Smart Mobility: The Cornerstone to Smart Growth

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ABSTRACT

Comprehensive Smart Growth strategies are necessarily multidimensional, but successful community design above all else must find a way to reduce motorized transport and increase transportation efficiency. The authors describe integrated, whole-community, sustainable mobility approaches that can form the foundation for sustainable communities. The paper showcases successful policies and programs used by communities around the world in reducing the negative impacts of vehicle transportation in urban areas. At the core of community-scale Smart Growth is the use of permitting that optimizes efficiency through building location, greater density and mixed-use development. The paper highlights successful experiences where such planning has reduced the need for driving. Smart Growth in terms of buildings alone, however, is not sufficient to achieve sustainable communities. Additional community-wide efficiency programs are needed to complement the benefits of efficient building location and design. These include strategies that reduce congestion and improve air quality in urban areas by reducing single occupancy vehicles, increasing the use and efficiency of mass transit, and improving traffic flow. For example, the paper highlights the most effective methods of minimizing the use of single occupancy vehicles, such as car-pooling, telecommuting, the promotion of non-motorized transport, and flexible work schedules. Congestion pricing that increases the cost of driving into downtown areas is one of a number of approaches that not only creates higher occupancy vehicles, but increases the use of mass transit. The paper also describes efficient traffic management systems that improve traffic flow.

Introduction and Overview

Traffic congestion and poor air quality are common problems in urban areas. Many if not most communities – especially suburban communities – were built with orientation toward private cars, thus creating or reinforcing reliance on the automobile as the primary or only option for getting from home to work and other destinations in the community. Government policies in the United States reinforce dependency on the automobile by spending 80 percent of the transportation budget on roads and only 20 percent on mass transit (Tirado 2008).[1]

With record-high oil prices, worsening traffic congestion, increasing travel times, and concern about global climate change and energy security, there is growing interest and demand for community development that reduces vehicle miles traveled (VMT) and time people have to spend in the car. A growing number of communities worldwide want to reduce the negative impacts of sprawling land use and urban growth patterns that have left people highly dependent on personal vehicles. One of the best ways to minimize these negative impacts is to reduce the VMT in a community and its surrounding areas. The communities that are most successful at reducing VMT use a combination of strategies – based on Smart Growth principles and smart mobility – that support and strengthen the entire system connecting various parts of the community, enabling it to thrive.

[1] Paraphrasing from statements in this article made by former Governor Parris Glendening.

Changing long-standing transport and land-use patterns in industrialized economies demands integrated policies, actions, and investments on many levels. The same is true for redirecting the growth patterns in emerging economies so they do not fall into the trap of dispersed land use that necessitates reliance on personal vehicles. The integration of such approaches that can change transportation habits and expand mobility options in a way that reduces VMT presents challenges and opportunities for established as well as developing communities. This paper explores those opportunities, and documents and evaluates the experience of how communities have contributed to the Smart Growth movement with what we call "smart mobility" strategies that decrease the use of single-occupancy vehicles, decrease transport-related fuel use, and increase transport-related energy efficiency. Smart mobility integrates more energy-efficient transportation options with community design and development that enables and encourages less driving.

The obstacles to smart mobility range from budgeting policies that favor driving, and inflexible zoning and permitting laws and lending practices that discourage mixed use building development, to lifestyle inertia that does not seek alternatives to driving as the primary means of mobility. While an in-depth analysis of these barriers is beyond the scope of this paper, we highlight some salient examples of how communities have addressed these challenges to Smart Growth and smart mobility.

Evaluation of Strategies

Strategies that improve access to alternatives to driving solo work best when they are complemented by strategies that improve the quality, reliability, and affordability of higher-occupancy and mass transit mobility options. Using specific examples from cities and states documented in this paper, Table 1 shows how access and mobility strategies work in tandem. Rather than examining the experience of a few communities in-depth, this paper shows the breadth of strategies used in different communities in the United States and selected other countries. In targeting this "breadth" it was not always possible to identify all of the strategies being used in parallel in each given community, although the communities that had the best results were typically those that used a number of different strategies.

Table 2 rates the potential of each strategy to achieve certain policy goals. The ratings of low, medium and high are based on the examples of these strategies documented in this paper. The potentials are rated in ranges, for example "low to medium" in cases where the practical implementation of a strategy might be on a small scale (hence the "low" end of the rating) but the overall effect in meeting the goal could be significant (the "medium" end of the rating) if the strategy were to be used more widely. For some examples, as with the commute trip reduction program in Washington state, the potential to reduce VMT and air pollution was quantified, so the ratings are based on quantified results, whereas other ratings are based on qualitative estimates of potential to reduce VMT, congestion, and costs of building more roads and energy-consuming community infrastructure.

How Communities Embrace Smart Mobility

Change in favor of smart mobility is both achievable and particularly tangible at the community level. Transit oriented design and development (TOD) experience shows that coordination and integration of policies and community planning affecting transportation, the

built environment and land use is possible and successful in advancing Smart Growth. According to former Maryland Governor Parris Glendening, an enthusiastic advocate of Smart Growth, "there is such a range of tools [to help reduce sprawl], but the feeling is that what seems to work best across the country is a series of incentives" (Tirado 2008).

Table 1: Examples of Smart Mobility Strategies at the City and State Levels Examined in this Paper

Strategy	Boulder	Portland	Boston	California	London	Curitiba	Bogota	Minnesota	Oregon	Washington
Higher density & mixed use TOD	X	X	X							
Better mass transit options	X	X								
Transit benefits/passes	X									
Bicycle paths		X								
Pedestrian zones		X								
Parking limits		X								
Transportation Access Plan Agreements			X							
Climate protection plans			X							
Car sharing										
Congestion pricing	X	X		X	X					
BRT			X	X		X	X			
Carpool lanes	X			X						
Employer-based incentive programs	X							X		X
PAYD insurance									X	

Employers have an important role to play in enabling smart mobility with incentives for their employees to drive less. Awareness programs that reward cities with recognition for environmental stewardship, innovations in sustainable community development and related achievements that designate them as "most livable" give community leaders incentives to compete with other towns for favorable recognition, desirable investments and jobs. Policies and measures that increase the cost of driving single-occupancy vehicles and improve the quality and reliability of mass transit or high-occupancy transport give drivers an incentive to choose smarter mobility options. Media coverage of smart mobility success stories increases public awareness and demand for it.

Due to the diversity of needs in a community, a comprehensive and integrated set of policies, measures and projects is necessary for smart mobility to work. Disincentives to drive need to be countered with incentives to use mass transit or non-motorized mobility options. The relative costs in terms of time and money factor most heavily into personal decisions about what form of transportation to use.

As the following examples show, citizen participation in community design and decision-making is critical to Smart Growth's and smart mobility's success. Moreover, the connection between energy and Smart Growth, and the quality of community life, is strengthened by smart mobility.

Table 2: Examples of Smart Mobility Strategies at the City and State Level and Their Potential Impacts

Strategy	Potential for: Reducing VMT and GHG	Reducing congestion	Decreasing Infrastructure Costs
TOD	Medium to high	Medium	High
Restricted parking	Low to medium	Low to medium	Medium
Bicycle paths & pedestrian zones	Low to medium	Low to medium	Low to medium
Car sharing	Low	Low	Low
Congestion pricing	Medium to low	Medium to high	Low to medium
Mass transit expansion	Low to medium	Medium to low	Medium
Carpool lanes	Low to medium	Low to medium	Low to medium
Transit benefits	Low to medium	Low to medium	Low to medium
Teleworking	Medium	Medium	Medium
Carpooling programs	Medium	Medium	Low to medium
PAYD insurance	Low to medium	Low to medium	Medium decrease of insurance costs

Strategies that Focus on Access

If people have access to resources – work, shopping, and community life – by convenient means other than driving, and if the cost of driving in terms of time and money increases, the expectation (and outcome as shown in the examples below) is that people will choose the smarter mobility option. Communities that focus on access make smart mobility possible and preferable by introducing measures that increase the cost and reduce the convenience of driving. An increasingly popular tool for creating better access is transit oriented design (TOD) and development.

TOD integrates buildings, land use, and transportation systems in favor of non-motorized transport in densely developed community centers with convenient access to a train station and other mass transit options. Different types of density are needed to meet community goals, and poorly planned density that fails to provide the desired access to resources can exacerbate transportation problems. Zoning for mixed-use buildings, pedestrian-only areas, bicycle lanes, and limited parking will affect the choices people have and the decisions they make regarding transportation.

According to research by John Holtzclaw (Holtzclaw 2000), the average resident in a high-density neighborhood in the San Francisco Bay area will drive 20 to 30 percent less than residents in neighborhoods half as dense. Density also reduces infrastructure costs per housing unit. According to the Urban Land Institute, the combined cost of utilities, schools and streets costs around $90,000 per housing unit when density is one dwelling per four acres, but drops to $10,000 per housing unit for development of 30 dwellings per acre (Local Government Commission of Sacramento 2003).

Studies of urban area development show that neighborhood design has direct influence on car ownership and use, and that individuals living in densely populated communities with mixed-use development and easy, pedestrian-friendly access to mass transit reduce their driving by 15 to 50 percent (Environmental and Energy Study Institute 2004).

One may argue that many people prefer to live in strictly residential zones and drive to their workplaces and community destinations, but advocates of TOD contend that once people experience more pedestrian-friendly, less car-dependent communities, they demand more such TOD spaces. Visual preference surveys reveal that concerns people have about density are related to insensitive design that creates traffic problems, lacks open space, etc. (TOD Advocate). Community leaders and policy makers can facilitate successful TOD by reforming restrictive zoning policies, anticipating project impacts and mitigating them, and engaging citizen participation throughout the design and development process.

The energy-efficiency benefits of TOD deserve closer study and publicity, especially now when record-high energy costs and trends in climate changes grab headlines and public attention on a global scale. While an in-depth analysis of these benefits is beyond the scope of this paper, available documentation of TOD shows that energy-efficiency improvements resulting from this design approach are relevant to addressing growing concerns about oil dependence and the economic impacts of rising energy costs. The following examples provide some insight into how TOD enables smart mobility that improves energy efficiency.

TOD in Boulder, Colo. A survey of three mixed-use zoning areas reveals that within the first two years since the TOD was completed, between 2000 and 2002, twice as many people used the bus to get to work, since most developments were located by two of the area's bus services. There was no change in the percentage of people who drove alone or walked, and fewer people carpooled and biked. It is possible then that some of the people carpooling or biking chose to bus instead, thanks to the improved access to frequent bus service. The number of vehicles available per household sank from 1.8 to 1.5. The mode and frequency of one-way daily trips per adult household member averaged 3.2 by car and 2.7 by bike or on foot. The number of respondents holding transit passes (called eco-passes in Boulder) increased from 39 percent in 2000 to 52 percent in 2002. Most eco-pass carriers received them either from work (up to 26 percent from 11 percent) or through a neighborhood program (11 percent in 2002 vs. 4 percent in 2000) (City of Boulder 2003).

TOD in Portland, Oreg. The city of Portland is widely hailed as a model for well integrated urban planning that exemplifies smart mobility. The city's design and development emphasizes access to efficiently run light rail, streetcars, and buses; to bicycle lanes and paths (750 miles); and to pedestrian zones that have together demonstrably reduced the portion of city residents commuting alone by car. In the decade from 1996 to 2006, cycling traffic in the city increased by over 250 percent, the use of mass transit increased 65 percent, and the projected 40 increase in congestion never materialized (Warsi 2006). Portland's strategy was to rezone the areas around rail stations for mixed-use development (Mehaff 2003) and enforce a set of parking policies that would discourage unnecessary automobile use.

The parking scheme is innovative. In contrast to many cities that impose parking minimums on developers, Portland has low parking maximums. The ratio of maximum parking spaces per area of building space varies depending on the availability of transit options and the type of use (retail, residential, office or restaurant). Although there are some areas of Portland with parking minimums, there are no minimum parking requirements where mass transit is accessible within 500 feet (Metropolitan Transportation Commission 2007). The City of Portland provides no parking to its employees other than car pool parking, giving employees a choice between that or transit passes, and it encourages businesses in the city to do the same.

Planning strategies in Boston, Mass. Towns in the Boston area use a variety of legal agreements and planning tools to encourage smart mobility. The Boston Transportation Department negotiates Transportation Access Plan Agreements (TAPAs) for large projects and institutional master plans that are then reviewed by the Boston Redevelopment Authority. Transportation demand management (TDM) measures are an integral component of the TAPAs. TDM aims to reduce dependence on, and trips taken with, private cars and encourage use of mass transit instead.

The Metropolitan Area Planning Council prepared planning guides for citizens and planners on mixed-use zoning that are designed to raise awareness and encourage uptake of TOD and mixed-use zoning. The guides showcase successful examples of mixed-use in Boston area towns, and emphasize that such zoning and planning is most likely to work if the impetus comes from a large-scale community effort. A toolkit in the Planner's Guide suggests using an overlay district as a zoning approach that "encourages coordinated, cohesive development across lots and through lot consolidation. Rather than allowing piecemeal development, it encourages a sense of place over a larger area" (Metropolitan Area Planning Council).

Community climate protection plans are useful tools for Smart Growth and smart mobility planning. A good example in the Boston area is Cambridge's plan that presents: trends in vehicle travel and ownership; development objectives; experience with and projected results from various measures to reduce traffic; and short-, medium- and long-term actions to take. The plan's authors note that there is considerable evidence that negative incentives like limits on parking are more effective than positive incentives such as nicer sidewalks to decrease driving, and while there is strong community support to reduce traffic, public opposition to such measures has often impeded their implementation (City of Cambridge).

Strategies to Manage Mobility

There are various approaches that communities use to manage the volume and flow of traffic that promote smart mobility and encourage alternatives to single-occupancy vehicles. Some of the most effective measures are congestion pricing and improvements to alternative transportation modes. Some of these approaches are community-driven, while others such as carpool lanes on state and inter-state highways and pay as you drive insurance are initiated at the state or federal level. The integration of several different measures can be particularly useful when combined with community-based marketing and outreach to encourage smart mobility.

Congestion pricing. This form of road pricing discourages drivers from entering the most densely trafficked areas in and around town by charging them a toll. The congestion price may vary depending on the time of day and the number of occupants in the vehicle. Some of the revenue from congestion pricing is often used to fund related transportation improvements such as expansion and enhancements of mass transit.

The judicious allocation of revenue can go a long way in addressing the first challenge to congestion pricing: opposition by the pubic. The most appropriate uses of the funds collected will depend on the local situation. In areas with significant numbers of low-income residents, or with a population sensitive to taxation, the revenue might be used to offset regressive taxes such as sales taxes, and/or to fund tax credits for the poor. Where traffic congestion is of paramount concern, the funds might be allocated toward making the public transit system more convenient.

Public opposition can also be addressed through a public awareness campaign explaining that congestion pricing has been proven to save motorists driving time and fuel costs. This has been demonstrated by a study of the system of four toll roads in Southern California (Munroe 2006). Setting prices requires a balance between being too low to be effective and being so high that traffic is inordinately curtailed and public resentment is generated. Likewise, the penalty for non-compliance must be high enough to be taken seriously.

The City of London's congestion pricing program introduced in 2003, the first in a major European city (though not the first in the world),[2] has received accolades from around the world because it demonstrably reduced traffic problems, resulted in a shift from single-occupancy cars to mass transit or other modes, and garnered significant community support in spite of strong opposition at the beginning. Automobile traffic in the congestion priced zone declined by 20 percent within the first few months, corresponding to 20,000 fewer vehicles per day, and a decline in the car's modal share from 12 to 10 percent, while traffic on the peripheral roads increased by 10 percent without increasing congestion (Litman 2006). Congestion-related delays related to the affected zone fell by 30 percent overall and by 50 percent for buses, while bus ridership rose by 14 percent and light rail use by 1 percent (Litman 2006).

The community's involvement in the London program was intense, both in favor of and against the measures. While some of the most vociferous opponents feared adverse economic impacts on local business, studies find that the overall impacts have been minimal (Litman 2006). Congestion pricing schemes are now being proposed, piloted, or are already implemented in other large cities around the world, from Stockholm to Seoul to Singapore and San Francisco.

Improvement and expansion of mass transit. Urban communities that invest in quality mass transit networks that are reliable, conveniently located, and competitively priced enable smart mobility alternatives to driving. Light rail and bus rapid transit (BRT) systems that link people and places over a wide metropolitan area become viable and attractive options when commuters can make better use of their travel time than they do in the car. In order to convince commuters to get out of the car and onto the train or the bus, the reduction in travel time is a significant factor. The increasing availability of computer plug-ins, WiFi and cell phone reception may help, especially as the reliability of these services improves with time.

Cities around the country are expanding their mass transit systems and there are an increasing number of TOD projects to facilitate access to them. In addition to upgrading and expanding light rail where it already exists, BRT systems offer an increasingly popular alternative to driving. BRT has higher quality features than a traditional bus system, such as specially designed buses – called "trunk" or "bi-articulated" buses – that can carry up to 140 passengers per ride, their own exclusive lanes, often with signal priorities at traffic lights. Because BRT generally utilizes or builds upon existing road infrastructure it is less expensive than light rail and thus a more approachable option for many communities.

While there are numerous BRT projects in the United States and around the world, two of the frequently referenced BRT successes are in Curitiba, Brazil and Bogota, Colombia (the latter called the TransMilenio project). Key to the success of these BRT programs was an extensive campaign that engaged the local communities in the projects' design and implementation. In terms of energy efficiency and smart mobility, both projects have some impressive results as well as some challenges.

[2] Singapore's congestion pricing scheme was the first widely known in the world, and its electronic pricing scheme is varied automatically according to time of day, day of the week, and traffic conditions.

The system in Curitiba was introduced in the 1980s and is used by 85 percent of the city's population, 75 percent of weekday commuters (Friberg 2000). Fuel consumption is 30 percent lower than in eight comparable Brazilian cities. Curitiba's BRT system is powered by diesel (as is Bogota's), so there is still room for environmental improvement, although analysts attest that the reduced number of cars makes up for the difference in carbon emissions (Scientific American 2003).

In Bogota, the mayor who introduced BRT and his successor were instrumental in garnering public support, and they emphasized strengthening of institutional infrastructure for BRT as well as for pedestrian and bicycle use. Key in Bogota's case was the inclusion of traditional transport service providers, without whose support the switch to BRT would not have been possible. Within the first two years (1998-2000) of its implementation, TransMilenio reduced travel time for commuters by 12 percent, increased mass transit use by 1 percent, decreased the modal share of private vehicle trips by 5 percent, increased the share of non-motorized vehicles by 4 percent (Hidalgo and Acevedo 2003).

There are several BRT networks in the United States, some established – Pittsburgh was the first, and many others under development, some of which have been cancelled – in Virginia Beach and Honolulu, for example – due to funding issues, concerns about impacts on local business due to conversion of certain streets to busways, and other issues. The BRT option in many communities from San Diego to Minneapolis to New York City will be an important enabler of smart mobility.

Carpool lanes. Much like the BRT concept that gives preference to buses, many states have established carpool lanes – also called high-occupancy vehicle (HOV) lanes – that can only be used by vehicles carrying two, three or more occupants during peak travel times. The federal transportation bill signed by President Bush in 2005 allows states to offer HOV exemptions to drivers of selected models of hybrid vehicles, and at least eight states offer such exemptions, although some studies have shown that this allowance negatively impacts the flow of traffic in carpool lanes, and it does not reduce driving (Varaiya 2007). The way that the carpool lanes are designed also affects use and effectiveness in encouraging carpooling. An in-depth study about HOV lanes in California showed that they are not very effective unless offered as double or more lanes because the speed of a single HOV lane is determined by the slowest drivers (Varaiya 2007). While carpooling lanes are not necessarily a community initiative, the communities that border on HOV-restricted expressways can facilitate smart mobility by providing incentives for carpooling and using mass transit.

Strategies that Give Tangible Incentives

Incentive programs encouraging smart mobility are instrumental in enabling Smart Growth, and the community plays a central role. Communities, especially businesses and agencies that are employers, can directly or indirectly leverage incentive programs established by the state and federal governments. Some specific examples include transit benefits, telecommuting, mileage based vehicle insurance, and carpooling incentive programs.

Transit benefits. In the United States, federal legislation allows employers to offer their employees transit benefits up to US$115/month and parking benefits (for parking at mass transit facilities) up to US$220/month – either tax-free or pre-tax. As this is a voluntary program, it is

then up to employers to decide if they will offer this benefit. Employers have an incentive to offer the benefits because it can strengthen recruitment and retention, and in some states the employer also gets a state income tax credit. For example in Minnesota, employers offering the transit benefits can reduce their state tax bill by 30 percent of the expenditure they make on bus passes or vanpool expenses for employees.

Teleworking. Another way to reduce congestion is to have employees work from home full or part time. Teleworking, also called telecommuting, is increasingly common in the United States. While there are many advantages to teleworking, reducing traffic congestion and air pollution are the two most frequently cited. The National Environmental Policy Institute estimated that if 10 percent of the workforce in the U.S. worked from home one day a week, 1.2 million fewer gallons of fuel would be used and almost 13,000 tons of air pollution would be avoided (DVRPC 2003).

Employers benefit from a reduced need for expensive office space and reduced absenteeism, especially in areas where inclement weather keeps employees at home unexpectedly. The barriers to teleworking are numerous but are generally tied to ingrained managerial disincentives and cultural biases that can be overcome by directly addressing them. The employers in a community need to decide on their own if teleworking is a good idea, and the more common it is, the more accepted it will become.

Carpooling incentives. Employers can make a significant difference in the battle against congestion through any or all of a suite of incentives that encourage employees to get to work by means other than solo driving. Probably the greatest leverage an employer has, at least in congested communities, is parking. Employers can best use this leverage by offering parking only to vehicles above a certain occupancy level, or at least by giving the best parking to high occupancy vehicles, or providing parking free of charge to HOVs if there is normally a fee. If an employer has been providing free parking and wants to change that, employees can be offered transit passes in exchange for their parking spaces.

Employers can make car pooling easier by offering a service, preferably web-based, through which employees can find car pooling partners who live nearby and have similar schedules. Some employees are reluctant to give up their solo driving because they need the flexibility to work late or occasionally end their workday at another site. For this the employer can guarantee that employees will be reimbursed for taxi rides home under these conditions.

A step beyond encouraging car pools is to provide the infrastructure for van pooling. For this an employer provides a fleet of vans for people to commute together, rather than having people use their personal vehicles. Someone from each group drives the van, but the employer supplies everything else: the vans and all associated support such as fuel, maintenance and insurance.

The Washington State Commute Trip Reduction (CTR) Program, created by the CTR Law, provides the mandate for this approach as a means to reduce traffic congestion in the state's nine most populous counties. The mandate applies to employers with 100 or more employees at a single site who begin their workday between 6:00 and 9:00 a.m. and work at least two days a week. King County sets an example for other employers in the county by offering a suite of smart mobility commuting options to its staff, ranging from transit benefits to vanpools.

An evaluation of the program's effectiveness was conducted in 2005 (CTR Task Force 2006), with some impressive results:

- The morning commute on Washington State roads was reduced by more than 20,000 vehicles.
- In 2005, there were 126 million fewer vehicle miles traveled statewide, saving 6 million gallons of fuel and avoiding emissions of 3,730 criteria pollutants and 74,000 tons of CO_2 equivalents.
- The percentage of employees at CTR worksites who drove alone to work was 66 percent in 2005. This compares to 75 percent of solo commuters statewide (in 2004) and 71 percent of employees at CTR worksites in 1993. For those employers who began the program in 1993, there was a 14 percent drop in the portion of solo driving commuters by 2005.
- Those CTR employees who always drove alone to work during 2005 were fewer in number by 23 percent from when the program began. For downtown Seattle, the reduction was 35 percent.
- The share of commuters who took the train or bicycled to CTR worksites grew by 44 percent and 21 percent, respectively, from 2003 to 2005.
- The share of CTR employees who telework increased 47 percent from 2003 to 2005.

These results show that employees respond to employer incentives to adopt alternatives to solo commuting, and that a whole community effort that invites participation of local governments and citizens can harness the benefits of smart mobility.

Pay as You Drive (PAYD) vehicle insurance. Under this scheme, vehicle insurance companies may offer policy premiums that are prorated based on how many miles are driven. A diverse group of stakeholders – including local governments and community groups advocating transportation reform – promote PAYD because it provides a wide range of benefits and supports numerous urban planning objectives consistent with smart mobility (Litman 2007).

Due to this broad-based support and advocacy, several states have passed laws that allow PAYD, and a few states also give insurers incentives to offer it to their clients. Oregon's law provides for a limited tax credit to insurers that agree to set up PAYD programs, the idea being that the tax credit helps offset the administrative costs of starting PAYD (Murray 2003). This provision was included thanks to a broad community effort involving consumer, environmental and business groups.

The energy-efficiency benefits of PAYD are estimated to be a reduction in driving of 9 to 10 percent and congestion-related savings of $9 billion annually, while consumers could save an average of 25 percent on their insurance bills (Murray 2003, Litman 2005).

Conclusion

In terms of energy efficiency, smart mobility strategies – especially several such strategies used together – reduce the number of trips and thus reduce VMT, fuel use, and pollution. Examples shown above at the community level attest to the improvements of reduced congestion, lower transport-related emissions, fewer vehicle miles traveled, and less gasoline consumed. Smart mobility initiatives, like Smart Growth, require a community wide effort and they need to be community-driven.

Unless people have access to viable and attractive alternatives to driving alone, the dependency on personal vehicles will remain high and so will other traffic-related problems. Policies at the state and federal level can provide an important framework and sometimes incentive funding in which smart mobility options can be introduced, but implementation and commitment needs to be local.

References

City of Boulder. "Mixed-Use Development Survey." http://www.bouldercolorado.gov/index.php?option=com_content&task=view&id=1492&Itemid=1713.

City of Cambridge. *Climate Protection Plan*. http://www.ci.cambridge.ma.us/cdd/et/climate/clim_plan/clim_plan_5.pdf.

CTR Task Force. February 2006. "2005 Report to the Washington State Legislature." http://www.wsdot.wa.gov/NR/rdonlyres/172087A9-85D1-416B-86C4-33281C7BDE68/0/ CTR_Report_05.pdf.

Deleware Valley Regional Planning Commission (DVRPC). July 2003. "Regional Analysis of What If Transportation Scenarios." http://www.dvrpc.org/LongRangePlan/2030/WhatIfFinal.pdf.

Friberg, Lars. 2000. "Innovative Solutions for Public Transport, Curitiba, Brazil." *Sustainable Development International*. Washington, D.C.: World Bank: 153-156. http://www.worldbank.org/transport/urbtrans/pub_tr/curitiba_summary.pdf.

Friedmann, Naomi. 2004. "Energy and Smart Growth: It's about How and Where We Build." Translation Paper Number Fifteen, Funder's Network for Smart Growth and Livable Communities.

Hidalgo, Dario and Jorge Acevedo. January 22-23,2004. In *Proceedings of the Joint Seminar: Reducing the Impact of Vehicles on Air and Environmental Quality in Cities*, 9-11; 42.

Holtzclaw, John W. June 23, 2000. "Smart Growth – As Seen from the Air, Convenient Neighborhood, Skip the Car," presented at the Air & Waste Management Association's 93rd Annual Meeting & Exhibition, Salt Lake City, Utah.

Hybridcars.com. February 2008. "Carpool (HOV) Lanes." http://www.hybridcars.com/local-incentives/carpool-hov-lanes.html.

Litman, Todd. March 2005. "Efficient Vehicles Versus Efficient Transportation, Comparing Transportation Energy Conservation Strategies." *Transport Policy* 12 (2): 121-129.

Litman, Todd. "London Congestion Pricing, Implications for Other Cities" Victoria Transport Policy Institute, 10 January 2006.

Litman, Todd. "Pay-As-You-Drive Pricing in British Columbia, Backgrounder," Victoria Transport Policy Institute, 6 October 2007.

Mehaff, M., "Making TODs Work: Lessons from Portland's Orenco Station," *Planetizen*, 16 June 2003, online at http://www.planetizen.com/node/92.

Metropolitan Area Planning Council, *Mixed Use Zoning, A Citizen's Planning Guide*, prepared with support from The Minuteman Advisory Group on Interlocal Coordination and the Commonwealth's Priority Development Fund.

Metropolitan Area Planning Council, *Mixed Use Zoning, A Planner's Guide*, prepared with support from The Minuteman Advisory Group on Interlocal Coordination and the Commonwealth's Priority Development Fund.

Metropolitan Transportation Commission. January 2007. "Developing Parking Policies to Support Smart Growth in Local Jurisdictions: Best Practices." http://mtc.ca.gov/planning/smart_growth/parking_seminar/BestPractices.pdf.

Munroe, Tapan. June 2006. "Economic Benefits of Toll Roads Operated by the Transportation Corridor Agencies." http://www.thetollroads.com/home/images/publications/6_15_06_LeCG_Toll_Road_Study.pdf

Murray, Elisa. October 9, 2003. "Is That American? Oregon posts reward for driving less." Great Lakes Bulletin News Service. http://www.mlui.org/growthmanagement/fullarticle.asp?fileid=16582.

Sacramento, Local Government Commission of, in cooperation with U.S. Environmental Protection Agency. September 2003. "Creating Great Neighborhoods: Density in Your Community." Chicago, Ill.: National Association of Realtors. http://www.sierraclub.org/sprawl/articles/designing.asp.

Scientific American. April 28, 2003. "Efficient transportation for successful urban planning in Curitiba."

Tirado, Jessica. "Smart Growth Advances Nationally." http://www.newurbanism.org/newurbanism/smartgrowth.html.

TOD Advocate. "Lessons Learned, Portland, Oregon." http://www.todadvocate.com/todlessons.htm .

Transit Benefits Guide. http://www.mplstmo.org/pdf/TransitBenefits.pdf.

Warsi, S. August 15, 2006. "Where the car is not king." BBC News. http://news.bbc.co.uk/2/hi/programmes/newsnight/4777801.stm.

Varaiya, Pravin. May 2007. "Effectiveness of California's High Occupancy Vehicle (HOV) System." Final Report for PATH TO 6301. Berkeley, Calif.: University of California. http://www.path.berkeley.edu/path/publications/pdf/prr/2007/prr-2007-05.pdf.