Improving Travel Efficiency at the Local Level: An ACEEE Policy Toolkit

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Contents

List of Tables

Abstract

A comprehensive approach to transportation energy efficiency at the federal, state, and local levels must include a combination of strategies targeted at both vehicle fuel efficiency and travel behavior. While the federal government, together with certain states, has taken the lead on vehicle efficiency policies, local and regional policies that expand alternatives to driving are also essential to achieving an efficient and sustainable transportation system.

This report or "toolkit" provides profiles of policies that increase transportation choice, reduce automobile trips, and decrease energy consumption, and can be implemented at the local level. The toolkit provides guidance for local and regional officials involved in land use and transportation planning in addition to state transportation and utility offices that work regularly on transportation efficiency programs. Each policy write-up includes a brief description of the policy, an outline of relevant stakeholders, anticipated costs and benefits, and a case study that exemplifies best practice for project implementation and design. Policies included in this toolkit demonstrate a high potential on their own or in combination with other policies to reduce transportation-related energy consumption at the municipal level.

Introduction

A comprehensive approach to transportation energy efficiency at the federal, state, and local levels must include a combination of strategies targeted at both vehicle fuel efficiency and travel behavior. While new federal fuel economy and greenhouse gas standards will strengthen the market for advanced technology vehicles and dramatically reduce fuel consumed per mile of driving, local and regional policies that reduce the need for driving are also essential to achieve efficient and sustainable transportation.

Americans have relied on the automobile as a primary means of transport since the 1920s. As a result, land use and transportation planning in recent decades has catered largely to the personal vehicle, leading to the creation of large, sprawling suburbs across much of the country, increased highway expansion, and congested downtown areas and highways. Recently, however, Americans have shown signs of changing their travel behavior. Public transit use has increased significantly (T4A 2012), and more and more people are choosing to bike or walk (Alliance for Biking and Walking 2012). To accommodate the growing demand for alternatives to driving, state and local governments must take the lead in providing residents with transportation choices and creating communities that support safe automobile-independent activities. Municipalities, particularly, play a critical role in shaping land use, as they have jurisdiction over zoning laws and regulations. Regional agencies such as Metropolitan Planning Organizations (MPOs) are important to the transportation planning and implementation process, bringing to the table both funding and analytical expertise.

This report or "toolkit" profiles policies that increase transportation choice, reduce automobile trips, and decrease energy consumption, and can be implemented at the local level. The toolkit provides guidance for local and regional officials involved in land use and transportation planning in addition to state transportation and utility offices that work regularly on transportation efficiency programs. Other stakeholders will also benefit from the detail provided in the toolkit, such as community and economic development organizations that have a vested interest in transportation and urban redevelopment issues.

Policy profiles are divided into four categories:

1. Policies to integrate land use and transportation
2. Multimodal infrastructure policies
3. Pricing policies
4. Mode shift policies

Each policy write-up includes a brief description of the policy, an outline of relevant stakeholders, anticipated costs and benefits, and a case study that exemplifies best practices for project implementation and design. Certain policies receive less detailed treatment based on their lower energy savings potential or the lack of municipal or regional jurisdiction over the recommended action. These policies are presented in side boxes throughout the report.

We chose policies to include in this toolkit based on their potential to reduce transportation-related energy consumption at the municipal level, either as freestanding policies or as key elements of a broader strategy to promote transportation alternatives. To provide a sense of cost and benefit for each of the policies included in the toolkit, we relied on *Moving Cooler—An Analysis of Transportation Strategies for*

Reducing Greenhouse Gas Emissions (ULI 2009a). *Moving Cooler* assesses three scenarios for each strategy: expanded current practice, more aggressive, and maximum effort. Expanded current practice assumes expansion of existing practices to reduce greenhouse gases (GHGs) in predominantly urban areas. The aggressive scenario assumes that strategies are implemented sooner, more broadly, and more aggressively. Finally, the maximum effort scenario assumes that GHG reducing strategies are implemented within the framework of major changes in policy and with levels of investment that demonstrate a dedicated commitment to GHG reduction nationally, regionally, and locally (ULI 2009a). These three scenarios are defined differently for each policy mechanism, as shown in the *Moving Cooler* technical appendices (ULI 2009b). Costs and benefits for each scenario were determined at the national level.

We scaled *Moving Cooler's* national savings figures to the metropolitan level, the level at which they are implemented, and calculated per capita costs and savings. Figures in the toolkit correspond to the maximum effort scenario for each policy relative to a business-as-usual scenario and therefore generally reflect the upper bound of energy savings, cost savings, and implementation costs found in *Moving Cooler*. It is important to note that in some cases, *Moving Cooler*'s maximum effort scenario is quite conservative. For instance, energy savings from the car sharing policy intervention amount to less than 1%. Per capita costs and savings are provided in the cost and benefits section of each policy profile. These per capita savings figures consist of fuel cost savings that result from reduced vehicle miles traveled (VMT) or improved traffic flow and non-fuel vehicle operating cost savings (savings in maintenance and depreciation) related to reduced VMT. The majority of policies included in the toolkit affect only light-duty vehicle fuel use. However, savings from the pricing policies category include light-duty, commercial, and freight truck fuel cost reductions.

Cost savings calculations are based on national annual averages for vehicle ownership per capita, annual vehicle miles driven, on-road vehicle fuel economy, gasoline/diesel vehicle penetration, and fuel costs (EIA 2012). For a full list of assumptions for each policy, please see Appendix A. Policy cost figures encompass direct capital, annual operating, and maintenance costs in addition to administrative costs. *Moving Cooler* does not incorporate the costs associated with tolls, taxes, fees, and other incentives in its cost-benefit analysis as the model assumes that these are societal transfers, i.e., any monies generated from the program are then reinvested in the community in some manner (ULI 2009a).

These figures are meant to be illustrative of the potential impacts of these policies. Actual costs and benefits will have to be adjusted based on local characteristics to be relevant at the municipal level. Additional non-energy benefits such as the value of time saved, safety benefits, and air quality improvements are not included in *Moving Cooler*'s cost-effectiveness analysis (ULI 2009a).

Municipalities can take advantage of a number of resources as they begin to evaluate the feasibility of implementing the policies described in this toolkit. The Center for Neighborhood Technology's Housing and Transportation Affordability Index (http://htaindex.cnt.org/) provides detailed information at the census block group level about the average household's transportation expenditures as well as other measures such as VMT per household, automobiles per household, and regional transit access. The Center for Transit Oriented Development's TOD Database (http://toddata.cnt.org/) is an online tool that provides economic and demographic data for existing and proposed transit systems across the country—a good starting point for evaluating policy opportunities related to transit-oriented development.

Additional policy-specific resources highlighted in this report provide program design information to ensure that municipalities have appropriate guidance for implementation.

More information on the calculations used to generate the cost and savings figures, as well as the ability to customize inputs to the calculations, will be available in ACEEE's Local Energy Efficiency Policy Calculator (LEEP-C), version 2, a companion piece to this toolkit that can soon be found at http://aceee.org/portal/local-policy/calculator.

I. Integrating Land Use and Transportation

Integrating land use and transportation is essential to ensuring that residents have convenient, efficient access to important destinations. Likewise, integration helps to provide access to daily destinations through a variety of transportation choices, including transit, walking, and biking, as well as private vehicles. This integration also serves to encourage "Smart Growth" in communities by curbing sprawl. Such development reduces the number of vehicular trips needed in a given day and allows for a range of transportation options. As a result, smart growth creates healthier communities by reducing air pollution and promoting active transportation like walking and bicycling. Economic performance also improves with smart growth by encouraging investment in existing neighborhoods. Reducing the average number of vehicle trips per household reduces fuel consumption and thereby lowers the overall carbon footprint of a community. The U.S. Environmental Protection Agency estimates that a household in the vicinity of a transit node will typically have overall energy consumption of 39% to 50% lower than an average household, depending on the type of home considered (EPA 2011). Even in communities without access to public transportation facilities, smart growth planning can reduce the overall number of trips by facilitating biking and walking.

Successful smart growth projects include "the 5Ds" of Ewing et al. (2007). These are:

- **Density**—ensure that an appropriate density of residents per unit of land exists to support transit use
- **Diversity** —include a diverse array of land use and housing types
- **Design**—consider the location of key buildings, services and resources in relation to one another and to transit
- **Destination Accessibility**—connect pedestrian and alternative transportation routes to transit nodes and other popular destinations in the community
- **Distance**—promote walkability by minimizing the distance of each trip within the community (Ewing et al 2007)

One of the most common forms of integrated land use and transportation planning is Transit Oriented Development (TOD). Such developments combine a mixture of housing, office, and retail facilities in an integrated, walkable neighborhood that is serviced by a stable, accessible public transportation system. The demand for walkable, transit-based lifestyle options has continued to grow in recent years. By 2025, 14.8 million American households will likely be looking for housing in high-density communities near transit facilities, double the number living within half a mile of transit nodes in 2004 (CTOD 2004). However, while the benefits of compact, walkable and transit-oriented communities are many, so are the barriers to development. The high cost of land near public transit and the high upfront cost of transit expansion are most often cited as key hurdles to implementing these projects (RA 2010). Nevertheless, a number of incentives and policy levers can make such developments a cost-effective reality in communities across the United States.

This section highlights three mechanisms that communities may use to integrate land use and transportation:

- Zoning for transit oriented development, mixed-use, and compact communities
- Parking requirements
- Developer incentives.

All costs and benefits for these policies can be found in a single table at the end of this chapter.

ZONING FOR TRANSIT ORIENTED DEVELOPMENT (TOD), MIXED-USE AND COMPACT COMMUNITIES

Zoning practices since World War II have generally segregated industrial and residential uses of land while some codes went so far as to divide land even further for commercial, institutional and recreational purposes. This, in combination with federal transportation investment focused largely on the construction and maintenance of highways, has worked against the creation of walkable, mixed-use communities. Municipalities must often tackle the reworking of established zoning laws to increase transit oriented development. Changes to municipal zoning regulations can direct investment and development towards high density, mixed use construction around existing transit facilities. According to the U.S. Environmental Protection Agency, current zoning regulations across the country must be modified to incorporate the following key points to ensure successful TOD and smart growth developments. Zoning regulations enabling transit oriented development should:

- Require mixed-use zones
- Recalibrate zoning standards to allow for compact urban development
- Increase density in city centers and around transit nodes
- Modernize street standards or enact new standards to foster walkable communities
- Reduce or eliminate parking requirements
- Designate preferred growth areas (EPA 2009)

Well-crafted zoning codes promote the creation of walkable, mixed-use communities. Such codes focus on the relationships between building facades and the public realm, the form and mass of buildings in relation to one another, and the scale and types of streets and blocks. Form-based zoning codes are particularly useful when planning compact, transit-oriented communities, as they allow for easier creation of mixed use developments. Additionally, the recognition that walkability and architectural design play a significant role in the creation of attractive communities makes form-based zoning ideal for TOD projects (EPA 2010). The City of El Paso, Texas recently rezoned a former industrial site using form-based zoning to create three transit-oriented neighborhoods linked by Bus Rapid Transit (BRT) services. The city also updated its comprehensive plan to reflect Smart Growth principles. These principles will be incorporated into future planning projects in an effort to provide residents with more transportation options and to create walkable communities (http://www.planelpaso.org).

Other approaches to zoning for smart growth communities include the use of overlay codes that add transit-related and density requirements without changing the general approach of the existing codes. These codes are particularly useful in areas that have already seen a certain amount of development (LGC 2003). Incentive-based zoning is another option, an approach that incorporates TOD incentives for developers and homebuyers to encourage high density, mixed-use development around transit nodes.

Relevant Stakeholders

Local Planning Boards—Zoning decisions and changes are under the jurisdiction of local planning boards, so buy-in from planning boards is a required part of establishing compact, mixed-use communities.

Metropolitan Planning Organizations (MPOs)—MPOs can encourage integrated land use and transportation by providing grants for sustainable planning practices and can play a vital role in encouraging compatibility in planning across municipal borders.

Transit Agencies (Local and Regional)—Coordination with transit agencies allows for the identification of existing and future transit nodes best suited to transit-oriented development. Furthermore, transit agencies often own the land immediately around transit stations, meaning that development can only proceed upon their approval (RA 2010).

Housing and Commercial Developers—Real estate developers play a critical role in integrating land use and transportation, as they provide the private capital needed to invest in new construction and in the revitalization of local communities.

Economic Development Authorities (Local and State)—Coordinated land use and transportation planning can serve to buoy local economies by attracting new businesses and commerce to areas easily accessed by alternative modes of transportation. Economic development authorities must, therefore, be looped into the decision-making process.

Upfront Investment and Financing Options

Projects that integrate land use and transportation planning can require a significant amount of upfront financing to get started. While traditional private real estate market investment mechanisms can still provide this upfront financing, municipalities can also take advantage of a number of other innovative mechanisms to promote such projects while generating a steady stream of revenue.

The concept of tax increment financing (TIF) has become a popular mechanism for funding development in compact, transit accessible communities. Tax increment financing is a value capture method that allows municipalities to promote residential and transit development by funding it with earmarked future increases in property tax receipts from a specific TIF zone (Dye and Merriman 2006). For instance, Chicago and Albuquerque have successfully created TIF zones within their boundaries for the express purpose of redeveloping blighted areas or encouraging sustainable developments. Crystal City in Virginia is currently contemplating establishing TIF zones to generate funds for a streetcar line that will connect some of the more residential areas of the city to the downtown service center (CDFA Webcast).

Other innovative mechanisms for funding include using revenues from direct fee programs (such as congestion or parking pricing programs) for transit and compact development expansion. Likewise, establishing public private partnerships (PPPs) with developers can effectively fund these large-scale projects (CDFA Webcast). The city of Quincy, Massachusetts has partnered with Street-Works, a private development firm, to overhaul its downtown area. Street-works is footing the $1.6 billion required for the

project based on the assumption that the city will buy the new infrastructure from them once they see additional revenue from new parking garages and from the increased tax base (ULI 2011).

Example

Charlotte, North Carolina

The city of Charlotte in North Carolina adopted a zoning ordinance that creates Transit Oriented Development Districts in the region with the express aim of constructing communities with "a high intensity mix of residential, office, retail, institutional, and civic uses." Within each of these districts, all development must occur within a half mile of existing rapid transit stations and must meet TOD-related development standards as identified by Section 9 of the development code. These requirements include:

- Residential developments within a ¼ of a mile walking distance from transit stations must have a minimum of 20 units per acre. Those within a ¼ mile to a ½ mile must meet a minimum density of 15 units per acre to encourage the development of multi-story buildings.
- Developments must also meet a minimum floor area ratio (the ratio of a building's total floor area to the size of the parcel of land it is constructed on) of .75 if they are within ¼ mile of a transit station and minimum FAR of .50 if they are within ¼ to ½ mile.
- Sidewalks internal to a development are required between buildings and must meet a minimum 6 foot width requirement. External sidewalks are also required, connecting each building to adjacent sidewalk networks and to nearby trails, parks and greenways

For more information on North Carolina's Transit-Oriented Development District code, please see http://ww.charmeck.org/Planning/Rezoning/TOD-TS-PED/ZoningOrd_TOD.pdf

Reducing or Eliminating Parking Requirements

Parking policy plays a critical role in creating walkable, sustainable communities and reducing vehicle miles travelled. A number of different parking mechanisms can be used to increase the feasibility of and reduce the costs associated with creating sustainable communities.

Conventional suburban construction often has minimum parking requirements: one or more parking spaces per housing unit for all occupied units, and multiple spaces for commercial and institution buildings. Such parking requirements use a significant area, preventing denser, more compact development from flourishing and perpetuating auto-oriented neighborhoods. To enable these communities to flourish, developers should be encouraged to set aside less land for parking purposes. Removing parking minimums altogether allows developers to determine how much parking space is really necessary for residents of the development. Putting *maximum* parking space limits in place may further improve space utilization and promote alternatives to driving. Freeing up this land increases the feasibility of mixed use development, reducing the need to drive and also saving developers and in turn residents significant chunks of time and money. The Victoria Transport Policy Institute (VTPI) estimates that the construction costs associated with one urban parking space can range from $2,000 to $22,000, depending on the type and location of each parking spot (VTPI 2011a). Spaces in high-value urban markets can cost as much as $60,000 (EPA 2010a).

Similarly, implementing shared parking programs also frees up land for efficiently-located projects. Shared parking structures allow for parking spaces to be shared not only by multiple users but also by multiple types of users (e.g., residential and commercial) and can reduce the amount of required parking in a community by 40% to 60% (EPA 2010a).

Relevant Stakeholders

Housing and Commercial Developers—Real estate developers must be willing to adapt to new parking requirements and will be responsible for the eventual construction of parking spots within the community.

Local Planning Boards—Parking requirements will likely be administered by local planning boards, making them a required part of establishing successful TOD communities.

Economic Development Boards—These agencies have a role to play in identifying the impacts of changing parking policies on the economic success of a community.

Neighborhood Associations—Residents must buy into any planned parking requirement adjustments as they are directly affected by any changes in traffic that such schemes can create.

Upfront Investment and Financing Options

Adopting parking maximums requires little to no upfront investment. Adjustments to zoning and parking codes may require upfront administrative involvement but, in the long run, the societal benefits from these policies far outpaces any upfront costs. Developers will also see significant cost savings by constructing fewer parking spaces for each new development.

Example

Portland, Oregon

The City of Portland, Oregon adopted a new parking code in 2010 that removed minimum parking requirements for a number of different areas and local sites. For instance, sites within 500 feet of a transit facility that has 20 minute peak hour service do not need to meet any parking minimums. Likewise, developments in the central residential and commercial hub of the city and those in neighborhood commercial zones are exempt from minimum parking requirements.

The same code also introduced a detailed list of maximum parking requirements for new and existing development that varies based on the location of each site and the land-use category. As an example, retail facilities must either meet a standard of 1 space maximum per 500 square feet of floor area or 1 space per 196 square feet of floor area, depending on their distance from the center of town. Restaurants and bars are also subject to these maximums—1 space for every 250 square feet or 1 space for every 63 square feet, again depending on distance from the city center. More information on the parking code in Portland can be found here: http://www.portlandonline.com/bps/index.cfm?a=53320. For other successful parking case studies, see http://www.mitod.org/todtargetedparkingregulations.php.

Developer Incentives

Municipalities may use a number of incentives to encourage compact growth and mixed-use projects, ranging from tax credits to expedited permitting,. Such policy leverage can make these projects deeply attractive to developers.

Financial incentives can help to promote transit-oriented development or other community land use priorities since they bring down the overall cost of construction for developers. Commonly used measures include low interest loans and property tax abatement programs. Giving developers the opportunity to borrow at below-market interest rates makes combined land use projects significantly more attractive. Likewise, property tax abatement programs remove one more cost element, which makes investing in projects that combine land use and transportation more attractive to developers.

Two of the more commonly used non-financial measures, often employed hand-in-hand with new zoning regulations, are density bonuses and expedited permitting. Expedited permitting speeds up development by fast-tracking the approval process for projects that meet certain smart growth requirements (RA 2006). Expedited permitting is valuable to developers because it can save significant time (and therefore money) during the construction process. In return it enables the creation of dense, mixed-use communities that reduce fuel use and encourage economic development. Density bonuses are provided to projects that meet specific sustainability benchmarks and industry standards in their construction, and can be a way to attract developers to an area. Using affordable housing as an example, developers are allowed to construct more market-rate housing than typically allowed for each unit of affordable housing provided (RA 2006). Such bonuses result in more housing and as a result a more vibrant community with more demand for transit. Additionally, affordable housing units ensure that new TOD developments with easy transit access will be affordable to a variety of households, including low and moderate income families. Density bonuses are a good way to entice developers as they provide added opportunity to make a profit on large projects, in return for a public good as defined by the local government.

The city of Vancouver, Washington has successfully incorporated density bonuses into its TOD ordinance. Any development within a designated transit overlay district may earn a density bonus for meeting a range of TOD criteria. These include installing on-site bus stops within ¼ of a mile of the given site, and creating direct walkways or bikeways to the nearest commercial or retail center of business (EPA 2010b).

Relevant Stakeholders

Local Planning Boards—Zoning decisions and changes are under the jurisdiction of local planning boards, making them a required part of establishing successful compact, mixed-used communities. Buy in from planning boards is needed to revamp existing zoning policies in favor of smart growth friendly regulations.

Housing and Commercial Developers—Real estate developers play a critical role integrating land use and transportation as they provide the private capital needed to invest in new construction and in the revitalization of local communities.

Lending Organizations—Low-interest loans and location-efficient mortgages are an effective incentive

for encouraging developers to invest in and homebuyers to purchase in compact, transit-oriented communities.

Upfront Investment and Financing Options

Like other policies that encourage the integration of land-use and transportation planning, developer incentives can be financed in a number of ways. These include

- Tax Increment Financing programs
- Sales taxes
- Revenues from road and parking pricing programs
- Public private partnerships
- Vehicle registration fees

Several other incentives such as low-interest loans and density bonuses for developers require little to no upfront costs beyond additional administrative costs.

Example

Arlington, VA

The county of Arlington, VA has long been a leader in the creation of transit accessible developments and communities. The Rosslyn-Ballston corridor, located along Metro's Orange Line, is often cited as a shining example of TOD planning in effect. In addition to using TOD-friendly zoning practices, the county uses a comprehensive package of incentives to attract developers to the area. These include density bonuses and height bonuses that were adopted in 2001 as part of amendments to Arlington's zoning ordinance.

In an effort to provide sufficient affordable housing close to each of the 5 metro stations along the Rosslyn-Ballston corridor, the county provides developers with a 25% density bonus or up to a 6 story height bonus if they incorporate affordable housing units in the construction of high rise apartment buildings. The expected income from market-rate units is used to offset the cost of building the additional low-income apartments. Additional information can be found in the Arlington zoning ordinance: http://building.arlingtonva.us/wp-content/uploads/2012/04/ACZOSection36.pdf (H.7(2))

Overall Costs and Benefits of Integrating Land Use and Transportation

Costs and benefits identified in Table 1 below are based on a range of combined land use interventions being adopted by a municipality. Specifically, the numbers assume that states and metro agencies adopt enforceable growth boundaries around urban areas consistent with the State of Oregon's model (which concentrates development inside strict urban boundaries) and that density minimums are established inside those urban growth boundaries. Additionally, requirements must be established for minimum fractions of new jobs and housing to be located within walking distance of high-frequency transit service. Metropolitan land use plans and local zoning should collectively provide for at least 90% of new development in attached or small-lot detached units, in pedestrian- and bicycle-friendly neighborhoods (e.g., sidewalks, bicycle facilities, good connectivity) with mixed-use commercial districts and high-quality transit.

Finally, the cost/benefit estimates also assume that local plan and zoning code compliance is 100%.

Savings identified in Table 1 can also be achieved through the use of other land-use related policy mechanisms. The policies described in this chapter, undertaken with regional coordination can likely achieve similar costs and benefits.

Table 1. Costs and Benefits of Integrating Land Use and Transportation

Policy	Year	Percent Fuel Savings	Per Capita Annual Fuel Savings ($)	Per Capita Annual Operating Cost Savings ($)	Per Capita Annual Implementation Costs ($)
Combined Land Use	2015	0.4%	$5	$19	$0
	2020	2.3%	$31	$113	$0
	2035	7.3%	$82	$403	$0
	2045	10.2%	$123	$601	$0

RESOURCES

"Mixed Income Transit Oriented Development Action Guide"—http://www.mitod.org/home.php

EPA, *Essential Smart Growth Fixes for Urban and Suburban Zoning Codes*—http://www.epa.gov/dced/pdf/2009_essential_fixes.pdf

Reconnecting America, *2010 Inventory of State, Regional and Local Transit-Oriented Development Plans and Projects*—http://reconnectingamerica.org/assets/Uploads/2010_inventory_of_tod_programs.pdf

EPA, "Smart Growth "—http://www.epa.gov/dced/index.htm

II. Multi-Modal Infrastructure Development

Post-World War II land use planning methods in the United States have created sprawling communities that cater largely to motor vehicles. In recent years, in response to the growing demand for walkable, transit-oriented living, several states and municipalities have adopted zoning, land use, and transportation planning practices that enable easy accessibility for all modes of transportation.

Multi-modal transportation systems provide residents with a variety of transportation choices for their daily activities. Building bicycle lanes and sidewalks, and ensuring that streets within a community are connected in a comprehensive network reduces a community's dependence on automobiles as the primary mode of transport while reducing fuel consumption and vehicle miles driven. Studies have shown that completing a sidewalk network in an average community decreases automobile travel by 5% while increasing non-motorized travel by 16% (Litman 2011). Complete streets policies are an effective way of achieving multi-modal communities. This chapter discusses complete streets policies and transit expansion as means of providing residents with alternative modes of transportation.

COMPLETE STREETS

Complete streets policies focus on the interconnectivity of streets and target safe, easy access to roads by all pedestrians, bicyclists, motorists and public transportation users. Complete streets foster increased use of alternatives to driving by creating a comprehensive network of connected streets, sidewalks and bicycle lanes or by connecting to non-motorized transit facilities and, therefore, can have a significant impact on a community's overall fuel consumption and economic development.

Implementing complete streets can have a number of energy and non-energy benefits. Complete streets can:

- Improve the economic vitality of a neighborhood
- Stimulate mixed land-use
- Improve access to public transit facilities
- Contribute to walkable and livable communities
- Improve access to service centers and other amenities
- Improve air quality
- Reduce fuel consumption and consequently, a community's carbon footprint
- Reduce congestion (NCSC 2012a)

According to the National Complete Streets Coalition (NCSC), nearly 30% of all trips in metropolitan areas are a mile or less and can be covered easily by walking or alternative forms of transport, minimizing the need to drive and saving consumers money on their gasoline bills. Households that are located in well-connected neighborhoods and near transit hubs drive, on average, 16 fewer miles a day than those located in traditional suburbs (NCSC 2012a).

The NCSC identifies ten elements that comprise an ideal complete streets policy. Amongst other criteria, such policies must:

- Include a vision for how to connect streets within a community

- Encourage street connectivity and aim to create an integrated network for all modes of transport
- Be accessible by all users within a community
- Apply to both new and retrofit projects
- Establish performance standards with measurable outcomes
- Include specific implementation plans
- Cover all roads (NCSC 2010)

In general, municipalities must ensure that such policies are sustainable and are long-term in order to take advantage of existing benefits and energy efficiency potential.

Complete streets policies have yet to gain traction at the federal level. Language directing the Secretary of Transportation to create national standards for the safe accommodation of all road users was included in the 2012 transportation funding bill passed by the Senate, but the language was not supported by the House and failed to make it into the final transportation bill. Nevertheless, the reauthorized transportation bill did include a new, more comprehensive definition of street users that incorporates complete streets definitions (SGA 2012b). States and municipalities, however, have shown the most interest in incorporating complete streets policies into their land use planning tools. 18 states have adopted complete streets mandates (Foster et al. 2012) while more than 350 communities across the country have implemented complete streets language (NCSC 2012b).

Relevant Stakeholders

Local and State Departments of Transportation—Complete streets policies are most commonly administered by state and local DOTs. These institutions are necessary for the planning, evaluation and monitoring of complete streets development

Local Transit Agencies—Coordinating with transit agencies is necessary to map out transit routes and to plan for future transit node development.

Local Planning Boards—Buy-in from planning boards is a required part of establishing a complete network of streets and sidewalks.

Health Organizations—The improvement in overall health of communities is one of the main benefits of a comprehensive, connected network of streets, as walking becomes easier and more feasible as a mode of transport. Health-related organizations can play an active role in getting support for complete streets policies, eventually leading to implementation.

Community-Based Organizations—Local community-based organizations (disability advocates, bicycle and pedestrian advocacy organizations, etc.) can be very useful in disseminating relevant information and educational materials that highlight the benefits of complete streets policies and in advocating for implementation.

Costs and Benefits

Moving Cooler separates its analysis of complete streets into two categories: bike strategies and pedestrian strategies. With regards to bicycle strategies, cost/benefit numbers from the maximum effort scenario

assume that complete streets policies are adopted by state and local transportation agencies and that appropriate bike facilities are provided on all major roadways. Additionally, all new commercial buildings of more than100,000 square feet will be required to provide showers, lockers, and covered/protected bicycle parking; all new multi-unit residential buildings will have indoor bicycle parking. Bicycle parking will be provided at all commercial destinations. Bike stations that provides services, including parking, rentals, repair, changing facilities, and information will be located at all major activity centers and transit hubs as well as in the CBD.

Most importantly, however, new development areas must be planned with a network of off-street bicycle paths at approximately one-quarter to one-half-mile intervals. This bicycle network will consist of a combination of bicycle lanes, bicycle boulevards, and shared-use paths and will be implemented in areas with population density >2,000 persons per square mile.

Cost/benefit numbers for the pedestrian strategies category assume that all new developments have buffered sidewalks on both sides of the street, marked pedestrian crossings at intersections on collector and arterial streets, and appropriate lighting. New or fully reconstructed streets in denser neighborhoods (greater than 4,000 persons per square mile and in business districts) incorporate extensive traffic calming measures such as bulb-outs and median refuges to shorten street-crossing distances. Complete streets policies must also be adopted by state and local transportation agencies, requiring appropriate pedestrian accommodations on all roadways. After 6 years, existing streets within one-quarter mile of transit stations, schools, and business districts are audited for pedestrian accessibility and retrofitted with curb ramps, sidewalks, and crosswalks.

Table 2. Costs and Benefits of Complete Streets and Bicycle/Pedestrian Strategies

Policy	Year	Percent Fuel Savings	Per Capita Annual Fuel Savings ($)	Per Capita Annual Operating Cost Savings ($)	Per Capita Annual Implementation Costs ($)
Pedestrian Strategies	2015	.2%	$	$8	$11
	2020	1.0%	$13	$48	$8
	2035	1.0%	$11	$53	$0
	2045	1.0%	$12	$57	$0
Bicycle Strategies	2015	.1%	$1	$2	$11
	2020	.4%	$6	$21	$9
	2035	.9%	$10	$49	$4
	2045	.9%	$11	$52	$2

Upfront Investment and Financing Options

While a significant amount of upfront investment may be required for the construction of sidewalks, bike lanes and other multi-modal facilities, as is also true with the construction of non-complete streets, complete streets policies can help residents save money in the long run.

Encouraging planners to accommodate multi-modal infrastructure at the beginning of a project cycle means that municipalities can easily identify the most cost-effective complete street strategies for implementation (NCSC 2012a). Coordinating pedestrian traffic signals, for instance, requires no upfront investment but makes walking a more appealing option. Communities that integrate multimodal infrastructure as a matter of policy every time a street is improved can often integrate the cost of complete streets in the budget for planned improvements. Some complete street upgrades can also be incorporated into periodic roadway resurfacing and maintenance schedules. This method of piggybacking the development of bicycle facilities onto planned street improvements is used in Cambridge, Massachusetts and other communities around the country (Mackres 2011). Additionally, complete streets policies prevent the need for major infrastructure retrofits and adjustments further down the road, making them highly cost-effective in the long run (NCSC 2012a). All too often, facilities for pedestrians, bikers and transit are implemented as afterthoughts, leading to expensive design revisions and delays.

In any case, a number of financing options exist to fund complete street projects. Revenues from direct funding mechanisms such as sales taxes, road use taxes and congestion pricing schemes can be re-invested in creating sustainable, walkable communities, while federal and state grants can also go far towards helping offset the upfront cost of additional construction. As discussed below, Birmingham, Alabama recently received a significant grant from the U.S. Department of Transportation to put towards creating a multimodal network of streets in the downtown area.

Example

Birmingham, Alabama

In response to a growing demand for alternative modes of transportation and a need to improve safety amongst walkers and bikers, the city of Birmingham, Alabama adopted a complete streets resolution in September 2011. The resolution states that, to the greatest extent possible, the municipality will maintain all city streets to provide an integrated network of services and facilities accessible to all members of the community. The rule applies to all construction, reconstruction and retrofit projects and calls for active community involvement in the decision making process.

The adoption of the policy in Birmingham has given the city an opportunity to overhaul its city-wide redevelopment plan with complete streets as the central tenet (SGA 2012a). Birmingham was also recently the recipient of a $10 million TIGER (Transportation Investment Generating Economic Recovery) grant from the U.S. Department of Transportation directed towards repairing and completing a multimodal street network in an area recently destroyed by tornadoes. The project will reconnect Birmingham residents with key public transit hubs, employment centers and historic civil rights sites (DOT 2012). More information on complete streets in Birmingham, Alabama can be found here: http://www.completestreets.org/webdocs/policy/cs-al-birmingham-resolution.pdf

TRANSIT EXPANSION

The demand for public transportation in the United States is higher today than it has been in the last 50 years (T4A 2012). A number of factors have contributed to this gradual increase in transit demand. Fluctuations in gasoline prices combined with the nation's greying population and the increasing preference of the "millennial" generation group for living in well-connected communities has meant that more people are abandoning the personal automobile as their primary mode of transport (T4A 2012).

As a result, many communities across the country are planning to either add new transit facilities or significantly expand existing transit systems. Expanding transit services provides residents with feasible and affordable alternatives to driving daily. In combination with mode shift strategies, well-planned transit facilities improve the overall efficiency of a given transportation system and can shape land use and development to create walkable communities, reduce congestion, improve economic development and create jobs, and reduce pollution (T4A 2012).

Planning for additional transit capacity must be conducted with a municipality's or region's land use and transportation goals in mind, as well as the anticipated annual maintenance and upfront costs. Financing is one of the biggest barriers to implementation for new transit facilities given the fact that federal and state funds are still largely targeted at highways.

Relevant Stakeholders

Local and Regional Transit Agencies—These agencies bring logistical and planning knowledge to the table during the planning and implementation process.

Federal Department of Transportation—Federal agencies play a critical role in providing funding for and evaluating new transit expansion projects.

Local and State Departments of Transportation—Local and state DOTs can be potential sources of funding for expansion activities.

Neighborhood Associations—Residents of neighborhoods that are to be connected by new transit facilities must be able to voice any concerns about potential plans.

Economic Development Boards—Expanding transit infrastructure and facilities has a direct impact on the economic development of municipalities by making them more accessible as centers of activity. Economics Development Boards must, therefore, be involved in the planning and implementation process.

Metropolitan Planning Organizations—MPOs can act as liaisons between state and local agencies, particularly with regards to funding allocations.

Costs and Benefits

Moving Cooler's maximum effort scenario for transit infrastructure expansion assumes that construction of new transit lines and facilities will expand proportional to an annual increase in transit ridership of 5%. Cost and benefits from this approach are highlighted in Table 3 below.

Table 3. Cost and Benefits of Transit Expansion

Policy	Year	Percent Fuel Savings	Per Capita Annual Fuel Savings ($)	Per Capita Annual Operating Cost Savings ($)	Per Capita Annual Implementation Costs ($)
Transit Expansion	2015	1.0%	$14	$48	$77
	2020	1.6%	$21	$79	$90
	2035	3.7%	$42	$205	$108
	2045	5.3%	$65	$316	$116

Upfront Investment and Financing

Funding for transit infrastructure improvements and expansion is provided by federal, state and local sources. Federal monies are allocated to transit providers by the surface transportation bill. The reauthorization package finalized in July of (2012) allocated about $10 billion in transit funding, in addition to $1.9 billion provided to the New Starts program, which provides grants to states for local transit capital investments.

In addition to federal funding, states and municipalities raise their own funds for transportation and public transit. In 2010, state funds amounted to $13.6 billion while federal monies added up to approximately $10.1 billion (AASHTO 2012a). State funds are also usually allocated by population- and income-based formula to municipalities, or on a grant-basis. Local funding for transportation is generated in a variety of ways. Sales and property taxes, user fees, revenues from road and parking pricing schemes, and transit fares are some common strategies for fund-raising.

Example

Charlotte, North Carolina

Charlotte's LYNX system was inaugurated in 2008 with 9.6 miles of light rail line stretching from downtown Charlotte to the South Carolina border. The expansion was paid for with a combination of federal, state, and local funds. The majority of federal funds originated from the federal New Starts program ($193 million), while the state contributed $116 million towards the project. $148 million in local funding was collected from a ½ cent sales tax that was approved by voter referendum (AASHTO 2012b). In 2009 the sales tax generated between $75 and $77 million, which not only went towards the development of LYNX but also towards bus line and bus service expansion (CATS 2008).

The development of the Lynx line has also helped spur economic development around transit stations. The Blue line has attracted 2,600 residential units, 420,000 square feet of retail space and 320,000 square feet of office space (T4A 2012). An additional 9.4 mile expansion is planned for 2017. Along with the TOD ordinance described in chapter 1, the City of Charlotte is making use of the interaction between travel behavior strategies to optimize light rail ridership and reduce VMT in the new transit corridor.

More information on the development of the LYNX line can be found here:
http://charlottechamber.com/clientuploads/Economic_pdfs/Transit_CATS_10-08.pdf

RESOURCES

National Complete Streets Coalition—www.completestreets.org

Complete Streets, *Local Policy Workbook*—www.completestreets.org/webdocs/resources/cs-policyworkbook.pdf

Transportation for America, *Thinking Outside the Farebox: Creative Approaches to Financing Transit*—http://t4america.org/wp-content/uploads/2012/08/T4-Financing-Transit-Guidebook.pdf

III. Pricing Policies

Pricing policies provide a monetary incentive for drivers to change their driving and parking behavior. Drivers are charged directly for the use of a given roadway or to park in a particular area. Historically, roads across the country have been undervalued by drivers, resulting in overuse and, eventually, congestion (Safirova et al. 2007). Federal and state fuel taxes recover some of the cost of the highway system for drivers but are insufficient to pay for the true cost our roads on their own. Road pricing corrects this imbalance by making users pay for the true value of the transportation system (NSTIFC 2009). Parking pricing policies aim to redistribute parking spots and to adjust parking behavior to prevent congestion in neighborhoods. Such policies are being increasingly implemented in urban areas with serious congestion problems, as a means to encourage people to reduce their dependence on personal vehicles and change their travel behavior by switching modes or changing the time of a given trip. Pricing policies serve a dual purpose—not only do they target vehicle congestion, they also serve as a sustainable source of revenue for transportation maintenance and construction investments.

The benefits of pricing policies depend on a variety of factors including geography, available alternatives to driving and the price elasticity of vehicle travel to the cost of driving. In general, however, such policies can work to encourage carpooling, land use changes and infrastructure development for transportation alternatives in addition to reducing congestion and overall fuel consumption. Below, we discuss the details of three key pricing strategies: congestion pricing, VMT fees, and parking pricing mechanisms.

CONGESTION PRICING

Congestion pricing is a market-based concept that can be applied in urban areas as a means to reduce traffic and improve travel efficiency. Congestion pricing shifts highway traffic onto other modes of transportation or to off-peak hours of the day, thus allowing the system to flow more efficiently and reducing the overall miles driven within a metropolitan area (FHWA 2010). In 2010, highway congestion lasted an average of 6 hours per day in the largest metropolitan areas, cost the nation approximately $101 billion and wasted 1.9 billion gallons of fuel (TTI 2011). Congestion pricing can be implemented in many forms. Some of the most common examples are highlighted below:

- **Variable priced lanes—**This category includes High Occupancy Toll (HOT) lanes and Express Toll Lanes. HOT lanes are open to high occupancy vehicles free of charge or at a reduced rate and to low occupancy vehicles that pay a toll for use
- **Variable tolls on roadways—**Flat toll rates on existing toll roads and bridges are changed to a variable toll schedule that increases during peak travel hours
- **Cordon charges**—Cordon tolls are paid by drivers that drive into a particular high congestion area within a metropolitan area e.g., a city center (FHWA 2006).

The benefits of congestion pricing are many but are highly dependent on whether or not reasonable travel alternatives exist. Implemented in conjunction with improved access to alternative modes of transportation, congestion pricing has the ability reduce peak period demand by inducing mode shift and may reduce vehicle travel overall. The resulting demand for alternative modes can subsequently spur development of transit facilities, changes in land-use patterns and, eventually, could encourage the

creation of compact, transit-oriented developments. Congestion pricing could also be used as an innovative financing method for new transit facilities. Funds generated can be invested in transit maintenance and development to provide commuters with alternative forms of transportation (VTPI 2011a).

Relevant Stakeholders

- **State and Local Departments of Transportation**—Implementation of congestion pricing schemes will largely fall to local DOTs. Their leadership is critical to the planning and implementation processes as well as to the identification of roads and highways to be designated congestion zones. Support from state DOTs is required for congestion pricing schemes to be successful.
- **Tolling Authorities—**These stakeholders will be responsible for implementation of a tolling system along with local and state DOTs as well as the actual collection of monies and maintenance of tolling facilities.
- **Transit Agencies—**Coordination with regional and local transit agencies is necessary to deal with the increased transit ridership that may result from implementing road pricing schemes.
- **Metropolitan Planning Organizations—**MPOs can bring analytical expertise to develop the most effective pricing policies within a metropolitan area.
- **Motorists**—Buy-in from drivers and commuters is critical to the long-term success of congestion pricing projects.

Costs and Benefits

Table 4 shows costs and benefits for a congestion pricing scenario where congestion pricing occurs on urban roads with prices sufficient to maintain a minimum level of service (LOS) of "category D." Category D is defined by the American Association of State Highway and Transportation Officials as "approaching unstable flow of traffic." Additionally, an average peak hour per mile price of $0.65 on congested segments must be maintained.

Figures for the cordon pricing category assume that municipalities begin to implement area pricing in central business districts (CBD), and major employment and retail centers. Implementation will ramp up over 10 years.

Table 4. Cost and Benefits of Congestion Pricing

Policy	Year	Percent Fuel Savings	Per Capita Annual Fuel Savings ($)	Per Capita Annual Operating Cost Savings ($)	Per Capita Annual Implementation Costs ($)
Congestion Pricing	2015	0.2%	$2	$11	$0
	2020	2.1%	$19	$137	$32
	2035	4.3%	$34	$303	$28
	2045	4.2%	$35	$320	$22
Cordon Pricing	2015	0.1%	$1	$6	$3
	2020	0.2%	$2	$13	$4
	2035	0.4%	$3	$30	$2
	2045	0.4%	$3	$31	$2

Upfront Investment and Financing Options

Congestion pricing programs can require a significant amount of upfront investment. Successful congestion pricing programs to date in places such as Singapore, London and Stockholm have involved the implementation of gantries, cameras and antennae for vehicle detection (ICCT 2010). Annual maintenance and operations costs and additional investments in public transit facilities to accommodate increased ridership must also be factored into any decision to implement such programs (ICCT 2010).

Ideally, incoming revenue from driver fees once the pricing scheme is up and running should offset the upfront, administrative and maintenance cost of the program. Alternatively, funding for the capital investments related to a congestion fee could be secured through public private partnerships while maintenance and administrative costs could be sourced from incoming fee revenues.

Example

San Diego, California

Since 1998, the metropolitan area of San Diego has required single occupant vehicles to pay a per-trip fee to access HOT lanes along the I-15 corridor. The FasTrack program covers 16 miles of express lanes between the neighborhoods of Kearney Mesa and Rancho Bernardo in San Diego. Carpoolers are allowed free access to the express lanes (SANDAG 2012).

Tolls are assigned based on a dynamic pricing system that considers the level of congestion on a given segment of highway and the distance driven by a given vehicle (FHWA 2006). Fees range from 50 cents to 8 dollars and can vary as often as every 6 minutes to maintain free flow traffic conditions on the express lanes. Funds raised from the program are reinvested in express bus services along the I-15 corridor. More information on the FasTrack program can be found here:

www.sandag.org/index.asp?projectid=67&fuseaction=projects.detail. Additional congestion pricing case studies can be found here: http://ops.fhwa.dot.gov/publications/fhwahop11030/cm_primer_cs.pdf.

VMT Taxes and Fees

A Vehicle Miles Travelled (VMT) fee is a form of distance-based pricing that is levied on drivers for use of the road and highway system. Fees are applied based on the distance each driver travels in a given time period. Data can be obtained through odometer readings or through the use of GPS systems. Federally, as a complement to the national fuel tax, VMT fees can be a stable and sustainable way to raise money for transportation infrastructure development across the country and induce changes in travel behavior at the same time. The same idea applies to the implementation of a state, local or regional VMT fee, although to date no municipal, state, regional or federal governing body has actually implemented a VMT fee.

VMT fees raise the cost of driving so that drivers pay for the actual social cost of the roadway system. Other than being a reliable source of funding for transportation projects, VMT fees would reduce total miles driven. In response to a VMT fee, drivers may choose to:

- Switch to alternative modes of transportation (e.g., public transit, biking, carpooling)
- Consider options to eliminate/reduce their trips or change the timing of trips
- Restructure their travel so that small trips are grouped into one large trip
- Seek out activities in more efficiently located communities or to relocate to more compact communities with additional transportation choices (EPA 1998)

The resulting changes in driving patterns and commuting behavior reduce the miles driven by a given vehicle and, consequently, the overall community fuel consumption and greenhouse gas emissions. Estimates from the Victoria Transportation Policy Institute show that, nationally, a 1.5 cent per mile fee could reduce mileage by about 2.7% (VTPI 2011b)

There are a number of barriers to implementing VMT fees as a viable fuel saving and finance policy, however. Equity is consistently brought up by the motoring public as a primary concern (NDOT 2010). Drivers who have no access to alternative modes of transportation and must rely on automobile travel to make frequent long trips would be subject to a greater proportion of total VMT fees (NDOT 2010). It is therefore important to ensure that any such fees are implemented gradually and that the resulting revenues help to address transportation needs of such drivers.

Additionally, privacy issues are typically at the forefront of any discussion about mileage-based fees (NDOT 2010). VMT fee programs incorporate the use of periodic odometer readings or GPS systems to track mileage in participating vehicles, raising concern about potential privacy violations and data security. In pilot studies conducted in Iowa and Oregon, privacy concerns were addressed by installing an onboard GPS unit that was capable of analyzing data from the vehicle, meaning that only information on the fee owed was transmitted externally (NDOT 2010).

In any case, VMT fees, in combination with some of the other pricing mechanisms discussed in this chapter, can be an effective tool for changing travel behavior and spurring sustainable development.

Relevant Stakeholders

Local and State Departments of Transportation—Implementation of VMT fee programs will largely fall to local and state DOTs. Their leadership is critical to the planning and implementation processes as well as to the identification of roads and highways to be designated congestion zones.

State Legislature—Implementing a regional or local VMT fee may require approval from the state legislature.

Local Tax Authorities—These agencies could potentially be responsible for the application and collection of VMT fees

Motorists Associations—Buy in from drivers is necessary before implementation of a VMT fee can proceed. These organizations can also convey any general concerns about the program from the driving population.

Costs and Benefits

The cost and benefit figures in Table 5 below are derived from the assumed implementation of a $0.12 per mile VMT fee that will be paid based on odometer audits during a vehicle inspection or sale. The transition to electronic monitoring will be made gradually. As *Moving Cooler* provides estimates only for urban areas across the nation, the operating assumption with regards to transportation alternatives is that drivers have access to a variety of alternative transportation modes.

Table 5. Cost and Benefits of VMT Fees

Policy	Year	Percent Fuel Savings	Per Capita Fuel Annual Savings ($)	Per Capita Annual Operating Cost Savings ($)	Per Capita Annual Implementation Costs ($)
VMT Fees	2015	7.9%	$114	$455	$4
	2020	7.9%	$111	$467	$4
	2035	8.1%	$99	$527	$2
	2045	8.1%	$102	$565	$2

Upfront Investment and Financing Options

The biggest upfront investments required for the implementation of a VMT fee program would be the installation of on board GPS systems in vehicles on the road and the creation of a central database system to process data from vehicles. For new vehicles, the cost of the on-board unit can be transmitted to auto manufacturers, who will include the additional cost in the price of new vehicles sold in the region (Whitty 2007). Older vehicles will have to be retrofitted with the GPS units, which may be a more expensive endeavor (CBO 2011). Alternatively, VMT can be tracked using periodic odometer audits conducted

either by the driver or a local authority during a vehicle inspection or sale. This approach would significantly reduce the upfront costs involved in implementing a VMT fee program.

Example

Oregon VMT Fee Pilot Project

To date, no municipality or state has adopted a VMT fee system. In 2006, however, the state of Oregon undertook a year-long pilot project to determine whether or not a VMT fee was a feasible undertaking. The process began in 2001 when the Oregon legislature created the Road User Fee Task Force and charged them to identify a feasible alternative financing option to the state gasoline tax. 290 participant vehicles were outfitted with GPS systems and payment of VMT fees was set up through two participant gas stations. Mileage-based fees were paid by each motorist whenever they stopped to refuel their vehicles. Gas taxes for participants were waived.

The pilot program found the VMT fee to be a viable program in Oregon. Ninety-one percent of participants found the system to be user-friendly and stated that they would be willing to continue paying the VMT fee if the program were implemented statewide. The study also found that the general cost of administration would be fairly low and that the mileage fee could be phased in gradually and could be collected easily through existing collection methods. A subset of drivers (95 out of 290) participating in the pilot program also saw a 12% reduction in the number of miles driven on a daily basis. For more information on the details of the pilot study, please see:
http://www.oregon.gov/ODOT/HWY/OIPP/docs/2005legislativereport.pdf and
http://www.oregon.gov/ODOT/HWY/RUFPP/docs/rufpp_finalreport.pdf .

Parking Pricing

Parking takes up a significant amount of space within a community and can be expensive to build and maintain. A typical urban parking spot has annualized land, construction, and operating costs between $500 and $1,500. A given vehicle uses an average of 3 to 6 parking spots within a community over the course of the day, making the costs of maintaining a large number of parking spots a pricey prospect (VTPI 2011a).

Parking pricing policies can defray these costs and promote the use of alternative modes by charging drivers directly for the use of each parking space. A number of different parking pricing strategies exist, including workplace parking pricing, on-street fees and residential parking permits, and fee differentials for long and short term parking facilities (CARB 2010).

According to experts, the optimal and equitable price for parking spaces is equivalent to the marginal cost to society (private cost to the user included) of those spaces. Parking pricing schemes also work best in areas where parking supply is in line with demand and if consumers pay directly for the cost of parking. For example, residential parking that is priced separately from housing can directly save households money if they reduce vehicle ownership. Similarly, employees that commute to work save if they choose to use alternative modes of transportation (VTPI 2011a). In general, prices should be set to maintain 85% to 90% parking spot occupancy rates—an approach called performance-based or responsive pricing.

Parking pricing schemes can be effective as part of a broader package of policies that target travel behavior change such as carpooling incentives or transit subsidies (VTPI 2011a). A study conducted in 2008 of 16 parking pricing programs showed that the median rate of reduction in driving was 2.2%. Increasing the price of parking increases the cost of private vehicle trips and encourages mode shifts, thus improving the possibility of reduced driving within a community (CARB 2010).

Parking pricing schemes can have a range of impacts on transportation demand patterns in addition to driving reduction. Some of these benefits include:

- Reductions in vehicle ownership (particularly residential parking pricing)
- Mode shift to public transit, walking, bicycling
- Congestion relief
- Residential location shifts to areas that are more connected by alternative transport facilities (VTPI 2011a)

If implemented properly, parking pricing programs have the ability to not only reduce congestion within a community, making the overall transportation system more efficient, but also create a steady revenue stream that can be dedicated towards enhancing facilities for alternative modes of transportation (FHWA 2012).

Relevant Stakeholders

State and Local Transportation Agencies—These agencies will likely undertake the implementation, monitoring, and evaluation of regional or local parking pricing programs. Transportation agencies can also work with local planning agencies and MPOs to identify areas of peak traffic and potential neighborhoods/sites for implementation.

Metropolitan Planning Organizations (MPOs)—MPOs are critical to identifying areas that will be targeted with pricing programs.

Local Planning Boards—Like MPOs, planning agencies must be involved in the selection of targeted neighborhoods and commercial districts for pricing programs.

Business Associations—Parking pricing programs have the potential to attract businesses to an area by shifting business to more accessible communities. Business associations must, therefore, be involved in the planning of any pricing program.

Neighborhood Associations—Residents must buy into any planned parking adjustments as they are directly affected by any potential inconvenience or increases in cost that such schemes can create.

Costs and Benefits

The maximum effort scenario described by *Moving Cooler* assumes that a municipality begins pricing all CBD, employment center and retail center street parking over the course of four years to encourage quick turnover parking. After approximately 5 years, the model assumes that the community introduces a tax on free private parking lots with more than 50 spaces (both retail and employer parking). In the same time

period, the municipality must also require a residential parking permit for on-street parking in residential areas. The minimum cost for this permit will be established at $100 biannually. Delivery and service vehicles plus visitors must also purchase residential permits, priced at $200 biannually and $3 per day respectively.

Table 6. Cost and Benefits of Parking Pricing

Policy	Year	Percent Fuel Savings	Per Capita Annual Fuel Savings ($)	Per Capita Annual Operation Cost Savings ($)	Per Capita Annual Implementation Costs ($)
CBD/Activity Center On-Street Parking	2015	0.1%	$2	$7	$0
	2020	0.2%	$2	$8	$0
	2035	0.2%	$2	$9	$0
	2045	0.2%	$2	$10	$0
Taxing Free Private Parking	2015	0.0%	$0	$0	$0
	2020	0.1%	$2	$7	$0
	2035	0.1%	$2	$8	$0
	2045	0.1%	$2	$8	$0
Residential Parking Permits	2015	0.0%	$0	$0	$0
	2020	0.2%	$3	$11	$0
	2035	0.2%	$3	$13	$0
	2045	0.2%	$3	$14	$0

Upfront Investment and Financing Options

Converting unpaid parking into paid parking spots requires some upfront investment in equipment in addition to annual operation cost expenditures. Depending on the type of equipment necessary (parking passes, traditional meters, electronic meter, payment machines), and the size of the affected area, costs can range significantly. Like many of the other pricing schemes described here, incoming revenue from the program should be sufficient to pay off the initial start-up and continued maintenance costs.

Example

Washington, District of Columbia

Washington, DC has long been a leader in parking management strategies. The District Department of Transportation in collaboration with Metropolitan Washington Council of Governments has implemented a number of innovative pricing techniques in recent years to cope with congestion in key neighborhoods.

In 2008, the city adopted the Performance Parking Pilot Zone Act to manage curbside parking and reduce congestion in identified performance parking zones. Two neighborhoods were chosen for the initial pilot program: Columbia Heights and the Ballpark District. As of March, 2012, a third neighborhood—the H Street Corridor—was identified for implementation.

The goals of the performance parking program are to facilitate regular parking turnover in commercial areas by reducing occupancy rates to 85%, protect resident parking in residential zones, promote the use of alternative modes of transport, and decrease congestion in each of the test neighborhoods. Parking spaces in each neighborhood were inventoried and data was collected on parking duration, and occupancy rate per peak hour. This information was then used to come up with a dynamic schedule of parking fees, which vary by neighborhood block and time of day and make use of newly installed electronic meters. For more information on Washington, DC's performance parking program, please see: http://ddot.dc.gov/DC/DDOT/On+Your+Street/Traffic+Management/Parking/Performance+Based+Parking+Pilots#TabbedPanels2. Additional case studies can be found here: http://ops.fhwa.dot.gov/publications/fhwahop12026/sec_7.htm

BOX 1. PAY-AS-YOU-DRIVE INSURANCE

One reason that people use their vehicles as much as they do is that a high percentage of vehicle-related costs are "fixed," i.e., independent of the number of miles the vehicle is driven. The impacts of vehicles, however, are very dependent on how much people drive. One approach to reducing miles driven is to convert fixed costs to variable costs. This can be accomplished in part by Pay-As-You-Drive (PAYD) insurance.

PAYD insurance ties the rate paid by an individual to the number of miles driven over a fixed period of time. Drivers would pay a portion of their premiums up front, and the remainder would be charged in proportion to mileage, as determined by a global positioning device or periodic odometer readings. Converting fixed insurance costs to variable costs through PAYD insurance could reduce vehicle use by as much as 8% given varying insurance rates (Bordoff and Noel 2008.)

Like other pricing policies designed to reduce miles driven and promote alternative travel modes, PAYD insurance may raise questions of equity, especially in rural areas, where alternatives to driving are not readily available. Insurance premiums are generally lower in rural areas than in urban areas, however, so high-mileage premiums would be smaller there. Moreover, a PAYD program could be designed to compare a rural driver's annual mileage to that of other rural drivers for purposes of determining the insurance premium. Also, low-income drivers generally drive less than higher-income drivers, and low-income drivers as a group consequently would be net beneficiaries of pay-as-you-drive insurance programs (Bordoff and Noel 2008). To maximize the benefits of PAYD insurance, drivers must have access to alternative modes of transportation.

While municipalities may not have jurisdiction over the decision to implement PAYD insurance programs, buy in from community members, businesses and departments of transportation is essential to successful implementation. Municipalities can, however, encourage the adoption of PAYD policies by providing insurance companies and drivers with a range of incentives such as tax credits and rebates. Nevertheless, state changes to insurance legislation may be required for the proliferation of PAYD insurance programs.

Benefits and costs associated with PAYD programs are highlighted in the table below. Figures are derived based on the assumption that the state permits the offering of per-mile insurance programs and that after 5 years all auto insurance policies must have at least 75% of premiums paid for on a mileage basis, allowing but not mandating adjustments in mileage rates based on time of day, location, driving style or other factors. The model assumes 100% penetration after 15 years.

Cost and Benefits of Pay-As-You-Drive Insurance

Policy	Year	Percent Fuel Savings	Per Capita Annual Fuel Savings ($)	Per Capital Annual Operation Cost Savings ($)	Per Capita Annual Implementation Costs ($)
PAYD Insurance	2015	3.8%	$54	$188	$5
	2020	4.5%	$61	$224	$4
	2035	5.4%	$61	$301	$3
	2045	5.80%	$70	$343	$

RESOURCES

Federal Highway Administration, *Contemporary Approaches to Parking Pricing: A Primer*—
http://www.parking.org/media/129582/fhwa%20parking%20pricing%20primer.pdf

City of Seattle, *Performance-Based Parking Pricing Study*—
http://www.seattle.gov/transportation/parking/docs/SDOT_PbPP_FinRpt.pdf

Federal Highway Administration, *Congestion Pricing: A Primer*—
http://www.ops.fhwa.dot.gov/publications/congestionpricing/congestionpricing.pdf

IV. Mode Shift

Driving is one of the single largest uses of energy within a community. Transportation costs account for approximately 18% to more than 30% of the average American household's income (T4A 2012; CNT 2012). As a result, switching to alternative modes of transportation, i.e., mode shift, can have a significant impact on residents' finances, as well as a community's transportation energy use and greenhouse gas emissions.

Mode shift can be achieved through a number of different policy levers. Employer benefits for carpooling or bike and transit use are often used as a starting point to encourage non-automobile commuting. Similarly, transit fare discounts and pre-tax transit benefits bring down the overall cost of commuting to work by public transportation. Finally, providing the appropriate infrastructure for bicyclists and pedestrians goes a long way towards achieving significant reductions in fuel use.

Estimates show that commuting by subways and metros emits 76% fewer emissions per passenger mile than travelling by a single-occupancy vehicle. Travelling by light rail and bus emit 62% less and 33% less respectively than travelling in an average passenger vehicle (FTA 2010). Below, we include a discussion of policies to improve public transit ridership and service.

TRANSIT SERVICE IMPROVEMENTS

Transit ridership has increased significantly in recent years. According to the American Public Transportation Association, the number of individuals taking some form of public transportation has risen by 30% between 2000 and 2012 (APTA 2012). Recent rises in public transit ridership could possibly have been spurred by the gradual growth in state and local public transportation expenditures (AASHTO 2012a) and by a growing preference for downtown, transit-oriented living (T4A 2012). A continued push towards public transit use is necessary to achieve an efficient transportation and travel system within communities across the country.

Transit agencies can undertake the following strategies to improve transit ridership in a given metropolitan area:

1. ***Service adjustments***—focus service on the most productive and popular routes while increasing the frequency of service.
2. ***Pricing adjustments***—create favorable pricing structures that encourage commuters to shift modes for their daily commute. This may also include the introduction of discount passes or cooperative transit programs with institutions and businesses.
3. ***Educational initiatives—***use public information campaigns tailored to specific subsections of the population to encourage use of existing transit services.
4. ***Service coordination—***coordination between different modes is necessary to ensure that a given transit system is efficient, usable and attractive to potential customers. (TRB 2007)

The success of each of these strategies depends to a certain extent on the geography of the service area (urban, suburban, and rural) as well as the demographic makeup of a community. To identify the most cost-effective and efficient strategies, each municipal transit agency must evaluate the nature of transit

demand within the community, identify the gaps in service, and understand the specific needs within each market (TRB 2007).

Combined with adjusted land use planning practices, public transportation can be a viable substitute for many auto trips taken in the United States. However, increased demand will require transit agencies to provide additional infrastructure and more frequent services. One of the biggest barriers to increasing transit ridership and service is upfront capital. Municipalities will have to consider using inventive financing mechanisms such as congestion pricing and VMT fees to achieve the dual goals of reducing automobile-based travel and finding a sustainable stream of revenue for transit infrastructure and service improvements.

Relevant Stakeholders

State and local transportation agencies—Improvements to transportation infrastructure will fall to transportation agencies to coordinate and finance

Local transit agencies—Scheduling, route changes and pricing adjustments will be the responsibility of local transit agencies and providers.

Community groups—These groups can provide the outreach base necessary for educational campaigns targeting transit services.

Economic developments boards—These entities can provide useful knowledge on financing mechanisms for transportation expenditures.

Costs and Benefits

Costs and benefits in Table 7 below are divided into two categories: increased transit service and reduced transit fare measures.

Numbers for the transit service category assume that the level of transit service is increased by 4 times the average historical revenue mile expansion rates Transit expansion investments should be targeted in areas with at least 4,000 people per square mile. Additionally, transit agencies must immediately begin implementation of signal prioritization, limited stop service, signal synchronization, intersection reconfiguration, etc. over three years to improve travel speed by an additional 30%. Agencies must also boost reliability of the transit system by 40% and boost ridership attraction through integrated transit fare systems. Municipalities should implement full scale bus rapid transit (BRT) deployment where it makes sense.

Numbers for transit fare measures are derived based on the assumption that transit fares are lowered by 50% in the maximum effort scenario from *Moving Cooler*.

Table 7. Cost and Benefits of Increased Transit Service

Policy	Year	Percent Fuel Savings	Per Capita Annual Fuel Savings ($)	Per Capita Annual Operation Cost Savings ($)	Per Capita Annual Implementation Costs ($)
Increased Transit Service	2015	0.2%	$3	$9	$10
	2020	0.4%	$5	$20	$15
	2035	1.6%	$18	$8	$23
	2045	3.0%	$34	$168	$27
Transit Fare Measures	2015	0.3%	$4	$14	$0
	2020	0.3%	$4	$15	$0
	2035	0.3%	$3	$16	$0
	2045	0.3%	$4	$17	$0

Upfront Investment and Financing Options

Like many of the policies described in this toolkit, transit service and ridership improvements can be financed through a combination of federal, state and local monies. Upfront capital will be necessary for any initial improvements to transit stops and existing facilities and to launch any marketing or educational programs targeted at improved ridership. Additional discussion about financing options for transit programs can be found in Transportation for America's Guidebook listed under the resources section.

Example

Denver, Colorado

The city of Denver, Colorado, has an impressive track record in encouraging transit ridership. The city adopted the FasTrack initiative in 2004, a program that is dedicated to building 119 miles of light rail diesel and electric commuter rail lines, all financed by $4.7 billion in sales tax funding from the city. Construction of those rail lines has yet to get off the ground due to the recent economic downturn, so in the meantime the city has focused its efforts on improving transit ridership on existing facilities. Denver's public transit ridership almost doubled between 2004 and 2008, rising from 5% to almost 9% in 2008.

The Denver area transportation plan was critical in achieving increased ridership. All transportation planning is conducted based on the concept of person trips rather than on the number of vehicles, thus shifting attention away from automobile-based travel towards other, more efficient modes. This approach, coupled with extended service hours and enhanced transit stops, worked to improve transit ridership over the 5 year period (City of Denver 2008).

For more information on FasTrack, see http://www.rtd-fastracks.com/main_1.

For additional details on the city of Denver's transportation plan, see http://www.denvergov.org/Portals/688/documents/DenverSTP_8-5x11.pdf.

BOX 2. EMPLOYER-BASED TRIP REDUCTION STRATEGIES

Employer-based trip reduction strategies are a way to encourage more efficient travel behavior amongst the commuting public. Using employers as mediators, the primary goal of such programs is to reduce the proportion of trips made by single occupancy vehicles .Work trips by automobile account for approximately a quarter of all vehicle trips in the United States (Zuehlke and Guensler 2007). Employer based strategies include financial incentives for carpooling, rideshare or transit, telecommuting, and flextime or compressed work week policies.

Employer-based programs can be mandated or encouraged at the state or local level, or they can be implemented by individual employers. One of the biggest challenges of implementing these programs is taking into account the varied and changeable needs of employees (Zuehlke and Guensler 2007). Taking alternative modes of transportation to work may be a feasible alternative for some commuters, while others may not live close enough to transit facilities to take advantage of available incentives. The ideal approach should include a package of policies that all employees can make use of.

A comprehensive trip reduction program can reduce peak period automobile trips by 5-20% at a given worksite (VTPI 2010). In general such programs save both employer and employee from paying the high cost of decreased productivity due to long commutes while reducing local fuel consumption and greenhouse gas emissions. Local governments can encourage the implementation of employer-based programs by creating a network of local business leaders, government representatives and employers to gather support for trip reduction measures and by providing incentives to employers to create these programs.

Estimates for savings at the municipal level are shown in the table below. These numbers assume that employers are required to pass along a federal/state tax levied on commercial parking spaces onto their employees and that proceeds are used to provide free transit passes for employees and towards other transit demand management schemes. Employers must also implement ride-matching, vanpool, transit discount and employer outreach programs.

Energy-Related Cost and Benefits Employer-Based Strategies

Policy	Year	Percent Energy Savings	Per Capita Annual Fuel Savings ($)	Per Capita Annual Operating Cost Savings ($)	Per Capita Annual Costs ($)
Employer-Based Trip Reduction Strategies	2015	0.96%	$13	$47	$3
	2020	5.74%	$77	285	$2
	2035	5.74%	$64	$311	$1
	2045	5.71%	$63	$309	$1

BOX 3. CAR SHARING

Car sharing services provide drivers with access to shared vehicles on an hourly basis in the absence of vehicle ownership. Car sharing programs essentially provide a substitute for vehicle ownership as and when a given driver requires a car (Litman 1999). The emergence of companies such as Zipcar and Car2Go in recent years indicates that these programs are becoming more popular with metropolitan residents who don't want the cost burden of owning a vehicle.

Car sharing is typically concentrated in metropolitan areas, cores and is only really effective in neighborhoods where walking, biking and transit are viable alternatives (TRB 2005). Car sharing enables households to give up owning a first, second or third vehicle and potentially rely on alternative modes of transportation altogether. According to the Transportation Research Board, at least 5 private vehicles are replaced by each shared car (TRB 2005). Car sharing converts largely fixed costs of car ownership, such as vehicle purchase, insurance, registration and parking, to variable costs that depend on how much the vehicle is used. This will tend to reduce participants' vehicle miles traveled and increase their use of other modes for some trips.

Additional benefits of car sharing programs include:

- Increased transit ridership as a result of a reduction in vehicle ownership
- Reduction in land dedicated to parking facilities
- Fewer greenhouse gas emissions
- Reduced congestion

The exact benefits of car sharing programs are hard to pinpoint because of the fact that they can induce and reduce driving at the same time. While they can potentially eliminate a household's need for a vehicle, car sharing also provides people who don't typically drive increased accessibility to automobiles, which can potentially increase the amount of driving within a community. Car sharing companies often make available highly efficient and advanced technology vehicles. In addition, since users can choose a vehicle suited to the task at hand, they will not typically use a pickup truck when a compact car will do. Thus fuel use per mile is likely lower for those using a shared vehicle than for those using their own vehicle.

Costs and benefits highlighted in table below are based on the assumption from *Moving Cooler* that local governments will provide a subsidy or encourage public procurement sufficient to ensure continuous presence of one or more public, private, or nonprofit car-sharing organizations per market. Local governments must also provide free or subsidized lease usage of convenient public street parking for carsharing vehicles. Municipalities must eventually meet a five-year goal of one car per 1,000 inhabitants in medium-density tracts and one car per 500 inhabitants of high-density census tracts.

Cost and Benefits Car Sharing

Policy	Year	Percent Fuel Savings	Per Capita Annual Fuel Savings ($)	Per Capital Annual Operation Cost Savings ($)	Per Capita Annual Implementation Costs ($)
Car Sharing	2015	0.66%	$9	$32	$0.04
	2020	0.66%	$9	$33	-
	2035	0.66%	$7	$36	-
	2045	0.66%	$8	$39	-

It should be noted that the modest energy savings shown reflect a relatively low participation rate, even in *Moving Cooler*'s maximum effort scenario. The assumed reduction in VMT per car replaced by the program is high (50%) (ULI 2009b).

RESOURCES

Transportation Research Board, *A Handbook, Using Market Segmentation to Increase Transit Ridership*—
http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_36-a.pdf

FTA, "Innovate Practices for Increased Ridership" searchable database—
http://ftawebprod.fta.dot.gov/BPIR/BestPractices/BP-Search.aspx

Transportation for America, *Thinking Outside the Farebox: Creative Approaches to Financing Transit*—
http://t4america.org/wp-content/uploads/2012/08/T4-Financing-Transit-Guidebook.pdf

Conclusion

With such a wide array of policies to choose from, municipalities can make significant strides towards changing community travel behavior and reducing their overall transportation-related energy consumption. Downtown revitalization, sustained growth in transit ridership over the past few years, and a continued increase in bicycle and pedestrian travel indicate that many Americans are looking for alternatives to driving. To accommodate the growing demand for compact, livable neighborhoods and alternative modes of travel, state, regional, and local government must take the lead to provide residents with transportation choices and improve the coordination of transportation and land use planning.

The policies outlined in this toolkit incorporate a range of approaches that will support efficient municipal and metropolitan transportation systems and enable residents to find feasible transportation alternatives. These include transportation and land use planning strategies, pricing strategies, transit investments, and service improvements. Additional benefits can be accrued by implementing multiple or complementary policies. While upfront costs may be significant for some of the strategies described here, benefits in the long run will be more than enough to cover those initial payments. Table 8 provides a summary of the associated costs and benefits of the policies described in this toolkit.

Table 8. Summary of Policy Costs and Benefits

Year	Policy	Percent Fuel Savings	Per Capita Annual Fuel and Operating Cost Savings	Per Capita Annual Implementation Costs ($)
2020	Combined Land Use	2.3%	$143	$0
	Pedestrian Strategies	1.0%	$61	$3
	Bicycle Strategies	0.4%	$27	$9
	Transit Expansion	1.6%	$100	$90
	Congestion Pricing	2.1%	$156	$32
	Cordon Pricing	0.2%	$15	$4
	VMT Fees	7.9%	$578	$4
	CBD/Activity Center On-Street Parking	0.2%	$11	$0
	Taxing Free Private Parking	0.1%	$9	$0
	Residential Parking Permits	0.2%	$15	$0
	Increased Transit Service	0.4%	$25	$15
	Transit Fare Measures	0.3%	$19	$0

Year	Policy	Percent Fuel Savings	Per Capita Annual Fuel and Operating Cost Savings	Per Capita Annual Implementation Costs ($)
2045	Combined Land Use	10.2%	$724	$0
	Pedestrian Strategies	1.0%	$68	$0
	Bicycle Strategies	0.9%	$63	$2
	Transit Expansion	5.3%	$381	$116
	Congestion Pricing	4.2%	$355	$22
	Cordon Pricing	0.4%	$35	$2
	VMT Fees	8.1%	$666	$2
	CBD/Activity Center On-Street Parking	0.2%	$12	$0
	Taxing Free Private Parking	0.1%	$10	$0
	Residential Parking Permits	0.2%	$16	$0
	Increased Transit Service	2.8%	$202	$27
	Transit Fare Measures	0.3%	$21	$0

References

[AASHTO] American Association of State Highway and Transportation Officials. 2012a. *Survey of State Funding for Public Transportation: Final Report 2012.* Washington, DC: American Association of State Highway and Transportation Officials.

_____. 2012b. "Center for Excellence in Project Finance: LYNX Blue Line." http://www.transportation-finance.org/projects/cats.aspx. Accessed September. Washington, DC: American Association of State Highway and Transportation Officials.

Alliance for Biking and Walking. 2012. *Bicycling and Walking in the United States: 2012 Benchmarking Report.* Washington, DC: Alliance for Biking and Walking.

[APTA] American Public Transportation Association. 2012. *The Benefits of Public Transportation.* Washington, DC: American Public Transportation Association.

[CATS] Charlotte Area Transit System. 2008. Mass Transit in Charlotte (Presentation). Charlotte, NC. Charlotte Area Transit System.

[CBO] Congressional Budget Office. 2011. *Alternative Approaches to Funding Highways*. Washington, DC: Congressional Budget Office.

City of Denver. 2008. *Denver Strategic Transportation Plan*. Denver, CO: City of Denver.

[CNT] Center for Neighborhood Technology. 2012. H&T Affordability Index Web-Based Tool. http://htaindex.cnt.org/. Accessed November. Chicago, IL: Center for Neighborhood Technology.

[CTOD] Center for Transit Oriented Development. 2004. *Hidden in Plain Sight: Capturing the Demand for Housing Near Transit.* Washington, DC: Center for Transit Oriented Development, Reconnecting America.

[DOT] U.S. Department of Transportation. 2012. *TIGER 2012 Awards.* Washington, DC: U.S. Department of Transportation

Dye, Richard and David Merriman. 2006. "Tax Increment Financing: A Tool for Economic Development." *Land Lines,* 18(1), 2-6.

[EIA] Energy Information Administration. 2012. *Annual Energy Outlook*. Washington, DC: Department of Energy, Energy Information Administration

[EPA] U.S. Environmental Protection Agency. 1998. *Technical Methods for Analyzing Pricing Measures to Reduce Transportation Emissions* . Washington, DC: U.S. Environmental Protection Agency

_____. 2009. *Essential Smart Growth Fixes for Urban and Suburban Zoning Codes.* Washington, DC: U.S. Environmental Protection Agency

_____. 2010. *Encouraging Transit Oriented Development: Case Studies That Work*. Washington, DC: U.S. Environmental Protection Agency.

_____. 2010b. *Strategic Package of Tools: Transit Oriented Development in Metropolitan Phoenix.* Washington, DC: U.S. Environmental Protection Agency

_____. 2011. "Location Efficiency and Housing Type—Boiling it Down to BTUs." http://www.epa.gov/smartgrowth/location_efficiency_BTU.htm. Accessed June 2012. Washington, DC: U.S. Environmental Protection Agency.

Ewing, R. Bartholomew, K., Winkelman, S., Walters, J., & Chen, D. 2007. *Growing Cooler: The Evidence on Urban Development and Climate Change*. Washington, DC: Smart Growth America.

[FHWA] Federal Highway Administration. 2006. *Congesting Pricing—A Primer*. Washington, DC: U.S. Department of Transportation, Federal Highway Administration.

_____. 2010. *Advancing Congestion Pricing in the Metropolitan Transportation Planning Process*. Washington, DC: U.S. Department of Transportation, Federal Highway Administration.

_____. 2012. *Contemporary Approaches to Parking Pricing: A Primer*. Washington, DC: U.S. Department of Transportation, Federal Highway Administration.

[FTA] Federal Transit Administration. 2010. *Public Transportation's Role in Responding to Climate Change.* Washington, DC: U.S. Department of Transportation.

Foster, Ben, Anna Chittum, Sara Hayes, Max Neubauer, Seth Nowak, Shruti Vaidyanathan, Kate Farley, Kaye Schultz, Terry Sullivan, Colin Sheppard, Arne Jacobson, Charles Chamberlin, and Yerina Mugica . 2012. *The 2012 State Energy Efficiency Scorecard*. Washington, DC: American Council for an Energy-Efficient Economy.

[ICCT] The International Council on Clean Transportation. 2010. *Congestion Charging: Challenges and Opportunities*. Washington, DC: The International Council on Clean Transportation.

[LGC] Local Government Commission. 2003. *Overcoming Obstacles to Smart Growth through Code Reform—Executive Summary*. Sacramento, CA: Local Government Commission.

Litman, Todd. 1999. *Evaluating Car Sharing Benefits*. BC, Canada: Victoria Transportation Policy Institute.

_____. 2011. *Introduction to Multi-modal Transportation Planning—Principles and Practices*. BC, Canada: Victoria Transportation Policy Institute .

Mackres, Eric . 2011. *Case Study: Cambridge Bicycle Programs*. Washington, DC: American Council for an Energy-Efficient Economy.

[NCSC] National Complete Streets Coalition. 2010. *Complete Streets Policy Analysis 2010: A Story of Growing Strength.* Washington, DC: National Complete Streets Coalition.

_____. 2012a. *Costs of Complete Streets*. Washington, DC: National Complete Streets Coalition.

_____. 2012b. *Complete Streets Policy Analysis 2011*. Washington, DC: National Complete Streets Coalition.

[NDOT] Nevada Department of Transportation. 2010. *Nevada Vehicle Miles Travelled Fee Study*. Carson City, NV: Nevada Department of Transportation.

[NSTIFC] National Surface Transportation and Infrastructure Finance Committee. 2009. *Paying Our Way—A New Framework for Transportation Finance*. Washington, DC: National Surface Transportation and Infrastructure Finance Committee

[RA] Reconnecting America. 2010. *2010 Inventory of TOD Program: A National Review of State, Regional and Local Programs that Fund Transit-Oriented Development Plans and Projects*. Washington, DC: Reconnecting America.

_____.2006. *Tools for Mixed-Income TOD*. Washington, DC: Reconnecting America.

Safirova, E., S. Houde, and W. Harrington. 2007. *Marginal Social Cost Pricing on a Transportation Network: A Comparison of Second Best Policies*. Washington, DC: Resources for the Future.

[SGA] Smart Growth America.2012a. "Using Complete Streets to Fight Obesity in Jefferson County." http://www.smartgrowthamerica.org/2012/06/25/using-complete-streets-to-fight-obesity-in-jefferson-county-al/. Accessed August. Washington, DC: Smart Growth America.

_____.2012b. "Complete Streets Chopped from Conference Bill." http://www.smartgrowthamerica.org/2012/06/28/complete-streets-chopped-from-conference-bill/. Accessed November. Washington, DC: Smart Growth America.

[T4A] Transportation for America. 2012. *Thinking Outside the Farebox: Creative Approaches to Financing Transit Projects*. Washington, DC :Transportation for America.

[TRB] Transportation Research Board. 2005. *TCRP Report 108: Car Sharing: Where and How It Succeeds.* Washington, DC: Transportation Research Board.

_____. 2007. *TCRP Report 111—Elements Needed to Create High Ridership Transit Systems*. Washington, DC: Transportation Research Board.

[TTI] Texas Transportation Institute. 2011. *2011 Urban Mobility Report*. College Station, TX: Texas A&M University.

[ULI] Urban Land Institute. 2009a. *Moving Cooler: An Analysis of Transportation Strategies for Reducing Greenhouse Gas Emissions*. Washington, DC: Urban Land Institute.

_____.2009b. *Moving Cooler: An Analysis of Transportation Strategies for Reducing Greenhouse Gas Emissions (Appendices)*. Washington, DC: Urban Land Institute.

_____.2011. "Changing Partnerships: New Approach to the Public/Private Paradigm." http://urbanland.uli.org/Articles/2011/ULI75/SheridanApproach. Accessed September 2012. Washington, DC: Urban Land Institute.

[VTPI] Victoria Transport Policy Institute. 2010. "Commute Trip Reduction." http://www.vtpi.org/tdm/tdm9.htm. Accessed September 2012. BC, Canada: Victoria Transportation Policy Institute.

_____.2011a. "Road Pricing." http://www.vtpi.org/tdm/tdm35.htm. Accessed August 2012 BC, Canada: Victoria Transportation Policy Institute.

_____.2011b. "Distance Based Pricing." http://www.vtpi.org/tdm/tdm10.htm. Accessed August 2012. BC, Canada: Victoria Transportation Policy Institute.

Whitty, James M. 2007. *Oregon's Mileage Fee Concept and Road User Fee Pilot Program*. Salem, OR: Oregon Department of Transportation.

Zuehlke, K. and R. Guensler. 2007. "Employer Perceptions and Implementation of Commute Alternative Strategies." *Journal of Public Transportation*, 10(4), 171-194.

Appendix A: Base Assumptions for Fuel Savings by Year

Year	Average Vehicles Per Capita (Light Duty)	Average Vehicles Per Capita (Commercial Light Duty)	Average Vehicles Per Capita (Heavy Duty)	Average Annual VMT per Vehicle (Light Duty)	Average Annual VMT per Vehicle (Commercial Light Duty)	Average Annual VMT per Vehicle (Heavy Duty)	Average Vehicle Stock FE in MPG (Light Duty)	Average Vehicle Stock FE in MPG (Commercial Light Duty)	Average Vehicle Stock FE in MPG (Heavy Duty)	Price of Gasoline ($)	Price of Diesel ($)	Percentage of Gasoline Vehicles (Light Duty)	Percentage of Diesel Vehicles (Light Duty)	Percentage of Gasoline Vehicles (Commercial Light Duty)	Percentage of Diesel Vehicles (Commercial Light Duty)	Percentage of Gasoline Vehicles (Heavy Duty)	Percentage of Diesel Vehicles (Heavy Duty)
2010	0.72	0.013	0.029	11,845	16,411	26,273	20.4	14.4	6.7	2.82	3.02	99%	0%	62%	38%	8%	92%
2011	0.71	0.013	0.029	11,728	16,216	26,921	20.6	14.6	6.7	3.52	3.83	99%	0%	61%	39%	8%	92%
2012	0.70	0.012	0.028	11,951	16,161	27,116	20.8	14.7	6.7	3.40	3.77	99%	0%	60%	40%	7%	92%
2013	0.70	0.012	0.028	11,995	16,516	28,095	21.0	14.8	6.7	3.37	3.47	99%	1%	59%	41%	7%	92%
2014	0.69	0.013	0.028	11,993	16,725	28,978	21.2	15.0	6.7	3.54	3.69	99%	1%	58%	42%	7%	92%
2015	0.69	0.013	0.028	11,992	16,866	29,514	21.5	15.2	6.8	3.63	3.81	99%	1%	58%	42%	7%	92%
2016	0.69	0.013	0.028	12,012	17,013	29,953	21.9	15.4	6.9	3.67	3.85	98%	1%	58%	42%	7%	92%
2017	0.69	0.013	0.029	12,041	17,198	30,128	22.3	15.7	7.0	3.72	3.91	98%	1%	57%	43%	7%	93%
2018	0.69	0.013	0.029	12,088	16,961	30,154	22.8	16.1	7.1	3.75	3.95	98%	2%	57%	43%	7%	93%
2019	0.69	0.013	0.029	12,141	16,960	30,289	23.3	16.4	7.2	3.78	3.97	98%	2%	57%	43%	7%	93%
2020	0.69	0.013	0.029	12,206	16,973	30,443	23.8	16.8	7.3	3.82	4.00	98%	2%	56%	44%	7%	93%
2021	0.69	0.013	0.029	12,272	17,198	30,584	24.4	17.2	7.4	3.85	4.04	98%	2%	56%	44%	7%	93%
2022	0.69	0.013	0.029	12,330	17,154	30,933	25.1	17.6	7.5	3.87	4.07	97%	2%	56%	44%	7%	93%
2023	0.69	0.013	0.029	12,390	17,066	30,871	25.8	18.0	7.6	3.91	4.10	97%	2%	56%	44%	7%	93%
2024	0.69	0.013	0.029	12,458	17,164	30,564	26.6	18.5	7.7	3.94	4.13	97%	3%	56%	44%	7%	93%
2025	0.70	0.014	0.029	12,538	17,042	30,430	27.5	19.0	7.7	3.99	4.20	97%	3%	56%	44%	7%	93%
2026	0.70	0.014	0.029	12,617	16,915	30,272	28.3	19.4	7.8	4.02	4.23	97%	3%	56%	44%	6%	93%

2027	0.70	0.014	0.030	12,709	16,784	30,008	29.1	19.9	7.8	4.01	4.22	97%	3%	57%	43%	6%	93%
2028	0.70	0.014	0.030	12,775	16,657	29,659	29.9	20.3	7.9	4.03	4.25	96%	3%	57%	43%	6%	93%
2029	0.70	0.014	0.030	12,841	16,548	29,353	30.7	20.7	7.9	4.07	4.29	96%	3%	57%	43%	6%	93%
2030	0.71	0.014	0.030	12,904	16,430	29,022	31.5	21.1	8.0	4.10	4.33	96%	3%	57%	43%	6%	93%
2031	0.71	0.014	0.031	12,962	16,299	28,794	32.2	21.5	8.0	4.16	4.42	96%	3%	57%	43%	6%	93%
2032	0.71	0.015	0.031	13,021	16,177	28,560	32.8	21.8	8.0	4.22	4.50	96%	3%	57%	43%	6%	93%
2033	0.71	0.015	0.031	13,070	16,042	28,233	33.4	22.0	8.1	4.14	4.42	96%	3%	57%	43%	6%	93%
2034	0.71	0.015	0.032	13,153	15,896	28,024	34.0	22.3	8.1	4.13	4.41	96%	4%	57%	43%	6%	93%
2035	0.71	0.015	0.032	13,215	15,747	27,688	34.5	22.5	8.1	4.17	4.47	96%	4%	57%	43%	6%	93%
2036	0.71	0.015	0.032	13,288	15,624	27,437	34.5	22.5	8.1	4.17	4.47	96%	4%	57%	43%	6%	93%
2037	0.71	0.015	0.033	13,361	15,502	27,187	34.5	22.5	8.1	4.17	4.47	96%	4%	57%	43%	6%	93%
2038	0.71	0.016	0.033	13,434	15,381	26,940	34.5	22.5	8.1	4.17	4.47	95%	4%	57%	43%	6%	93%
2039	0.71	0.016	0.033	13,508	15,260	26,696	34.5	22.5	8.1	4.17	4.47	95%	4%	57%	43%	6%	93%
2040	0.71	0.016	0.034	13,582	15,141	26,453	34.5	22.5	8.1	4.17	4.47	95%	4%	57%	43%	6%	93%
2041	0.71	0.016	0.034	13,657	15,023	26,213	34.5	22.5	8.1	4.17	4.47	95%	4%	57%	43%	6%	93%
2042	0.71	0.016	0.034	13,731	14,905	25,975	34.5	22.5	8.1	4.17	4.47	95%	4%	57%	43%	5%	93%
2043	0.72	0.016	0.034	13,807	14,789	25,739	34.5	22.5	8.1	4.17	4.47	95%	5%	58%	42%	5%	93%
2044	0.72	0.017	0.035	13,883	14,673	25,505	34.5	22.5	8.1	4.17	4.47	95%	5%	58%	42%	5%	93%
2045	0.72	0.017	0.035	13,959	14,558	25,273	34.5	22.5	8.1	4.17	4.47	95%	5%	58%	42%	5%	93%

Source: EIA 2012