5th SASTech
Iran | Mashhad
May 12 - 17 | 2011
5th Symposium on Advances in Science & Technology

Investing in a better future: evaluating Smart growth and TDM strategies for overcoming sprawl and automobile dependency

1-Khadijeh.Qolipour/ Behshahr, Iran/leila1291@yahoo.com

2- Leila Yousefi/ Qazvin, Iran/leilaazin2006@yahoo.com

Paper Reference Number: 0502-950
Name of the Presenter: khadijeh Qolipour

abstract

Increasing needs for higher mobility are often met by design and implementation of new infrastructure provisions. The challenging question is whether this choice elevates the general goal of sustainable development. In this context, the land-use and transportation interactions need to be envisaged as well. In land use planning a debate between "sprawl" and "Smart Growth" has been taken into consideration. As for transport planning the issues regarding "automobile dependency" and "transportation demand management" or TDM are brought up. Because land use and transportation are closely connected, these are actually two facets of the same debate. Smart Growth can be considered the land use component of TDM, and TDM can be considered as the transport component of Smart Growth. Many current transportation policies and planning practices tend to focus on mobility at the expense of accessibility, therefore unintentionally lead to automobile dependency and sprawl. Proactive tools focusing on environmental, economic and social impacts of transportation and land use have the potential to disrupt the status que, providing an opening for sustainable practices. This paper identifies land use policies and TDM strategies that support smart growth. It discusses the benefits and equity impacts. These policies and strategies can help to correct existing policies and planning practices that encourage sprawl and automobile dependency. They tend to reduce per capita land consumption, improve land use accessibility, increase transportation options and help to achieve social welfare, equity and environmental sustainability.

Keywords: automobile dependency, smart growth, sprawl, sustainability, TDM

1. Introduction

While sustainable urban development (SUD) encompasses a wide range of urban planning interests, for example, sustainable urban economy, infrastructure and services, integration of communities, green attitudes, public participation, and governance, most of the SUD issues are discussed focusing on spatial considerations, particularly on the urban form and its effects on mobility patterns. Starting with the revelation this interdependence between the urban form and travel pattern of the individuals/households could make it possible to address causes of and intervention options to pressing sustainability problems. These problems consist of urban sprawl, high vehicle kilometers travelled (VKT) and auto dependence, low public transport patronage, transport related pollution, excessive land consumption, disruption of ecosystems, and so on. While rhetorical discussions related to these problems provides a conceptual framework to achieve a comprehensive approach, modeling studies are invaluable sources for identification of causal relationships between urban land use and travel demand.

Until recently there was little objection to planning that favored sprawl and automobile oriented transportation system. Land use planning consisted of accommodating urban growth, and transport planning consisted of accommodating motor vehicle traffic (1). But now there is growing international recognition of the impact that the built environment has on physical activity. Urban sprawl with long distances between places increase the demand for travel and gives priority to cars, rather than encouraging people to walk, cycle, use, public transport and be more physical active. Research has shown that increasing housing density, mixed-density, mixed-use planning and connectivity all contribute to the increase use of active transport (2). Additionally, people lived in an aesthetically pleasing environment were 41 percent more likely to walk (3). Many people and groups now advocate alternative planning practices. This shift is occurring within many jurisdictions, agencies and professional disciplines. This is beginning to change.

In fact, increased traffic congestion, loss of open space, infrastructure costs, and a desire for more housing options have all made smart growth and TDM increasingly powerful strategies for building and revitalizing communities, catalyzing economic development and protecting the environment. Critical instruments for this policy option include coordination with public transport infrastructure development, mixed land use, urban boundary, and coordination of different levels of government.

There is considerable debate over whether sprawl is “bad” for society, and whether Smart Growth policies are superior to current practices. Similarly, there is debate over whether current levels of automobile use are “good” or “bad” for society, and whether TDM policies are desirable. This paper attempts to apply a more rigorous analysis by evaluating current and alternative land use and transportation policies and based on economic, social principles and environmental standards related to efficiency and equity. The purpose of this paper is to provide evidence and rationale for excluding sprawl and automobile- oriented patterns.

2. Introducing Smart Growth and TDM

2.1 The Problem with Sprawl and Automobile Dependency

Sprawl development is most often characterized as low density, spread-out development that is disconnected or isolated from existing development. Sprawl is sometimes called “unplanned” development, meaning there is little coordination among private development, public services and policy objectives such as green space preservation (1). This type of development often uses open space inefficiently and its spread-out nature increases the cost of delivering services. It tends to direct resources away from older areas, potentially contributing to the decay of downtowns and existing development. Sprawl development typically produces uniform housing types with little price variety, and new developments usually have limited transportation

options, requiring access by car and reducing the ability to walk to schools, libraries, stores, and jobs. (4) in fact, this form of development has been generated in accordance with dependency on cars.

Automobile dependency is defined as high levels of per capita automobile travel, automobile oriented land use patterns and reduced transport alternatives. (5) The opposite of automobile dependency is a balanced transportation system with more mixed travel patterns. Automobile dependency is a matter of degree.(6) in its extreme, nearly all local trips are made by personal automobile because alternatives are so inferior (7)

Based on a review of previous literature on sprawl, Burchell, et al developed a list of 10 common elements found in the varying definitions. (8) Developments that contain most of 10 elements are viewed as sprawl:

1. Low residential density.
2. Unlimited outward extension of new development.
3. Spatial segregation of different types of land uses through zoning regulations.
4. Leapfrog development.
5. No centralized ownership of land or planning of development.
6. Transportation dominated by privately- owned motor vehicles.
7. Fragmentation of governance authority over land use between many local governments.
8. Great variance in fiscal capacity of local governments within a metropolitan area (revenue- raising capability strongly tied to property values and economic activity within municipal borders).
9. Widespread commercial strip development along major roadways.
10. Major reliance on the trickle- down process to provide housing for low- income households.

Many of the policies and practices that encourage sprawl and automobile dependency can be considered market distortions because they violate efficient market principles, including consumer choice, cost-based pricing and public policies, as are listed in below : (9)

- Underpricing location-related costs
- Excessive parking and roadway requirement
- Roadway right-of-way
- Brownfield development barriers
- Undervaluing nonmotorized modes and transit
- Residential lending practices
- Overlooking environmental impacts
- Underpricing automobile travel

The impacts of these market distortions are cumulative, exacerbating many problems including traffic congestion, accidents, infrastructure costs, consumer costs and pollution emissions. The negative consequences of sprawl are listed in eight points : (10)

> 1)It needlessly destroys the economic, environmental and aesthetic value of resource lands; 2) it creates an inefficient land use pattern that is very expensive to serve with public funds ; 3) it blurs local government roles, fueling competition, redundancy and conflict among those governments; 4) it threatens economic viability by diffusing rather than focusing needed public infrastructure investments; 5) it abandons established urban areas where substantial past investments, both public and private, have been made; 6) it encourages insular and parochial local policies that thwart the sitting of needed regional facilities and the equitable accommodation of locally unpopular land uses; 7) it destroys the intrinsic visual character of the landscape ; and 8) it erodes a sense of community, which, in turn, has dire social consequences.

2.2 The Smart Growth and TDM Alternatives

The alternative to sprawl often referred to as smart growth. Smart growth is an urban planning and transportation theory that concentrates growth in the center of a city to avoid urban sprawl; and advocates compact, transit-oriented, walkable, bicycle-friendly land use, including neighborhood schools, complete streets, and mixed-use development with a range of housing choices. Smart growth values long-range, regional considerations of sustainability over a short-term focus. Its goals are to achieve a unique sense of community and place; expand the range of transportation, employment, and housing choices; equitably distribute the costs and benefits of development; preserve and enhance natural and cultural resources; and promote public health. (11)

in fact, considering to the definition of smart growth, this type of growth has relied on TDM strategies on transportation field.TDM is a wide range of policies, programs**,** services and products that influence how, when, where and why people travel to make travel behaviours more sustainable. (12).Most analysis suggest that TDM is essential for achieving more sustainable transportation, although the term "Transportation Demand Management" is not always used(13)

Economic efficiency and resource conservation are important principles sustainability. This suggests that TDM strategies that reflect market principles, encourage more resource-efficient travel choices, or result in more efficient land use tend to support sustainability. TDM can also help achieve livability objectives such as increased local environmental quality and community cohesion. (14)

Market Principles	Efficient Land Use	Efficient Transportation
Comprehensive market reforms	Smart growth	Walking and cycling improvement
Road pricing	Location efficient development	Transit improvement
Parking pricing	New urbanism	Ridesharing
Carbon taxes	Transit oriented development	HOV priority
Least cost planning	Access management	Commute tripe reduction
Asset management		
Institutional reforms		

Table 1: market principles and efficient land use and transportation

Incorporating sustainability principles, objectives and evaluation criteria into transportation decision-making can support increased implementation of TDM, and greater coordination between transportation and land use planning.

Smart growth trend to reduce automobile dependency through specific mechanism described below. (15)

- Clustering of population and employment , which increases accessibility, and travel choice
- Land use mix, such as commercial and public services located within or adjacent to residential area, which increases access and travel choice.
- Parking management and parking pricing can reduce automobile travel, encourage use of alternative modes, and reduce the amount of land paved for parking facilities, creating accessible and pedestrian-friendly landscape

- Traffic calming and other measure that reduce automobile traffic speeds, which reduces driving and improves conditions for walking, cycling and use.
- A more connected street network improves access.
- More attractive, safer streets, and pedestrian-oriented land use, encourages nonmotorized travel.
- An effective transit system trends to reduce per capita automobile travel, particularly when integrated with supportive land use
- Other TDM strategies can be incorporated into smart growth, including commute tripe reduction, school and campus trip reduction, carsharing and road pricing, to further reduce pe capita vehicle travel.

2. Advantages of Smart Growth and TDM

Smart Growth and TDM tend to have synergistic effects (the total is greater than the sum of their parts). They can provide a variety of economic, social and environmental benefits. These benefits result from various features of Smart Growth and TDM, including reduced per capita land consumption, less dispersed development, and more diverse transportation systems. Of course, the benefits of a particular Smart Growth program depend on its specific features and the conditions in which it is implemented.

Economic	Social	Environmental
Reduced development costs. Reduced public service costs. Reduced transportation costs. Economic of agglomeration. More efficient transportation. Supports industries that depend on high quality environments (tourism, farming , etc)	Improved transport options and mobility, particularly for non-drivers. Improved housing options. Community cohesion. Preserves unique cultural resources (historic sites, traditional neighborhoods, etc.) Increased physical fitness and health.	Greenspace & habitat preservation. Reduced air pollution. Increased energy efficiency. Reduced water pollution Reduced “heat island” effect.

Table2. Smart growth benefits (16)

In continue, some of the advantages of smart growth and TDM will be considering.

3.1 Smart Growth and TDM Reduce the Cost of Providing Infrastructure and Delivering Service

A number of conclusions about the fiscal benefits of smart growth can be drawn from the voluminous literature that investigates the costs of alternative development patterns. These benefits to state and local governments, while diverse, tend to be associated with the provision of infrastructure and, to a lesser extent, with the provision of services.

Frank (1989) identified various factors that affect these costs, including density and distance from the existing urban center (town or city).what Frank found was stark. By his calculations, the per- dwelling – unit public cost of providing streets, sewers, water systems, storm drainage, and schools to new residents varied sharply from $20,300 in the densest, most centralized configuration to $92,000 for houses 10 miles from central facilities on 1 dwelling-unit (d.u)-per- four- acres (ac.) "estate" zoning. Within this 80 percent variation were other telling comparisons. Most notably, Frank calculated that moving to closer-in compact growth at 12 d.u. with half the units multifamily could cut to $24,000, or halve, the $48,000 per home capital costs of low-density (3 d.u./ac.) sprawling growth 10 miles from central services. Another note: Throughout Frank’s tabulations utility costs occupy a surprisingly large share of the per-unit costs. His work has the capital cost of streets varying from $29,898 per unit on the fringe down to $1,843 in core high-rise neighborhoods. By contrast, outlays for sewers, water lines, and storm systems vary from $49,551 to $5,789. (17)

Duncan and others (1989) examined the total public facility expenses associated with eight actual developments in Florida. These case studies represented five different development patterns (compact, contiguous, satellite, linear, and scattered). The result: The public capital and operating costs for close-in, compact development were much lower than they were for fringe, scattered, linear, and satellite development.

To be specific, the costs per dwelling unit ranged all the way from a low of $9,252 for downtown Orlando (1989 dollars) to a high of $23,960 to serve new homes in Wellington, a low-density fringe development. And the study went further. By deeming the "compact" and "contiguous" growth cases "planned" and the others "unplanned" the analysis estimated the savings that might accrue from smarter, planned growth. This estimate concluded that planned growth could save significantly on road costs (60-percent savings over unplanned growth) and on utilities (40-percent savings), but only modestly on schools (7.4-percent savings). (18)

Spire and Stevenson (2002) study the relationship between costs of providing water and sewer services and development patterns by isolating 3 spatial attributes: (1) *lot size*—the separation between houses, (2) *tract dispersion*—the separation between development tracts, and (3) *distance*—separation from existing water and sewer centers. Based on a hypothetical scenario of 3,000 new single-family detached housing units in a town of 30,000 (3.5 people per housing unit), they used a cost simulation model to analyze 60 different scenario combinations. The 3 attributes are combined in different ways with each attribute allowed to vary across all scenarios while the other 2 are held constant. This way the cost consequence of each attribute can be isolated. The study found that smaller lots, shorter distances and lower tract dispersion all led to reduced water and sewer costs. The cost of services was most sensitive to changes in lot size (.25 to .5 acre) with an average increase of 30%. Cost increases attributed to a doubling in tract dispersion (1 to 2) and distance (.25 to .5 mile) were about 6% and 3%, respectively. Large lots were also assumed to use more water to water lawns, so water use was increased by 25%, a valid adjustment. (19)

A National Academy of Sciences and Transportation Research Board review found substantial regional and state-level infrastructure cost savings from compact development. (8)

Public –private capital and operating costs	Lexington, KY, and Delaware Estuary	Michigan	South Carolina	Newjersey
Infrastructure roads (local)	15%-20%	12%	12%	26%
Utilities (water/sewer)	7%-8%	14%	13%	8%
Housing costs	3%-8%	7%	7%	6%
Cost-revenue impacts	7%	4%	5%	2%

Table 3 : savings of smart growth compared to trend development

Burchell and Mukherji (2003) updated this analysis and applied it nationally to estimate costs under smart growth scenarios compared to trend development over the period 2000–2025. They found that sprawl produces a 21 percent increase in amount of undeveloped land converted to developed land. This increases water and sewer costs by 6.6 percent and increases local road costs by 9.2 percent. Altogether, the costs of sprawl increase the cost of housing by 8 percent, or $13,000 per dwelling unit. (20)

Jacob and Lopez (2009) found that stormwater runoff volumes, and the amount of phosphorous, nitrogen and suspended solid water pollution increase with density measured per acre but declined per capita. Their model showed that doubling standard suburban densities [to 8 dwelling units per acre (DUA) from about 3 to 5 DUA] in most cases could do more to reduce contaminant loadings associated with urban growth than many traditional stormwater best management practices (BMPs), and that higher densities such as those associated with transit-oriented development outperform almost all traditional BMPs, in terms of reduced loadings per capita. (21)

Overall, the various studies described above indicate that Smart Growth can provide direct savings in publicly-borne development costs (roadways and utility lines) ranging from $5,000 to as much as $75,000 per unit, compared with the same quality of infrastructure provided to dispersed, automobile-dependent development one or more miles beyond the urban boundary. Annualized, these savings range from $270 to $4,000 per unit (assuming 7% interest over 20 years). In addition, incremental operations, maintenance and service costs (maintaining longer roads and utility lines, increased pumping costs, higher delivery costs for public services, etc.) are probably at least as large, indicating that Smart Growth can provide public cost savings ranging from $500 to nearly $10,000 annually per unit.

3.2 Smart Growth and TDM Increase Walking and Biking and Reduce Greenhouse Gas

Bicycle advocates calculate that, nationwide, non-motorized transportation, such as bicycling and walking, already reduce greenhouse gas (GHG) emissions as much as 12 MMTCO2 per year, with potential GHG reductions from future increases in non-motorized transportation between 33 and 91 MMTCO2 per year.(22) Non-motorized transportation infrastructure is relatively inexpensive compared to other types of transportation

investments, though a lack of comprehensive data has until now hampered cost-effectiveness calculations of such investments on a national level.

Portland, Oregon invested substantially in both bicycling and data collection, and has documented GHG reduction benefits from these investments. Between 1992 and 2008, bicycling increased at an annual rate of 10 percent while the city constructed 300 miles of bikeways through a $57 million investment. The Rails-to-Trails Conservancy calculates that bicycling in Portland could reduce GHGs by 0.73 MMTCO2 by 2040, with a net economic *benefit* of $1.2 billion from fuel and health care cost savings from an investment of about $7 per resident per year.(23) These calculations do not include benefits from trips longer than three miles or co-benefits such as road infrastructure savings, congestion relief, avoided traffic injuries, health benefits from reduced air pollution, and increases in real estate values, which have all been associated with investments in bicycle and pedestrian infrastructure.

3.3 Smart Growth and TDM Can Reduce Overall Household Costs

Residents of smart growth communities tend to spend 20-40% less on transportation than in more automobile-dependent communities, and if smart growth policies include affordable housing strategies (such as reduced and more flexible parking requirements, increased allowable density and building types, and utility fees that pass on the public service cost savings of more compact development to residents), resident can save substantially on combined transport and housing costs. These savings can lead to substantial net benefits to lower income households, and for many industries, particularly those that rely on numerous lower-wage workers. (24)

The Center for Neighborhood Technology (CNT) has shown that transportation is an integral part of the household budget and transportation costs often decline when housing costs increase. For households, this means that the additional housing cost they incur to live in a walkable area are often much less than what they save by using the alternative transportation options.

Living in a central city means living closer to work, shopping, recreation, schools, and other amenities, and working families living closer to their daily needs can reduce their transportation cost from as much as 37 percent to as little as 22 percent of their income, without a corresponding increase in housing costs. (25) The study has shown that how the location of "working family" homes affects their annual housing and transportation expenditures. Studies have shown that households with one car and access to public transportation annually save an average of $6,251, when compared to an equivalent household with two cars and no access to public transportation.(26) The savings from living in an accessible area therefore represents additional disposable income. As land-use density increases, household VMT decreases, insulating households in denser communities from rising fuel prices and other transportation costs.(27) Indeed, there is growing consensus that more compact, walkable neighborhoods have had substantially less price change since the housing bubble burst in 2007 and 2008 than those located in more sprawling neighborhoods.(28,29)

In addition to lowering overall household costs, smart growth can positively impact vulnerable communities by improving access to jobs for workers without a car.(30) Research has shown that low income workers without cars have very limited job opportunities and have reduced access to the regional economy. Investments in smart growth, particularly transit improvements, can provide high levels of benefits per taxpayer dollar, based on studies of the efficacy of different kinds of programs (e.g., reverse commute programs vs. traditional welfare programs).

3.4 Smart Growth and TDM Can Leverage Private Investment

Transit investments coupled with compact land-use strategies can help attract significant levels of private investment, leveraging scarce public resources toward even higher returns. The Center for Transit Oriented Development estimates $1 in public transit investment can leverage up to $31 in private investment.(31) Little Rock, Arkansas spent $20 million of public money on the Little Rock Streetcar, which helped leverage $200 million in private investment; Tampa, Florida spent $60 million in public money in the TECO Streetcar, which helped leverage $1 billion in private investment; and Portland, Oregon spent $73 million on the Portland Streetcar, which helped attract $2.3 billion in private investments within two blocks of the line, a more than 30- fold return on investment. Thanks to orders from Portland Streetcar, Oregon Iron Works began manufacturing the first U.S.-built modern streetcar in 2008, creating more that 20 new local jobs. In Atlanta, the expected tax revenues of over $500 million from the Atlantic Station development far outweigh the $195 million in upfront costs. Smart growth policies to increase the density of development along public transit lines in Arlington, VA, expanded travel options, improved travel information for users, and strengthened TDM

programs, resulting in a successful transit-oriented community. Due to the high value dense development, 8 percent of County land generates 33 percent of real estate taxes.(32) The economic benefits include millions of square feet of new offices and tens of thousands of new residential units, yet because 89 percent of all Arlington office space and 40 percent of all housing units are in Metro station areas, many roads in the county now carry less traffic than they did in 1996.(33) Moreover, development takes up only two square miles around Metro stations in Arlington that would have covered 14 square miles at typical regional suburban densities, thereby reducing infrastructure costs.

3.5 Smart Growth and TDM Can Reduce Energy Consumption

Smarter growth land use policies and TDM have both a direct and indirect effect on energy consuming behavior. For example, transportation energy usage, the number one user of petroleum fuels, could significantly be reduced through more compact and mixed use land development patterns served by a variety of transportation choices. Improved planning and design could reduce energy demand and also help to increase supply by tapping into renewable energy resources. When we integrate energy considerations into development decisions, we can more effectively address the key way to secure our energy future, which is by reducing energy demand and diversifying supply. (34)

Residential units in more compact counties use 20 percent less energy for heating and cooling than those in more sprawling counties. (35) In addition, smart growth design strategies can help mitigate urban heat islands, reducing heating and cooling requirements for urban buildings. Smart growth strategies can help manage future consumer demand for electricity, which can help electric utilities meet their emissions caps.

3.6 Smart Growth and TDM Can Improve Public Health and Reduce Health Care Costs

Smart growth can improve public health in two ways. First, reduced driving and congestion can improve air quality and reduce the incidence of air pollution related illnesses (e.g. asthma, cancer, respiratory distress). Second, smart growth can reduce the rate of obesity – and attendant health risks such as type 2 diabetes, heart disease, and hypertension -- by increasing activity levels. Since annual health costs for obesity-related problems total over $76 billion, increasing activity levels and reducing obesity can potentially save the U.S. billions of dollars annually through improved productivity, reduced workers compensation claims, and reduced obesity-related health care costs. (36)From 1975 to 1995, the number of trips U.S. adults made by walking plummeted 42 percent, while the annual amount of miles driven in the U.S. has risen 4 times faster than the population. (37) Improving walking conditions and destinations influences whether or not people choose to walk, bike or take transit, for work, play and for running errands, making this a key area of health improvement and a way to reduce public and private health costs.

Ewing, Schieber and Zegeer (2003) find higher per capita traffic deaths in sprawled communities .They estimate that each one percent increase in their sprawl/Smart Growth index reduces the area's traffic fatality rate by 1.5%.(38) Ewing, Pendall and Chen (2003) find that sprawl communities have about 50% higher maximum ozone levels.(39) Durning (1996) and Lucy (2002) found that the higher crash rates of sprawled communities overwhelm other personal risks, making urban locations safer that sprawled suburbs.(40, 41)

3.7 Smart Growth and TDM Increase Tax Revenues and Economic Returns

Because Smart Growth encourages more compact, mixed development, it tends to increase tax revenue per acre, and because it reduces public infrastructure and service costs per unit, it tends to provide greater economic returns to developers and local governments. For example, a fiscal impact analysis study of Sarasota County, Florida showed that county property tax revenue per acre is many times higher for compact, mixed urban development than in low-density, sprawled development, as illustrated in Figure 1. Urban mixed-use high-rise generates 34 times as much tax revenue per acre as a successful shopping mall, and about a 100 times as much as a WalMart. Even low-rise urban development generates far more tax revenue than any suburban development**.** (16)

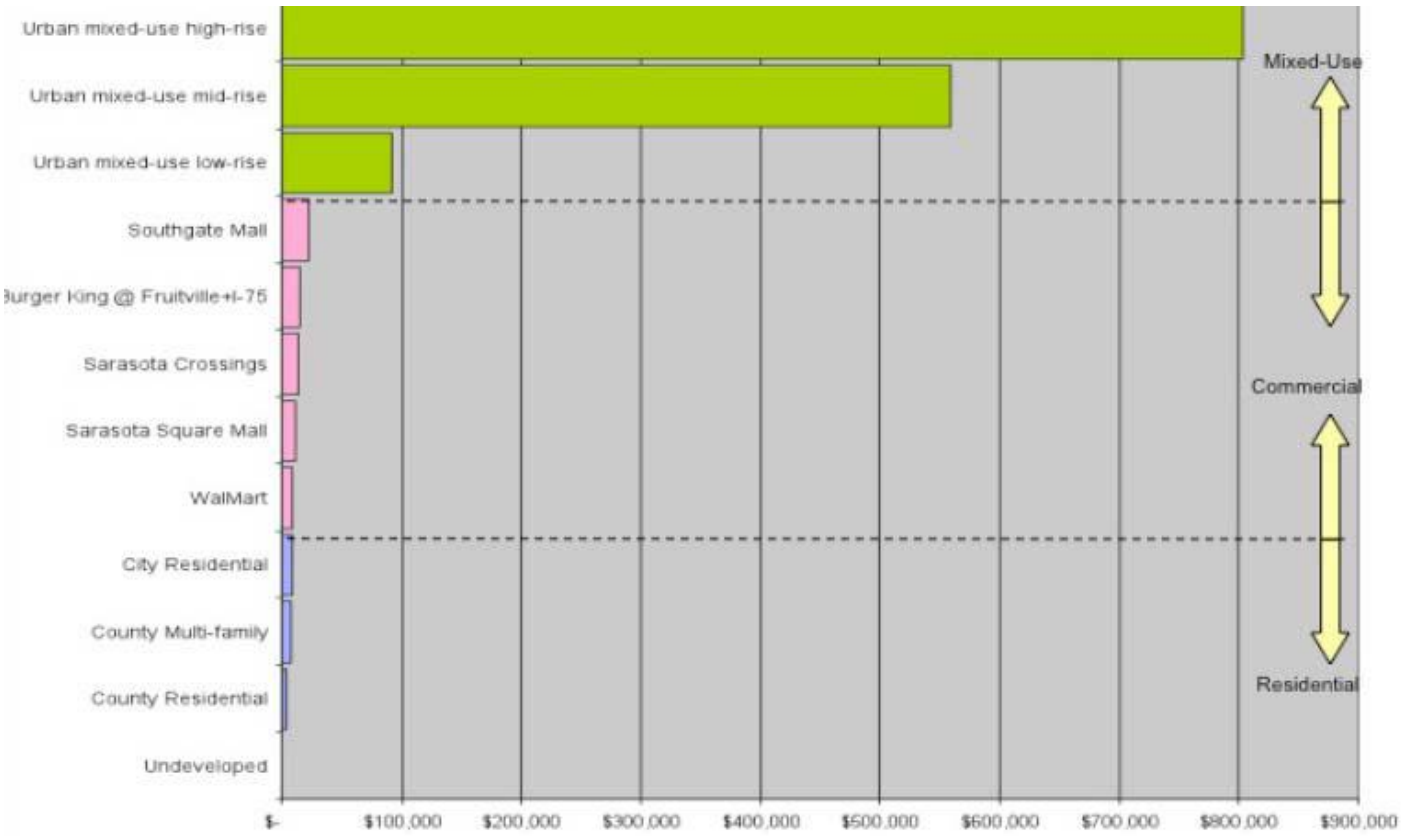

Figure1. Tax Revenue Per Developed Acre (42)

Because infrastructure costs per housing unit are about half as high for compact development compared with sprawl, the annual infrastructure return on investment (annual tax revenue relative to annualized infrastructure costs) is about 35% for compact development, compared with only 2% for sprawled development, so an urban high-rise repays its infrastructure costs in about three years, compared with 42 years for suburban multi-family development. Using real examples in Sarasota County, the study found that 3.4 acres of urban mixed-use development provides the same number of housing units as 30.6 acres of suburban multi-family housing, consuming about one-tenth of the land and only 57% of infrastructure costs, while provide 8.3 times as much tax return.

3.8 Smart Grows and TDM Can Improve Economic Performance

Smart growth and TDM can provide economic development benefits. Land use density and clustering tend to provide agglomeration benefits, which consist of increased productivity due to improved access and network effects. Automobile-dependency increases consumer expenditures on vehicles and fuel, which tends to provide less employment and economic activity than other consumer expenditures, particularly in regions that do not produce vehicles and fuel. by reducing transportation and infrastructure costs, increases productivity, shifts expenditures to more locally produced goods and redeveloping activity centers it tends to increase local employment, productivity, property values and tax revenues, providing a high return on public investments (43).

Ciccone and Hall (1996) have quantified the economic benefit of density, which reduces transportation costs, puts more workers and companies in close contact, and promotes beneficial exchange among workers and organizations. Using county-level data on employment density and state-level data on productivity, they used statistical modeling to estimate that doubling employment density increases average productivity by around 6 percent. More tangibly, they found that workers in the 10 densest states produced $38,782 of value annually while those in the 10 least dense states produced only $31,578 in output– about 25 percent less. Overall, Ciccone and Hall attributed more than half of the variance of output per worker across states to differences in the density of economic activity, rather than other factors like the size of the cities or public investment levels there. (44)

Nelson and Peterman (2000) conclude that metropolitan areas that practice growth management actually can improve their economic performance relative to other regions. To do that, their regression analysis of 182 mid-

sized metro areas in the 1970s and 1980s assessed changes in the relative share of total personal income garnered by 26 metros that were deemed to utilize some form of growth management, whether urban growth boundaries, urban service limits, or regionalized planning. What they found was a positive association between growth management and improved economic performance. Those communities that engaged in growth management realized about a 1-percent improvement in their market share (as measured by personal income) between 1972 and 1992, relative to other metros, all other things being equal. (45)

Carlino (2001) inks denser local economies to increased patenting activity—a key measure of idea generation and economic vitality. Employing multiple regression analysis, his exploration of 1990s data from 270 metropolitan areas reveals that patenting was significantly greater during the decade in regions with higher employment density. For example, the number of patents per capita rose, on average, 20 to 30 percent in a metro for every doubling of density. Given that local employment density varied by 2000 percent in this sample, Carlino's results imply that denser places are enjoying significant innovation edges over less-dense competitors. (46)

Research by the National Association of Local Government Environmental Professionals (NALGEP 2004) and the International Economic Development Council (IEDC 2006) identify several ways that sprawl can reduce business profitably and competitiveness and how smart growth can supports economic development. As a result, business attitudes are shifting in favor of smart growth policies. This research indicates that: (16)

- Quality of life is critical to business- business leaders emphasize that quality of life directly affects their bottom line and that sprawl undercuts their employee's quality of life. For example, the Silicon Valley Manufacturing Group and BellSouth have a commitment to smart growth strategies that provide transportation and housing choices for their employees, because they know that they must improve local quality of life to attract and maintain a highly qualified workforce.
- Reinvestment in established communities makes business sense- Businesses are promoting reinvestment in established communities and existing infrastructure over the costly approaches of providing new infrastructure to new growth areas. These investments are reducing costs and boosting profits over the short- and long-term.
- Smart growth is an emerging market opportunity- Retailers, developers, and other businesses are pursuing smart growth market opportunities to gain competitive advantage, tap new customer demand, and increase profits.
- Leading businesses seek to improve growth management in their regions- Business leaders are joining with localities, states, and grass roots organizations to encourage smart growth planning and management.
- Smart growth sells in both up and down economies - Businesses are making long-term investments in smart growth because smart growth makes economic sense in both growing and slowing economies. Smart growth projects are often stable investments, smart growth services sell, and smart growth public policies help avoid the costs and inefficiencies of sprawl.

3.9 Smart Growth and TDM Can Increase Equity

Smart growth and TDM strategies have a wide range of equity impacts. Many strategies support equity objectives by improving travel choices or affordability to disadvantaged groups. Others support some equity objectives but contradict others, such as HOV facilities that seem unfair to motorist but benefits disadvantaged groups. The overall equity impacts of pricing strategies depend on how prices are structured, how revenues are used, and the quality of travel alternatives. (1)

For example, parking pricing can benefit lower- income people if there are good travel alternatives, revenues are used progressively, and if it helps reduce their traffic problems (47). Nearly all TDM strategies benefit people who are transportation disadvantaged indirectly by increasing travel alternatives. Virtually any Smart Growth or TDM program can be designed to achieve equity objectives. Some strategies require subsidies, which can be considered horizontally inequitable. However, such subsidies are often less per capita than current subsidies for driving (road and parking facility expenses, and other external costs). If so, subsidies for programs that benefit non-drivers increase horizontal equity. (1)

3.10 Smart growth and TDM Preserve Greenspase

Some researchers have made persuasive arguments that the provision of green infrastructure (parklands, greenways, and trails) should be equated with the provision of sewer and water lines, roads, and schools (so-

called gray infrastructure) (48) because it provides a variety of economic, social, cultural environmental and aesthetic values.

Brabec (1992), Lerner and Poole (1999), Crompton (2002), Geoghegan (2002), and Tajima (2003) conduct and summarize studies that document higher real estate values closer to parks, greenways, and preserved open space in urban areas. These studies indicated that land preservation can actually expand the property tax base. In the long run, land preservation can end up costing residents less than they would pay to provide public services to developed land (49).

Greenspace preservation helps improve water quality and groundwater recharge, reduce stormwater management costs, and reduce heat island effects. Many people value having traditional farm activities in their communities, and value being able to purchase locally produced food. Many people value the preservation of historic sites, unique natural features and attractive views, and these are important to the economy of many communities (for example, as tourist attractions). Many geographic areas have unique ecological features and habitats that are threatened by sprawl. Urban sprawl and excessive vehicle traffic can threaten the attributes that make a place special and attractive, and therefore increase land values and economic activity. These are all additional values from greenspace that Smart Growth can help preserve, which are not recognized by critics. (50)

4. Criticism of Smart Growth and TDM

Smart Growth and TDM represent fundamental changes in land use and transportation planning, so it is not surprising that they are often face heated criticism. Some criticism concerns specific technical issues, such as the best way to implement a particular strategy, but other criticism is broader, attacking the fundamental assumption that society can benefit from reduced sprawl and driving. This is sometimes presented as a conflict between motorist and transit interests.(51)

Critics assume that existing policies are overall neutral, and so current land use and transport patterns reflect consumer preferences, and Smart Growth policy changes are therefore harmful to consumers and the economy. But there are many existing market distortions that tend to increase land use consumption and motor vehicle travel. Many Smart Growth strategies are market reforms that correct these distortions, and so tend to increase efficiency and equity, making consumers and the economy better off overall. Other strategies, such as regulations and favorable tax policies and public investments to support Smart Growth, may be justified on second-best grounds until all market-based reforms are fully implemented and their full effects have had time to occur.(50)

Some criticism concerns the goals of Smart Growth, others with the methods used to achieve these goals. Critics can be divided into two general groups: those that oppose a particular aspect of Smart Growth out of self-interest (i.e., they or their industry will lose benefits or bear costs), and those that have an ideological opposition, on the assumption that Smart Growth increases government intervention in a free market.

A comprehensive analysis of all criticisms is beyond the scope of this research. However, some of them will be outlined and brief rebuttal will be presented.

- **'Smart Growth' is just another expression for 'no growth'**.

  But Smart Growth recognizes that both population growth and land development are unavoidable. Responsible planning will mitigate the worst impacts of this growth, and could even result in a better life for our children than the one we enjoy today.

- **Smart growth is anti- suburb.**

  But Smart growth encourages development that meets different objectives in various locations, including suburbs, downtown, and in between.

- **Smart growth increases red tape, slows the approval process, and increases project costs.**

  By streamlining development regulations and permitting procedures, municipalities can reward smart growth developers with speedier approvals, and increased predictability.

- **Smart growth does not satisfy market demand for low-density, single family development.**

  But Recent demographic and lifestyle shifts mean that 2-adult, 2.5- child, middle-class families no longer dominate housing markets. In fact, the emergence of smaller families, empty nesters, childless marriages, singles and aging boomers has created a shortfall in the availability of alternative housing options.

- **Urban growth boundaries mean higher housing prices.**

But concentrated growth and higher densities mean more housing options, a greater supply of dwelling units, and thus lower housing prices. Integrate urban growth boundaries with other smart policies that support more affordable housing options.

- **Smart growth means more high rises.**

But Smart growth supports housing options and promotes good urban design that integrates higher density with adequate open space, a pedestrian friendly environment, and traffic calmed streets. High rises are considered appropriate only in some places.

- **Smart growth is harmful to the economy.**

But smart growth can increase economic efficiency and productivity, and is associated with higher incomes and economic growth.

- **Smart growth reduces freedom.**

But many smart growth strategies reduce existing regulations and increase various freedoms. Overall, smart growth tends to increase more freedoms than it reduces, for example, by allowing more flexible development designs and providing more consumer travel options.

- **Public transit investments are not cost effective.**

but this overlooks the fact that transit ridership tends to be greatest on major urban corridors where congestion is greatest, that improving public transit is often more cost effective than highway capacity expansion, that smart growth and TDM strategies can increase transit operating efficiency and ridership, and that transit provides many other benefits to society. When all cost costs and benefits are considered, smart growth and TDM programs that improve transit service and encourage transit ridership are often the most cost effective way to improve transportation systems.

5.conclusion

The rise of sprawl and automobile dependency and the ensuing economic, social, and environmental consequences have challenged the urban experts to seek solutions to combat this problem. To do so, random solutions were proposed until the last decades of 20th C when the smart growth, as a comprehensive approach to stop the growth of sprawl, and TDM strategies, as to sustainable transportation and reduce automobile dependency , have been implemented in some cities.

Smart Growth and TDM include more than 40 strategies to encourage more efficient use of land and transportation resources. Most reflect market principles of consumer choice, cost-based pricing and economic neutrality. They give consumers incentives to choose more accessible homes and reduce driving. Consumers can benefit directly from financial savings, improved choice, reduced congestion and safety; and indirectly through public savings and environmental improvements. These reforms tend to increase consumer welfare and equity. Even strategies that increase user fees can increase vertical equity if revenues are used in ways that benefit disadvantaged people. Blunt strategies, such as restrictions on development and vehicle use, may be justified as second-base solutions until more efficient market reforms are implemented.

Smart Growth and TDM strategies are often evaluated individually, but they tend to have synergetic impacts, and so can be much more effective if implemented as a coordinated package.

Like any new practice, TDM and Smart Growth can be implemented ineffectively and have unexpected consequences. It is therefore important that they be carefully planned. this paper does not prove that all Smart Growth and TDM strategies are always appropriate, but it suggests that in many situations they are justified and can provide significant direct and indirect benefits to individuals and society.

Although the choice and execution of smart growth and TDM strategies have been successful in some countries, utilizing them as a long-term solution to organize the urban areas of our country will be fruitful if all aspects are taken into account and their principles and techniques are updated in proportion with changes in outlooks, lifestyles, and regional differences. Consideration of smart growth approaches and TDM in urban and transport planning in current conditions can greatly promote urban development strategies.

References

1.Litman.Todd .(2000). *An economic evaluation of smart growth and TDM : social welfare and equity impacts of efforts to reduce sprawl and automobile dependency*.Victoria Transport Policy Institute. Novamber 9. (www.vtpi.org).

2. Gebel K., King L., Bauman A., Vita P., Gill T., Ridby A. AND Capon A (2005). *Creating healthy environments: A review of links between the physical environment, physical activity and obesity*. NSW Health Department and NSW Centre for Overweight and Obesity. Sydney. Australia.

3. Humpel, N., Marshall, A.L., Leslie, E. et al. (2004). *Changes in neighbourhood walking are related to changes in perceptions of environmental attributes*. Annals of Behavioural Medicine, 27:60–7.

4. Humstone, Elizabeth. (2004). *Sprawl-smart growth: the power of the public purse.*Communities&banking.summer.

5. Newman, P. & Kenworthy, J. (1998). *Sustainability and Cities; Overcoming Automobile Dependency*, Island Press (www.islandpress.org).

6. Wickham, J & Lohan,M.(1999). *The Social Shaping of European Car Systems*, Employment Research Centre, Trinity College Dublin; (www.tcd.ie/erc/cars/reports.html), European Commission.

7.Litman.Todd & Laube, Felix. (2002). *Automobile dependency and economic development*.Victoria Transport Policy Institute.6 Augest. (www.vtpi.org).

8.Burchell, R. et al .(1998). *The Costs of Sprawl—Revisited*. Transportation Research Board. Report No. 39, Washington DC, National Academy Press.

9.Litman, Todd. (2011). *Smart growth reforms:changing planning, regulatory and fiscal practices to support more efficient land use.*Victoria Transport Policy Institute. 6 Jaunuary. (www.vtpi.org).

10. Puget Sound Regional Council. (1995). *VISION 2020*. Growth Management, Economic and Transportation Strategy for the Central Puget Sound Region." Adopted 25 May.

11. Yongseok Kim, Heewon Lee, Hyerim Suh. (2004). *A Study on the Concept of Smart Growth and Its Implication*, Journal of Daejeon-Chungnam Chapter of Architectural Institute of Korea, AIK, Korea.

12.ACT Canada. (2008). *The case for TDM in Canada: transportation demand management initiatives and their benefits* .Association for Commuter Transportation of Canada.Octobr.

13.World Bank .(1996). *Sustainable Transport; Priorities for Policy Reform*, World Bank (http://www.worldbank.org/).

14. TDM Enclopedia . (2010).*Sustainable transportayion and TDM; planning that balances economic, social and ecological objectives*. Victoria Transport Policy Institute.12 Novamber.(www.vtpi.org).

15.TDM Enclopedia. (2010). *Land use impacts on transport ; how land use patterns affects travel behavior*. Victoria Transport Policy Institute.(www.vtpi.org).

16.Litman, Todd. (2010). *Understanding smart growth savings; what we know about public infrastructure and service cost savings, and how they are misrepresented by critics.Victoria Transport Policy Institute.*6 July. (www.vtpi.org).

17. Frank, James E. (1989). *The Costs of Alternative Development Patterns: A Review of the Literature.*Washington: Urban Land Institute.

18. Duncan, James, and others. (1989). *The Search for Efficient Urban Growth Patterns: A Study of the Fiscal Impacts of Development in Florida.* As discussed in Office of Technology Assessment.

19. Speir, C & Stevenson,K. (2002). *Does Sprawl Cost us All? Isolating the Effects of Housing Patterns on Public Water and Sewer Costs*. Journal of the American Planning Association 1(68): 56-70.

20. Burchell, R. and Mukherji, S. (2003). *Conventional Development Versus Managed Growth: The Costs of Sprawl*. American Journal of Public Health.93: 1534–1540.

21. Jacob, J. & Lopez,R. (2009). *Is Denser Greener? An Evaluation Of Higher Density Development As An Urban Stormwater-Quality Best Management Practice*. Journal of the American Water Resources Association (JAWRA), Vol. 45, No. 3, pp. 687-701.

22. *Active Transportation for America: A Case for Increased Federal Investment in Bicycling and Walking*. (2008). RTC, (www.railstotrails.org/atfa).

23. Gotschi, T. (2009). *Cost-effectiveness of Nonmotorized Transportation Investments as a Greenhouse Gas Reduction Strategy*. Rails-to-Trails Conservancy, April .

24. Rodier ,C, et. Al (2010). *Equity Analysis of Land Use and Transport Plans Using an Integrated Spatial Model*. Report 09-08, Mineta Transportation Institute (www.transweb.sjsu.edu).

25. Lipman, Barbara J. (2006). *A Heavy Load: The Combined Housing and Transportation Burdens of Working Families*. Center for Neighborhood Technology (CNT).(http://www.cnt.org/repository/heavy_load_10_06.pdf).

26. Bailey et al.(2008). *The Broader Connection between Public Transportation, Energy Conservation and Greenhouse Gas Reduction*. Requested by: American Public Transportation Association.(http://www.icfi.com/Markets/Transportation/doc_files/public-transportation.pdf)

27. Cortright, Joe. (2008). *Driven to the Brink: How the Gas Price Spike Popped the Housing Bubble and Devalued the Suburbs*. CEOs for Cities .(www.ceosforcities.org/newsroom/pr/files/Driven%20to%20the%20Brink%20FINAL.pdf)

28. Stiff, David.(2008). *Housing Bubbles Collapse Inward*. Fiserv Lending Solution.

29. Realtytrac foreclosure summaries by counties, data converted to foreclosures per 10,000 residential unit. (2009). 10February. (http://www.realtytrac.com).

30. Gao, Shengyi and Robert A. Johnston. (2009). *Public vs. Private Mobility for Low Income Households: Transit Improvements vs. Increased Car Ownership in the Sacramento Region*. Proceedings of the 88th Transportation Research Board Annual Meeting. Washington, DC, January 11-15.

31. Center for Transit Oriented Development. *Jumpstarting the Transit Space Race: How the New Administration Could Make America Energy-Independent, Create Jobs and Keep the Economy Strong*. (http://www.reconnectingamerica.org/public/reports/375).

32. Dennis Leach, personal communication.

33. Leach, D. (2008). *Meeting Community Sustainability Goals Through Coordinated Investments in Transportation and Development*. presented at ICMA.

34. Friedman, Naomi. (2004).*energy and smart growth: it's about how and where we build*. Funders' Network for smart growth and livable communities.

35. Ewing, Reid, K. Bartholomew, Steve Winkelman, Jerry Walters and Don Chen. (2008). *Growing Cooler: The Evidence on Urban Development and Climate Change*. Urban Land Institute.op cit, chapter 7.

36. Center for Disease Control. (2009). *Overweight and Obesity Trends Among Adults*. accessed 7 May. (http://www.cdc.gov/nccdphp/dnpa/obesity/trend/index.htm)

37. McCann, Barbara. and B. Delille. (2000). *Mean Streets 2000*. Surface Transportation Policy Project.(http://www.transact.org/PDFs/ms2000/ms2000.pdf)

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

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

40. Alan Durning .(1996). *The Car and the City*. Northwest Environment Watch , now called the Sightline Institute (www.sightline. Org).

41. William Lucy .(2002). *Danger in Exurbia: Outer Suburbs More Dangerous Than Cities*, University of Virginia (www.virginia.edu); at http://arch.virginia.edu/exurbia/death-inexurbia.pdf.

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

43. IEDC. (2006). *Economic Development and Smart Growth: Case Studies on the Connections Between Smart Growth Development and Jobs, Wealth, and Quality of Life in Communities*. International Economic Development Council (www.iedconline.org); at (www.iedconline.org/Downloads/Smart_Growth.pdf).

44. Ciccone, Antonio, and Robert E. Hall. (1996). *Productivity and the Density of Economic Activity*. American Economic Review 86 (1): 54–70.

45. Nelson, Arthur C., and David Peterman. (2000). *Does Growth Management Matter: The Effect of Growth Management on Economic Performance*. Journal of Planning Education and Research 19: 277–285.

46. Carlino, Gerald. (2001). *Knowledge Spillovers: Cities' Role in the New Economy*. Business Review Q4: 17–24. Available at (www.phil.frb.org/files/br/brq401gc.pdf).

47. John Kain .(1994). *Impacts of Congestion Pricing on Transit and Carpool Demand and Supply*. Curbing Gridlock, National Academy Press (Washington DC; www.nas.edu/trb), p. 502-553.

48. Beatley, Timothy, and Katherine Manning. (1997). *The ecology of place: Planning for environment, economy, and community*.Washington, DC: Island Press.

49. Crompton, John L. (2002). *Parks and economic development*. Planning advisory service report 502. American Planning Association, Chicago.

50. litman,Todd.(2010).*evaluating criticism of smart growth.* Victoria Transport Policy Institute.12 Novamber. (www.vtpi.org).

51. 1000 Friends of Oregon. (1997). *Making the Connections: A Summary of the LUTRAQ Project*, 1000 Friends of Oregon .(Portland; www.friends.org).