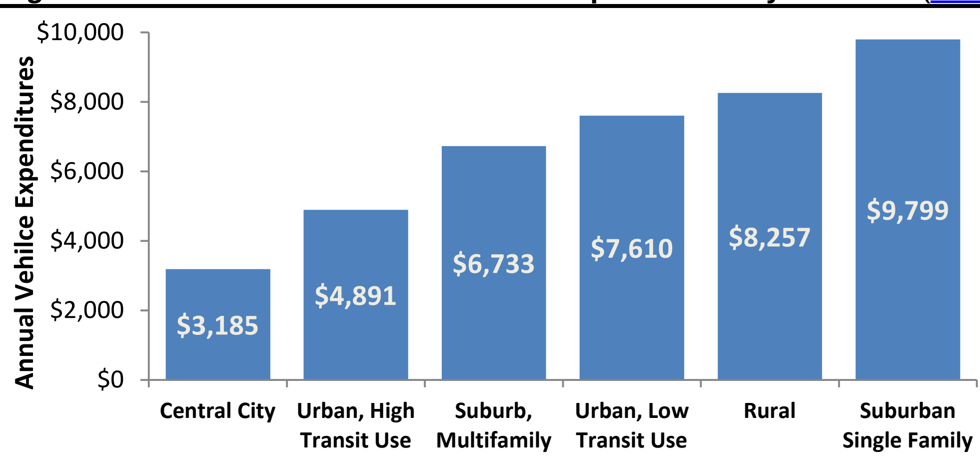
Table 8 **Smart Growth Household Affordability Impacts**

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. Reduces costs of many consumer goods.	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 to own and operate automobiles, and associated costs (Burda and Singer 2015). Cervero and Arrington (2008) and Schneider, Handy and Shafizadeh (2014) found that households in Smart Growth neighborhoods own fewer vehicles and generate fewer vehicle trips than they would in automobile-dependent, sprawled areas, providing large savings. Travel survey data indicate that central city households spend about a third as much on vehicles as suburban residents (Figure 10).

Figure 11 **Household Motor Vehicle Expenditures by Location** (Salon 2014)



Urban residents spend far less on vehicles than in suburban and exurban areas. (This analysis assumes that suburban and rural drivers pay 45¢ and urban drivers 50¢ per vehicle-mile on average.)

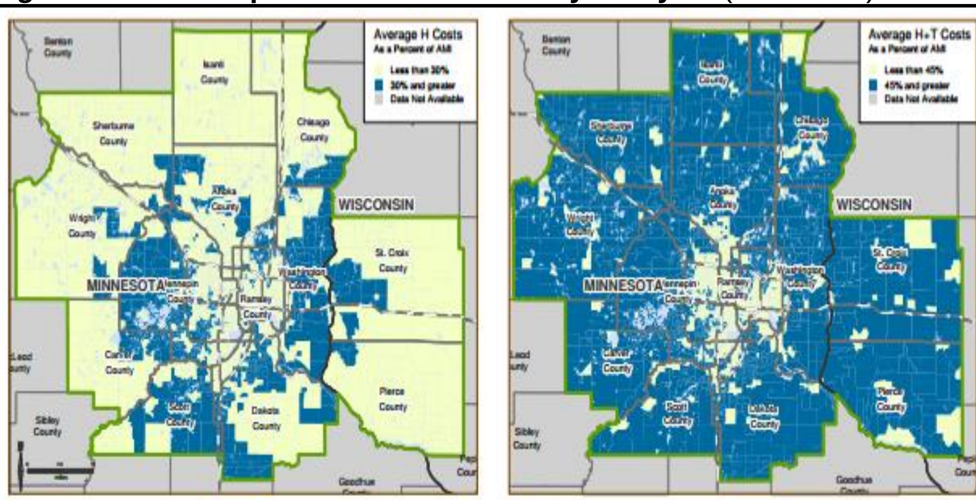
A detailed study, *Travel Demand Management: An Analysis of the Effectiveness of TDM Plans in Reducing Traffic and Parking* measured trip generation at nine typical office buildings in the Minneapolis-St. Paul metropolitan region. It found that office buildings that implemented TDM plans generate, on average, 34% to 37% less traffic and need 17% to 24% fewer on-site parking spaces than Institute of Transportation Engineers' predicted rates. Similarly, Similarly, the study, *Don't Underestimate Your Property: Forecasting Trips and Managing Density over the Long Term* (Galdes and Schor 2022), found that 13 residential and commercial developments with TDM programs actually generate 63% fewer trips than trip generation models predict, more than double the targets. As one traffic engineer explained,

> "Underestimating trip generation can have deleterious effects on a neighborhood because trip generation is so closely linked to the amount of square footage that a property is allowed. More than any other feature of a development, vehicle trip generation estimates determine density limits and impacts." (Mike Workosky, traffic engineer and President of Wells + Associates)

These vehicle and infrastructure cost savings are partly offset by additional transit expenditures but still result in thousands of dollars in average net savings (CNT 2006; Makarewicz, et al. 2008) and *potential* savings are probably even greater since transit-oriented locations allow residents to further reduce their transport expenses if needed due to a vehicle failure, reduced income or other factors. These potential savings increase household's disposable income, particularly for low-income households (Bouzarovski and Herrero 2017; Liddell and Morris 2010).

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, et al. 2013). 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 savings ranging 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 11).

Figure 12 **Comprehensive Affordability Analysis** (CNT 2010)



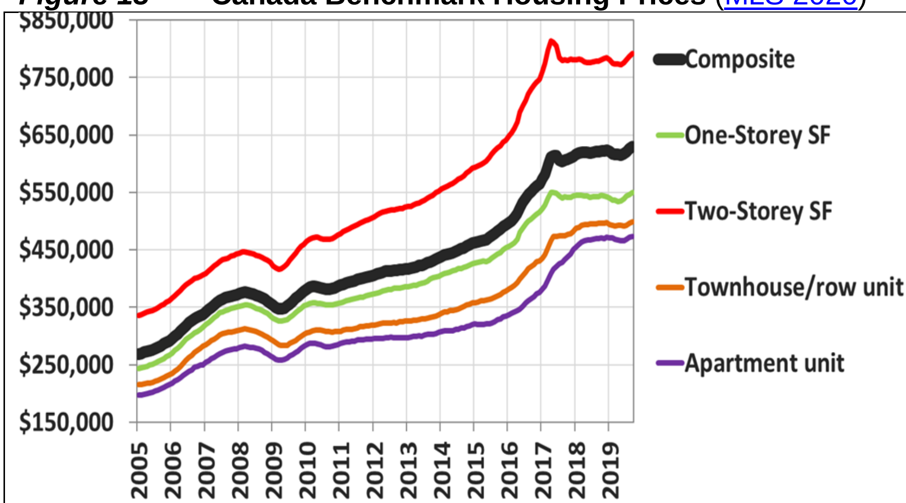
Sprawled areas tend to have lower housing costs but higher transportation costs. Smart Growth areas tend to be more affordable overall, considering total housing and transportation costs, and many Smart Growth policies can further increase affordability by supporting lower-priced housing development, 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 resilience, that is, they are better able to respond to unexpected economic stresses such as reduced incomes or additional financial burdens (Chakraborty and McMillan 2018; Gilderbloom, Riggs and Meares 2015; NRDC 2010; Pivo 2013; Rauterkus, Thrall and Hangen 2010; Won, Lee and Li 2017; Wang and Immergluck 2019; Welch, Gehrke and Farber 2018).

Criticisms. Critics 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.
- 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). For15b 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 below, 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 13 **Canada Benchmark Housing Prices** (MLS 2020)



Because they require more land and have higher construction costs, single family homes typically cost a third more than townhouses and twice as much as apartments, particularly in cities with high land prices. As a result, policies that favor development of single family over compact housing types reduce affordability.

- Academic studies indicate that land use regulations increase housing costs (Gyourko, Summers and Saiz 2008); 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 development density and mandate parking supply (Glaeser and Gyourko 2008; Manville 2010). 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, Gyourko, Summers and Saiz (2008), found positive correlations 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 those studies actually found that sprawl-inducing restrictions on density and building height contribute most to housing price increases, and these restrictions tend to be greatest in sprawled, suburban areas. Smart Growth reduces these regulations and their costs.

- 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. High housing price cities tend to be geographically constrained so it is infeasible for grow based on large-lot, single-family houses. 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 (More Independent 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 7.

Table 9 **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 highways with abundant parking, 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.

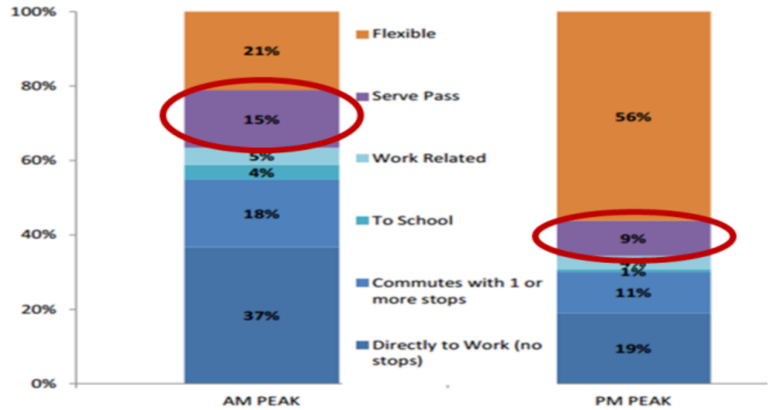
Although individual policies typically reduce only a few percent of total vehicle travel, integrated Smart Growth programs often reduce per capita vehicle ownership and use by 20-50% (Cervero and Arrington 2008; CARB 2010-2014). Improving transportation options tends to increase overall transport system 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.

Non-Auto Travel Demands (Litman 2022)

- 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 vehicle traffic 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), as illustrated below.

Figure 14 **Vehicle Travel in AM and PM Peak Periods** (McGuckin 2009)



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).

Frederick, Riggs and Gilderbloom (2017), analyzed the relationships between commute mode diversity (CMD, the portion of commuters who use non-auto modes, which ranges from 11% to 36%) as an indicator of a multimodal community, and public health and quality of life indicators for various mid-size U.S. cities and counties. Accounting for various demographic factors, they found statistically strong relationships between modal diversity and positive public health outcomes including healthier behaviors reported in the Gallup/Healthway's Well-Being Index, more leisure quality reported by Sperling's Cities Ranked and Rated, more access to exercise reported by the Environmental Systems Research Institute, less sedentary living and obesity reported in the Center for Disease Control's Diabetes Interactive Atlas, more Years of Potential Life Lost (an indicator of longevity and overall health), and higher birth weights (an indicator of infant health) reported by the National Center for Health Statistics. These relationships are stronger than many other sociological, geographical, and economic indicators including density, latitude, race, education and income, suggesting that living in a more multimodal community provides significant health benefits.

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 Travel Time 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 and travel time (Cortright 2010; Litman 2013; Melia, Parkhurst and Barton 2011; Millward and Spinney 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, indicated by the Travel Time Index, which measures the reductions in vehicle traffic speeds during peak periods, but lower *congestion costs* (fewer hours of annual delay per capita) due to lower automobile mode shares and shorter trip distances. More sprawled, automobile-oriented cities such as Houston, Atlanta and Detroit tend to have less intense congestion but higher congestion costs, and residents spend more total time travelling. As a result, compact cities rank worse if evaluated by congestion intensity but better if evaluated by congestion costs, as shown in the following table.

Table 10 **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 evaluating optimal transport system improvements. By dispersing destinations and favoring automobile travel, 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. One study found that in typical urban conditions, a percentage increase in development density increases overall accessibility ten times more than the same percentage increase in vehicle traffic speeds (Levine, et al. 2012).

Regardless of how it is measured Smart Growth summarized in Table 11 can help reduce congestion costs. Ewing, Tian, and Lyons (2017) used various datasets to measure how compact development affects congestion costs. They found that more compact development reduces per capita vehicle travel but also concentrates the driving in smaller areas. The former effect is slightly larger than the latter, and the relationship between compactness and congestion measured using the Travel Time Index, falls short of statistical significance. This suggests that, under typical North American conditions, the congestion reduction benefits of reduced vehicle travel approximately offset the more concentrated traffic, resulting in no net increase in congestion intensity and tends to reduce per capita congestion costs. 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 residents of higher-density neighborhoods averaged 36% shorter commute trips and 25% shorter shopping trips than in sprawled areas.

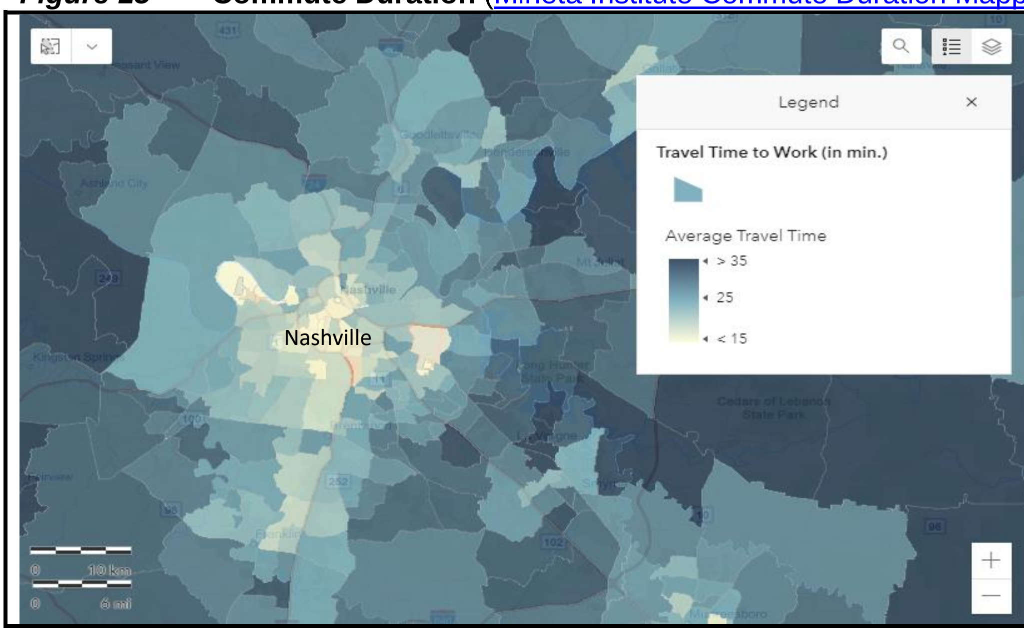
Table 11 **Smart Growth Congestion Reduction Strategies** (Litman 2013)

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.

Even if alternative modes only carry a minor portion of *total* regional travel, their mode shares tend to be much higher on congested corridors, and so can provide significant congestion reduction impacts. For example, although Los Angeles had only 11% transit commute mode share, it 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.

Figure 15 **Commute Duration** ([Mineta Institute Commute Duration Mapping System](#))



Average commute duration (minutes per commute) are generally much higher in automobile-oriented, urban fringe areas than in central neighborhoods.

This figure shows this effect in Nashville, Tennessee, using US Census Data. Similar patterns are seen in most cities.

Smart Growth is particularly beneficial if transportation system performance is evaluated based on the total travel time rather than just congestion delay. Although transit-oriented cities often have longer average commute duration than sprawled, automobile-dependent cities (transit trips often takes longer than driving to the same destination including access and waiting time; and buses often operate in mixed traffic), but 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), making central locations attractive to people with high values of time (Edlund, Machado and Sviatchi 2015).

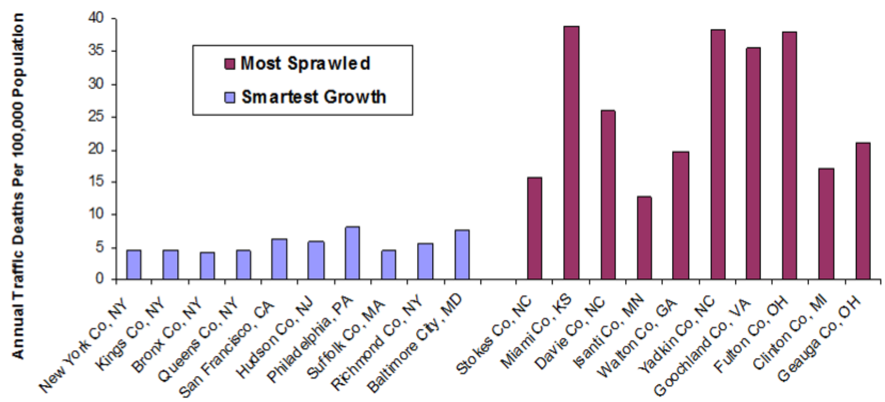
In a detailed study of travel activity in Halifax, Canada, Millward and Spinney (2011) found that the total amount of time people spend travelling declines with compact development, despite the fact that urban areas have slower traffic speeds and residents rely more on slower modes (walking, bicycling and public transit). This indicates that travel distance, and therefore the dispersion of destinations, is more important than speed in determining total travel time costs. They found that total average time spent travelling increased from 92 daily minutes for urban residents, 94 daily minutes for suburban residents, 107 daily minutes for closer exurban and 104 for the most distant exurban residents. Mean one-way commute durations increased from 12.7 minutes in the inner city, 15.7 minutes in suburbs, 18.1 minutes for closer exurbs and 21.9 minutes for the most distant areas. Urbanites spend more time walking, bicycling, and using transit, and a smaller proportion of travel time in cars: inner-city respondents average only 56 minutes per day in a car (45 as driver, 11 as passenger), whereas suburbanites average 72 minutes, and exurban residents average 85 to 91 minutes. Average daily time devoted to active travel (walking and bicycling) declined from 27.8 in urban areas, 16.5 in suburbs, 13.7 for closer exurbs and 13.2 in outer exurbs.

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 methods and data sets indicate that Smart Growth reduces traffic deaths and injuries (Ahangari, Atkinson-Palombo and Garrick 2017; Ewing, Hamidi and Grace 2016). Figure 15 illustrates one study's results.

Figure 16 **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.

Economic Opportunity and Resilience

Improving affordable housing and transportation options tend to provide large benefits to physically, economically and socially disadvantaged people (Jaffe 2016). This can significantly increase their economic opportunity by improving access to education, employment and services (Ewing, et al. 2016; Glaeser, Kahn and Rappaport 2008; Levy, McDade and Dumlao 2010; Otero, Volker and Rozer 2021; Sisson 2018), particularly for lower-income children (Agnello 2020) and adult non-drivers (Kneebone and Holmes 2015).

The Equality of Opportunity Project investigated geographic factors affect *upward mobility*, the chance that a child born in poverty will become more economically successful as an adult (Chetty, et al. 2014; Cortright 2018). Using this data set and accounting for other factors, Ewing and Hamidi (2014) found that each 10% increase in their Smart Growth index is associated with a 4.1% increase in residents' upward mobility. Chetty, et al. (2022) found that *economic connectedness*, the share of high socioeconomic status (SES) friends among individuals with low SES, is among the strongest predictors of upward income mobility identified to date, indicating that economically disadvantaged children benefit significantly by growing up in mixed-income communities. Using different research methods, Chyn (2016) found that children who left concentrated poverty neighborhoods are 9% (4 percentage points) more likely to be employed as adults relative to their non-displaced peers, and have $602 higher average annual earnings – a 16% increase.

Talen and Koschinsky (2013) found strong correlations between neighborhood accessibility (based on WalkScores) and economic mobility; a child born to the bottom fifth income group in a walkable neighborhood has a much better chance of becoming financially prosperous than if born in a sprawled, automobile-dependent area. Similarly, using income and travel data for more than three million Americans, Oishi, Koo and Buttrick (2018) found that employment and income disparities between workers who could and could not drive was much smaller in more walkable cities, indicating that walkability is particularly important for non-drivers. They also found that as neighborhood workability increased residents' sense of community belonging. Frederick and Gilderbloom (2018) found that increased commute mode diversity (smaller automobile mode shares) is associated with less income inequality between races and genders, and higher earnings for white women and African-American men.

Ganong and Shoag (2017) find that regional income convergence (the tendency of incomes in poor and rich economies to equalize) declined in the U.S., in part, due to high housing prices that reduce workers ability to move to higher wage regions. Historically, both high- and low-skilled workers migrated from low- to high-wage states, which reduced wage imbalances, but since the 1980s, migration and income convergence declined, partly due to differences in housing costs. Increased land use regulation since 1965 made it more difficult for developers to build new housing, increasing housing prices in more successful regions, which is particularly detrimental to lower-wage workers, preventing them from moving to higher-wage states, since their remaining income, after housing expenditures, is actually often lower than in high-wage regions. For example, after considering housing costs a NYC janitor may earn less than in Mississippi. The authors estimate that if interstate income convergence had continued at the pre-1980 rate, hourly wage inequality would have been 8% smaller in 2010.

Ding and Hwang (2016) found that less-advantaged residents (those with low credit scores, older and longer-term residents, or those without mortgages) who remain in gentrifying neighborhoods (those that gain relatively affluent residents) gain economically, as indicated by significant improvements in their credit scores, while moving from gentrifying neighborhoods is negatively associated with credit score changes of less-advantaged residents who move to lower-income neighborhoods. This suggests that public policies which retain and increase affordable housing supply in economically successful urban neighborhoods help increase disadvantaged households' economic opportunities.

Social Integration

Public policies that increase housing prices and reduce housing diversity, such as excluding multifamily housing, tend to exclude lower income and minority households, and people with disabilities. Lens and Monkkonen (2016) and Furth (2022) find that regulations that limit infill development increase economic segregation. Conversely, Smart Growth policies that allow more lower-cost housing types, such as townhouses and low-rise apartments, can increase integration (Litman 2017).

Upzoning, infill development, and amenities such as public transit improvements and bikelanes are sometimes criticized for causing gentrification and displacement, although the impacts are mixed; many lower-income residents benefit from more compact infill development and multimodal transportation (Demsas 2021). For this analysis it is important to differentiate between *gentrification* (more affluent people living in minority and lower-income neighborhoods) and *displacement* (lower-income residents forced out of their neighborhoods) (McMillan 2021). Neighborhood reinvestment (new buildings and businesses), and the population and economic growth it stimulates can benefit low income residents with better economic opportunities, public safety and public services, without displacing lower-income households. Studies by Cortright (2018), Rosenthal (2014), and Zuk and Chapple (2016) indicate that increasing moderate-priced housing supply reduces low-income household displacement, although subsidized housing has greater impacts than market-rate units, and market-rate housing production can increase lower-income housing prices in the short-run, despite long-run price reductions. Montreal (Andrew-Gee 2018), Portland and Seattle provides empirical evidence that increasing housing supply can reduce prices, or at least price escalation, in affected markets.

For example, a major study of housing markets in 100 U.S. urban regions (Myers and Park 2020) found that new market-price apartments created affordable housing opportunities for very low-income households (earning less than 50% of area median incomes) through filtering. As the properties grow older, their rents and residents' average incomes decline. In years when there is substantial moderate- and higher-priced housing construction, filtering produced a substantial boost in apartments available to low-income households. Between 1990 and 2011, new moderate-priced housing construction increased the low-income occupancy share by 11% of 1960s-built apartments, 8.6% of 1970s-built apartments, and 10% of 1980s-built apartments. From 2011 to 2018, when fewer new apartments were built, the low-income share declined by 3.8% to 6%. As new construction declined, so has affordability. As one study author explained, "In decades past it was the substantial flow of new construction, largely targeted to middle- and higher-income groups, that enabled the filtering process to operate. In the face of its current constriction, well below levels normally associated with employment growth, we gain fresh appreciation for the broader benefits of housing construction."

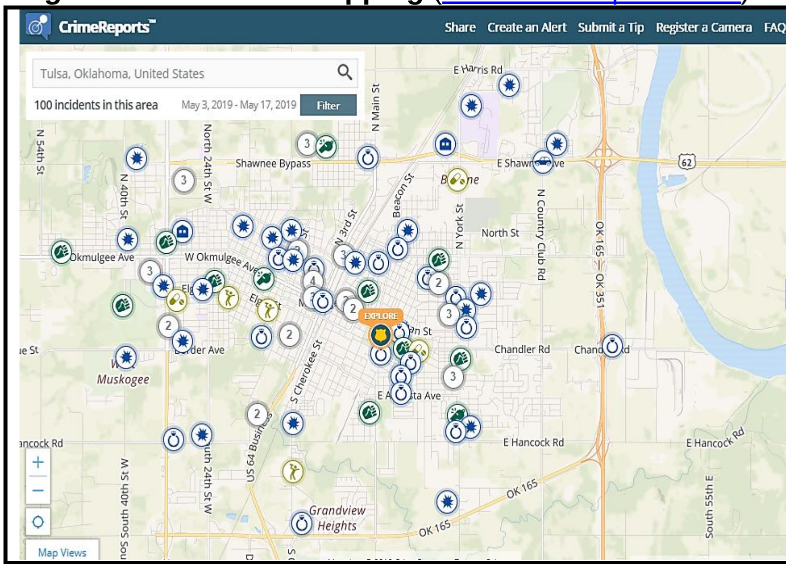
In the book, *Homelessness is a Housing Problem* (Aldern and Colburn 2022) researchers Clayton Page Aldern and Gregg Colburn found that local market housing prices and availability are the most important factors affecting homelessness rates; more important than poverty, addiction or mental illness rates. Describing their research, Colburn explained, "Pretty soon it became very clear that rental costs and vacancy rates were by far the biggest predictor of rates of homelessness in a community. It's not the only factor. There are all sorts of complicated phenomenon, but it's a far more convincing phenomenon than anything else."

This indicates that Smart Growth policies that support development of lower-cost housing types, such as townhouses and low-rise apartments in walkable urban neighborhoods help support income, racial and ability integration.

Social Problems (Poverty, Crime and Mental Illness)

Poor households tend to locate in central urban neighborhoods for maximum access to services and economic opportunities (Glaeser, Kahn and Rappaport 2008). As a result, some urban neighborhoods have concentrated poverty and associated social problems such as crime, addiction and mental illness. In addition, some crime types are associated with certain commercial activities such as stores and banks (robberies) and bars (fights). New crime-reporting apps and crime mapping systems, which show police-reported crime and residents' suspicious activity reports, give an exaggerated impression of urban crime: they indicate *crime density* (crimes per square mile or kilometer) which many people misinterpret as indicating *crime risk* (crimes per capita), causing people to overestimate the actual crime risk of urban locations (Molla 2019).

Figure 17 **Crime Mapping** (www.crimereports.com)



Crime reporting and mapping apps like Nextdoor, Citizen, Neighbors and Crimereports.com indicate that crime density (crimes per square-mile or -kilometer) increases with development density and mix, but fail to account for population density or the special risks associated with commercial activities such as banks and bars, and so does not really indicate that per capita crime rates or typical individuals' crime victim risks increase with density and mix. Research that accounts for these factors indicates that per capita crime risk tends to decline with more compact and mixed development that increases natural surveillance.

As a result, people sometimes conclude that denser development increases social problems, but this confuses cause and effect; suburban policies, such as restrictions on apartment buildings and automobile-dependent transportation systems exclude poor people, which shifts these problems to urban areas. There is actually no evidence that denser development increases total poverty, crime or mental illness (1000 Friends 1999; Meyer 2013), on the contrary, as previously described, credible research suggests that, by improving disadvantaged people's access to services and economic opportunities, and increasing community cohesion (positive interactions among neighbors), Smart Growth helps reduce social problems (Talen and Koschinsky 2014).

High quality studies indicate that, all else being equal, crime rates tend to decline with urban density and mix, due to more *passive surveillance* (also called *eyes on the street*) as more residents and by-passers can see and report possible threats (Gilderbloom, Riggs and Meares 2015; Tang 2015). 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 that per capita violent crime rates decline with density 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, burglaries per house during a five-year period decline from 0.209 on streets with fewer than 11 dwellings, to 0.142 on streets with 50 dwellings, and just 0.086 on streets with more than 100 dwellings. Foster, et al. (2019) found a large and statistically significant negative relationship between a New Urbanist design index and self-reported crime rates: accounting for neighborhood demographic factors, each 10% increase in their New Urban policy compliance index, the odds of being a crime victim declined 40%, with particularly large reductions (51%) associated with improved neighborhood walkability. Using international data, Ahlfeldt and Pietrostefani (2017) found that crime rates increase with density in the US cities, but decline with density in other OECD countries, perhaps reflecting the location of concentrated poverty.

Using high-resolution data to evaluate how land use factors affect street crime (robbery and assault) in Chicago, Twinam (2018) found that crime rates decline with population density, and although they increase near commercial land uses, particularly liquor stores and late-hour bars, dense mixed-use areas are safer than typical residential areas. The results suggest that zoning which supports higher density and mixed-use development tend to reduce crime risks compared with conventional development policies. Chang and Jacobson (2017) found that, all else being equal, Los Angeles neighborhood crime rates decline with walkability. Temporary closures of medical marijuana dispensaries, due to state laws changes, and to restaurants due to health code violations, caused street crime rates to increase, and then decline again after they reopened. The authors conclude that this probably reflects "eyes upon the street" crime deterrent effects. Also using high-resolution land use and crime data, Humphrey, et al. (2019) found that crime rates increase in commercial districts, they decline near businesses, such as cafes and convenience stores, that are open more weekly hours.

Litman (2016) investigated how urban living affects residents' mental health and happiness. This research indicates that city living can have various mental health impacts. Credible research suggests that urban residency can *increase* psychosis and mood disorder risks, addiction to some drugs, and some people's unhappiness, but *reduces* dementia, some types of substance abuse and suicide rates, and increases many people's happiness, particularly those who are poor or alienated. Urban living also tends to *improve* mental health by increasing economic and social opportunities, fitness and health, and access to mental health services, and higher mental illness rates reported in cities may partly reflect better reporting. A recent study of U.S. maternal-infant interactions and parenting stress, found that, accounting for socioeconomic factors such as income and education, urban mothers demonstrated significantly more responsiveness and reciprocity than their rural counterparts, and rural mothers rated their infants significantly higher in negative affectivity and distress (Neumann, et al. 2020).

This is not to ignore the increases in local social problems that may result from compact and mixed development that attracts lower-income households to a neighborhood; it is important to address these problems. 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.

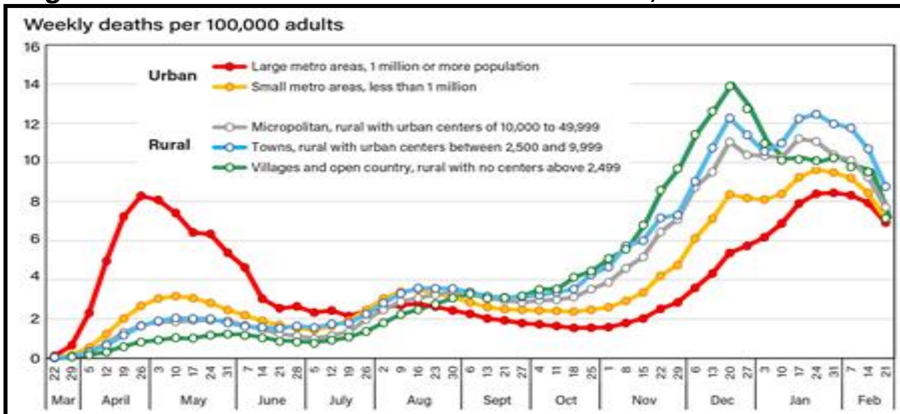
Criticisms. Critics use simple correlations between density and social problems as evidence that Smart Growth causes such problems (Burnett and Villarreal; O'Toole 2008), ignoring confounding factors and evidence that Smart Growth policies reduces poverty and crime rates.

Public Fitness and Health

Smart Growth tends to improve physical fitness and health by increasing active travel (walking and bicycling) and reducing per capita crash rates (Ewing and Hamidi 2014; Iravani and Rao 2019; Rachele, et al. 2018). Although there are many ways to exercise, most require special time, expense and effort, which discourages their use, particularly by sedentary and overweight people. For many people, the most practical way to exercise is to walk and bike for utilitarian trips and recreation. Since most public transit trips include walking and bicycling links, active travel tends to increase exercise. Communities can increase physical fitness by improving walking, bicycling and public transit, and encouraging use of these modes (CDC 2010).

Many people assume that contagion risk increases with density, making cities dangerous, but this is generally untrue (Hamidi, Sabouri and Ewing 2020). Although the COVID-19 pandemic took longer to reach rural areas, once established it had higher fatality rates due to higher-risk populations, low vaccination rates, and weaker public health and healthcare services, as illustrated below. The article *Treating Two Pandemics for the Price of One* (Frank and Wali 2021), finds that compact, walkable neighborhoods reduce infectious disease *and* chronic health problems such as cardiovascular illnesses.

Figure 18 **Urban-Rural Covid Death Rates, March 2020 to Feb. 2021** (CDC Data)



COVID infection and death rates were initially higher in large cities because they have more international travel and employment, but once infections reached rural areas their death rates increased and are much higher than in urban areas due to older and less healthier populations, lower vaccination rates, weaker public health programs and less access to healthcare.

In a study of residents in 14 international cities, Sallis, et al. (2016) found that controlling for other factors, net residential density, intersection density, public transport density and number of parks were significantly, positively related to physical activity. The physical activity differences between residents of the most and least activity-friendly neighbourhoods ranged from 68 to 89 min/week, which represents 45–59% of the 150 min/week recommended by guidelines. This suggests that, to improve public fitness and health, cities should be designed for walkability and ensure that appropriate parks and recreational facilities are located within walking distance of most homes.

A ten-year study in Perth, Australia found that residents overall health improved if they moved from sprawled to more compact, walkable 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 (park, beach, etc.) residents' physical activity increased another 21 minutes per week. Using sophisticated statistical analysis that accounts for various demographic and economic factors, Ewing, et al. (2014) found that Smart Growth is associated with reduced obesity and associated health problems, and Ewing and Hamidi (2014) found that it increases longevity; doubling their Sprawl Index increased life expectancy approximately 4%, which translates into an average three-year difference in life expectancy between people in less compact versus more compact counties.

Hamidi, et al. (2018) used cross-sectional data to evaluate the associations between sprawl and life expectancy for metropolitan counties in the United States in 2010. After controlling for demographic factors the study found significantly higher life expectancy in compact than in sprawling counties. The researchers found that compactness affects mortality both directly, and indirectly, for example, by increasing traffic speeds and emergency response times, and reducing access to health care services and healthy foods. Compactness affects mortality indirectly by increasing total vehicle travel and therefore crash exposure, and by increasing body mass index which contributes to chronic diseases. These findings support further research and practice aimed at identifying and implementing changes to urban planning designed to support health and healthy behaviors.

Frederick, Riggs and Gilderbloom (2017), analyzed the relationships between *commute mode diversity* (CMD, the portion of commuters who do not drive an automobile, which ranges from 11% to 36%) an indicator of a multimodal community, and twelve indicators of measure public health and quality of life outcomes for various mid-size U.S. cities and counties. The results indicate that, after adjusting for various demographic factors, there is a strong statistical relationship between more modal diversity and positive public health outcomes including healthier behaviors reported in the Gallup/Healthway's Well-Being Index, more leisure quality reported by Sperling's Cities Ranked and Rated, more access to exercise reported by the Environmental Systems Research Institute, less sedentary living and obesity reported in the Center for Disease Control's Diabetes Interactive Atlas, fewer Years of Potential Life Lost (an indicator of longevity and overall health), and higher birth weights (an indicator of infant health) reported by the National Center for Health Statistics. These relationships are stronger than many other sociological, geographical, and economic indicators including density, latitude, race, education and income, suggesting that living in a more multimodal community provides significant health benefits. These findings underscore the positive impact of sustainable transportation policies on community health and open up a new direction for public health research and the built environment.

Using U.S. national travel survey data and accounting for demographic factors, Dong (2020) found higher rates of utilitarian walking and bicycling in central neighborhoods and suburbs, and in rural areas, than in outer suburbs. Inner-city residents walk and bicycle about three times more, and rural residents about 50% more, than in outer suburbs. A detailed review of neighborhood attributes cardiovascular health impacts found that many Smart Growth urban design features, including walkability, residential density, safety from traffic, recreation facilities, street connectivity, and local grocery stores tend to increase physical activity and reduce body mass index, diabetes and cardiovascular disease (Malambo, et al. 2016).

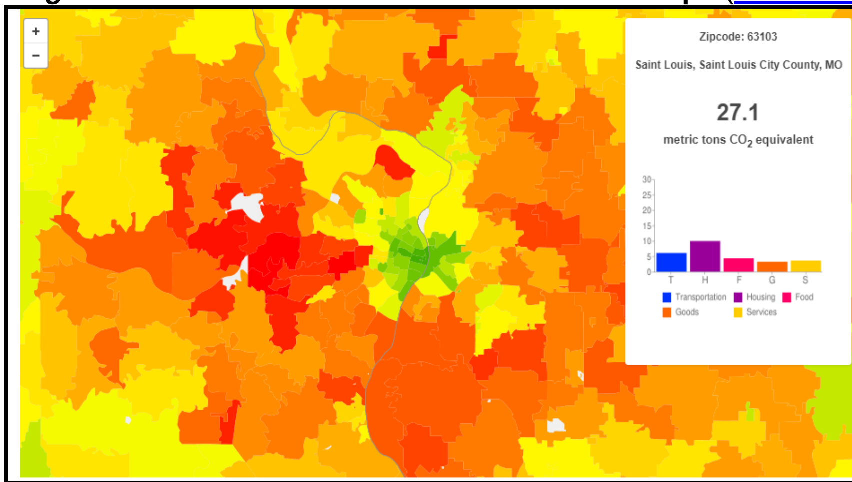
Other studies also indicate that Smart Growth increases overall safety and health (Lucy 2002; Myers, et al. 2013). However, increased urban densities can increase some health risks such as exposure to noise and local air pollutants. Public safety and health therefore justifies Smart Growth strategies 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 argue that Smart Growth provides, at most, only small health benefits, and cite statistics showing that suburban residents are healthier than urban residents, ignoring confounding factors such as income and age (Gordon and Richardson 2000). Using a survey that tracked 6,111 people between 1978 and 1994, Eid, et al. (2008) found no significant weight impacts from those that move to more or less sprawled neighborhoods, and conclude that the positive relationship between sprawl and obesity found in other studies reflects the tendency of overweight people to move to sprawled neighborhoods.

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 (Decker, et al. 2017; Dingil, et al. 2019; Ewing and Rong 2008; Güneralp, et al. 2017; Jones and Kammen 2014; Lefèvre 2009; Litman 2008 and 2014; Lee and Lee 2014; LSE 2014; Landis, Hsu and Guerra 2017; Mehaffy 2015; Wilson and Melton 2018; Wu, et al. 2020). The **CoolClimate Calculator**, illustrated below, estimates household transportation, housing, food, goods and services carbon emissions for U.S communities. Total emissions are much lower in compact, multimodal neighborhoods.

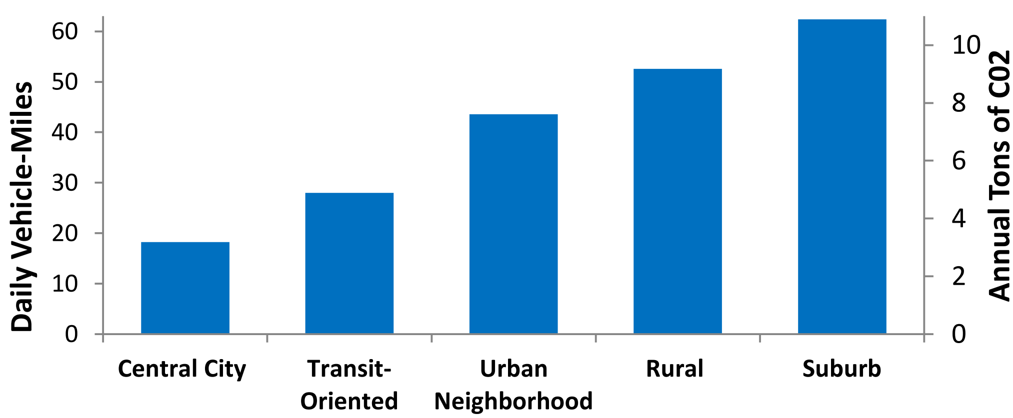
Figure 19 **CoolClimate Carbon Emission Maps** (CoolClimate Maps)



CoolClimate Maps show per-household carbon emissions including transportation, housing, food, goods and services consumed, at a zipcode scale. This example of St Louis, Missouri indicates that emissions range from less than 30 metric tons in central areas (dark green) to more than 60 (dark red) in outlying suburbs. Similar patterns exist in most urban regions.

Salon (2014) used detailed travel survey data to analyze how demographic and geographic factors affect travel activity (how and how much people travel), and developed models for predicting how various land use development changes will affect travel. The figure below illustrates the key results. She found that per capita vehicle travel peaks at $175,000 annual income, above which it declines. Transit access, and pedestrian and bicycle-friendliness reduce vehicle travel. The number of jobs within five miles is associated with lower VMT, while the number of jobs beyond five miles is associated with higher VMT. Decker, et al. (2017) used Salon's model to estimated that policies that encourage urban infill could reduce a region's average household travel by about a third, from 57 down to 39 average daily vehicle-miles.

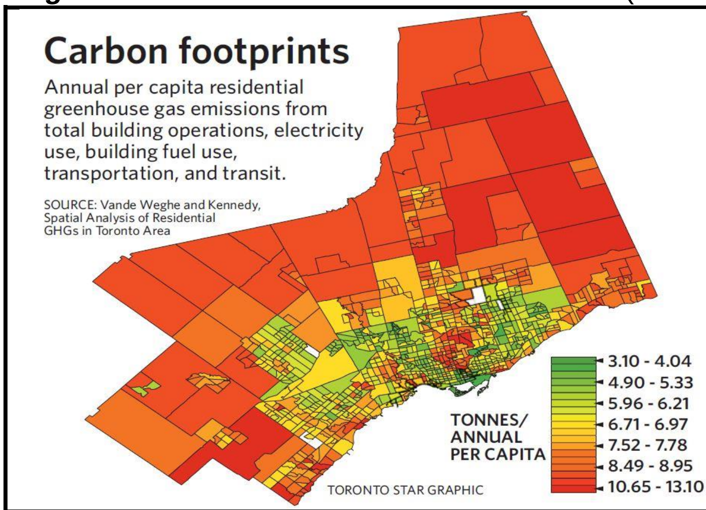
Figure 20 **Household Vehicle Travel by Location** (Salon 2014)



Motor vehicle travel and emissions are much lower (20-60%) in compact, transit-oriented than in sprawled, auto-dependent areas.

Jones and Kammen (2014) performed extensive analysis of factors affecting household energy consumption and emissions (described as a *household climate footprint* or HCF) resulting from energy generation, housing, transportation, food, goods, and services. They found that income is the most significant single factor affecting HCF, but geographic factors such as differences in electric generation (coal increases emissions), climate (hotter and colder climates increase household heating energy) and transportation (more sprawled locations increase vehicle travel and fuel consumption) have more total impacts. Within urban regions, motor vehicle travel, fuel consumption and emissions tend to decline when population density exceeds about 3,000 residents per square mile (about 5 residents per acre). Using Montreal, Canada travel data, Winkelman, DeWeese and El-Geneidy (2019) found that living in a more accessible, Smart Growth neighborhood reduces driving by 20-50%. Similarly, VandeWeghe and Kennedy (2007) found that per capita building, electrical use and transportation emissions tend to be much lower in central, multimodal neighborhoods than in automobile-dependent urban fringe areas in Toronto, Canada, as illustrated below.

Figure 21 **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.

Drew, Nova and Fanning (2015) compared the land and energy consumption, and lifecycle carbon emissions, of various housing typologies ranging from skyscrapers to single family residences. The results indicate that mid-rise (3-4 story) is generally most resource-efficient overall. Popovich, Rojanasakul and Plumer (2022) describe how emission rates vary by neighborhood. Central neighborhoods generally have the lowest emissions, although some dense areas have high emission rates due to affluence and some rural areas have low emission rates due to poverty, but these are despite rather than caused by geography: affluent city residents would have even higher emission rates if they located in automobile-dependent areas.

Lee and Lee (2014) examined how urban form influences household carbon emissions in the 125 largest U.S. urban regions. Their analysis indicates that doubling population-weighted density is associated with a 48% reduction in transportation emissions and a 35% reduction residential energy consumption. They also find that doubling per capita transit subsidies leads to a nearly 46% lower vehicle miles traveled (VMT) and an 18% reduction in transportation CO2 emissions. Ewing and Hamidi (2014) found that each 10% increase in their compact development index reduced vehicle travel by 7.8% to 9.5%. Detailed analysis by Schneider, Handy and Shafizadeh (2014) found that, all else being equal, businesses and households in Smart Growth neighborhoods generate far fewer vehicle trips than in automobile-oriented locations.

Criticism. Critics argue that Smart Growth energy savings and emission reductions are small and not cost effective (Pisarski 2009). National Association of Home Builders sponsored studies (NAHB 2010 and 2011) claimed 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 the table below.

Table 12 **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."	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."	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."	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."	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."	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."	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 Productivity and Development

Smart Growth tends to increase economic development, productivity, innovation, property values and tax revenues (Ahlfeldt and Pietrostefani 2017 and 2019; Angel and Blei 2015; Boarnet, et al. 2017; Decker, et al. 2017; FBCI and SGA 2021; Fontagné and Santoni 2016; GCEC 2014; Litman 2014; Prince's Foundation 2020; Renaissance Planning 2012; Rodriguez and Leinberger 2023). This reflects the economic savings and benefits provided by more efficient services, improved accessibility and agglomeration efficiencies. Table 13 summarizes these impacts.

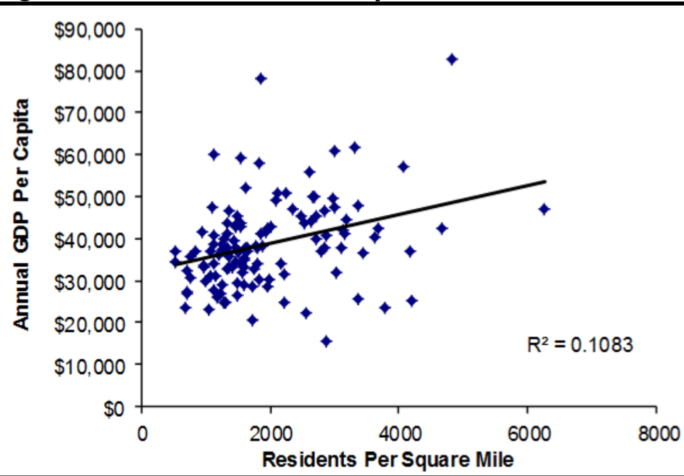
Table 13 **How Smart Growth Can Increase Economic Productivity**

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.

Agglomeration efficiencies (also called *economies of agglomeration*) refers to economic productivity gains provided by more compact development which facilitates economic interactions (Chatman and Noland 2013; Donovan and Munro 2013; Melo, Graham, and Noland 2009; Hardesty 2013). On average, doubling urban density increases productivity by 2–6% (Abel, Dey and Gabe 2012). This correlation is particularly strong for knowledge-based industries (Boarnet, et al. 2017; Glaeser and Resseger 2009). Figure 21 illustrates how per capita GDP tends to increase with regional population density. 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).

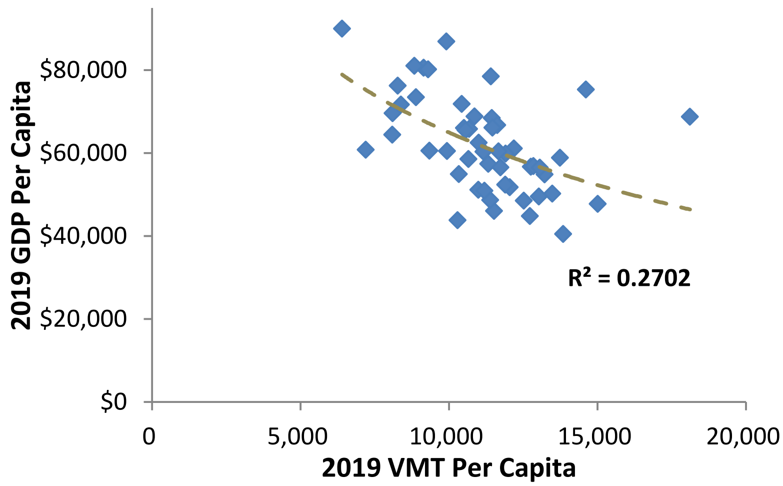
Figure 22 **Per Capita GDP and Urban Density** (BTS 2006 and BEA 2006)



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

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) as illustrated below. This probably reflects the efficiencies of compact land use development and the transportation system efficiencies that result from a more multimodal transportation system.

Figure 23 **Per Capita GDP and VMT for U.S. States (FHWA 2019)**



Per capita economic productivity tends to increase as vehicle travel declines. (Each dot is a U.S. state.)

This suggests that more compact and multimodal urban regions tend to be more economically productive than sprawled, automobile dependent regions.

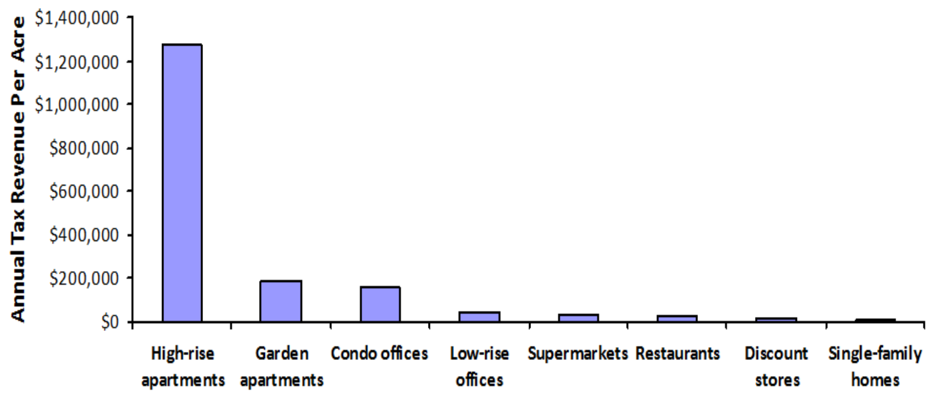
Xiao, Wu and Kim (2021) find a significant negative effect from commuting distance on inventor productivity: every 10 km increase in distance is associated with a 5% decrease in patents per inventor–firm pair per year and a 7% decrease in patent quality. They conclude that development restrictions on multifamily construction reduce efficient and innovation by increasing average commuting, and so advocate policy reforms to allow higher urban densities. Ahlfeldt and Pietrostefani (2019) found positive relationships between urban density and wages, rents and economic productivity.

To the degree that Smart Growth policies allow more compact development in growing urban regions, they tend to increase overall productivity. Hsieh and Moretti (2015 and 2017) analyzed the economic impacts of restrictions on development density in Boston, New York, Seattle, San Francisco and Washington DC. They estimate that allowing more affordable infill in these highly productive cities could increase aggregate national economic output by 13%, equivalent to several thousand dollars per worker, and improve economic opportunity to economically disadvantaged workers.

The report, *The Root of Local Government Revenues: Rethinking the Intersection between Land Use Planning and Finances* (RTR 2022) describes how land use decisions affect municipal revenues and identifies policies for more revenue-positive outcomes, including favoring compact infill over urban expansion, and applying regulations and fees that encourage cost-efficient development. More compact development tends to increase tax revenue per acre (CMAP 2014; McCarty 2017; McKeeman 2012).

As previously described, more compact development reduces per capita costs of providing public infrastructure and services, and increases revenues. One study found that 3.4 acres of mixed urban development in Sarasota County, Florida provides the same number of housing units as 30.6 acres of suburban housing, has only 57% the infrastructure costs, and provides 8.3 times as much tax revenue (PIP 2009), resulting in a 35% annual infrastructure return on investment (annual tax revenue relative to annualized public infrastructure costs), compared with only 2% for sprawled development, so an urban highrise repays its infrastructure costs in about three years, compared with 42 years for sprawled development. The figure below illustrates the typical revenue per acre for various land uses.

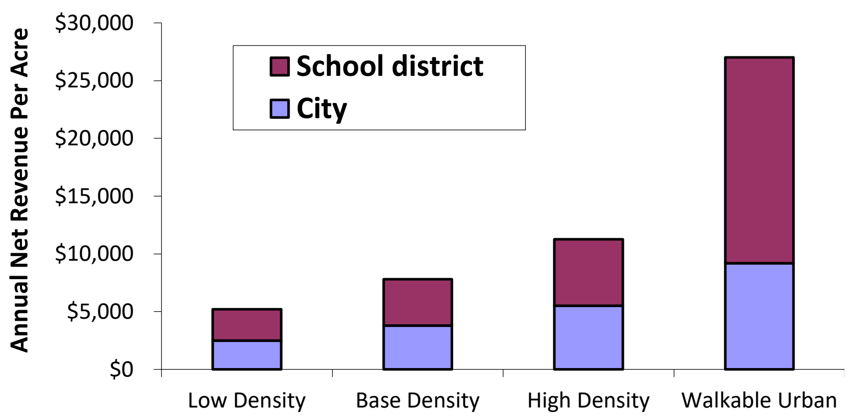
Figure 24 **Fairfax County Tax Revenue Per Developed Acre** (McKeeman 2012)



Compact development generates far more tax revenue per acre than lower-density 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 indicated below.

Figure 25 **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.

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 (Litman 2014). 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, that ignores theoretical and empirical evidence of Smart Growth productivity gains. Overall, more compact cities tend to have more economic productivity, higher incomes, and more tax revenue per acre than sprawled, automobile-dependent cities.

Smart Growth Costs and Sprawl Benefits Summary

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. The following tables summarize these impacts.

Table 14 identifies various economic, social and environmental benefits of Smart Growth.

Table 14 **Smart Growth Benefits by Category**

Economic	Social	Environmental
• Openspace preservation increases agricultural and recreation industry productivity. • Reduced costs of providing public infrastructure and services. • Improved accessibility reduces vehicle travel and associated costs to households, businesses and governments. • Agglomeration efficiencies, which increase economic productivity. • Reduced vehicle and fuel spending reduces export exchange burdens.	• Increased accessibility and improved mobility options increase opportunities for physically, economically and socially disadvantaged people. • Reduced traffic casualties (injuries and deaths). • Improved public fitness and health. • Increased community cohesion (positive interactions among neighbors). • Reduced chauffeuring burdens.	• Openspace preservation maintains wildlife habitat and other ecological functions. • Reduces surface and groundwater disruptions, maintains water quality, and reduces stormwater management costs. • Reduces per capita energy consumption and pollution emissions. • Reduces heat island effects.

By reducing per capita land consumption, improving accessibility and reducing automobile travel, Smart Growth tends to provide various economic, social and environmental benefits.

Comprehensive analysis should consider all of these impacts. 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, many of these costs 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 preserves 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.

Critics often argue that sprawl has benefits that offset costs, but most of the benefits they cite are direct user benefits and economic transfers, such as larger yards, increased privacy and reduced crime; 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.

Table 15 categorizes benefits and costs as *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 15 **Smart Growth Benefits and Costs**

	Internal (To Smart Growth Residents)	External (To Other People)
Benefits	Increased accessibility, which reduces travel time and money costs, and increases affordability. Improved mobility options, which increases non-drivers' independence and economic opportunity, and reduces drivers' chauffeuring burdens. More affordable housing options (townhouses, apartments, accessary units, etc.). Increased economic resilience. Increased traffic safety. Improved fitness and health.	Open space preservation (farm and natural lands). Reduced public infrastructure and service costs (roads, utilities, emergency and transit services, etc.). Reduced congestion and crash risk imposed on other people. Reduced healthcare and disability costs. Increased local 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. Increased local social problems (poverty and crime). More exposure to some pollutants.	Increases in some infrastructure costs such as curbs and sidewalk. More local traffic and parking congestion.

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.

Many impacts vary depending on the scale of analysis. For example, more compact development tends to increase local traffic and parking congestion, but because it causes residents to reduce their vehicle ownership and use, it reduces total regional vehicle travel and traffic problems. As a result, compact, multimodal cities such as New York and Boston tend to have more *intense* congestion but lower *per capita congestion costs* because residents drive less under urban-peak conditions. Similarly, by attracting more people and businesses to an area, more compact and mixed development tends to increase local crimes, but by increasing passive surveillance ("eyes on the street") and improving disadvantaged residents' economic opportunities, it tends to reduce total per capita crime rates, and therefore total regional crime risk. 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 (Burda 2014). For example, the National Association of Realtors' *Community and Transportation Preferences Surveys* indicate that approximately half of respondents prefer "Houses with small yards and it is easy to walk to the places you need to go" over "Houses with large yards and you have to drive to the places where you need to go," and 20% of detached house occupants would prefer living in more compact housing in a more walkable and accessible location. Similarly, a survey of Kitchener Waterloo, Canada residents found that 37% of respondents would prefer living in a transit oriented areas, but purchased outside TOD areas (Huang, Parker and Minaker 2021). These households are primarily young families (aged 25–34) with children and represent a possible missing target in TOD housing supply in our study area.

Analysis by the real estate brokerage firm, Redfin found that homes within walking distance of schools, shopping, parks and other urban amenities sell for an average of 24%, or $77,668, more than comparable properties in car dependent areas (Katz 2020).

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; NAR 2023).

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 (Huang, Parker and Minaker 2021). To the degree that this is true, Smart Growth policy reforms, such as those described in the following table, tend to 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 16 **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; Litman 2014). In contrast, excepting Kotkin and Cox's 2013 four-page review article, none of the critics' publications are peer reviewed.[1]

Critics often misrepresent Smart Growth and consider only a small portion of total Smart Growth policies, impacts and outcomes, as summarized below.

Table 17 **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 capita) 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.

[1] 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 provide incomplete or biased evidence. For example, Diana Budds' 2020 article, "Will Upzoning Neighborhoods Make Homes More Affordable?" cited Yonah Freemark's 2019 study, which found that upzoning around Chicago transit stops drove up land prices and delivered few new housing units, but only a small portion of the total neighborhood area was upzoned, and the study only considered a few years of impacts, and so does not really indicate whether neighborhood-wide upzoning would increase long-term affordability. More comprehensive studies do find that allowing more infill development increases affordability (Rosenthal 2014; Zuk and Chapple 2016), benefiting lower-income residents (Mast 2019).

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.

The table below critiques typical Smart Growth criticisms. None withstands scrutiny.

Table 18 **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 (Decker, et al. 2017; 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 et al. 2016).

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. Compared with residents of conventional, automobile-dependent areas, residents of Smart Growth communities tend to:

- Spend a much smaller portion of their household budgets on transportation.
- Have access to more jobs, have shorter duration commutes and spend less time travelling.
- Have much less disparity in access and economic opportunity between drivers and non-drivers.
- Spend less time and money chauffeuring non-drivers.
- Are more economically productive.
- Require less expensive public infrastructure.
- Have much lower traffic death rates.
- Are more likely to achieve physical activity targets, are less likely to be overweight, and have fewer health problems associated with sedentary living.
- Have longer lifespans.
- Consume much less energy and produce more pollution emissions.
- Consume less land for housing, roads and parking facilities, and displace less openspace (farmland and habitat).

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.

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.

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