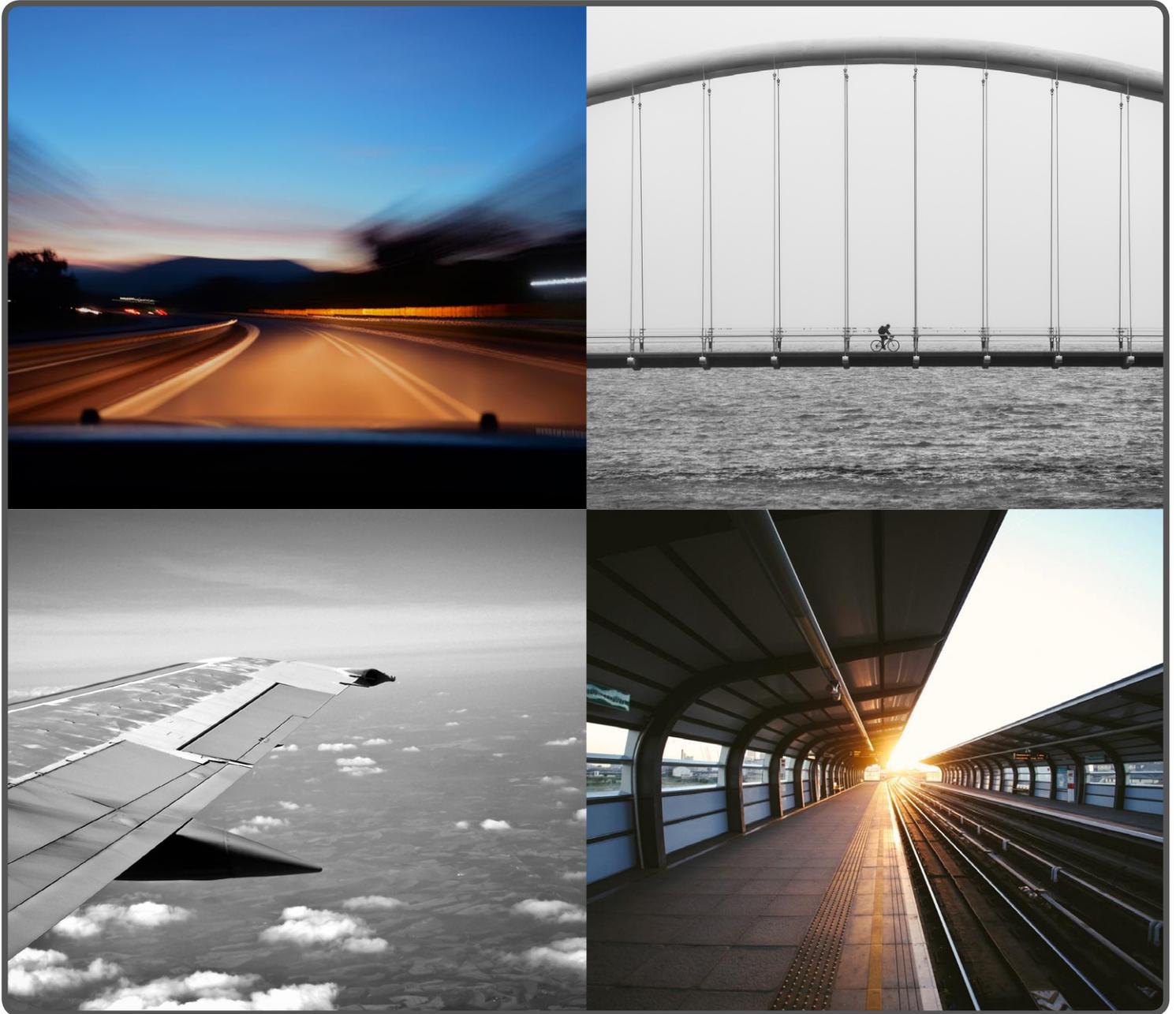


On the Horizon:

State of Transportation Planning 2016



American Planning Association
Transportation Planning Division

Making Great Communities Happen

Introduction

April 2016

Dear members and friends of the Transportation Planning Division (TPD) of the American Planning Association:

We hope you will enjoy the 2016 edition of TPD's **State of Transportation Planning: On the Horizon**. Since the last edition of the State of Transportation Planning in 2013, planners have had to become familiar with new transportation technology and new planning concepts. This edition features articles on connected vehicles, high speed rail, freight policy, integrated fare payment systems, and many others. Many thanks to the authors and review team.

For good planning,

Jo Laurie Penrose, AICP
Publication manager

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Rail-Trails as Commuter Conduits

Randall J. Rook, AICP

Transitions in the railroad industry over the past several decades have created opportunities for their reuse that allow Americans to lower their carbon footprint while pursuing healthy lifestyles. Pruning of the US freight rail network has occurred due to factors such as shifts from intermodal competition, overseas relocation of manufacturing, productivity gains and rail carrier mergers. The result is an over 40 percent route mile reduction of operating rail routes over the past century.

The 1983 addition of rail provisions to the National Trails Act enabled preservation of abandonment-endangered rail corridors for trails and future rail restoration. Many government entities acquired lines that had been abandoned and put up for sale for potential rail restoration or transit use (railbanking), and often converted them to trails in the interim and for longer term recreational or conservation use. The Surface Transportation Board (STB) regulates railroads and has mechanisms to allow interim public use (including trails) while corridors are in ownership transition, as long as the rail carrier is relieved of liability. Not all cases undergo this interim stage, and title is directly transferred through sale under the STB regulatory process. More than 1,900 rail trails presently extend over 22,000 miles in the US.

While trails are widely known for their recreational use, rail-trail conversions in urban regions have created successful commuter routes in recent years, including use as “first mile/last mile” transit feeders. With safety and liability concerns mitigated, rails-with-trails installations have proved successful in shared corridors, and presently number at least 88. Such trails include the Burlington (VT) Island Line Rail Trail and the Oceanside (CA) Coastal Rail Trail.

In addition to the personal benefits of active transportation facilities, local economies grow when new or existing businesses leverage trail locations. The environment benefits to the extent that active modes can reduce the number of single-occupant vehicles from congested roadways and lower greenhouse gas emissions. Regional ecology benefits from connecting corridors to each other and to open spaces in attractive networks.

Examples of commuter rail-trails abound nationwide, from Portland, OR (Springwater Corridor) to Miami (South Dade Rail Trail). Two such valuable routes that link suburban communities to the urban cores of Boston and Philadelphia regions are highlighted here—the Minuteman Bikeway and the Schuylkill River Trail, respectively. A description of the strictly urban Atlanta BeltLine follows.

Minuteman Bikeway

This ten-mile multi-use trail from Boston through its northwestern suburbs to Bedford was railbanked by the Commonwealth of Massachusetts and completed in 1999. As part of a regional trails network, future plans include an extension by incorporating the Reformatory Branch Trail, which will extend its reach an additional four miles to Concord. The Bikeway's routing through the commercial centers of many suburban towns provides significant economic benefits and averages over 5,000 daily users. Connections to MBTA buses and the heavy-rail Red Line at Alewife Station enable intermodal travel, by parking bikes at the station or bringing them on transit vehicles.

Schuylkill River Trail

Philadelphia's 60-plus-mile Schuylkill River Trail parallels its namesake river through suburban towns, including Conshohocken and Norristown, and Valley Forge National Historic Park. It has been growing incrementally since its 1990 inception, with the 27-mile Phoenixville segment serving as a popular commuter route. There are approximately 2,800 daily trail users (including bikers, walkers, and runners), and many utilize it for accessing work places in the city and suburban communities along its route. Eventually the entire 130-mile (largely) former Pennsylvania Railroad corridor will enable users to travel from Philadelphia to Pottsville.

As part of the region's planned and growing 750-mile Circuit trail network, numerous connections to other trails extend the Schuylkill River Trail's reach. The ultimate network connection will be to the developing Maine-to-Florida East Coast Greenway. Transit connections are possible at various locations in the region, including use of this trail as a rails-with-trails example in local transit agency SEPTA's Norristown Line Regional Rail corridor.



A business along the Schuylkill River Trail (left) and the Spring Mill Station (right). Photos by author.

Cooperation between Philadelphia, suburban municipalities, SEPTA, and freight rail carriers CSXT and NS has been essential for establishing a safe and contiguous route. Most notably, the Schuylkill River Trail was recently named the best urban trail in USA Today's Readers' Choice contest.

The Atlanta BeltLine

Known as the Emerald Necklace, this is a unique rail-trail system that is entirely urban and circular in nature rather than following the hub and spoke pattern from city to suburb. Originally serving to connect multiple rail carriers, it now ties multiple parks and neighborhoods together. Transit is an important component of the trail system and the regional transit system, as new intersecting MARTA stations and service patterns have been developed. When fully built out, the new Atlanta Streetcar will also link the BeltLine to downtown Atlanta. Since its inception, successful public and private development and neighborhood revitalization have taken advantage of what was conceived as a master's thesis for transit use seventeen years ago. The BeltLine has since been shepherded toward completion by state and city leaders.

In her book *MetroGreen*, Donna Erickson advocates consideration of non-motorized travel corridor networks as integral parts of local transit systems, with Denver and Calgary as examples. Such networks not only provide ecological rewards (especially when trails link open spaces); their popularity has prompted retailers to analyze user data when considering future locations. When combined with transit, a "systems" approach promotes "creating a contiguous and integrated open space system that takes advantage of both natural and constructed features."

Forward-thinking transit agencies such as Philadelphia's SEPTA are onboard with this type of thinking. SEPTA, in conjunction with local MPO Delaware Valley



Regional Planning Commission, recently released its Cycle-Transit Plan, which promotes bicycle use through recommending additional storage at rail stations and increased onboard capacity, improved bike path-station connections, and use of its own railbanked corridors.

Bicyclists on the Eastside Trail. Source: Atlanta BeltLine, www.beltline.org

Suggested Reading for Rail-Trails

<http://www.railstotrails.org/rtc-offline.html>

<http://www.minutemanbikeway.org/>

<http://schuylkillrivertrail.com/>

<http://beltline.org/about/the-atlanta-beltline-project/atlanta-beltline-overview/>

MetroGreen: Connecting Open Space in North American Cities, Donna Erickson, 2006.

America's Rails With Trails: A Resource for Planners, Agencies and Advocates on Trails Along Active Railroad Corridors, Rails-to-Trails Conservancy, 2013.

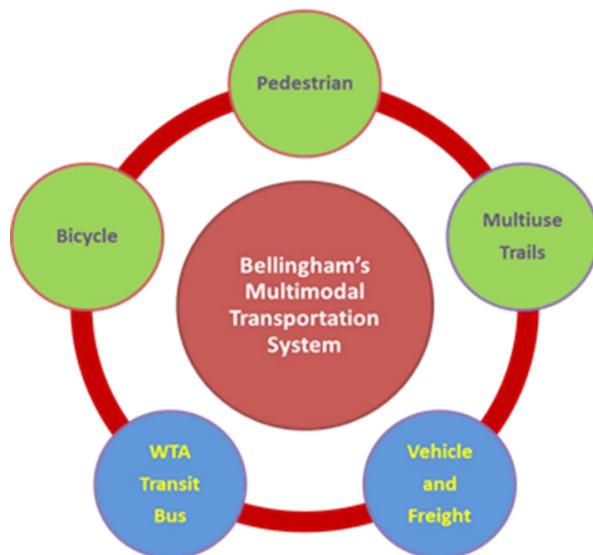
Randall Rook, AICP is a rail/transit planner and senior OCS engineer at AECOM while completing a master's degree in the Community and Regional Planning program at Temple University. randall.rook@aecom.com.

Complete Networks Approach to Transportation Planning in Bellingham, Washington

Chris Comeau, AICP-CTP

Prior to the popular rise of the national "Complete Streets" movement, the [City of Bellingham](#), Washington expanded its citywide transportation planning to focus on multiple modes. This included mode-shift goals, policies, and project recommendations to accommodate pedestrians, bicyclists, and transit riders, as well as vehicle drivers on all arterial streets. In 2004, Bellingham transportation planners worked directly with [Whatcom Transportation Authority \(WTA\)](#) to establish a Primary Transit Network and the Bicycle and Pedestrian Advisory Committee (BPAC) to develop the 2006 Bellingham Transportation Element. In 2009, Bellingham created a [Multimodal Transportation Concurrency Program](#), which integrated level of service (LOS) standards for sidewalks, bikeways, transit, and autos with various land use contexts instead of relying solely on traditional auto-oriented LOS standards from the Highway Capacity Manual.

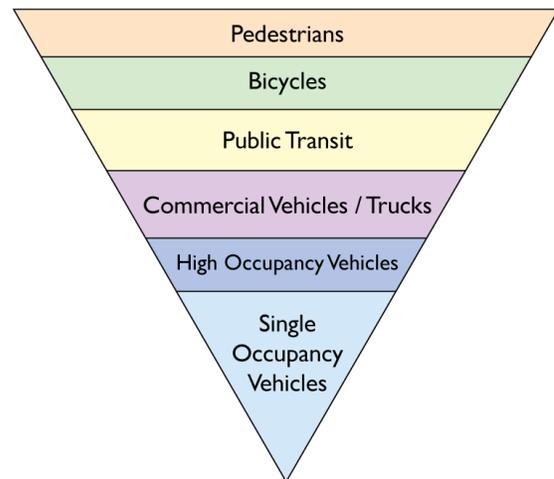
Since then, Bellingham created comprehensive Primary Pedestrian and Bicycle Networks detailed in both the 2012 [Pedestrian Master Plan](#) and 2014 [Bicycle Master Plan](#). Bellingham's progressive multimodal transportation planning has evolved into a Complete Networks approach, which not only incorporates all of the principles



Bellingham's Multimodal Transportation System.
Graphic by author.

of the Complete Streets movement, but also provides a [Transportation Report on Annual Mobility \(TRAM\)](#). TRAM is an annual progress report on the completeness of each modal network and how well the multimodal transportation system addressed new growth and development (concurrency) needs. TRAM also tracks current mode shares from Census data and suggests strategic adjustments aimed toward achieving the City's long-term transportation mode-shift goals to increase active and high-occupancy trips while decreasing single-occupant trips.

Much of Bellingham's Complete Networks approach involves building new sidewalks and/or bikeways on the existing street network or including sidewalks and/or bikeways in new street designs constructed by public or private interests. When designing multimodal transportation improvements, Bellingham transportation planners and engineers always consider the safety and mobility needs of all user groups, with a priority emphasis placed on the most vulnerable user groups, as illustrated here.



Bellingham's Pedestrian Master Plan identifies a 266-mile Primary Pedestrian Network and 343 individual sidewalk and intersection

crossing projects. The Plan provides for a consistent and connected pedestrian network, by recommending opportunities to remove barriers to safe walking and identifying future projects and needs to improve safety and design. Bellingham's Bicycle Master Plan identifies a 160-mile Primary Bicycle Network and 185 individual bikeway projects that have been subject to significant analysis and prioritized according to the needs of bicyclists. Both of these extensive multi-year planning efforts were informed with broad community input and both are integrated with Bellingham's 70-mile off-street [Greenways multi-use trail network](#).

Transportation Hierarchy. Institute of Transportation Engineers (ITE) Complete Streets Council.

Bellingham's motorized transportation system includes a citywide WTA Primary Transit Network and a designated 48-mile Freight Truck Network within the citywide 265-mile arterial street network. WTA's Primary Transit Network in Bellingham is focused on four major high-frequency transit corridors with public transit bus service provided every 15 minutes in each direction connecting all of Bellingham's higher density mixed-use Urban Village centers. Bellingham incentivizes infill development in Urban Villages by acknowledging lower vehicle trip generation due to the mixed use environment, WTA transit service proximity and frequency, and completeness of pedestrian and bicycle networks, and has thereby reduced transportation impact fees through an Urban Village TIF Reduction Program. Developers can choose to further reduce transportation impact fees through the purchase of WTA bus passes for their residents or employees.

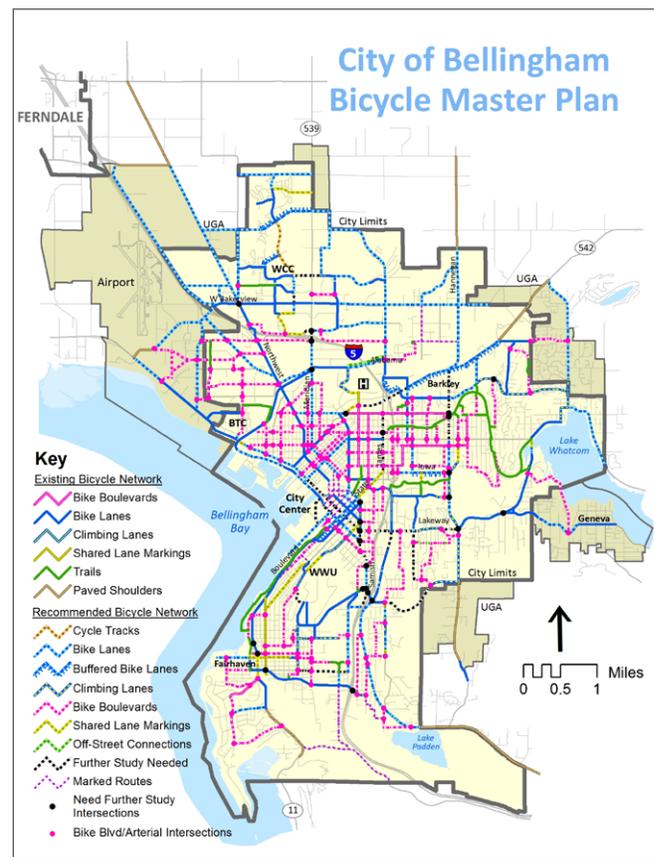
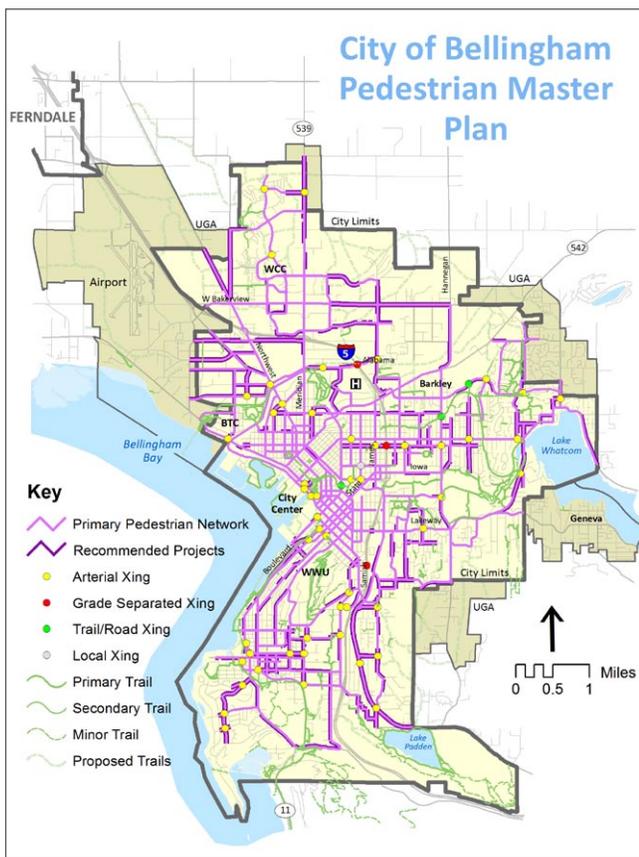
Bellingham's commitment to completing pedestrian and bicycle infrastructure, as well as promoting development in Urban Villages, helps the citywide Complete Networks approach toward achieving long-term mode shift goals adopted in the transportation

MULTIMODAL TRANSPORTATION

element of the comprehensive plan, which serve as targets to reduce the percentage of total trips made by single-occupant vehicles while increasing the percentage of total trips made by pedestrians, bicyclists, and transit riders.

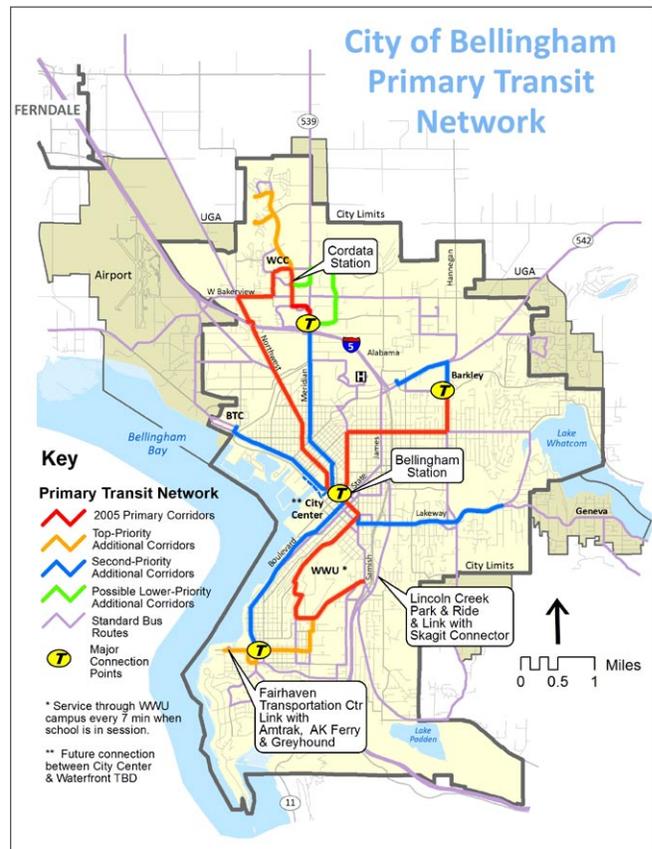
Defining multimodal transportation networks and creating plans is an important start, but without a commitment for implementation, plans just become "shelf art" that gather dust without providing any measurable benefit to the community. The Pedestrian Master Plan includes a prioritized list of 343 sidewalk and intersection improvements and the Bicycle Master Plan includes a prioritized list of 181 bicycle facility projects. The estimated cost to complete the long-term bicycle and pedestrian networks is over \$270 million dollars, which is far in excess of Bellingham's ability to construct with local funding alone. Bellingham's long-term plans for new arterial streets is estimated to cost an additional \$100 million.

In 2010, Bellingham voters approved a **Transportation Benefit District (TBD)** funded by a two-tenths of one-percent sales tax collected within the City limits of Bellingham. Funds are directed to arterial street resurfacing, non-motorized transportation improvements, and supplemental WTA transit service provided through a contract



All maps by Chris Behee and Kate Newell, City of Bellingham.

MULTIMODAL TRANSPORTATION



with the City. The TBD revenue is available for a 10-year period (2011-2020) and is greatly assisting Bellingham to complete the citywide pedestrian and bicycle networks identified in the Pedestrian and Bicycle Master Plans, support WTA’s efforts to provide a robust urban transit system, and help achieve and sustain the City’s long-term transportation mode-shift goals.

As an example, in 2015, Bellingham constructed 1.66 miles of new ADA-compliant sidewalk and 6.5 miles of new bikeways throughout the City, much of it funded with sales tax revenue from the TBD. As documented in the TRAM, connectivity is improving each year on Bellingham's multimodal networks and this is generating both increased interest and use by people who might not otherwise walk, bike, or ride public transit for local trips.

Fortunately, Bellingham has become increasingly successful at maximizing efficiencies and accomplishing multiple goals when committing funding to public infrastructure improvements. Repairing water and sewer utilities under arterial streets creates opportunities to add both bicycle and pedestrian improvements and, wherever possible, arterial street resurfacing projects always include the installation of bicycle lanes and ADA-compliant sidewalks and curb ramps. Bellingham has also been very

successful at leveraging local dollars for state and federal grant funding and creating funding partnerships with the transit agency, universities, WSDOT, Whatcom County, and private developers, making limited local funds go farther.

Bellingham is already a great place to live with many neighborhoods and community activity centers connected with sidewalks, bike facilities, and multi-use recreational trails. Bellingham is currently certified as a silver-level "Bicycle Friendly Community" by the League of American Bicyclists, but has aspirations to achieve gold-level status in the near future. Furthermore, WTA is one of the most successful public transit agencies in Washington and provides excellent service for local residents. Bellingham's commercial and industrial centers are easily accessible for customers traveling by foot, bicycle, transit, private vehicle, as well as goods being shipped by freight truck. Bellingham's Complete Networks approach to transportation planning has set the city on a path to become one of the most livable communities in North America for people of all ages and abilities.

Chris Comeau, AICP-CTP is the City of Bellingham's transportation planner with more than 22 years of planning experience in Washington, Alaska, and Arizona. For more information about Bellingham's Complete Networks approach to multimodal transportation planning, please contact him at ccomeau@cob.org or (360) 778-7946.

Woonerfs: Living Streets for all Users

Jonathan Paul, AICP

Communities throughout the US have begun to embrace a Complete Streets concept aimed at improving the safety and mobility of all users of our transportation system. Florida in particular, which consistently ranks as the most dangerous place in the country for bicyclist and pedestrians, has taken a number of steps over the last several years to begin a transition from principally moving people by motor vehicles to safely accommodating all modes of travel. Starting in the mid-1980s with Dan Burden, the Florida Department of Transportation's (FDOT) first Bicycle and Pedestrian Coordinator, the state began developing policies for Complete Streets and in the early 1990s became one of the first states to adopt a Complete Streets program.

The initial emphasis of the Complete Streets program was to ensure that design policies at the state level included bicycle and pedestrian facilities in new and widened roadways and where practical, during the reconstruction and repaving of existing roadways. These design policies were included in technical design manuals and have been implemented by the vast majority of local governments in Florida as part of their Comprehensive Plans and Land Development Regulations.

Within urbanized areas, the concept of road diets (popularized by Dan Burden and Peter Lagerway in their 1999 article "Road Diets: Fixing the Big Roads") sought to repurpose existing multi-lane roadways by reducing the number of lanes and adding elements such as turn lanes, on-street parking, and bicycle lanes. Edgewater Drive in the College Park neighborhood of Orlando, Nebraska Avenue in the Tampa neighborhoods of Ybor City, Tampa Heights, and Seminole Heights, and Main Street within downtown Gainesville are all examples of road diets in Florida. The roadways were redesigned to calm traffic, accommodate bicyclists, and improve walkability.



Examples of "living streets" in Asheville, North Carolina (left) and Haarlem, Netherlands (right). www.pedbikeimages.org. Dan Burden.

Even with the multi-decade effort to provide bicycle and pedestrian facilities on roadways, its inviting climate that allows residents and visitors to walk and bicycle all year round, and the prevalence of bicycle and pedestrian facilities on roadways throughout the state, Florida still leads the nation in the number of bicycle and pedestrian fatalities per capita. Part of this stems from the roadway designs themselves, the volumes of traffic on the roads, and the speeds at which vehicles travel. Traffic engineers emphasize safety for motorists through wide travel lanes, large clear recovery zones, clear sight triangles, pavement markings, and signage. While bicycle lanes and sidewalks have been incorporated, the focus has still principally been on moving motorists rather than all modes of transportation.

Local governments throughout Florida are addressing motorist, bicyclist, and pedestrian safety through roadway design elements like narrower travel lane widths, on-street parking, wider bicycle lanes, and lower design speeds. Recently FDOT, through the leadership of District 1 Secretary Billy Hattaway and Bicycle and Pedestrian Coordinator DeWayne Carver, have led the effort at a statewide level to narrow travel lane widths to eleven feet on arterials with posted speed limits of 45 mph or less and increase the width of bicycle lanes from 4 to 7 feet. The state has also developed guidance for road diets, roundabouts, and transit oriented developments and has developed a webpage where this information can be downloaded (www.dot.state.fl.us/rddesign/CSI). These efforts are very important as many local governments look for direction and guidance from the state on Complete Street design.

Beyond the statewide push for Complete Streets, in 2007 the Florida legislature introduced the concept of mobility plans and mobility fees as a replacement to transportation concurrency, which emphasized accommodating the impact of new development by building roads and widening existing ones. In 2011, the legislature abolished statewide transportation concurrency and in 2013 established mobility plans and mobility fees as the preferred way to deal with development impacts.



Groningen, Netherlands (left) and Copenhagen, Denmark (right). www.pedbikeimages.org. Ryan Snyder.

These changes are significant in that they allow the state and local governments to shift focus from addressing travel demand by adding new roadway capacity to encouraging and promoting mobility through all means of travel. The 2010 Alachua County Mobility Plan was the first mobility plan adopted by a Florida local government that emphasized walking and bicycling in traditional neighborhood developments and transit oriented developments, as illustrated in the following policy of the Future Land Use Element of the Comprehensive Plan:

“Policy 1.6.7 Transportation Network: The transportation network shall be designed as a continuous interconnected network of narrow streets, including a pedestrian and bicycle circulation system, designed to calm traffic speeds and encourage walking and bicycling throughout the development, provide connectivity, and functionally and physically integrate the various uses within and beyond the neighborhood to reduce the distances of travel between uses and promote the internal capture of trips, reduce impact on external roadways, and promote transit use.”

Beyond just encouraging walking and bicycling through complete street design principals, the policies went even further by allowing woonerfs in the Alachua County Unified Land Development Code:

“Policy 407.68 (d) 1. e. Innovative traffic calming techniques, except along roadways identified on the Future Highways Functional Classification Map in the Comprehensive Plan, are allowed along roadways and at intersections within the development. Techniques may include raised intersections, Woonerfs (streets where pedestrians and cyclists have legal priority using techniques including shared space, traffic calming and low speed limits), shared multi-modal spaces with reduced markings and signage in addition to other innovations that enhance pedestrian and bicycle mobility.”

A woonerf, also known as a “living street,” is a Dutch concept that emphasizes the role of streets as public spaces where pedestrians and bicycles can freely, safely, and legally travel. Motor vehicles are still allowed within these environments, albeit at much slower speeds and without the curbing, pavement markings, and design speeds that are common elements on roadways and Complete Streets. With its absence of dedicated travel lanes, curbs, pavement markings, and regulatory signage, a woonerf at first glance appears chaotic. The free movement of all modes of travel in the shared public space results in an appreciation of the order in which mobility occurs.

While increasingly common in Europe, the woonerf is a relatively new concept in most communities in the United States. Unless specifically authorized by a local government’s comprehensive plan, zoning, or land development regulations, it is most likely not allowed in local street design. The AASHTO Green Book and the Manual of Uniform Traffic Control Devices (MUTCD) provide little guidance in directly addressing woonerfs.

Woonerfs are most appropriately designed on a case-by-case basis and should be done in a context sensitive manner. The City of San Francisco has prepared a Living Alleys

Program that embraces the woonerf concept and developed a helpful toolkit for planning such facilities.¹ Residential streets, mixed-use developments, and walkable retail developments are examples of land use patterns in the US where communities have implemented woonerfs.

In Europe, woonerfs exist in a variety of locations including higher volume roads within in the centers of villages and smaller cities, as well as in residential areas and city centers. Common design elements include level travel areas without raised curbing or distinct facilities that separate pedestrians, bicyclists, and motorists; no or little regulatory signage; and no pavement markings that denote dedicated spaces for a particular mode of travel. Woonerfs can include alternative pavement treatments, trees, landscape planters, street furniture, bicycle racks, lighting, outdoor cafes and restaurants, and play areas for children.

Celebration Pointe, Alachua County's first transit oriented development approved under the County's Mobility Plan policies, is exploring a pedestrian friendly design for its Main Street that incorporates the woonerf concept. The street will have children's play areas, fountains, outdoor seating, gazebos, and small retail structures. Large live oaks that have been saved from other developments in central Florida will be incorporated into the streetscape to provide shade and create distinctive outdoor spaces. While vehicles will be permitted along portions of the woonerf, priority is given to pedestrians and bicyclists. Overall, woonerfs have the potential to be transformative elements within a community and can create vibrant environments that promote walking and bicycling.

Jonathan Paul, AICP is the Principal of NUE Urban Concepts, LLC specializing in creative and innovative land use and mobility strategies and can be reached at nueurbanconcepts@gmail.com or www.nueurbanconcepts.com.

¹ <http://www.sf-planning.org/index.aspx?page=3510>.

Boulder Greenhouse Gas Reduction in Transportation

Randall Rutsch, AICP

The Boulder Transportation Master Plan (TMP) is set within the broader context of the Boulder Valley Comprehensive Plan and supports the sustainability and quality-of-life goals set by the community. Boulder's TMP establishes the goals, policy guidance, and measurable objectives for operating and investing in the city's multimodal transportation system. In collaboration with local and regional partners, the TMP focuses on creating a complete transportation system providing multiple travel options for increased person trips, managing traffic congestion, and reducing air pollution and noise.

Based on consistent policy direction, Boulder has achieved the 1996 TMP objective to return Vehicle Miles Traveled (VMT) to 1994 levels. Boulder residents' per capita VMT is less than half the regional average and Boulder VMT peaked a decade before the rest of the region. This success is a result of the synergy between land use policies and the multimodal transportation investments made by the city. These efforts have already reduced VMT and thereby greenhouse gas (GhG) emissions by over 30 percent from where they would have been without these actions. However, the 2014 TMP contribution needed to meet the city's Climate Commitment goals calls for a 20 percent reduction in VMT and a reduction in resident single occupant vehicle (SOV) mode share to 20 percent of all trips by 2035. The material below describes the analysis used to establish these ambitious objectives.

During the 2014 TMP process, the city began pursuing a Climate Commitment of an 80 percent reduction in GhG emissions by 2050. This target represents the scientific consensus on the reductions needed to avoid significant impacts from climate change and will require aggressive action across all parts of the community. Part of the TMP process involved collaboration with the city's Climate Commitment analysis to quantify the GhG emissions generated through the transportation sector and identify strategies making a significant contribution to the 80 percent GhG reduction target.

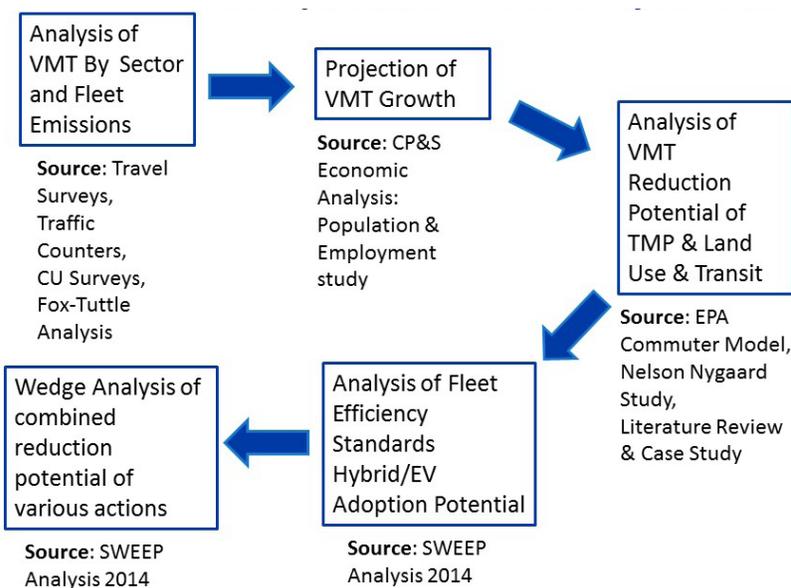
The core intent of this interdepartmental effort was to establish an ambitious but achievable objective for transportation GhG reduction, recognizing the progress already achieved by the community. Previous inventories had established that the local transportation sector contributed about 22 percent of Boulder's GhG emissions. The previous Climate Action Plan did not have a reasonable transportation objective.

A multi-departmental and consultant team including Nelson/Nygaard, Fox/Tuttle/Hernandez, and the Southwest Energy Efficiency Project (SWEET) conducted this analysis and the strategy development process. The steps of the analysis process were:

- Quantify existing VMT and GhG emissions from seven leading transportation sectors.
- Factor up travel expectations to 2035 based on population and employment forecasts.
- Project the VMT reduction potential of the range of travel demand management (parking and access management) and travel mode change actions (bike/walk promotion, transit system development, other travel share programs) being developed for the TMP.
- Evaluate heavy vehicle emissions of GhG, including transit, and different clean vehicle options for this fleet.
- Quantify the anticipated GhG reductions created by federally-mandated improvements in light-duty vehicles (CAFE standards).
- Identify the additional reductions needed from innovations like energy efficiency, fuel source switching, land use change, and additional TDM programs like expanded parking management.

The sequence of this analysis and the related data sources are shown in Figure 1. The first step was a detailed analysis of Boulder vehicle fleet characteristics based on the Colorado database of registered motor vehicles. This inventory showed that there were about 68,000 vehicles registered in Boulder. As might be expected from Boulder’s green reputation, there are a high number of hybrid and electric vehicles, making up about

Figure 1: Transportation GhG Analysis Process



five percent of the fleet and being about five times the national average. However, the Subaru Outback is the most popular vehicle and combined with a high number of sport utility vehicles (SUVs), the Boulder fleet average miles per gallon is similar to the national average. Table 1 shows the ten most popular vehicles in the Boulder fleet.

Boulder has been collecting detailed travel data on both residents and non resident employees since 1990, allowing for an estimate of daily individual VMT for each transportation sector. The comparison of calculated daily VMTs for the city and region are shown in Table 2. Using the knowledge of vehicle fleet characteristics and travel behavior data for Boulder residents and non resident employees, we were then able to calculate the total and relative share of VMT and GhG emissions for the different sectors of transportation. These calculations included factors for multiple occupant vehicles and multiple refinements represented in 21 versions of the spreadsheet.

Table 1: Top Ten Vehicles in the Boulder Fleet

Rank	Make	Model	Number	Percent of Total
1	Subaru	Outback	1,400	2.0%
2	Honda	Civic	1,053	1.5%
3	Subaru	Legacy	1,043	1.5%
4	Subaru	Forrester	973	1.4%
5	Toyota	Prius	904	1.3%
6	Honda	Accord	866	1.3%
7	Toyota	4Runner	713	1.0%
8	Toyota	Camry	689	1.0%
9	Volkswagon	Jetta	659	1.0%
10	Toyota	Rav4	599	0.9%
Total			8,899	13%

Table 2: Compared Daily VMT

2005 Regional Per Capita VMT	26.3
2035 Regional Per Capita VMT	23.7
Boulder non-resident employee	28.4
Boulder resident	11.2

Findings of this analysis show that Boulder residents are responsible for the majority of transportation related GhG emissions, either from auto vehicle use or from freight

deliveries. Freight and transit also have a disproportionate share of GhG emissions relative to their VMT, due to their diesel engines and heavy weight. Table 3 shows the calculated 2014 VMT and GhG emissions for each transportation sector and totals.

Table 3: Boulder Valley Transportation Emission Sources by Sector

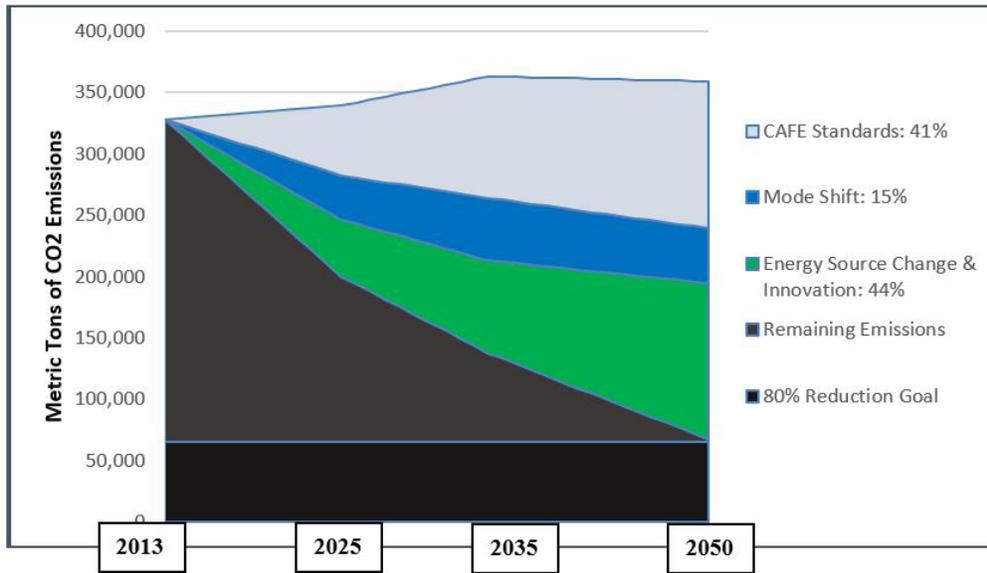
	Annual VMT	% VMT	Annual GhG (MT)	% GhG
Resident	323,769,600	51%	118,809	38%
Non-Resident Employee	192,192,000	30%	70,526	23%
Student	70,200,000	11%	25,760	8%
Visitor	25,550,000	4%	9,376	3%
Transit	10,435,000	2%	31,110	10%
Freight	18,250,000	3%	52,980	17%
Boulder Personal Aircraft			2,188	0.7%
Annual GhG (Metric Tons)			310,749	100%

In parallel to the vehicle fleet and GhG inventory effort, the actions being proposed for the 2014 TMP were evaluated to assess their VMT reduction potential. This assessment included a literature review, collection of case studies of other community’s GhG reduction efforts, and the use of the EPA Commuter model to assess the effects of the proposed TMP mode share targets. Taking into account the progress already made in the community to reduce VMT, the team concluded that a 20 percent VMT reduction objective was aggressive but achievable using the strategies and tools contained in the draft plan. This conclusion was supported by a sensitivity analysis showing that additional areas of managed parking or increased availability of the Eco Pass, an annual transit pass, would significantly increase transit ridership.

The existing VMT and GhG emissions were then factored up to a 2035 forecast using the city’s existing population and employment projections and adjusted to reflect the effects of successfully implementing the TMP’s “Renewed Vision for Transit.” This level of investment is expected to more than double transit ridership. The 20 percent reduction in VMT was calculated to produce a net 15 percent reduction in GhG emissions once the emissions from the increased level of transit service are included.

The known expected reductions in transportation GhG emissions are then reflected in Figure 2, compiled by SWEEP. This figure shows the reductions expected from the improved light vehicle efficiency mandated by the federal CAFE standards and the results of successfully implementing the TMP actions. The large green wedge represented efforts that still needed to be defined, which could include additional TDM and land use changes as well as vehicle electrification.

Figure 2: Projected GhG Reductions by Action Area



Southwest Energy Efficiency Project 2014 Analysis

Personal electric vehicles are among the options available for the innovations wedge, which also includes land use changes to make long trips into short, walkable/bikeable ones. Such changes will have many co-benefits to the community, including livability, economic vitality, equitable access, and a wide array of environmental benefits.

But knowing that additional reductions were needed in the transportation area and that a growing number of cleaner fuel options are available for the transit fleet, including electric vehicles, an additional analysis of the potential for transit clean fuel options was conducted by Nelson/Nygaard. The first step of this analysis produced the emissions factors and comparisons between available clean fuel transit vehicles (see Table 4). One of the early findings of the analysis showed that electric vehicles would have limited benefit with the current fuels mix of electricity in Boulder. As Boulder is involved in an electric municipalization effort driven by the desire for a clean electric supply, the analysis included this option.

These emission factors were then applied to the 2035 projected VMT by transportation sector for the Boulder valley. The following tables assume complete fleet conversion to the identified fuel source and the GhG savings of the increased transit ridership called for in the TMP. Current year transit emissions are estimated at about 25,500 metric tons (MT) carbon dioxide equivalent (CO2e) for RTD, the regional transit provider, and Via, the community’s special transit provider. An estimated 35,000 MT CO2e are avoided from existing annual transit trips in Boulder County.

Table 4: Annual Transit GhG Savings from Cleaner Fuel/Energy Adoption, MT CO2e, Current and 2035 Fleet Scenarios

Current Year (2013 Base)	Fuel Type	Metric Tons of CO2e Emissions per Year	Difference from A.	Difference from B.	Difference from C1.	Difference from C2.	Difference from D1.	Difference from D2.	% Change from Current Year Diesel Fleet
	A. Diesel	25,530	0	9,910	9,890	15,040	9,870	20,830	NA
	B. Hybrid Electric (HEV)	15,620	-9,910	0	-20	5,130	-40	10,930	-39%
	C1. Electric/HEV (Current Energy Mix)	15,640	-9,890	20	0	5,150	-20	10,950	-39%
	C2. Electric/HEV (Low Carbon Energy Mix)	10,490	-15,040	-5,130	-5,150	0	-5,170	5790	-59%
	D1. Full electric (Current Energy Mix)	15,660	-9,870	40	20	5,170	0	10,970	-38%
	D2. Full electric (Low Carbon Energy Mix)	4,700	-20,830	-10,930	-10,950	-5,790	-10,970	0	-82%
	Fleet VMT/Year: 8,703,000								

2035 Transit Scenario	Comparisons to 2035 Scenario Base Emissions									Current Base
	Fuel Type	Metric Tons of CO2e Emissions per Year	Difference from A.	Difference from B.	Difference from C1.	Difference from C2.	Difference from D1.	Difference from D2.	% Change from 2035 Diesel Fleet	% Change from Current Year Diesel Fleet
	A.	39,870	0	17,960	17,940	22,010	17,900	33,280	NA	56%
	B.	21,910	-17,960	0	-20	4,050	-60	15,320	-45%	-14%
	C1.	21,930	-17,940	20	0	4,070	-40	15,340	-45%	-14%
	C2.	17,860	-22,010	-4,050	-4,070	0	-4,110	11,270	-55%	-30%
	D1.	21,970	-17,900	60	40	4,110	0	15,380	-45%	-14%
	D2.	6,590	-33,280	-15,320	-15,340	-11,270	-15,380	0	-83%	-74%
Fleet VMT/Year: 15,064,00										

* Current mix of electricity: 60% coal with scrubbers, 22% natural gas, and 18% wind and other “green” sources.

** “Low carbon mix” is an average CO2e (24.8g) output of bio-mass (18g), Solar PV (46g), Solar CSP (22g), and wind (12g), adjusted for CO2 equivalency.

Source: Moomaw, W., et al, 2011: Annex II: Methodology. IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation [O. Edenhofer, et al [eds.]], Cambridge University Press, Cambridge, New York, NY.

http://srren.ipcc-wg3.de/report/IPCC_SRREN_Annex_II.pdf

Table 5: City of Boulder 2035 GhG Forecast and Reductions due to Passenger VMT Avoided and Transit Fleet Fuel/ Energy

		Annual VMT	% VMT	Annual GhG (MT)	% Reduction of Transit-Related GhG Emissions (c)	% of Total Boulder 2035 Transportation GhG Forecast (d)
A.	Non-Resident Employee	235,152,000	36%	86,290	-	31%
B.	Resident (walk/bike)	309,581,170	47%	113,603	-	41%
C.	Student (walk/bike)	94,500,000	14%	34,677	-	12%
D.	Total without Transit (a)	639,233,170	97%	234,571	-	84%
E.	2035 Transit Scenario - Diesel (b)	15,064,200	2%	39,900	-	14%
F.	Transit - CU/NCAR/BVSD (a)	3,269,500	0%	8,400	-	3%
G.	Total with Transit	657,566,900	100%	282,900	-	100%
GhG Reductions (Energy or Rider VMT Avoided)						
H.	Reduction with HEV fleet			-18,000	-45%	-6%
I.	Reduction with Electric/HEV with existing energy mix			-18,000	-45%	-6%
J.	Reduction with Electric/HEV with low-carbon mix			-22,000	-55%	-8%
K.	Reduction with Full Electric with existing energy mix			-17,900	-45%	-6%
L.	Reduction with Full Electric with low-carbon mix			-33,300	-83%	-12%
M.	Transit Riders VMT/GhG Avoided (e)			-40,200	-101%	-14%
Net RTD/VIA GhG						
N.	With Diesel Fleet and Rider VMT Avoided			-300	-1%	0%
O.	With Hybrid-Electric Fleet and Rider VMT Avoided			-18,300	-46%	-6%
P.	With HEV/Electric existing energy mix and Rider VMT Avoided			-18,300	-46%	-6%
Q.	With HEV/Electric low-carbon mix and Rider VMT Avoided			-22,300	-56%	-8%
R.	With Full Electric existing energy mix and Rider VMT Avoided			-18,200	-46%	-6%
S.	With Full Electric low-carbon mix and Rider VMT Avoided			-33,600	-84%	-12%

(a) From GhG Transportation Data Book, for 2035.

(b) From fleet analysis or revised calculations.

(c) Percentages are relative to the RTD/Via transit emissions only.

(d) Percentages are relative to the total City of Boulder Transportation GhG Forecast.

(e) Transit scenario estimate adapted for this analysis including an adjustment for weekend riders.

Key Findings and Lessons Learned

Key findings from the transit analysis include:

- Maintaining the status quo primarily diesel bus transit fleet would decrease the current net GhG emissions benefit from transit by 2035 due to increased transit service and increased passenger vehicle fuel efficiency. This would occur even with an assumed 18 percent efficiency improvement in standard transit vehicles. Based on this analysis, the benefit is small but still a net reduction in GhG emissions.
- It is necessary to transition the transit fleet to cleaner fuel/energy sources to increase net GhG emissions reductions from transit.
- With the current electricity energy source mix in Boulder, a conversion to electric buses offers little overall benefit in reducing GhG emissions—comparable to converting to hybrid-electric vehicles. However, shifting to an electric bus fleet does reduce local emissions of various air pollutants while generating emissions at the energy source, e.g., coal or natural gas power plant.
- A low-carbon energy source mix reduces the overall GhG emissions of the fleet, reducing 2035 emissions to 26 percent of the current level (74 percent reduction) and to 17 percent of the 2035 scenario estimate (83 percent reduction).
- An all-electric transit fleet scenario may not be supported by battery technology by 2035, however an alternative technology is likely to be available that can provide comparable emissions benefits to the alternative analyzed.
- Transit also provides indirect GhG benefits, contributing to land use development patterns that support reduced VMT and have a smaller GhG footprint. Transit plays a key role in shaping built form and compact, walkable neighborhoods. Residents in walkable neighborhoods drive less not only by walking and biking more but by using transit more often.

Broader lessons learned as part of the analysis include:

- The city has a detailed understanding of our fleet mix including the penetration of clean fuel vehicles.
- In contrast to past efforts that considered only VMT in the Boulder Valley, we now understand the role of non-resident employees, per ICLEI protocol that requires the city to include one half of those commute trips in our GhG inventory.

- The city can achieve deep transportation GhG reductions but only if we clean the vehicle fleet, including the transit fleet.
- Actions are needed that are far more significant than anything done to-date. The city's 80 percent reduction goal by 2050 requires an average 4.6 percent reduction every year.
- Conservation and efficiency alone will not achieve the goal.
- Significant emission reductions will only be achieved through collective action and fundamental systems change, such as achieving a clean electricity mix and creating more walkable neighborhoods.

Randall Rutsch is a transportation planner for the City of Boulder, Colorado.
rutschr@bouldercolorado.gov.

Transportation Energy Beyond Fossil Fuels: Improving Vehicle Energy Intensity

Kimberly Burton, P.E., AICP CTP, LEED AP ND

Transportation Energy Overview

According to the US Energy Information Administration (US EIA), “[p]assenger transportation, in particular light-duty vehicles, accounts for most transportation energy consumption – light-duty vehicles alone consume more than all freight modes of transportation, such as heavy trucks, marine, and rail.”¹ The US has historically consumed more energy from petroleum than from any other energy source,² and 92 percent of US transportation energy use came from petroleum.³

According to the US EIA’s world consumption trends research, this pattern is projected to continue. The three main concerns associated with current energy consumption patterns center around:

- Environmental Damage – climate change, air pollution and extraction
- Nonrenewable Supplies – supply limitations and price fluctuations
- Nondomestic Supplies – security and dependability concerns

To address these transportation energy-related issues, solutions can be grouped into three main categories:

1. Improve vehicle energy intensity
2. Use low-carbon fuels
3. Reduce vehicle miles travelled

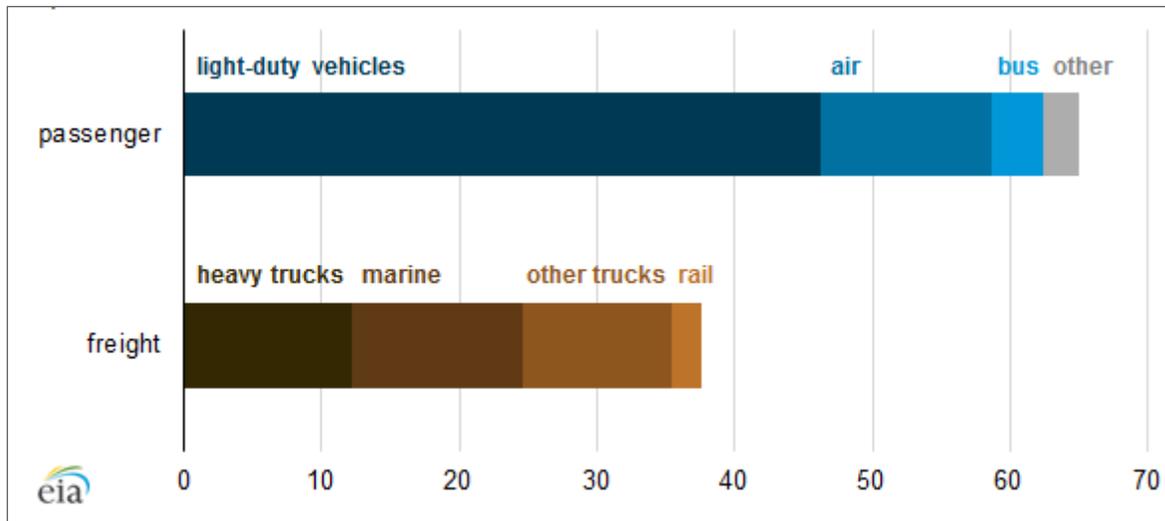
An overview of these three areas was provided in a 2013 State of Transportation Planning article. This article will focus in detail on how to address the first category: improving vehicle energy intensity.

1 Dorman, Linda and Nick Chase, “Today in Energy: Passenger travel accounts for most of world transportation energy use,” US Energy Information Administration (November 2015). www.eia.gov

2 Primary Energy Consumption Estimates by Source, US EIA, 2014.

3 Primary Energy Consumption Estimates by Source and Sector, US EIA, 2014.

Annual Global Transportation Energy Consumption by Mode, 2012 (quadrillion Btu), US EIA



Vehicle Energy Intensity Defined

The main factors that influence the vehicle energy intensity of light-duty vehicles are technology, fuel prices, public policy, and consumer choice. What does it mean to improve vehicle energy intensity? It involves increasing the vehicle efficiency or fuel economy of a vehicle, including:

- Improving conventional gasoline engines via more efficient combustion technologies and transmissions.
- Developing advanced vehicle technologies, such as regenerative braking.
- Reducing the weight of materials and aerodynamic resistance in vehicles.
- Increasing alternative fuel vehicles – battery electric, hybrid electric, flex-fuel, fuel cells, and various combinations.

Current efficiency for a typical gasoline-powered vehicle is 20 to 25 percent.⁴ With today's technologies, conventional gasoline engines can be improved using more efficient combustion technologies and transmissions, and vehicles could be constructed with lighter-weight materials and aerodynamic designs.

Technology Solutions

Increasing vehicle electrification, hybrids, and hydrogen-powered cars, trucks, and buses would improve vehicle efficiency and reduce GHG emissions. Options include:

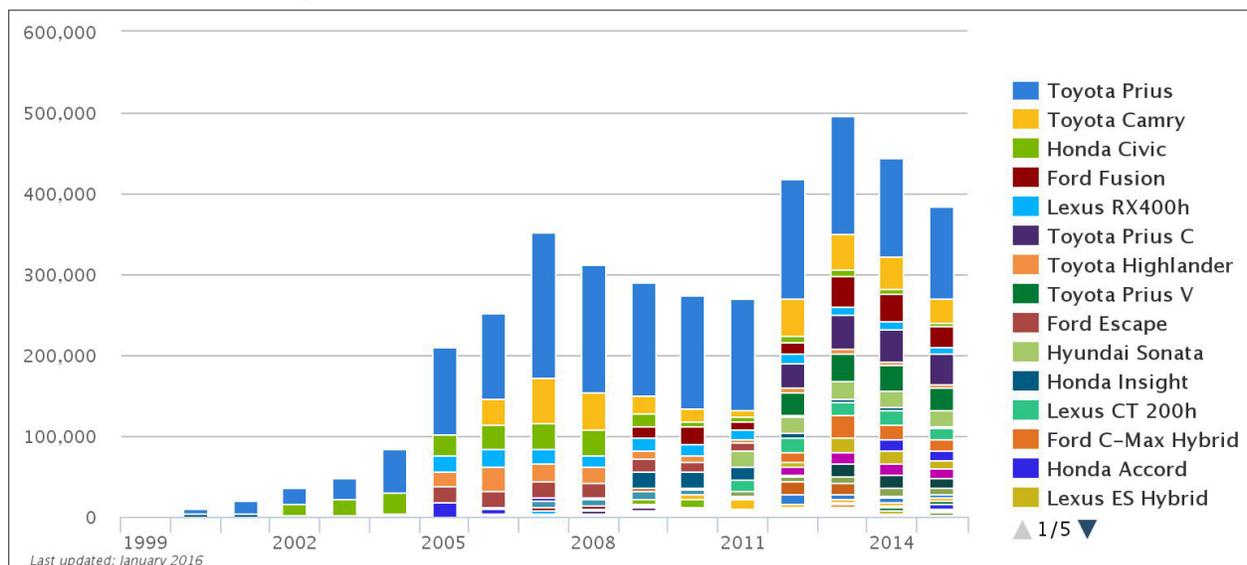
⁴ Randolph, John and Gilbert Masters, *Energy for Sustainability*, Island Press, 2008. p505.

- FFVs – Flex Fuel Vehicles can run on gasoline or alcohol blends up to 85 percent.
- HEVs – Hybrid Electric Vehicles have gasoline engine like conventional vehicles but also have an electric motor drive that works in tandem with the gas engine.
- PHEVs – Plug-In Hybrid Electric Vehicles are HEVs that can use grid power to assist with charging the battery.
- FF-PHEVs – Flex Fuel Plug-In Hybrid Electric Vehicles use a flex-fuel engine that can run on gasoline or ethanol blend, which would further reduce petroleum usage. The miles per gallon of gasoline would be 500 to 700—95 percent less gasoline usage than the average car on the road today.⁵
- BEVs – Battery Electric Vehicles run solely on a battery.
- FCEVs – Fuel Cell Electric Vehicles convert hydrogen to electricity without emissions.
- Hypercars™ focus on improvements to make the vehicle lighter, independent of the propulsion system, and could integrate various vehicle types. Physicist Amory Lovins, co-founder of the Rocky Mountain Institute and Hypercar, Inc., maintains that “contrary to folklore, it’s more important to make a car lightweight and low-drag than to make its engine more efficient or change its fuel.”⁶

5 Ibid. p524.

6 Rocky Mountain Institute, 2004. <http://www.rmi.org>

US HEV Sales by Model



US Department of Energy Alternative Fuels Data Center, www.afdc.energy.gov/data/

HEVs have been the predominate type of efficient vehicle sold in the US. From 1999 to 2014, HEV sales grew significantly. In 2005, there was surge in sales due to new federal and state tax incentives and rebates. The decline in sales from 2008 to 2011 was connected to the recession, but sales have rebounded due to the economic recovery and the new CAFE (Corporate Average Fuel Economy) standards. In addition, there are many choices available—today there are nearly 60 different models.

For comparison purposes:

- Increasing vehicle efficiency from 22 to 32 miles per gallon would reduce vehicle petroleum use by 31 percent and imports of petroleum by 20 percent.⁷
- Increasing to an HEV equivalent of 42 miles per gallon would cut vehicle oil use by half and imports of petroleum by 30 percent.⁸
- Increasing to a PHEV/FF-PHEV equivalent of 100/500 miles per gallon would reduce petroleum imports by 50 percent and 62 percent, respectively.⁹

Fuel Price Solutions

Although fuel prices typically only affect travel behavior in the short term, in the longer term, consumers do make purchasing decisions related to vehicle efficiency. If fuel prices remain high, consumers tend to choose more fuel-efficient vehicles. Fuel prices are set by market influences; however, federal and state taxes can be added to (or removed from) fuel prices to have a direct effect on long-term vehicle efficiency.

Policy Solutions

The US could also make policy changes to increase vehicle efficiency performance standards, industry commitments, and purchasing incentives. For example, the primary policies in place today that regulate vehicle efficiency are CAFE standards. Congress first adopted federal auto efficiency standards in the 1975 Energy Conservation Policy Act, which mandated doubling average 1974 new auto fuel efficiency to 27.5 miles per gallon by 1985. The CAFE standards were lowered to 26 miles per gallon from 1986-1989 but raised back to 27.5 miles per gallon in 1990. In 2011, the current federal administration developed new CAFE Standards, and they represent the toughest fuel economy standards to date. Under these new standards, average fuel efficiency for cars and trucks will nearly double, reaching an average performance equivalent of nearly 55 miles per gallon by 2025, but US vehicle efficiency standards still lag behind the standards of many other countries. Over time, CAFE standards have been effective at increasing the average fuel economy of

7 Randolph, John and Gilbert Masters, *Energy for Sustainability*, Island Press, 2008. p511.

8 Ibid. p511.

9 Ibid. p512.

automobiles; however, the average fuel economy has been negatively affected by the increase of light duty trucks and SUVs, relatively low fuel prices, and the fact that the CAFE standards had not been increased from 1990 to 2011—over 20 years.

Challenges

The main challenges associated with improving vehicle efficiency include:

- Vehicle cost – typically, hybrids and other fuel efficient vehicles cost more than standard vehicles.
- Information – it is difficult to translate the upfront cost of a fuel efficient vehicle into long-term savings on gasoline. In addition, information is not widely available on many vehicles options, their positives and negatives, and fueling station locations to help people make informed decisions on car purchases.
- Policy Implementation – although changing the CAFE standards in 2011 was step in the right direction, it will only affect vehicles built after that year. Older vehicles that remain on the road will still be less efficient than desired up until they are retired after an average 10-year lifespan.
- Policy Effectiveness – the penalties associated with not meeting CAFE standards are not always significant enough to ensure compliance. Many car manufacturers find it cheaper to pay the penalties than meet the efficiencies.
- Policy Strength – CAFE standards allow for more lenient efficiencies for light duty trucks and SUVs, and there has been an increase in sales of both.

Next Steps in Reducing Vehicle Energy Intensity

Reduction of vehicle energy intensity is one of the factors that needs to be addressed in order to transition the transportation sector off of fossil fuels and onto more sustainable energy patterns. Vehicle energy intensity is influenced by technology, fuel prices, public policy, and consumer choice, so solutions include:

- Switching to energy efficient vehicles that use low / no-carbon fuels.
- Implementing programs, grants, and policies that support efficient vehicle technologies.
- Closing loopholes and increasing penalties in the CAFE standards so that vehicle manufacturers more closely adhere to them.
- Increasing federal and state gas taxes to influence consumer choice.

Kimberly Burton is an associate professor of practice in city and regional planning at the Ohio State University and president of Burton Planning Services in Columbus, Ohio. burton.90@osu.edu.

Integrating Freight into Livable Communities

Kristine Williams, AICP and Alexandria Carroll

Freight mobility is critical to the economic vitality of any community. Efficient freight movement ensures that stores and restaurants are stocked appropriately, that manufacturers get the raw materials they need, and that regional freight distribution centers and local businesses receive packages, office supplies, and other goods. Much of the visible freight activity in urbanized environments involves deliveries destined for local businesses and homes.

Often referred to as “last-mile” activity, this is the most costly and problematic phase of freight movement. Last-mile freight activity in urban areas not only competes for public space, but can also create negative externalities (air and noise pollution, congestion, and infrastructure damage).

Yet factors that make a community livable can create conditions that increase freight demand, while reducing freight access. For example, conditions that increase freight demand are increased density and a diverse mix of uses in close proximity—the same factors that contribute to community livability and walkable neighborhoods. Road diets and changes to street network design and site access to support bicycling and pedestrian activity generally involve wider sidewalks, bicycle lanes, narrower intersections with tight turning radii, and on-street parking. These changes benefit pedestrians, yet make it harder for trucks to navigate turns, leading to congestion, crashes, sidewalk encroachment, and curb damage.

Additionally, livability plans may reduce or fail to accommodate dedicated truck parking areas. A lack of dedicated truck loading zones can increase roadway congestion and vehicle emissions by forcing trucks to either circulate in search of a parking space or double park. Fines from parking illegally can also increase freight operational costs.

This tension between freight movement and community livability presents a paradox. In communities where livability is a goal of the planning process, freight runs the risk of being considered only as an afterthought or as a nuisance. Vibrant urban cores require an appropriate balance between accessibility for freight delivery and pedestrian/bicycle friendly environments. Communities need to provide efficient access for large trucks, freight rail, and other modes of freight transportation without impeding bicyclists, pedestrians, and transit users.

A number of options are available to local and regional planning agencies for use in managing this interaction between freight movement and livability objectives. Given that communities are unique in their mix of vision, target industries, development patterns, and transportation systems, these strategies will need to be tailored to the local and regional context. Below is a summary.

Infrastructure Planning and Design

- **Designated Truck Routes.** Designated truck routes typically guide heavy vehicles and hazardous materials toward roadways better equipped to accommodate their size and impacts. This strategy is compatible with layered network plans, context sensitive solutions, and complete streets roadway classification schemes.
- **Intermodal Freight Connectors.** Connectors facilitate the movement of high volumes of freight and provide alternative access to major freight facilities, while removing or reducing truck traffic on neighborhood streets. In Tampa, for example, the I-4/Selmon Connector provides direct access for trucks into the Port, removing heavy truck traffic from urban streets in historic Ybor City.
- **Highway Bypasses.** Bypass routes redirect through traffic around populated areas or downtowns to reduce roadway congestion, improve travel times, and reduce negative impacts from heavy trucks. Bypassed routes can then be rightsized in urban centers to increase walkability.
- **Geometric Modifications.** Various design strategies can be employed to make roadways and intersections more accommodating to large trucks on designated truck routes. Design considerations include curb return radii, exclusive turn lanes, length of turn lanes, horizontal and vertical clearances, and width of travel lanes. Street design in community activity areas can emphasize non-auto functions.
- **Multi-Use Lanes.** Certain travel lanes can be shared among specific types of vehicles to improve traffic flow. Paris, France allows delivery vehicles to use a portion of its bus lane network to access loading zones during off peak hours. Special markings indicate where goods vehicles may load and unload and design strategies allow trucks to straddle the sidewalk so buses can easily pass.

Parking and Loading

- **Peak Hour Clearways/Parking Restrictions.** Parking or stopping for loading and unloading is prohibited on certain roads or sections of roads during periods of high traffic demand. This technique preserves the capacity of the roadway without the cost of creating additional travel lanes.



Federico Rostagno/123RF.

- **On-Street Parking and Loading Zones.** Street design is modified and curb space is reallocated to accommodate freight vehicles. When adequate parking and loading space is provided, truck drivers spend less time searching for curb space and can access goods receivers more easily.
- **Off-Street Parking and Loading Requirements.** Local land development codes can be enhanced to accommodate goods delivery by requiring on-site parking and loading facilities and storage space.
- **Vehicle Parking Reservation Systems.** Truck drivers can reserve parking and loading spaces in advance through the use of wireless communication technology.

Land Use Management

- **Preferential Zoning and Tax Relief.** Preferential zoning and tax relief programs encourage the preservation of industrial activity on existing industrial sites and prevent industrial sprawl.
- **Urban Freight Villages.** Intermodal freight staging facilities enhance connectivity across and between modes, consolidate logistics activities, and improve operational efficiency.

Traffic and Delivery Management

- **Voluntary Off-Peak Deliveries.** Voluntary off-peak delivery programs can be used to reduce the amount of roadway congestion during peak travel times.
- **Alternate Pick up/Delivery Locations.** Alternate pick up/delivery locations are a last-mile strategy which specifically targets home deliveries. Deliveries to alternate pickup points help maximize route efficiency, lower freight operating costs, and potentially reduce vehicle miles traveled.

Noise Reduction

- **Quiet Delivery Schemes.** Strategies that minimize freight-generated noise pollution include changes to vehicle technology, delivery equipment, or driver behavior.
- **Quiet Zones.** Trains are exempted from sounding their horn in advance of crossings on certain segments of railroad lines due to the presence of added safety features.

Safety

- **Truck Side Guards.** Safety barriers are placed between truck tires, preventing vulnerable road users (i.e. bicyclists and pedestrians) from falling under the rear wheels and being fatally injured.

Incentives

- **Certification Programs.** Market-based strategies can be designed that encourage freight companies to meet certain performance targets relative to issues such as emissions or energy efficiency. Freight carriers can earn recognition or benefits when they meet voluntary standards.
- **Incentives for Green Vehicles.** Communities and states can offer incentives to freight companies that use environmentally friendly vehicles.

Stakeholder Engagement

- **Freight Advisory Committees.** Freight industry representatives and other stakeholders are directly engaged in the planning process to advise transportation planning agencies on freight-related issues.



Carolyn Torma. Copyright 2005 American Planning Association.

Integrated long range transportation and land use planning and context-sensitive solutions are also important to help ensure roadways are designed with the primary users and intended function in mind. Context sensitive street design guidelines can be developed to benefit trucks and other roadway users by providing street design prototypes relative to land use context. In areas with high levels of freight activity, roadways should be designed to accommodate large trucks.

In dense urban areas, multimodal amenities, landscaping, smaller travel lanes, and smaller intersections can be provided. In areas with a diverse mix of community and freight activity, design strategies can be employed that accommodate a more diverse mix of users, including trucks.

A good example of integrated planning and context sensitive solutions is the Freight Roadway Design Considerations report developed for the Florida Department of Transportation (available online). The City of Portland has also developed context sensitive design considerations for trucks and a Central City Sustainable Freight Strategy. By integrating transportation and land use planning, metropolitan regions are positioned to coordinate on wise transportation investments, avoid unintended consequences, and address both freight and community needs.

A continuing issue is the need for current freight data that is simplified for use by planning agencies and policy makers so they can better understand and plan for

freight trends and needs. Freight data obtained from private providers is voluminous and difficult to navigate for planning purposes. Travel survey data from state and regional freight studies and involving freight carriers in data collection will be beneficial in addressing this issue.

The Tampa Bay Regional Goods Movement Study, for example, includes a Commercial Freight Improvement Database (CFID) of freight hotspots and other issues affecting goods movement in the broader region. CFID is accessible online for use by planning agencies in future plans and improvement projects.

Public education on freight benefits and needs, as well as freight stakeholder engagement in local and regional planning, are also critical to achieving a better balance between freight and livability objectives. The Portland, Oregon Freight Advisory Committee, for example, has actively participated in the regional planning process for more than a decade and was instrumental in the development of freight policies and programs in the region. The committee has lent industry perspective to the planning process, raising issues that may not have been addressed in the desire for more walkable and livable streets and neighborhoods.

The strategies noted here, plus a series of freight and livability case studies, are documented in the 2015 report “Integrating Freight into Livable Communities,” prepared by the Center for Urban Transportation Research for the National Institute for Transportation and Communities.

Kristine Williams, AICP directs a research program in Planning and Corridor Management at the University of South Florida, Center for Urban Transportation Research (CUTR). She is an access management and multimodal planning specialist, and is currently researching methods for integrating equity into the MPO long range planning process. kwilliams@cutr.usf.edu.

Alex Carroll is a Research Associate with the Planning and Corridor Management team at USF’s CUTR. Her specialties include multimodal transportation planning, land use and transportation policy, freight planning, livability, and sustainable development. acarroll@cutr.usf.edu.

Urban and Port Planning: An Integrated Effort at All Levels

Noël P. Comeaux, AICP, PMP

While transportation planning is commonly directed to road, rail, and pedestrian projects, an often overlooked transportation mode is local port and marine terminals. Planning and funding start at the federal level based on programmatic goals and trickle down to state, regional, and local levels where people live, work, and play. However, this funding is not always directed to port and maritime projects that comprise a vital part of state and local economies.

National Goals

Transportation planning is led by the federal government through legislation, policy, and subsequent regulations, appropriations, funding and financing, and grants programs. Since 1991, the federal government has taken a greater focus on freight starting with the Intermodal Surface Transportation Equity Act (ISTEA, 1991), the Transportation Equity Act for the 21st Century (TEA-21, 1997), the Safe Accountable Flexible Efficient Transportation Act - A Legacy for Users (SAFETEA-LU, 2005), the Moving Ahead for Progress in the 21st Century (MAP-21, 2012), and most recently Fixing America's Surface Transportation (FAST) Act of 2015. Each respective piece of legislation has provided a greater or new focus on freight; for example, ISTEA first considered intermodal goods movement versus MAP-21 that mandated a National Freight Strategy. In light of the fact that the US is currently a net import country for non-energy related products, goods movement is vital to the US economy.

Integration into the State and Local Planning Process

Regional goals are outlined in various documents including those developed by the state departments of transportation; regional metropolitan planning organizations, regional planning commissions, and/or councils of government; port commissions; ferry transit agencies; and other public transportation stakeholders having an interest in regional goods and people movement. It is important that freight and port projects are included in the state and local transportation improvement programs, long range transportation plans, and city capital improvement programs for a more comprehensive review of funding needs in the national transportation and freight systems. To consider channel improvements when landside access for a port is insufficient is simply appropriating funding inefficiently. And what if the port is considering buying a new crane or improving its gate when the city is looking to



Port of Seattle. Source: Jeffrey L. Spencer.

redevelop a corridor the following year? It does not make sense to improve one part of a regional supply chain when another part still hinders the overall flow of goods (or even passengers). Instead, to prioritize funding based initially on economic development (“greatest benefit to the community”) and then transportation needs (“what makes the most sense”) is critical. Even considering pedestrian needs for a ferry or cruise service might be just as critical as marine terminal access needs, given a potential conflict between trucks and pedestrians.

Public Engagement

A port or its operating agency, such as a district or commission, must engage the public when proposing improvements or development, and it can do so directly or with the help of its public agency partners (MPOs, local planning departments, etc.). For example, the port could provide a resource center for the public and venue for project-specific meetings, and ensure that minutes from public meetings are published. As a result of the outreach, residents may understand how a port operates, its role in the local economy, and why a proposed improvement may be necessary to support the local economy. Providing education and resources to local residents and other agencies can facilitate proposed projects by gaining buy in or support.

Projects proposed by the US Army Corps of Engineers, including shallow and deep draft navigation, flood-management, or recreation that benefits the community, must include a public outreach process. In many cases, a port can be affected and the port operator would become an important stakeholder. Although the port operator would not serve as the lead agency for the proposed project, the port operator should assist the lead agency, in this case the Corps of Engineers, with the public outreach process. Participation in the public outreach process would serve as the foundation of an ongoing partnership with the Corps of Engineers and other stakeholders while providing an opportunity to contribute to the best possible outcome.

A Collaborative Planning Process

Given the need to work collaboratively with local, urban, state, and federal planners and program managers, it is important that port projects should be represented in various programming documents and not just the state freight or goods movement plans. The basic purpose is to consider individual projects in light of other projects that might affect them, notably those in different agencies.

On a geographic scale, regional projects should be considered in light of their ultimate purpose, to sustain the local, regional, and state economies. This means a conjoined effort to ensure project needs are met. Priorities (or reasons) might include sustainability, capacity building, emergency evacuation, facility or even national security—emphasizing again the need to look to federal (or national) goals.

Funding Projects

Federal funding sources include numerous programs from many agencies, depending on the current programs and respective appropriations Congress has provided. In FY13, there were more than 50 programs to help fund projects in the Marine Transportation System (MTS); in FY15, there were more than 80. These included agencies such as the US Department of Transportation's Federal Highway, Transit and Railroad Administrations; the Maritime Administration; US Army Corps of Engineers; the Environmental Protection Agency; the Department of Homeland Security; the Department of Housing and Urban Development; and the US Departments of Agriculture and Energy. Programs include foci on coastal management, clean diesel, brownfields, surface transportation, ferry services, freight rail, small shipyards, and even farm or sugar storage.¹

¹ Specific programs are not listed here due to changing priorities, authorizations, appropriations, and hence programs.

As a result of authorizing and in some cases appropriating legislation, there are either grants or financing options provided such as private activity bonds, the Transportation Investment Generating Economic Recovery (TIGER) Grant Program, Grant Anticipation Revenue Vehicles (GARVEEs), and even Transportation Infrastructure and Finance Investment Act (TIFIA) loan funding for transportation projects in the regional or state transportation improvement programs. Specific to the marine industry, local, regional, and port planners know where to maximize their investment, evidenced by the Marine Transportation Security Act of 2002, the Water Resources Development Act of 2014, ISTEA, the FAST Act, and the Rail Safety Improvement Act of 2008.

To find sources of federal funding, look to www.grants.gov, a federal government searchable site that provides background, value, and submission information for various grants. A direct source of funding information in the Marine Transportation System is the MTS Funding Handbook, which provides the funding agency, a brief description of the programs, and contact information for the program manager. It can be found at www.cmts.gov.

Noël P. Comeaux, AICP, PMP is a certified planner and project manager with 18 years of professional experience in the transportation industry, notably in the maritime, freight, and defense security sectors. noel.comeaux@dot.gov.



MTS Funding Handbook. US Committee for the Marine Transportation System.

The Evolving World of Freight and Goods Movement: Implications for Transportation Planning and Community Design

Peter E. Plumeau

The emergence and continued growth of e-commerce, the mobile internet, and a global consumer class has led to an environment in which businesses and purchasers depend on freight and goods being shipped and delivered wherever and whenever they are desired. The same-day delivery offered now by Amazon Prime, Jet, and other firms provide examples of the current cutting edge in this area. This relatively new “pull economy,” in which consumers and users of commodities and products drive the production and shipping activities, differs significantly from the historical “push economy,” in which manufacturing cycles and processes generally dictated when and where commodities would be needed and products would be available to consumers.

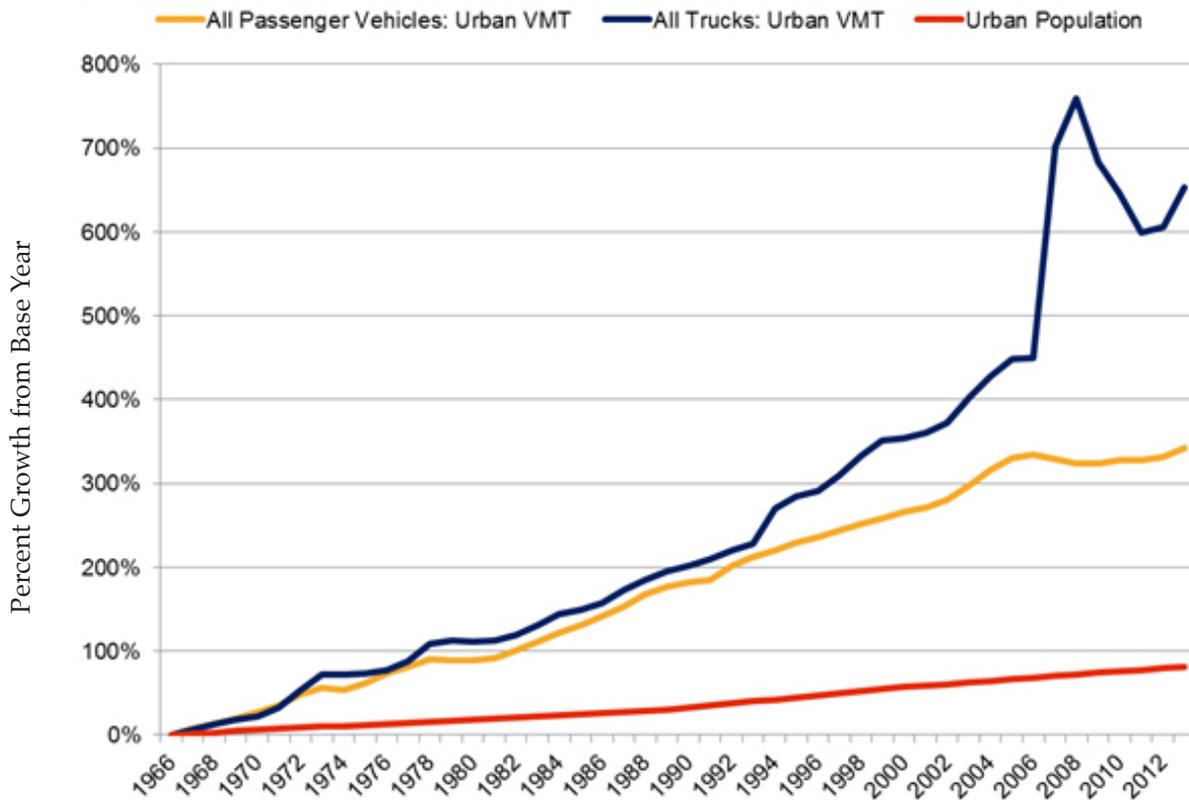
The ability to efficiently move goods and services is critical to supporting the pull economy, in which over 60 million tons of freight, worth \$40 billion, move through the US transportation system every day. Efficient movement of freight (e.g., mode selection, routing, and intermodal transfer) is necessary to make the best use of our transportation facilities, protect the environment, and reduce energy requirements, while keeping up with the ever-increasing demand for goods. For transportation and community planners, therefore, it is important to understand not only the dynamics underlying the evolving freight and goods movement world, but also the implications for planning, land use, and policy.

Continued Growth of Freight and Goods Movement

In 2015, industry researchers projected that the US would experience a 28.6 percent increase in freight tonnage and an increase in freight revenues of 74.5 percent to \$1.52 trillion by 2026. Similarly, intermodal freight is forecast to grow at 4.5 percent annually through 2021 and increase 5.3 percent per year thereafter.¹ Further, as shown in Figure 1, urban trucking increased dramatically after 1990, reaching almost 800 percent growth until the Great Recession led to reduced demand. This pattern coincided almost perfectly with the rise of e-commerce and the use of digital

¹ New Report Predicts Continued Growth in Freight, Trucking. PR Newswire. July 2015. www.prnewswire.com/news-releases/new-report-predicts-continued-growth-in-freight-trucking-300118151.html

Figure 1: Driving and Population Growth Rates, Various Indicators, 1966-2013.



Brookings Institution, 2015.

communications to manage shipping for logistics firms like UPS and FedEx and major private shippers like Walmart.² Most researchers and experts believe this growth will continue for the foreseeable future.

Continued growth in e-commerce may have significant impacts on local and regional land use. For example, big box retailers that more directly compete with internet stores must consider new real estate models, which may include reduced store space and heightened calls for redevelopment of vacant sites. In addition, internet giants rely on dispersed supply chains, meaning the fringe areas of major metropolitan regions may experience an increase in warehousing, distribution, finishing and intermodal facilities, such as that taking place in locations like Southern California³ and the Greater Toronto Area.

² Tomer, Adie. New E-Commerce Entry Jet Means Rock-Bottom Prices and More City Trucks. July 2015. www.brookings.edu/blogs/the-avenue/posts/2015/07/28-e-commerce-jet-city-trucks-tomer.

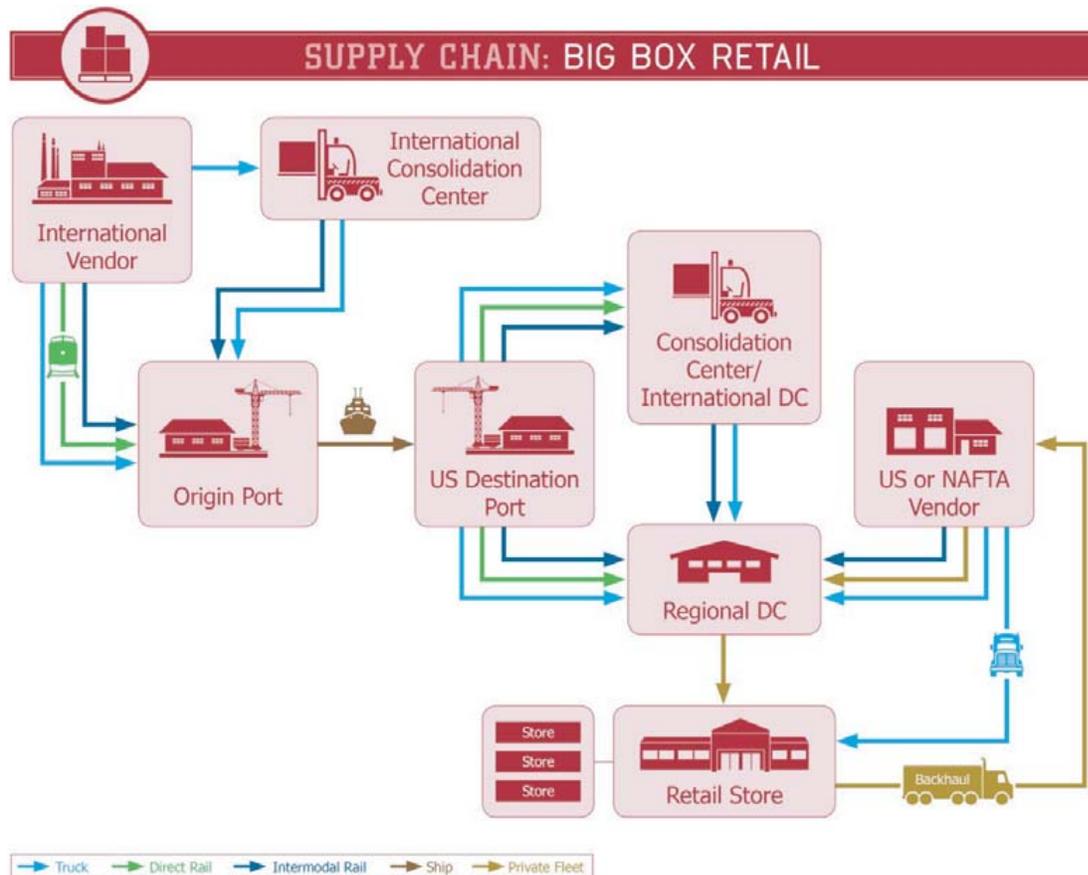
³ Ibid.

Today’s Economy Relies on Complex Supply Chains

As the volume and value of freight and goods movement grow, their origins and destinations expand as well. Commodities and products travel between and within countries, regions, metropolitan areas, and local communities. Most take multiple smaller trips: for example, a product may travel from the manufacturer to a distributor, and then to individual stores. Some goods movement takes place only on a local scale (e.g., from a farmer to a farmer’s market), while other types may move through a region with no local destination (from a foreign producer, through a port, to a destination across the country). This system that takes unprocessed raw materials from suppliers and delivers finished products to the final customer is the supply chain.

As shown in Figure 2, the supply chain supporting a typical big box store can be very complicated and involve many shippers, operators, infrastructure providers, and receivers (as well as transportation brokers and third party logistics providers (3PLs)) around the world. With today’s “just in time” inventory and delivery

Figure 2: Example of Big Box Retail Store Supply Chain Elements



NCFRP Report 14, Guidebook for Understanding Urban Goods Movement (2011).

systems, disruption to one or more of the links in the supply chain, natural or man made, can have significant effects on the overall operation and ability to supply the ultimate destination. For example, in the aftermath of the 2011 Tōhoku earthquake and tsunami in Japan, the shutdown of Japanese parts suppliers disrupted US production of various automobile models.⁴ Without a backup or redundant source or means of obtaining the needed parts, this one broken link in the supply chain led to the shutdown of production of various cars for several weeks. Similarly, at the local level, the unreliability of a particular road (e.g., due to congestion or poor pavement condition) connecting a distribution center to an interstate highway may lead to truckers seeking faster, more reliable routes, though undesirable in the community's eyes, that help them adhere to tight schedules. In extreme cases, such unreliability may precipitate the moving of the distribution center to another location its owners deem to have more reliable access for trucks.

Shipments and Deliveries Play Beat the Clock Every Day

The emergence of these complex and inter-related supply chains, supported by public and private transportation investment, have allowed businesses to reduce inventories while simultaneously achieving greater economies of scale in a global trade environment. Today, trucks, trains, ships, and planes effectively serve as “warehouses in motion.” Most firms typically only maintain enough inventory of their goods or supplies adequate for anywhere from a few days to as little as the next hour. With modern information technology, real-time inventory management systems are widely used to automatically inform suppliers and distribution centers of a firm's needs on a continuous basis, and shelves can be restocked within a few hours or minutes of being depleted. This approach means firms can minimize the space and carrying/ insurance costs devoted to on-site inventory and focus on sales and service. However, it also means that shippers and freight operators delivering supplies and goods must have reliable access to these firms' locations, often on a 24 hours/7 days a week basis. Depending on the setting (urban, suburban, industrial area, etc.) and transportation environment (loading zones, pedestrian heavy, etc.), the lack of such access can lead to the unsafe and inefficient operations of freight vehicles.

Particularly in densely developed metropolitan areas, what distinguishes urban goods movement from other freight movement is the last mile.⁵ Urban freight movements mainly involve making efficient trips with frequently smaller shipments and smaller

4 www.nytimes.com/2011/03/25/business/global/25auto.html?src=recg&_r=0

5 The “Last Mile” (or “Last Kilometer”) is a common distribution problem where, near the destination, a high capacity long distance transport system faces high costs and complexity. It is related to the need to break down the size of the transport unit (less economies of scale) and where congestion impairs reliability as well as capacity. https://people.hofstra.edu/geotrans/eng/ch5en/conc5en/elements_last_mile_logisitcs.html.



Trucks in Congested Urban Traffic Conditions. Author's Collection.

vehicles to dense mixed-use areas. These movements include pickups and deliveries that are vertical as well as horizontal; goods must travel vertically to high-rise office buildings and rooftop restaurants, and they travel horizontally on cross-town trips to meet delivery and pick-up schedules through the most difficult congestion in the country.⁶ As noted earlier, the emergence and growth of e-commerce for consumer goods and grocery deliveries has accelerated the growth of goods movement in urban areas. A seemingly small disruption in the reliability of the urban transportation system (e.g., a street closing for construction), however, can rapidly precipitate delays and/or rerouting of trucks to less appropriate roads (e.g., through residential neighborhoods) in order to meet tightly-scripted delivery schedules. Such disruptions can also be costly, to both freight operators and the overall economy. Shippers and carriers cost out transit time at \$25 to more than \$200 per hour, depending on the product being moved. Unexpected delays can increase that cost by 50 to 250 percent.⁷ The time-sensitivity of today's supply chains makes a reliable freight transportation system that much more indispensable.

Implications for Planning and Community Design

Freight and goods movement are an essential part of the transportation system and our communities. Virtually any product that one purchases or uses was transported in some form through a complex supply chain, often involving multiple modes and many stops across the locale, nation, and world. An efficient, reliable, and safe transportation system that accommodates and facilitates freight movement is essential

⁶ <http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=2411>

⁷ www.fhwa.dot.gov/publications/publicroads/06jul/07.cfm

for supporting economic growth and quality of life. With the projected massive growth in freight and goods movement across the country, and across all modes, it is imperative that planners and policy-makers understand these dynamics and address them immediately in transportation planning and community design. Such efforts should focus on:

- **Integrating Goods Movement Needs into Community Design.** Vital communities rely on efficient and reliable freight systems. As cities, towns, and villages seek to encourage and implement mixed-use, human-scale development, it is important to consider the needs for commercial and residential goods movement access and mobility. For example, the City of Seattle instituted a flexible approach to implementing Complete Streets based on the unique qualities of the street, including freight mobility needs.⁸ In most cities and regions, however, Complete Streets initiatives and efforts do not include accommodations for trucks and goods movement, potentially leading to delivery vehicles attempting to serve businesses and homes through double-parking, blocking of bike lanes, and other undesirable actions. Cities and suburbs will also need modern parking regulations and street design that ensure trucks can access dense pick-up and delivery locations without interfering with local vehicle, bike, and pedestrian traffic. The same applies to the noise and other environmental impacts trucks deliver at a higher relative rate than smaller vehicles.⁹
- **Focus on Transportation System Reliability.** Reliability is a measure of the variability of travel times. When a system is reliable, people and goods get to their destinations on-time, every time. As noted earlier, freight shippers, receivers and operators view the ability to plan trips, deliveries, and transactions down to hours and minutes—rather than days and weeks—as essential to productivity and economic survival. Reliability is thus one of the most important performance measures for the goods movement industry.¹⁰ Freight shippers, for example, may have more expectations for a reliable off-peak transportation network than for peak period conditions. Freight movers try to use the generally less congested off-peak periods, but transportation agencies often scale back incident management activities between the peaks. Given the important role of just-in-time manufacturing, however, the midday periods may be those when incident management is most important to the provision of travel time reliability.¹¹
- **Proactively Engage Stakeholders.** The freight and goods movement environment is dynamic and complex, making it challenging to understand and address

8 www.seattle.gov/transportation/completestreets.htm.

9 www.brookings.edu/blogs/the-avenue/posts/2015/07/28-e-commerce-jet-city-trucks-tomer.

10 www.fhwa.dot.gov/publications/publicroads/04nov/09.cfm.

11 <http://onlinepubs.trb.org/onlinepubs/shrp2/SHRP2prepubL05Guide.pdf>

effectively in the conventional transportation and community planning processes. Since effectively planning for freight requires an understanding of these dynamics, planners need to identify and talk with key industry stakeholders, both public and private, including representatives of transportation firms, shippers, receivers, distribution centers, ports, airports, brokers, 3PLs and others. Establishing positive relationships with freight stakeholders creates a setting for ongoing dialogue that facilitates the identification of win-win solutions to transportation problems and more community-friendly accommodation of freight and goods movement needs.

Freight and goods movement needs to be part of the planning process from the beginning, rather than a stand-alone effort or afterthought. Planning processes that place a greater emphasis on reliability and supply chain management while also balancing community concerns increase the importance of efficient local and regional freight movement, whether ultimate shipping destinations are across town or across the world. Through such integration, plans and designs can be made more efficient, cost-effective, and supportive of desirable development.

Peter Plumeau leads RSG's Freight Planning and Data work, and specializes in helping public and private officials facilitate and plan improvements to goods movement infrastructure and operations. peter.plumeau@rsginc.com.

Filling in the Gaps: Bridging Private Technology and Public Transit

Peter Costa, AICP and Aliza Paz

There is no doubt that burgeoning technology and the birth of mobile applications in the early 21st century have changed the way people commute and generally move around on a daily basis. Such technologies have enhanced transportation access and mobility on an unprecedented level. An easy-to-use, navigable interface combined with a convenient user-payment process, and reliable service is paramount, and millions are taking advantage of the situation. The soft touch of one's fingertip can provide anyone with a smartphone device access to on-demand transportation services, a map of nearby transit, rideshare, and bikeshare facilities, or allow users to pay for a parking spot in advance—just to name a few. This mobile app movement is reshaping the transportation network and reevaluating existing transportation services while also allowing for private enterprises to throw their hat into the public transportation ring and perhaps lead the charge in an era of shared mobility.

One of the fundamental principles of invention is to first identify an unmet need. The amount of traction app-based transportation services are gaining shows that a need is being met, but it must be asked: does such an invention aim to fix a longstanding problem or does it intend to disrupt traditional practices and create universal change? With respect to public transportation in the US and elsewhere, most experts and transit patrons would agree that the key elements of operating a sustainable and perhaps profitable public transit system largely revolve around a few basic concepts: convenience, reliability, and accessibility. Transportation start-up companies are mixing these three essential elements in their alchemy to provide increased access and mobility for the common commuter. This is changing the dialogue around transportation and with this new conversation will come a fundamental change in planning practice. Although this may sound daunting, such actions may be for the overall good by improving access and mobility around cities and towns.

The rise of private, app-based transportation services is reinforcing the power of obtaining rich data by incorporating technology into a long-standing, necessary service. Planners rely heavily on data; it's the backbone of any program development or crafted policy. The data being collected by these privately-owned transportation companies is in high demand. Moreover, these data could be a treasure trove for planners and the companies or agencies they represent. This real-time, finite information could allow planners to quickly identify constrained locations or deficient areas throughout the transportation system and better streamline these

improvements. Of course, being respectful of our varying interests, most (if not all) data collected by private companies is proprietary and not available for public consumption, which is a major conflict point between private and public interests with respect to public transport and balancing user needs. Nevertheless, achieving an agreement to share big data and establishing an amicable relationship between public and private entities is an important first step in leveraging collaborative planning and co-existence to improve mobility to the users of any transit system.



Bridj Bus. Nelson\Nygaard Consulting Associates, Inc.

With the private transportation services kicking off business by providing rides to individuals, it may be hard to view them as an asset to the transportation system. On the contrary, as these companies make a shift from providing individual ride services to carpool and vanpool services, the benefits of leveraging modern technology with community needs and data rich transportation services are becoming more evident. Since these services have been a viable transportation option in large US cities, it has become clear that people's travel behaviors are beginning to shift, with more people willingly sharing rides with other community members. This is supported by Lyft data showing that as of April 2015, 50 percent of rides have been true rideshare services (i.e., "Lyft line").¹ This shift in travel behavior may just have a dramatic effect on our city street. In fact, a recent study from the Massachusetts Institute of Technology (MIT) shows that the shift from private to shared rides can reduce pollution and congestion while making private transportation services more affordable.² These notable, potential effects will help public transportation agencies improve their service by allowing for reduced delays and more innovative and sustainable solutions to inevitable last mile problems.

Recently, we have seen a surge of innovative private transportation companies popping up in cities, and whether or not one agrees or disagrees with the services, it is clear that their unforeseen popularity is beginning to affect the way residents

1 www.geekwire.com/2015/lyfts-carpooling-service-now-makes-up-50-of-rides-in-san-francisco-30-in-nyc

2 www.geekwire.com/2014/mit-study-shows-services-like-uberpool-lyft-line-reduce-transit-time-pollution

and visitors get around urban areas. In San Francisco—the undisputed “technology hub” of the country—rideshare services like Lyft and Uber that provide private or shared rides (carpooling) around the region have expanded to provide service in cities around the globe. More recently, vanpool type services like Chariot (San Francisco) and Bridj (Boston and Washington DC) have started to gain popularity by allowing for higher



Chariot Bus. Nelson\Nygaard Consulting Associates, Inc.

density carpooling, accommodating up to 14 persons. Similar to Lyft and Uber’s carpooling service, these companies create cross-city routes based on the origins and destinations of their users. While Chariot has predetermined routes, with specific stops, Bridj allows for route flexibility while maintaining designated stop locations by using origin-destination analytics. A more aggressive approach was seen briefly in San Francisco with an effort to create standard-sized, high-end buses that provided more direct and comfortable services between popular destinations, and at a fare cost comparable to taking the public bus.

These services are all working to provide transit options that patrons want to use by creating comfortable and reliable services that fill the gaps in service, or simply provide a more enjoyable experience. There has been loud and strong push back against these services for numerous reasons, but when looking at how we envision the future of cities and mobility, the question must be asked: does this fight help get us to that future? Given the fact that there is always a learning curve and room for improvement when creating new systems, could private and public transit systems work in unison, leverage each other’s greatest assets, to satisfy the needs of many and ultimately strengthen constrained and struggling public transportation system?

There has been a lot of attention on rideshare companies and other private transportation options like bike share, scooter share, and luxury buses. These services, no matter how different they may seem, have all found a gap in publicly-accessible transportation services and have leveraged technology and community to provide alternative, attractive solutions. Planners and policymakers have been on the defensive, trying to protect and secure public transportation systems and limit

the capabilities of private transportation companies out of fear that an imbalance will come to general service and social equity. These are without a doubt important concerns but who is to say that private transportation systems are unable to provide services without satisfying these concerns, or conversely, provide support that enables public transportation systems to satisfy these concerns more effectively?

The numbers are hard proof that people are looking for new, reliable, comfortable and easier ways to get around. As spoken by Anthony Foxx, the US Secretary of Transportation, “The key word about transportation in the 21st century is ‘choice.’”³ The rise of private transportation options in the public transportation industry is the start of a unique opportunity to embrace shared mobility.

If system-wide gap-filling by private transit companies is viewed as an asset rather than a threat, this may be an opportunity for collaboration with a goal of enabling public transportation systems to strengthen the existing systems. And in turn, create a place for private transportation alternatives to solve complex public transit issues, including “last mile” connections, traffic congestion, parking constraints, and rising costs to maintain the status quo.

This is only the start of the technology boom in the transportation industry. If public and private transit providers (and planners that support these entities) work together, there is opportunity to develop a cohesive system that provides both attractive and reliable service while improving accessibility and mobility for the public good.

Peter Costa, AICP is a Senior Associate with Nelson\Nygaard Consulting Associates, Inc. in San Francisco, California. Peter has over a decade of experience in project management, community development, and technical expertise in transportation planning. pcosta@nelsonnygaard.com.

Aliza Paz is an Associate with Nelson\Nygaard Consulting Associates, Inc. in San Francisco, California. Aliza is a multidisciplinary planner and researcher who specializes in active transportation, transportation policy, and system design. apaz@nelsonnygaard.com.

³ “Anthony Foxx.” BrainyQuote.com. Xplore Inc, 2015. 25 June 2015. www.brainyquote.com/quotes/quotes/a/anthonyfox663011.html

Can Next-Generation Payment Systems Transform the Way We Ride While Driving Down the Cost of Service?

Derek Toups, AICP

Like other elements of the nation's transportation infrastructure, fare collection requires significant investments in labor and revenue for transit facility operators. And while the methods used in fare collection have evolved over time—from tokens and tickets, to today's modern electronic payment systems—fare collection essentially remains a means to an ends in a chronically underfunded industry. Next-generation payment technologies are emerging that have the potential to lower cost and increase benefits, but many questions remain.

Framing the Issue

Nearly 11 billion transit trips will be taken this year in the United States, and agencies will collect in excess of \$14 billion in passenger fare revenues. However, agencies are expected to spend between five to 15 percent of this revenue on the manufacture and distribution of fare media, fare system equipment maintenance, and in direct labor for the collection and processing of fares. In total, US transit agencies will spend around \$1 billion to collect fares this year. This is in addition to the \$100-\$200 million spent each year on new fare collection equipment outlays.^{1 2}

Smart Cards

Contactless smart cards have several benefits over manual payment methods. They are more convenient for customers, reduce fare evasion rates, eliminate fraud from cash handling, increase throughput, and reduce security risk. However, some expectations for these systems (e.g., reduced cost of fare collection and availability of origin-destination data) have not fully materialized, due to operational issues and privacy concerns. Origin-destination data for planning was one of the original arguments for investing in smart card systems, which have soared in cost since they

1 APTA Public Transportation Fact Book, 65th Edition, November 2014. <http://tinyurl.com/17gfwxr>

2 Smart Card Alliance. Planning for New Fare Payment / Collection Systems: Cost Considerations and Procurement Guidelines. March 2010. <http://tinyurl.com/p97jj5l>

were initially conceived in the late 1990s.

In the San Francisco Bay Area, which has perhaps the most complicated fare system in the world, nearly \$300 million has been spent to date to design, build, operate and maintain the Clipper® (formerly TransLink™) system that serves 22 transit agencies and is responsible for processing around \$500 million in fares each year. The original estimate for that system was about half of the actual cost. Other smart card projects have had similar cost overruns. Many of these systems are approaching end of life, and there are other limitations to these card-based systems that warrant a design change.

Open Payments

With a card-based system—since the value is stored on the card—it can take several days before an online transaction reaches the card. Latency is a factor of the communications network and system design, but many first-generation smart card systems utilize a store-and-forward architecture that mostly operates offline.

More recently, agencies are extending their communication networks and pushing fare calculation and general ledger functions into the back office.³ This is preferable, since commercial off-the-shelf accounting systems are readily available and generally considered to be more secure, reliable, and accurate. In an account-based system, the smart card functions like a token; all of the customer transaction and balance information resides in a back-end account. This is similar to other industries, including electronic toll collection systems, which utilize a similar basic architecture. Migrating to an account-based architecture allows the system to accept multiple forms of payment. These include closed-loop transit smart cards, as well as contactless bank cards and mobile wallets. Customers can manage their account online and easily add or remove payment sources associated with the account.



Card Reader for the Bay Area's Clipper Card. Copyright © 2016 Metropolitan Transportation Commission, all rights reserved.

³ Transit Cooperative Research Program, Report 177: Preliminary Strategic Analysis of Next Generation Fare Payment Systems for Public Transportation. <http://tinyurl.com/oj5op62>

Contactless Bank Cards

Growth in credit and debit card fraud has led the global payments industry to shift to chip technology for bank cards. Europay, Mastercard, and Visa (EMV) have developed specifications that define how smart chip-based bank cards will operate in the US and abroad.⁴ US banks are currently in the process of replacing less secure magstripe cards with EMV chip cards that utilize the same near-field communications (NFC) technology as transit smart cards.

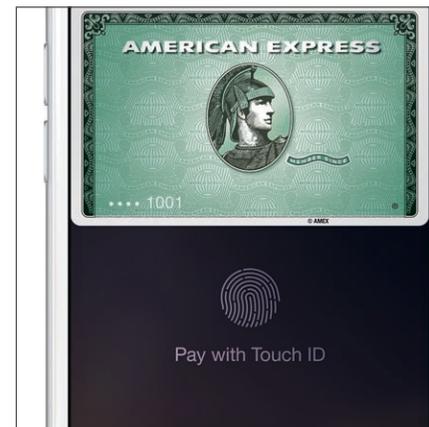


Europay, MasterCard, and Visa
Chip-enabled credit cards.
Copyright © 2016 Can Stock Photo Inc.

Transit agencies are deploying card readers that are certified to accept contactless smart cards and EMV bank cards. This introduces several new challenges and opportunities, such as first-ride risk: essentially granting a rider access to the system before payment can be authorized. Agencies are using hotlists downloaded to the card reader to authenticate trusted cards and prevent repeated abuse by fraudulent cards.

Mobile Wallets

Mobile wallets have also matured in the past few years. Google launched its Google Wallet service in 2011 but struggled to obtain market share and has recently acquired the intellectual property of Softcard (formerly Isis) that has the support of the major cell phone carriers AT&T, Verizon, and T-Mobile. This has given Google access to the secure element of the phone that was previously locked by the carriers. That may have been a benefit for the development of Android Pay, as it forced Google to develop a software-based workaround called Host-based Card Emulation that allows any Android application to emulate a card and talk directly to the card reader.⁵



Apple iPhone Pay with Touch ID
screen. Copyright © 2016 Apple
Inc. All rights reserved.

Apple has been quiet about customer adoption rates for Apple Pay, which helped kickstart consumer adoption of mobile wallets when it launched in 2014. That's probably because the number of Apple Pay transactions is a fraction of a percent when

⁴ Smart Card Alliance. Technologies for Payment Fraud Prevention: EMV, Encryption and Tokenization. October 2014. <http://tinyurl.com/om9aly3>

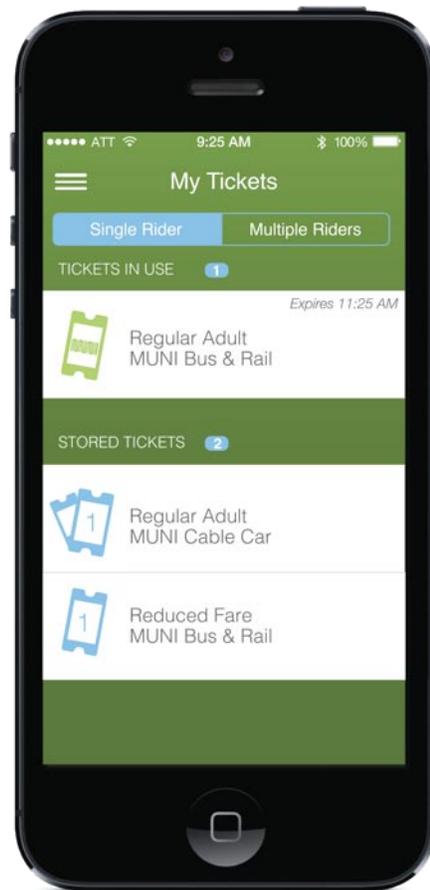
⁵ Google. Host Card Emulation Developer Guide. <http://tinyurl.com/jvlgcnq>

compared to the \$3 trillion payments market.⁶ However, recent changes in Apple's support could change things. In June, Apple announced that it would add support for rewards programs and store-issued credit and debit cards with iOS 9.⁷ This should pave the way for transit agencies to emulate their closed-loop smart cards on Apple's wallet service.

Wanting to get in the game, Samsung announced it would launch a mobile wallet service on its popular Galaxy mobile phones and tablets. Samsung Pay will function similar to Apple and Google's wallets, and all are dependent upon partnerships with the card issuing banks, retail merchants, and phone carriers.⁸

Mobile Tickets

Mobile ticketing is a different type of mobile payment solution, geared primarily for special events and proof-of-payment (POP) services such as light-rail and commuter rail. Mobile tickets offer the convenience of paper tickets at a fraction of the cost of agency-issued fare media.⁹ There are minimal upfront costs and reasonable commission fees that can be bundled into the ticket price. They make it easy for people to purchase rides whenever and wherever an Internet connection exists, and drive down the cost of fare collection because riders pay for the fare equipment instead of the agency.



San Francisco MUNI's Mobile Ticketing App. © 2016 Globe Sherpa Inc.

Consumer Adoption

The latest Pew Research polls indicate that 9 out of 10 American adults own a cell phone, and nearly two-thirds of these devices are smart phones.¹⁰ Research by the

6 Mashable. 01/29/15. Just how big is the Apple Pay mobile payment pie? <http://tinyurl.com/oeu63sw>

7 Apple. Apple Pay Developer Resources. <http://tinyurl.com/q6ayur6>

8 Samsung. Samsung Pay Developer Support. <http://tinyurl.com/qbyk9u8>

9 Government Technology. March 26, 2015. How Mobile Technology Makes Transit Convenient. <http://tinyurl.com/o8mrf9d>

10 Pew Research Center. Internet, Science & Tech. <http://tinyurl.com/nndjmcp>

Payments Terminology

Account-based. A common payments architecture that uses fare media to identify a patron account where all fare processing is performed by a central (back-office) system and all value is stored in the patron's unique account.

BiBo-System. Be-in/Be-out, a phrase coined by Siemens AG, describes a solution to record a smart card or mobile device via radio-controlled room monitoring using BLE.

BLE. Bluetooth low energy, a wireless protocol that allows nearby devices that can operate with very low power consumption to communicate over radio waves.

Card-based. A store-and-forward technology primarily used in transit payments that writes value to a closed-loop fare card.

Closed-loop. Payments that utilize agency or third-party issued media, processed within the fare system.

EMV. Europay, MasterCard and Visa; security standards for chip-enabled credit and debit cards and terminals.

First-ride risk. In an account-based fare collection system, granting a rider access to the system before payment can be authorized.

HCE. Host-card emulation; a software-based mobile payment solution that allows an application to emulate a card and communicate directly to an NFC reader.

NFC. Near-field communication technology, that allows smartphones and other devices (like a payments reader) to communicate with each other when they are close together.

Open payments. Payments that accept bank-issued fare media (i.e., debit and credit cards and mobile wallets), processed through banking networks.



Fare gate with NFC card reader. Copyright © 2015 American Express Company. All rights reserved.

Federal Reserve indicates a similar level of mobile phone ownership among unbanked and underbanked portions of the population.¹¹ With such high levels of phone ownership, mobile payments are very appealing to transit agencies and make mobile ticket sales extremely cost effective.

The Tri-County Metropolitan Transportation District of Oregon (TriMet) just celebrated over 5 million mobile ticket sales in under two years. That's about 10 percent of TriMet's fare sales. Mobile ticket sales for transit operators in Boston and Dallas have eclipsed the 2 million mark, and numerous other agencies are following suit.¹² And while consumer adoption of contactless bank card and mobile wallet payments thus far remains low, there is potential for rapid growth in the future.

Since Transport for London (TfL) launched support for contactless bank card and mobile payments in its London Underground stations and buses, it has seen over 300 million such transactions in a year's time.¹³ TfL has the highest usage of Apple Pay among all retailers in the UK, and is among the fastest growing contactless bank card merchants in all of Europe.^{14 15}

11 Board of Governors of the Federal Reserve System. Sept. 2012, Vol. 98, No. 4. Use of Financial Services by the Unbanked and Underbanked and the Potential for Mobile Financial Services Adoption.

<http://tinyurl.com/owfpdhh>

12 TriMet. August 26, 2015. TriMet Mobile Tickets Top 5 Million in Less Than Two Years!

<http://tinyurl.com/o2jmeuq>

13 Transport for London (TfL). Contactless Payment. <http://tinyurl.com/oelzkqe>

14 TfL named fastest growing contactless merchant in Europe. <http://tinyurl.com/oppgztx>

15 The Drum. July 20, 2015. TfL proves most popular retailer on Apple Pay UK following launch.

<http://tinyurl.com/p2j3ps3>

Predicting the Future

Most of the mobile ticketing applications in use today are operating as stand-alone systems that require manual reconciliation with other agency fare collection methods. As legacy smart card systems are retired or replaced, it looks more likely that mobile ticketing will account for an increasing share of the revenues collected for small and mid-size transit authorities. But the largest agencies in major metro areas will always want a full-proof payment system, and are likely to invest in open payments. The Chicago Transit Authority will spend \$500 million on its new Ventra open payment system.¹⁶ TriMet is developing an open payment system too, and hopes to spend far less than Chicago did to build the new system and integrate its popular mobile ticketing service into the new back-end.¹⁷ Only time will tell.

Lessons from Abroad

In Europe, Siemens is testing a new kind of payment system that would require a rider to take no action when boarding a bus or train to render a fare payment. The “Be-in/Be-out” or BiBo-System, as they call it, uses Bluetooth® low energy (BLE) radio transmitters that can detect a smart card or mobile phone at greater range than a contactless NFC card reader. The rider simply registers an account with a valid payment source and turns on Bluetooth® on their phone (or carries a BLE card). The mode of transportation being used as well as the passenger’s entry and exit points are automatically detected via radio frequency.¹⁸

Despite raising the ire of privacy advocates, this sort of frictionless payment system may be what consumers really want in a fare payment experience. The technology is still in a research and development phase, but it may be more cost effective than legacy card reader technology. Bluetooth® sensors can be purchased for under \$30 per device (as little as \$5 per device) making them the ultimate companion to the mobile phone.^{19 20}

Derek Toups, AICP is a senior program manager for the Metropolitan Transportation Commission in the San Francisco Bay area. dtoups@mtc.ca.us.

16 The Chicago Tribune. March 29, 2015. Ventra contract swells by about \$65 million because of add-ons. <http://tinyurl.com/qhoez42>

17 The Oregonian. September 3, 2015. TriMet’s new electronic fare system dubbed ‘Hop Fastpass’. <http://tinyurl.com/o36zvnw>

18 Siemens AG. Integrated mobility with eTicketing. <http://tinyurl.com/nnoe3lt>

19 Apple. iBeacon for Developers. <http://tinyurl.com/kemhzup>

20 Vincent Hoogendoorn. Building Cross-Platform iBeacon Apps for iOS, Android and Windows. <http://tinyurl.com/qe54znw>

The Case for “Fair” Fares

Jonathan Sigall

During his 2012 gubernatorial campaign, Washington State Governor Jay Inslee made job creation his first priority. Linked to that focus was a pledge to revitalize Washington’s transportation infrastructure in order to generate near-term construction jobs and to build a foundation for long-lasting economic prosperity.

Inslee, who secured passage of a \$16 billion transportation investment package in July 2015, is not unique among elected officials in making the economy and associated spending on transportation a lynchpin of their platforms. On the other side of the country, New York City is the best case that can be made for building and maintaining a robust transportation network. It first rose as a world leader because of its enviable ribbon of waterways and then emerged from near fiscal ruin three decades ago in large part due to a commitment to restoring its transit and commuter rail systems.

As vital as these improvements are, expanded and upgraded transportation systems are but one piece of a larger puzzle. Affordable fares are key, too, as they make transit more accessible. Recent studies demonstrate the link between transit fares and ridership. The higher the fare, the lower the ridership.¹ This dynamic is especially played out for low-income groups. Often, they cannot move around because of unaffordable fares.² This barrier inhibits their ability to climb the economic ladder as well as access needed services, notably healthcare and education.

Key metropolises around the country recognize the significance of transit fares as a policy issue, one that must be addressed to close the socioeconomic divide. Most notable is King County Metro serving Seattle, which in March 2015 launched a reduced fare program targeted for all low-income riders. Eligibility is based on income alone.

Metro Transit isn’t the first transit provider to offer discounted fares to low-income riders. Neighboring Kitsap (County) Transit has had a reduced fare program since shortly after its inception in 1985. But the trend is accelerating as other US transit agencies are recognizing the economic and social value of reduced fares for low-income riders. Last December, Metro Transit in Minneapolis-St. Paul launched a pilot program while other providers in the Seattle metropolitan area began efforts to align their policies with King County Metro.

1 MacKechnie, C. (23 May 2015). Elasticity of Ridership In Regards to Transit Fare and Service Changes. http://publictransport.about.com/od/Transit_Funding/a/Elasticity-Of-Ridership-In-Regards-To-Transit-Fare-And-Service-Changes.htm.

2 A. Khawarзад, WE ACT, personal communication, August 28, 2015.

Why Discounted Fares

In gauging the affordability of urban neighborhoods, the traditional yardstick is whether housing costs are more than 30 percent of household income.³ However, that measure leaves out a critical piece of the equation: transportation costs. A neighborhood that is considered affordable based on housing costs alone may place residents at a significant disadvantage because of poor and costly transportation.

The H+T Index, a proprietary model published by the Center for Neighborhood Technology in Chicago, is a valuable tool that adds the impact of transportation costs to affordability. Incorporating the location of efficiency of municipalities—compact, walkable, mixed-use communities within convenient reach of job markets and well served by mass transportation—this tool aggregates housing and transportation costs to benchmark affordability. A community is seen as affordable if the combined costs don't exceed 45 percent of household income. Where 55 percent of US households are “affordable” when only housing costs are used, only 26 percent are “affordable” after accounting for transportation costs.⁴

While the index also includes accessibility and service quality in measuring transportation costs, it aptly illustrates the role fares alone can play in mobility and economic opportunity. In New York City, riders who rely on the bus to connect with the subway enjoy free transfers, but that wasn't always the case. Free transfers and the elimination of two-fare zones date only to 1997, shortly after the systemwide roll-out of the MetroCard made free subway-to-bus transfers more feasible.

Joan Byron, director of policy for the Pratt Center for Community Development, notes that this was a watershed moment in transit equity in the city.⁵ Free transfers halved the commuting costs for many of the lowest-income residents. Two-fare zones were mainly in the furthest reaches of the city, where housing costs are usually lower.

To appreciate the transformative value of free transfers, consider that transit costs today could shoot up by at least \$1,320 annually if free transfers were eliminated. (This assumes the same \$2.75 one-way base fare and another 40 paid trips per month—five-day work week, two additional paid rides daily.)

In Jamaica, Queens, \$1,320 is the equivalent of one-month rent for a one-bedroom apartment.⁶ Put another way, it's more than one month's pay for a worker whose

3 Governing. www.governing.com/gov-data/economy-finance/housing-affordability-by-city-income-rental-costs.html.

4 Housing and Transportation Affordability Index. <http://htaindex.cnt.org>.

5 J. Byron, personal communication, July 28, 2015.

6 www.zillow.com.

earnings are at the federal poverty threshold of \$11,770 for a single-person household.⁷ It's easy to see why progressive fare policies are such an attractive option for officials and localities seeking to right the economic and social scales.

King County Metro

While Metro Transit wasn't the first to the table on equitable fares, its program is the most expansive and promising. Low-income riders on the Muni in San Francisco can buy a monthly "Lifeline" pass for \$35, half the regular price for a monthly card. Eligibility is similar to Metro—up to 200 percent of the federal poverty level—but participation at 20,000 riders is small.⁸ The low volume may reflect the fact that the program is limited only to monthly passes, where Metro allows for all ticket types.

Kitsap Transit is comparable to Metro in that all ticket types are eligible. However, Metro dwarfs its peer in size: annual ridership on Metro is 114.6 million, versus 2.7 million on Kitsap. The pool of eligible residents is 480,000 people on Metro, while it's only 65,000 on Kitsap.⁹

The seeds for Metro's program took root in 2012, when the King County Council approved a motion establishing an advisory committee to evaluate ways for enhancing the mobility of low-income people. The objective was to expand the "human services safety net" for this population, as part of the county's overall emphasis on achieving equity and social justice. As the advisory committee's final report notes, low-income people often rely exclusively on public transit to get around, yet mobility barriers such as unaffordable fares "can impede their ability to sustain a job, access critical services, and obtain basic necessities."¹⁰

The committee evaluated a range of price points, from as low as \$0.75 to \$1.50, ultimately suggesting adoption of a low-income fare but not a specific price.¹¹ Instead, it was mindful of the deleterious impact reducing the fare could have on Metro's already strained bottom-line. The committee noted that Metro was facing a projected \$75 million shortfall in 2014. Among the options to close the gap were sharp service cuts, up to 600,000 annual service hours.¹² Any further service reductions to offset the lost revenue from low-income fares would be self-defeating.

7 Poverty Guidelines 2015. Office of the Assistant Secretary for Planning and Evaluation, US Department of Health & Human Services. <http://aspe.hhs.gov/2015-poverty-guidelines>.

8 Johnson, K. (28 February, 2015). Targeting Inequality, This Time on Public Transit. New York Times.

9 King County Metro. (June 2013). King County Low-Income Fare Options Advisory Committee: Final Report and Recommendations. www.kingcounty.gov/transportation/LowIncomeOptions.aspx.

10 Ibid.

11 Ibid.

12 Ibid.



King County Metro Bus (King County Metro).

Brian Taylor is a professor of urban planning at UCLA and heads both the Lewis Center for Regional Policy Studies and Institute of Transportation Studies. In discussing the trade-off between service and reduced fares, he commented that low-income riders, like other commuters, are more service elastic than price elastic. Given the choice between applying a hypothetical \$2 million grant towards service improvements and lower fares, they would opt for better service.¹³ Ultimately, Metro set the reduced fare at \$1.50.

Another key recommendation was to simplify the enrollment process. Dr. Taylor emphasized that it is important to limit the transaction costs of reduced-fare programs, noting that one way to do so is to partner with other human service agencies.¹⁴ It's easier for them to incorporate the registration process into their existing functions (e.g. providing rent, income, or healthcare assistance), versus having a transit agency venture outside its area of expertise and add an essentially redundant function.

Working with outside agencies is precisely what Metro Transit did, according to agency spokesperson Rochelle Ogershok. "One of the challenges we faced was how to approach implementation and get people to sign up." They partnered with the King County Health Department, which like Metro is part of King County government, and eight other human service agencies in the area. These agencies have their own network of other public benefit providers, which magnifies the outreach potential.

¹³ B. Taylor, personal communication, September 24, 2015.

¹⁴ Ibid.

“[Providing] one stop shopping opportunities for anyone seeking these services,” Ms. Ogershok said, has been extremely effective in reaching riders. The customer participation rate bears out just how effective. As of September 18, 2015, there were 17,314 card holders. More tellingly, pass holders took 296,000 trips in August; that’s more than a three-fold increase from 83,341 in March, when the program started.¹⁵

The end of the tale isn’t written yet for Metro Transit. A critical unknown is whether the reduced-fare program is sustainable from a revenue perspective. Actual ridership revenue figures aren’t available yet, but the project manager, Carol Merrill, said the revenue loss could be upwards of \$5 million per year. She cautioned, though, that any estimate is an approximation at this point. More precise figures won’t be available until Metro crunches the numbers. So far, low-income trips represent 3 percent of total rides, according to Ms. Merrill.¹⁶

Other Transit Agencies

In an era of constrained funding for US transit agencies, the potential for revenue loss is an important consideration. That does not mean other providers shouldn’t enact their own low-income fare programs. Fair and just fares are a valuable arrow in the quiver of municipalities seeking to expand the human services safety net and help people climb the economic ladder.

Equitable transit fares are indeed gaining traction. Other providers in King County are in the process of adopting low-income fare programs to align their policies with Metro while Metro Transit in Minneapolis-St. Paul was planning to launch a pilot program on December 1, 2015. Slated for clients of Metro HRA, the pilot will encompass 8,713 participants. The fare will be \$1, compared to \$2.25 during rush hours and \$1.75 at other times. HRA was chosen largely because of the population it serves. The agency provides services to the most-needy groups in the Twin Cities region, including rental assistance to 7,000 people. Overall, access to transit is a major obstacle for impoverished area residents. Of the 256,342 low-income adults in the Twin Cities, 236,000 are unserved by transit altogether.¹⁷

In New York City, leading transit advocates are proposing a lower fare for commuter rail trips within city limits. The Transit Riders Council (TRC) and the Tri-State Transportation Campaign each recommend the adoption of a ticket that can be used across all Metropolitan Transportation Authority (MTA) transit modes: subways,

15 R. Ogershok, personal communication, September 30, 2015.

16 C. Merrill, personal communication, September 30, 2015.

17 Metro Transit. (28 September, 2015). Low Income Fare Pilot Program Proposal. [http://metrocouncil.org/Council-Meetings/Committees/Transportation-Committee/2015/September-28,-2015/Info-1-Low-Income-Fare-Program-Pilot-\(corrected\).aspx](http://metrocouncil.org/Council-Meetings/Committees/Transportation-Committee/2015/September-28,-2015/Info-1-Low-Income-Fare-Program-Pilot-(corrected).aspx).

buses, and commuter rail. A unified ticket would allow for free transfers between the transit systems.

In testimony before the NYC Council in November 2015, the TRC stressed that commuter rail fare today is out of reach for residents in isolated sections of the city. TRC called for a proof of concept for its proposed ticket—Freedom Ticket—in Southeast Queens, one of the most isolated sections of the city. Where the Long Island Rail Road (LIRR) would whisk commuters directly into Manhattan, riders are priced out. Instead, they're confronted with a long, two-seat ride on the subway and bus. TRC Executive Director William Henderson underscored the stark difference in trip times in his testimony: 37 minutes on the LIRR, compared to no less than 60 minutes on NYC Transit, for people coming from Rosedale.¹⁸

MTA seems open to considering the idea and is in discussions with New York City. However, authority leadership estimates that the revenue loss could be \$70 million a year, a huge dent in its budget considering the constant pressure to pinch pennies. MTA leadership says the city would have to reimburse the revenue loss, which is an iffy proposition even if the city initially agrees.¹⁹ New York has backed away from obligations in the past, notably its subsidy for discounted student MetroCards.

Looking Ahead

Moving forward, Metro Transit and other agencies evaluating the fitness of low-income fares must be cognizant of several important considerations. Most notable is not compromising service availability and quality for the sake of lowering fares. Too many people in poor neighborhoods live in transit wastelands, where service is inadequate and trips are long and onerous. Urban gentrification only exacerbates the issue.

Joan Byron of the Pratt Institute commented that new development in such New York City neighborhoods as East New York, already on the fringes of the city, is pushing low-income residents even further from the reach of transit. They're moving to areas like Canarsie, which is on the easternmost edge of Brooklyn. Compounding matters for Canarsie residents, the area is served by only one subway line, the L. Large swaths of the community are cut off from the subway altogether or need to take a bus to access it. This pattern is played out in other neighborhoods, including southeast Queens and the southeast Bronx. L train riders also are facing a full or partial shutdown of the Canarsie Tubes, the line's only connection to Manhattan.

¹⁸ PCAC to the MTA (12 November, 2015). Testimony before the NYC Council Committee on Transportation. www.pcac.org.

¹⁹ Rivoli, D. (12 November, 2015). City in Talks with MTA to Roll Back Commuter Rail Prices on Metro-North, LIRR: Officials. www.nydailynews.com.

Beginning in 2018, the MTA plans to repair damage from Superstorm Sandy. It is working with the affected communities to mitigate the enormous effects of this service disruption.²⁰

Joan Byron notes that skewed housing policies play a significant role in fostering transit impoverishment. While it's important to ensure that everyone has access to good and affordable housing,

maintaining close proximity to job centers and other key destinations is vital as well. Endlessly pushing people further on the fringes worsens the transit struggles low-income people already confront daily.²¹



Carolyn Torma. Copyright 2005 American Planning Association.

Directly addressing transit imbalances is the surest way to improve outcomes. While that includes equitable fares as discussed, it also means vastly expanded and improved service. Given current funding constraints, meaningful upgrades may be difficult to come by. Nonetheless, government and transit leaders are finding ways to deliver both funding and creative transit solutions.

Because buses are the quickest and easiest service to get up and running, locales like New York and San Francisco are proceeding with ambitious programs to bring bus rapid transit to the underserved peripheries of their cities. Bus rapid transit offers more frequent, reliable, and faster service than regular bus service, largely because it runs in lanes separated from main traffic. However, even an expansion in the reliability, reach, number, and frequency of traditional routes would be meaningful.

As costly as rail expansion is, major metropolises are making investments in these projects. Washington, DC, continues to build out its Metro. Sound Transit in Seattle expects to open a new link in 2016. The New York MTA has a bevy of projects. One is already operational—an extension of the 7 subway line to the far west side of midtown Manhattan—and others would provide much needed capacity, connectivity, and resiliency for the region (e.g. a third track along the LIRR Mainline and the Penn

²⁰ MTA Announces Plan to Engage with Community on L Train Tunnel Reconstruction Work. (6 February, 2016). www.mta.info/press-release/nyc-transit/mta-announces-plan-engage-community-l-train-tunnel-reconstruction-work

²¹ J. Byron, personal communication, July 28, 2015

Station Access expansion plan for Metro-North Rail Road).

Perhaps the most notable initiative from an equity perspective is the Penn Station Access project, which will bring Metro-North into Penn Station and provide four new commuter rail stations in the underserved southeast Bronx. In doing so, the project will enhance economic opportunities and give residents quick and convenient access to Manhattan and burgeoning job centers north of the city. Trips today are long—as much as two hours to Manhattan—and require burdensome transfers.²²

The catch as always is funding. MTA’s 2015-2019 Capital Program is a year overdue, not fully funded, and still winding its way through the legislative process.²³

Achieving transit equity clearly requires a comprehensive effort from government and transit leaders. Equitable fares may be just one piece of the puzzle, but they are indispensable. If riders can’t afford the fares, they have to make other sacrifices or may simply be stuck. King County Metro Transit’s ORCA Lift program is a laudable experiment in closing transit gaps. As the first true test of low-income fares by a major provider, it’s prompting broad consideration of equitable transit fares elsewhere. It has the potential to be the next watershed in the movement towards transit equity.

Jonathan Sigall is a transit financing and planning professional with twenty years of experience in the downstate New York metropolitan region. jonsigall@gmail.com.

22 MTA. (June 2014). http://web.mta.info/mta/planning/psas/pdf/PennAccess_MTAweb.pdf

23 Lentz, J. (14 January 2016). State to Fund MTA Capital Plan, But Find the Funding Later. City and State. <http://cityandstateny.com>

High-Performance Passenger Rail: The View from Virginia

Emily Stock, AICP

Virginia enjoys a border view—the border between north and south, accompanied by a rich history ingrained in the landscape outside your window while traveling by rail through the Commonwealth along the former Richmond, Fredericksburg, and Potomac Railroad (RF&P) line. With roots back to 1834, this corridor has served as a critical connection between rural Southside Virginia and Washington, DC. Today it is owned and operated by CSX Transportation, Inc. (CSXT), and is the northernmost link for all passenger rail service on the eastern seaboard to Amtrak’s Northeast Corridor (NEC).

In passenger rail terms, Virginia is the border between the NEC—home to Acela, the only true high speed rail service in operation, with express service and premium amenities—and conventional Amtrak service. To those accustomed to the passenger rail experience north of the border, the grass is indeed greener on the other side.

Broader View

Virginia Department of Rail and Public Transportation (DRPT), the agency tasked with improving passenger rail south of the border, must rearrange the letters and take a broad view—to integrate with high-performance, electrified rail operating successfully on Amtrak-owned, dedicated passenger infrastructure just north of the Potomac. Even without those advantages, Virginia is eking out a high-functioning system that does not break the bank, and is able to meet the needs of its growing population and increasingly dense, urbanized land use patterns.

As anyone who has ventured south of the Mason-Dixon line via Amtrak knows, a trip on a Northeast Regional train makes an extended layover at Union Station in Washington, DC to switch engines from electric to diesel. Amtrak’s northeast corridor is “under the wire” or the catenary, which carries electrical current above the tracks for passenger-only trains. Electrification is prohibited by host freight railroads in the region because of safety concerns and the limitations (due to electrical clearance issues) it can pose on a freight carrier’s ability to handle oversized cargo, double-stacked intermodal container shipments, and the like.

The Commonwealth supports these freight movements, which in turn support Virginia’s industries and the Port of Virginia. The lack of electrification contributes to speed limitations south of the border, however, where passenger trains operate

on infrastructure owned and maintained by Class I freight rail carriers. DRPT works within the current framework to achieve the best passenger rail bang for the buck—and employs the following strategies to achieve a balanced, incremental approach to rail investment:

- Planning for incremental passenger rail improvements in partnership with host railroads that deliver freight benefits as well. Plans focus on taking trucks off the road and delivering more reliable and frequent passenger rail service to the parts of the Commonwealth that need it most—those with the worst traffic and the highest population growth.
- Supporting a successful commuter rail service to Washington, DC. Virginia Railway Express (VRE) operates conventional commuter trains from Manassas and Fredericksburg (along the former RF&P), with expansion plans in the works.
- Operating a state transit and rail agency that is independent from the Virginia Department of Transportation (VDOT). This model is unique among states with rail programs that are typically housed within the DOT, and sometimes overshadowed by highway priorities.
- Preparing for change. Virginia led the nation in securing dedicated funding for passenger rail operating and capital, and in reaching agreement with Amtrak to provide regional passenger rail at the advent of the Passenger Rail Investment and Improvement Act of 2008 (PRIIA). One of the biggest impacts of PRIIA was the requirement for states to assume increased financial responsibility for Amtrak’s regional routes of less than 700 miles.
- Recognizing that the success of rail in the Commonwealth depends on regional service. Most of its Amtrak passengers travel north of the border to Washington, DC and other destinations in the Northeast Corridor. During the period between 2008 and 2013, when PRIIA took effect, Virginia added new frequencies to Richmond, Lynchburg, and re-instated Amtrak service to Norfolk, which had not operated since 1973.
- Validating improvement plans through operations modeling that pinpoints capacity improvements with maximum results for passenger and freight rail.
- Working with the Federal Railroad Administration to advance Virginia rail improvements as part of its Southeast High Speed Rail initiative.

View from the Top: Virginia is a Critical Connection in US High Speed Rail Network

In 1992, the US Department of Transportation designated the Southeast High Speed Rail Corridor (SEHSR) connecting Charlotte, NC, Richmond, VA, and Washington, DC. This designation was extended south to northern Florida through subsequent actions.

DRPT received over \$40 million in federal funding and support for National Environmental Policy Act (NEPA) compliance and preliminary engineering for high speed rail from Richmond to Raleigh, DC to Richmond, and Richmond to Hampton Roads. Virginia is currently engaged in a fast-track Tier II NEPA process for the section of SEHSR between DC and Richmond, known as DC2RVA Rail. In partnership with North Carolina, it is wrapping up a Tier II NEPA for Richmond to Raleigh.

Momentum for high speed rail projects such as these remains strong in the US at the highest levels. Upon the September 2015 approval by the Federal Railroad Administration (FRA) of the SEHSR Tier II Final Environmental Impact Statement (FEIS), US Transportation Secretary Anthony Foxx and Richmond, Virginia Mayor Dwight Jones issued a joint commentary to the Richmond Times Dispatch extolling the virtues of Southeast High Speed Rail:

“Now we have to ask ourselves a simple question: How do we keep the effort to build a powerful Southern rail network connecting Atlanta, Charlotte, Raleigh, and Richmond to Washington, DC and Northeast Corridor service moving full speed ahead? It is true that it took a generation of discussions, planning, and designing to get us to where we are today. But it is also true that we do not have another generation to reach the finish line. High speed rail in this region is not a luxury; it is a necessity, and the clock is ticking. If we cannot figure out how to build this network soon, it is not hyperbole — it is a fact — that the South is going to be stuck in traffic for a very long time.”

View from the Middle: The Incremental Approach

While momentum and support for the projects are high, some dispute the assertion that what is being planned in the southeast is true high speed rail, and are frustrated by the slow speed at which the program is implemented.

According to FRA’s High Speed Rail Overview (www.fra.dot.gov), the objective of FRA’s High Speed Intercity Passenger Rail Program is to:

- Build new high-speed rail corridors that expand and fundamentally improve passenger transportation in the geographic regions they serve;

- Upgrade existing intercity passenger rail corridors to improve reliability, speed, and frequency of existing services; and
- Lay the groundwork for future high-speed rail services through planning efforts.

There are sections of the SEHSR network that are well-suited for new or future high speed rail objectives, but increasingly southern states are taking an incremental approach, working within existing freight rights of way to achieve maximum benefits with minimal impacts to cultural and natural resources. The Tier I EIS that covered Washington, DC to Charlotte, NC puts much of that corridor into the “upgrade existing” category. It is important to keep this in mind as the network takes shape, along with FRA’s definitions for high speed rail. Virginia’s rail corridors tend to fit into FRA’s definition of “Emerging High Speed Rail.”

Definitions: High-Speed Rail and Intercity Passenger Rail*

HSR – Express. Frequent, express service between major population centers 200 to 600 miles apart, with few intermediate stops. Top speeds of at least 150 mph on completely grade-separated, dedicated ROW (with the possible exception of shared track in terminal areas). Intended to relieve air and high-way capacity constraints.

HSR – Regional. Relatively frequent service between major and moderate population centers 100 to 500 miles apart, with some intermediate stops. Top speeds of 110 to 150 mph, grade-separated, with some dedicated and some shared track (using positive train control technology). Intended to relieve highway and, to some extent, air capacity constraints.

Emerging HSR. Developing corridors of 100 to 500 miles, with strong potential for future HSR Regional and /or Express service. Top speeds of 90 to 110 mph on primarily shared track (eventually using positive train control technology), with advanced grade crossing protection or separation. Intended to develop the passenger rail market, and provide some relief to other modes.

Conventional Rail. Traditional intercity passenger rail services of more than 100 miles with as little as one to as many as 7–12 daily frequencies; may or may not have strong potential for future HSR service. Top speeds of 79 to 90 mph generally on shared track. Intended to provide travel options and to develop the passenger rail market for further development in the future.

*Source: High Speed Rail Strategic Plan, FRA, 2009. Corridor lengths are approximate; slightly shorter or longer intercity services may still help meet strategic goals in a cost-effective manner.

Virginia's DC2RVA Rail Project is in full swing and examining high speed rail improvement alternatives through a comprehensive Tier II Environmental Impact Statement and associated preliminary engineering. It will include service development plans in collaboration with CSXT and VRE, station improvement alternatives, and additional rail infrastructure improvement alternatives (additional track, crossovers, sidings, improved grade crossings, etc.).

DRPT is also partnering with neighboring departments of transportation on High Speed Rail projects, including Washington, DC and North Carolina. Washington, DC is developing a plan to improve the Long Bridge, the rail bridge that crosses the Potomac. Virginia and North Carolina have formed an interstate compact to reinstitute the S-line, an abandoned section of freight rail that, if rebuilt, could shave time and allow for 110 mph maximum authorized speed (MAS) between Raleigh and Richmond, and make the recently-completed Richmond to Raleigh FEIS a reality.

Please check www.DC2RVARail.com or www.drpt.virginia.gov for updates on Virginia's latest rail improvement activities.

Emily Stock, AICP is Manager of Rail Planning at the Virginia Department of Rail and Public Transportation. emily.stock@drpt.virginia.gov.

Automated Vehicles: Transformation of the Transportation Industry

Santanu Roy, PTP

Automated Vehicles have the potential to change the world as we know it. Imagine reading the newspaper while a car is driving you to work. How about a drone delivering to your doorstep the television you purchased on Amazon 15 minutes ago? While these may seem like science fiction, automated vehicles have gained tremendous momentum in recent years, and many expect them to become reality as early as 2020.

Automated Vehicle (AV) is an umbrella term that encompasses both Connected Vehicle and Autonomous Vehicle technologies. Connected Vehicles use a number of different communication technologies to communicate with the driver, other cars on the road, roadside infrastructure, and other objects. The vehicles utilize Dedicated Short Range Communications (DSRC) to exchange information between systems. Autonomous Vehicles are self-driving vehicles in which operation of the vehicle occurs without direct driver input to control the steering, acceleration, and braking. They are designed so that the driver is not expected to constantly monitor the roadway while operating in self-driving mode.

The US Department of Transportation's National Highway Traffic Safety Administration (NHTSA) has defined vehicle automation in five levels (Levels 0 - 4); the higher level means more automation. Level 0 represents no automation; the driver is in complete and sole control of the primary vehicle functions (brake, steering, throttle, and motive power) at all times. Level 4 represents full automation; the vehicle is designed to perform all safety-critical driving functions and monitor roadway conditions for an entire trip. The Level 4 design anticipates that the driver will provide destination or navigation input but is not expected to be available for control at any time during the trip. The third-generation Google car is an example of full self-driving automation. Many believe that the convergence of autonomous and connected vehicle technologies is expected to provide the optimum solution for automation.

Research and testing are underway at the national and state levels to understand the opportunities and challenges, create the framework for deployment, and prepare the nation for change. AV technology holds significant potential for efficiency and safety improvements. Over 32,000 people are killed in the US by traffic-related accidents each year, and over 2 million people are injured in these accidents. According to NHTSA, the annual societal cost of traffic crashes in the US is estimated to be over



Google's Self-Driving Car (Google).

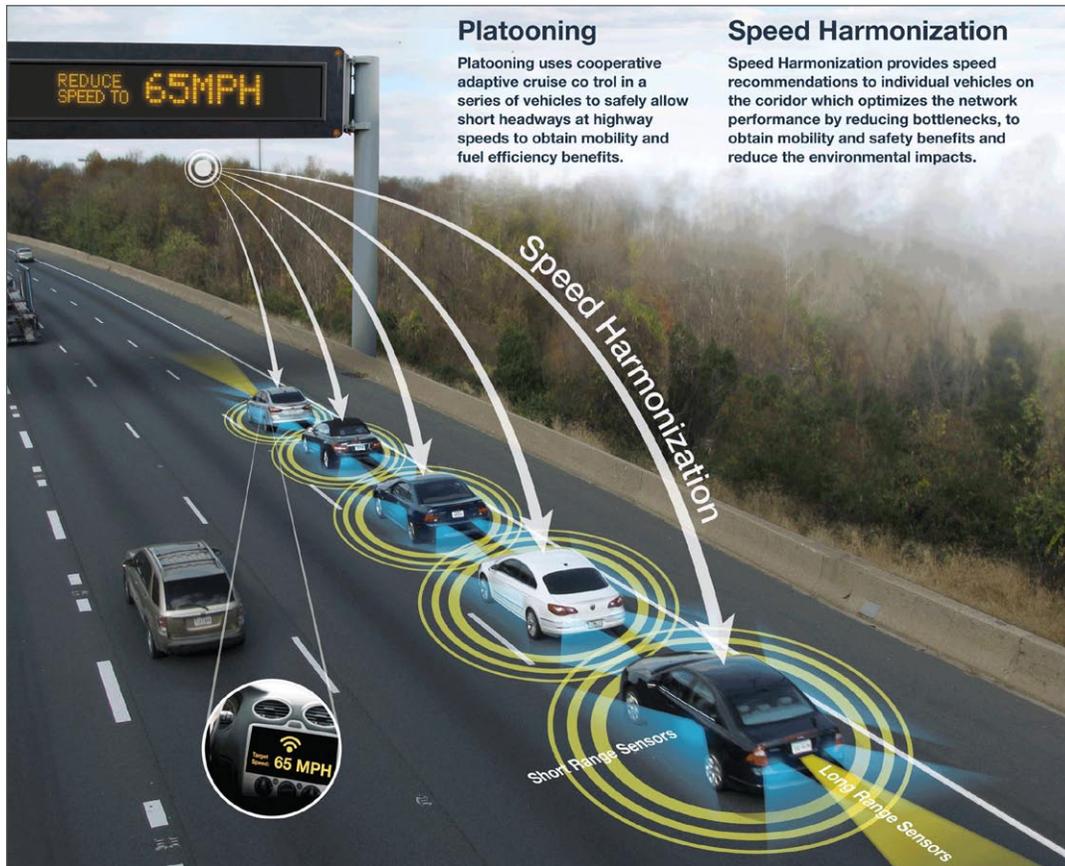
\$900 billion.¹ Since 90 percent of these crashes are attributable to human error, the introduction of AV technology will result in significant safety benefits.

In addition, AV technology could vastly increase highway capacity and fuel economy by allowing vehicles to optimize acceleration and deceleration and potentially travel closer together. At 100 percent market penetration rate, AV technology can increase roadway capacity by over 80 percent.² Research is indicating that vehicle platooning can potentially realize up to 35 percent fuel savings, which will have significant impacts on cost of travel and emissions. New options for the mobility challenged (elderly, disabled, and children) can be provided, enhancing their quality of life and that of their families and associates. AV technologies for freight and transit systems can improve productivity, profitability, and efficiency in moving people and goods.

Advancements in AV technology are nearing readiness for market introduction, as evidenced by announced plans of many of the vehicle manufacturers and aftermarket system suppliers. The promise AV holds to improve safety, mobility, and quality of life is inspiring the transportation industry to prepare for testing and deployment. Key challenges associated with the technology relate to liability, security, reliability, lack of

1 National Highway Traffic Safety Administration. The Economic and Societal Impact Of Motor Vehicle Crashes. May 2015 (Revised).

2 Shladover, Steven, Su, Dongyan, and Lu, Xiao-Yun, 2012, "Impacts of Cooperative Adaptive Cruise Control on Freeway Traffic Flow," Proceedings of the 91st Annual Meeting of the Transportation Research Board. Washington, DC.



Platooning Connected Vehicles (USDOT).

standards, regulatory barriers, lack of funding, and potential labor resistance. These factors are being carefully considered and evaluated at the national and state levels.

Florida is one of seven states that enacted legislation to test and deploy automated systems. The Florida Automated Vehicle (FAV) Initiative is underway to create the framework for implementation by engaging stakeholders, developing research and pilot projects, and creating awareness of the technologies and how they support FDOT's vision statement. Florida is committed to being a national leader in the testing, evaluation, and deployment of automated vehicle technology. More information on the FAV initiative is available at www.automatedfl.com. As the nation approaches an automated reality, transportation professionals are challenged to make the right decisions and drive the transformation of the industry for a better tomorrow.

Santanu Roy, PTP is the Florida Transportation Planning Manager at HDR and leads the company's Travel Demand Modeling Practice. He was appointed by FDOT to serve as the Modal Applications Working Group Secretary for the Florida Automated Vehicles Initiative. Santanu.Roy@hdrinc.com.

The Future of Parking

Richard Willson, Ph.D., FAICP

Planners face an unprecedented rate of change in regulatory and management practices for parking. Pressure for change will only increase in the coming decade, as Smart Growth is simply incompatible with the post-war tradition of oversupplied and underpriced parking. Planners, researchers, developers, and community activists are asking for two types of reforms: 1) reducing or eliminating minimum parking requirements, and 2) effectively using management tools such as parking pricing.¹

The economic justifications for requirement reform and pricing are well documented—a less regulated, market-based parking system leads to more efficient land use and a multimodal transportation system.² Drivers should no longer receive subsidies that are not available to pedestrians, cyclists, and transit riders. Charging for curb parking based on demand, for example, is a best practice because priced spaces are used more times per day and better serve customers and visitors. Pricing encourages people to use less-known off-street spaces, reducing pressure to require or build expensive new parking facilities. Moreover, pricing provides revenue for local improvements. The most successful business districts charge for curb parking; the lagging ones do not.³

Fortunately, technological advances in parking information systems, parking meters, and integrated management systems make these reforms and pricing schemes more doable than ever. Moreover, the demand for parking per unit of development is likely to decrease in the future as technology disrupts the traditional model of car ownership. Taxi alternatives, temporary car rental, real-time ridematching, and peer-to-peer carsharing are rapidly deploying in urban areas. Add to that the lower rates of licensure by 16 to 24 year-olds and we can see that total parking supplies might be reduced in the future, not increased.⁴

Despite substantial progress in cities like San Francisco, Los Angeles, and Seattle, innovation in most communities is too slow. It takes a long time to change traditional

1 The arguments for these reforms are found in:

Litman, T. 2006. *Parking Management Best Practices*. Chicago: American Planning Association, Shoup, D. 2011. *The High Cost of Free Parking*, Updated ed. Chicago: American Planning Association, Willson, R. 2013. *Parking Reform Made Easy*. Washington, DC: Island Press, and Willson, R. 2015. *Parking Management for Smart Growth*. Washington, DC: Island Press.

2 See citations above, particularly Shoup (2011). The original argument for pricing was made by Vickery, W. 1954. "The Economizing of Curb Parking Space." *Economic Journal* 21(1): 1-9.

3 See, for example, the Old Pasadena commercial district compared to other Pasadena commercial districts, discussed in Willson (2015), p. 35.

4 For example, Slvak, M. and B. Schoettle. (2012) found that the percentage of 19 year olds with a driver's license was 87.3% in 1983, 75.5% in 2008, and 69.5% in 2010.

perceptions about parking. This article describes typical community parking issues and provides ideas on how to make progress in the challenging political setting of parking reform.

Everybody has the worst parking

Recently I gave a parking management presentation to a community group in Silver

Lake, a neighborhood in the city of Los Angeles. Residents told me they had the worst parking problems in the city. If I had a dollar for every time a community group told me that their parking problems are the worst ever, I would be wealthy.



Kelly Wilson. Copyright 2015 American Planning Association.

Silver Lake's parking conditions are typical of many revitalizing urban communities—more residents, buildings converted to higher intensity uses, older buildings with no off-street parking, more economic activity, and no vacant land for surface parking. In short, Silver Lake is the type of hip neighborhood that is attractive to many people. To check the community's claims, my students conducted parking occupancy studies. They found that, indeed, on-street parking occupancies were high.

Silver Lake locals yearn for the old days of easy parking, but that would require reversing the economic vitality of the neighborhood and chasing residents out. There is no magic solution, but existing parking resources can more effectively serve the community. Silver Lake already has LA Express Park variable meter pricing on Sunset Boulevard, the main commercial corridor. Many neighborhoods have residential permit programs with short-term commercial parking allowed during the day. So what else can be done? Here are some options:

- Use parking in lieu fees and other parking revenue to create appropriately-sized public shared parking structures.
- Negotiate time-specific shared parking arrangements with private off-street parking facilities, such as those controlled by schools and businesses.
- Expand metered parking pricing to residential streets adjacent to commercial areas for use by shoppers and visitors.
- Expand the metered rates to all times with demand (maybe even 24/7!).
- Develop a shared valet parking program.
- Return parking revenues to the community for neighborhood access improvements, including parking.

- Charge a market price for residential permits that balances supply and demand to discourage excess vehicle ownership and encourage the use of off-street residential garages for parking (this would require a change in California law, which restricts the permit price to the administrative cost).

There is no way to return to the “good” old days, when parking was free and easily available. By managing parking in a way that is comprehensive (considering all parking resources) and coordinated, parking will be less chaotic, business activity can grow, and the community can prosper.

Parking management and community image

I also gave a talk in the nearby City of South Pasadena. That experience helped me understand why so many good parking management ideas encounter resistance. I’ve engaged in hundreds of dialogues with officials and community members on parking management. The resistance isn’t about data or rational argument—it’s cultural. Locals have a “small town” image of their community. South Pasadena is one of those places—a city of 25,000 people in the heart of the largest county in the US. Drive down the streets of South Pasadena and you might think you are in a small town, but you are part of the 10 million residents of Los Angeles County. You participate in that economy and infrastructure system.

How does small town culture translate into parking in a small town? The perception is that you park in front of the destination, for free. Local government requires that developers build lots of parking. Off-street parking is private, and so it isn’t shared with other uses. And curb parking in neighborhoods is “owned” by residents even though it is a public asset.

Big city parking is different. If you use a car, you park nearby your home or destination (probably off-street) and walk. Parking costs money, sometimes a lot, and you decide on the tradeoff between price and walking distance. And because parking is worth something, there is an economic incentive for off-street parking owners to share it. A single space serves daytime retail customers, evening restaurant patrons, and overnight residents. That’s how



Sylvia Lewis. Copyright 2008 American Planning Association.

parking works in downtown Los Angeles, a mere seven miles from South Pasadena.

There is a continuum between small town parking and big city parking. Where is your community on this continuum? What is the best way to nudge policy makers toward urban parking? South Pasadena, for example, should install meters on popular curbside spaces and leave free parking options elsewhere. Bigger cities should adjust parking pricing dynamically to ensure a few available parking spaces on every block.

All the parking studies in the world won't change minds if local culture drives perspectives. Here's an approach forward. Create a discussion about broader community goals and show how parking management supports them. Make sure that all the voices are present—new business owners are more open to pricing than the old timers. Show decision-makers examples of successful districts that use pricing and all the public improvements that result from the revenue. Just up the road from South Pasadena, Old Pasadena has shown the benefits of pricing for decades.

Refuting arguments against parking pricing

Arguments against parking pricing lie at the heart of resistance to parking reform. Since the beginning of time, parkers have argued that they should have free parking. The clever ones know that insisting on high minimum requirements mean they will never have to pay because parking will be oversupplied. I have been chronicling those arguments in my work with local stakeholders. The top four arguments I have heard are described below along with responses that may be useful in the heat of the battle.

Parking pricing won't work.

- Arguments: "People love their cars and will not change their parking behavior even if prices change.", or "I have to drive because of reasons x, y and z and everyone is like me," and/or "I enjoy showing off my parking prowess by circling blocks to find the best space."
- Response: Yes, some people love their cars, must drive, and/or enjoy hunting for parking, but that's not the point. Parking pricing seeks to change behavior at the margin, not for everyone. In other words, if your alternatives to driving are pretty good and you drive because parking is free, pricing will induce you to consider changing modes or parking location. Seeking 85 percent curbside parking occupancy with dynamic pricing, for example, requires that only a few people change.

Parking pricing will kill business.

- Argument: "I won't shop in this shopping district if you price parking, and no one else will either. We'll go to the mall instead."

- Response: That's a bluff. People who spend \$100 on dinner say they won't pay \$3 to park. A few people may do that, but most will go to the restaurant they like. People will pay for parking to gain access to a district with competitive businesses. Instead of improving their businesses, uncompetitive districts hold on to free parking like it is a life preserver in a stormy sea, thinking it draws customers. The stakeholders screaming the loudest about parking charges probably spend the least money in the district.

Parking pricing is unfair.

- Argument: "No one should pay for parking because charges burden low-income drivers."
- Response: The SFpark dynamic pricing program shows that while prices on the prime blockfaces increased, the average price declined because prices were lower in less-used locations, so affordable parking was still available, albeit with a longer walk. Using parking revenues to improve transit and active transportation is a better path.

Parking pricing is a money grab by local government.

- Argument: "Cities push parking pricing just to generate revenues for the general fund."
- Response: Fair enough. Lots of cities are so motivated. The answer is to set prices to achieve target occupancies, not a revenue target, and return all or a portion of the funds for local parking, transportation, and community improvement in the neighborhood being priced.

Making progress in parking requirement reform and parking management requires all the evidence that the profession can muster. Convincing a person to change her or his mind is, of course, the greatest challenge of all. It has stumped teachers, marketers, philosophers, and religious leaders through the millennia. But is it possible, and it is more likely, when you understand the core ideas in the objections and frame the issue in a way that acknowledges them. Much as I would like to advance parking reform and management with technical arguments, I've learned it demands dialogue, community by community. It takes the parking equivalent of a "horse whisperer."

Richard Willson is author of *Parking Management for Smart Growth* (2015) and *Parking Reform Made Easy* (2013). rwwillson@cpp.edu.

New Measures of Success: Using Accessibility to Measure Transportation System Performance

Vlad Gavrilovic, AICP

Accessibility has been a focus of discussion in transportation planning for the past 40 years or more and has been the subject of much debate over that time. Recently, with the new performance-based planning discussions emerging from MAP-21, there has been a great deal more interest in the potential of using accessibility to supplement the traditional metrics of transportation performance. Accessibility as a measure of performance holds the promise of bringing new “mode neutral” measures of the benefits of transportation systems to individual users, rather than just measuring the performance of individual travel modes. Moreover, accessibility has the potential to account for land use in its measure of performance, and is a truer measure of the combined benefits of transportation and land use on our daily interactions. This is because accessibility measures the combined value of access to key destinations such as jobs, schools, recreation, or healthcare. It measures how well our transportation systems connect us and not just how fast we travel on them.

Accessibility measurement is moving rapidly from theoretical models to practical applications at both the state (DOT) and regional (MPO) levels and seems poised to become a standard for measuring transportation performance at the federal level too. The potential applications of measuring accessibility are still emerging and the field is a dynamic one. With the emergence of crowd-sourced “big data” and powerful new analytic models, the field of accessibility measurement will continue to evolve and offer new ways of measuring the value of transportation to the traveling public.

What is Accessibility?

Among the many definitions that have been proposed for accessibility, most center on the idea of providing opportunities for connecting people, activities, and desired destinations within reasonable travel times. The often discussed distinction between accessibility and mobility has been much debated and is sometimes hard to pin down. In general, though, accessibility deals with our ability to connect to important destinations, which has been described as the goal of transportation itself. Mobility, on the other hand, deals with the ability of people to move through a transportation

system, which is more often considered as only one of the means of achieving that goal. For example, if you deliver pizzas, your goal is to be able to access as many houses that might order pizzas as possible in a given time frame. The measure of how many pizzas you can deliver in a given time is a measure of accessibility (ignoring, of course, how much time you spend at each house). However, one of the ways that you can deliver more pizzas in a given time is by being able to travel faster on a given network. That is a measure of mobility, and is ultimately a means of achieving your goal of accessibility.

Fundamentally, though, the distinction is made most obvious by looking at what each measures. Classic mobility metrics focus only on the travel network and measure things like travel time, congestion, and other aspects of physical travel. Accessibility metrics, on the other hand, measure things like the number of destinations reachable in a given travel time, or the number of opportunities accessible in a given geographic area. Thus, accessibility goes beyond the transportation network and accounts for the proximity of destinations in its measurement, with obvious tie-ins to land use planning. One exciting potential in defining transportation performance in terms of access to destinations is the opportunity to monetize those benefits in terms of economic benefit to users. Quantifying accessibility benefits is sometimes challenging but one well known example¹ analyzed the increased values of housing correlated to higher “walk scores.”² If accessibility can be better measured, and translated into real economic terms, the societal benefits of transportation can be more clearly demonstrated, as a system that helps us connect to the people, places, and activities that enrich our lives.

New Tools to Assess Accessibility

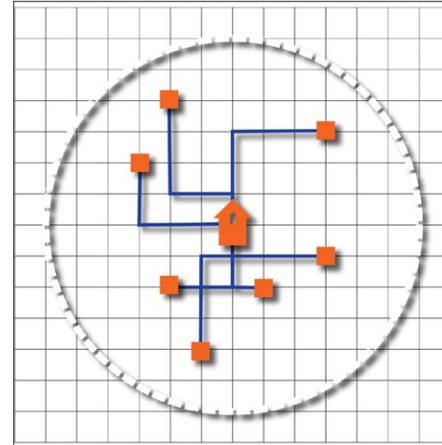
As planners, we recognize that land use and transportation have to be integrated to create more accessible places for those who walk, bicycle, or use transit in addition to autos. Getting buy-in for such multimodal and integrated planning approaches requires demonstrating the benefits associated with a better planned and more integrated pattern of development and street networks that give more balanced priority among all travel modes. This is where accessibility metrics have shown early promise in reorienting the dialogue of transportation performance around a more

1 CEOs for Cities, “Walking the Walk,” 2009, <http://blog.walkscore.com/2009/08/new-study-shows-one-point-of-walk-score-worth-up-to-3000/#.VgGdZmddGKE>

2 Walk Score is a composite measure of walkability for places (www.walkscore.com).

Figure 1

Accessibility can be defined as the cumulative number of opportunities reachable on a given network in a given travel time (Renaissance Planning).



holistic benefit to users that increases their access to opportunities and destinations.

At the national level, MAP-21 emphasizes performance-based planning and decision-making, especially identifying viable multimodal measures of performance that focus on meeting user needs rather than just maximizing the extent or performance of individual travel modes. Emerging tools and data are rapidly empowering us to find these measures. Overlays of GIS data on land use and transportation networks is being skillfully combined with path building and selection algorithms to measure how well a transportation network is connecting opportunities in its service area with residents, businesses, and visitors. Through analytics built into these new accessibility tools, it is possible to ascertain accessibility levels by mode for any geography and for almost any type of opportunity. From that information we can not only measure the effectiveness of the overall connectivity in a network, but explore a wide range of modal and land use solutions to improve that connectivity.³

How is this new focus on accessibility as a metric of transportation performance playing out in real world applications? Two state DOTs are among the vanguard of agencies that have been applying new accessibility metrics to planning challenges at both the statewide and corridor scale.

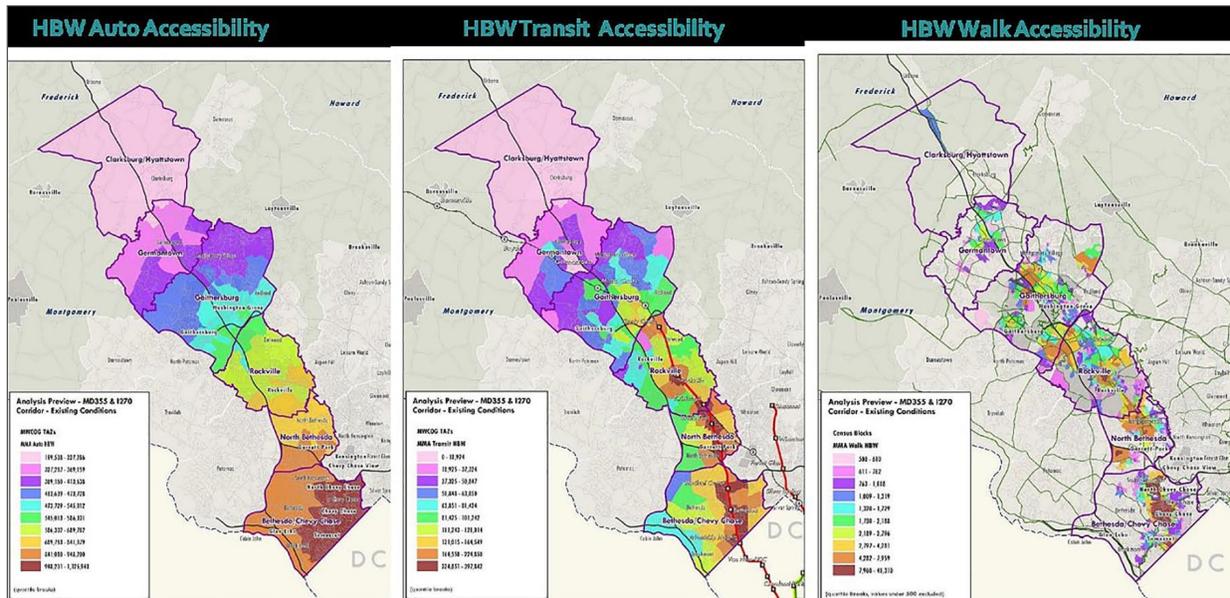
Real World Application: Maryland DOT Corridor Planning

In Maryland, the DOT is testing the application of a multimodal accessibility approach in a major urban corridor.⁴ This project used a technique first developed in NCHRP Report 770 for predicting pedestrian and bicycle travel demand for planning and project development, and further expanded to include auto and transit modes. The approach focuses on measures of accessibility, which are calculated using GIS tools and data to link the opportunities present in the landscape (activities) with the access provided by the respective modal travel network. Accessibility scores, similar to the types of measures offered by Walk Score, are calculated for each mode for different trip purposes, reflecting different activities of interest. Moreover, the value of each destination is “decayed” according to how long it takes to get to it. Traveler surveys were used to create “decay curves” for each travel mode. For example, travel surveys showed that a job 10 minutes away is valued more highly than one 45

3 Concurrent efforts to develop and refine accessibility “models” or toolkits are occurring throughout the country. Recent efforts include those by the Delaware Valley Regional Planning Commission’s Transit Score tool, the University of Minnesota’s Accessibility Observatory, Atlanta’s Equitable Target Area Index, the Los Angeles’ Equity Atlas, Policy Link: National Equity Atlas, EPA’s Smart Location Mapping and Smart Location Database, and AARP’s Livability Index.

4 The task is part of a larger work effort in which Renaissance Planning is advising MDOT on ways to improve its analytic capabilities for planning and decision-making on increasingly complex transportation and land use issues.

Figure 2 MDOT has recently been using accessibility metrics to do cross modal comparisons of access to employment in the MD 355/I-270 corridor (Renaissance Planning).



minutes away. This survey data was used to value each opportunity accordingly. By comparing the accessibilities, it is possible to explain patterns in mode choice that are highly correlated to the built environment. The correlation to land use, in fact, has allowed an additional potential to be able to predict how changes in accessibility, whether through land use or network changes, can ultimately impact mode choice in an area. The accessibility tool can be used to both visually portray conditions across a study area (activity center, corridor) or be used for planning purposes. Since accessibilities can be changed by either alterations in land use patterns or in the connectivity of the transportation network, the changes in accessibility thus rendered can be directly related to expected changes in mode choice and a variety of other transportation outcomes (vehicle trips, VMT, congestion, etc.). The DOT hopes to use the tool for a wide range of purposes, from multimodal investment analyses and project prioritization to traffic impact studies, to interacting with local jurisdictions in support of Plan Maryland, the state’s comprehensive land use plan.

Real World Application: Virginia OIPI Statewide Planning

In Virginia, the Office of Intermodal Planning and Investment (OIPI), which is responsible for the development of Virginia’s Long-Range Multimodal Transportation Plan, has developed a series of quantitative measure for statewide accessibility.⁵

⁵ In 2011, Renaissance Planning, Michael Baker International, and CDM Smith worked with OIPI, VDOT and other modal agencies in Virginia to define, develop, and test measures of accessibility in a variety of contexts. Recommendations for specific improvements to intermodal centers were incorporated into the

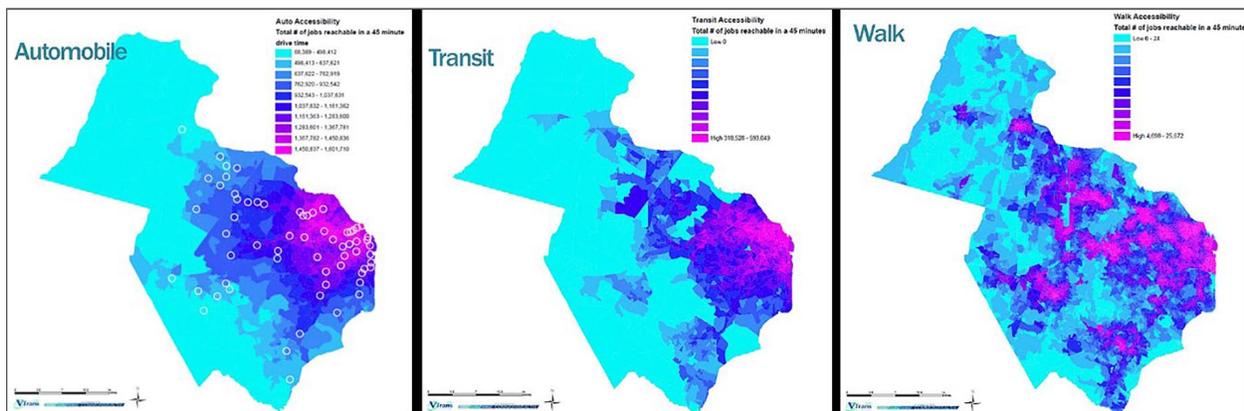
Most recently, Virginia has adopted legislation for mandatory screening of all transportation projects funded by the state, which includes screening for accessibility. Under the groundbreaking legislation called House Bill 2 (HB2 for short), all projects subject to state funding will now be screened and scored on the basis of five factors: congestion, safety, accessibility, environment, and economic development. The accessibility screening is based on access to employment for the population as a whole and specifically for the disadvantaged population, and uses the accessibility tool first described in NCHRP Report 770 and applied in Maryland.

The significance of this statewide application of accessibility for project rating is potentially profound. Measuring projects from the standpoint of accessibility—in this case as providing the greatest access to destinations—allows for a new dimension of performance assessment and a paradigm shift in how we look at the value of transportation. In particular, measuring access to employment allows for the value of a compatible land use context to factor into the scoring of a transportation project. Projects that provide greater access to employment rich areas will score higher than projects that provide improved access where jobs are scarce. Moreover, this measure of accessibility is conceptually mode-neutral; meaning that competing modal corridor improvement proposals (such as a Bus Rapid Transit versus adding a lane of traffic) could be compared on the same platform—how well each increases access to jobs.

This approach fits in well with the transportation priorities of Virginia’s Governor Terry McAuliffe who has said that the state’s prime transportation priorities will be serving the needs of the 21st century workforce and goods movement for Virginia businesses. The administration has focused on prioritizing transportation investments

VDOT work program. Since then, this same team has continued to develop an accessibility index for both statewide needs assessments and project scoring and evaluation.

Figure 3 Virginia’s OIPI is using access to employment as one way of looking at accessibility in its statewide transportation needs assessment. Shown is access to employment across modes in Northern Virginia. Note that the scale for high to low accessibility is different for each mode and each map only measures relative accessibility for that mode (Renaissance Planning).



that serve the economy and measuring projects on how well they serve employment.

Implications for the Future

Transportation exists to connect people to places and opportunities. Accessibility as a lens for assessing the effectiveness of transportation allows us to optimize transportation networks in a way that is directly related to this primary purpose of transportation. As accessibility increases, so do opportunities to reach places quickly and efficiently across various modes.

Accessibility in the context of transportation planning is a rapidly evolving science. As a metric of performance, accessibility is finding its way increasingly into different types of planning contexts. For example, accessibility assessment can be a framework for analyzing equity considerations such as relative equality of access by different populations to similar opportunities, and with different modes of travel. In the field of regional scenario planning, accessibility can be a key metric allowing cross modal comparisons of different land use and network scenarios. By using access to key destinations as a frame for comparing scenarios, the standards of comparison are less speed of movement in a region and more the things that directly relate to economic vitality and quality of life, such as access to jobs, schools, healthcare, or recreation.

One area in particular that holds exciting new potential is the integration of accessibility measurement with crowdsourced big data on transportation patterns and behavior. If accessibility is about the potential to access opportunities, big data gives us the opportunity to test how these opportunities are actually being accessed by the traveling public. What will we learn in the coming years about the relationship between potential, predicted, and actual travel? Many aspects of accessibility as a metric in transportation planning have yet to be explored. One thing that is becoming clear, however, is that accessibility as a performance lens and decision making tool can help us understand how transportation and land use work together to enhance our economic and social wellbeing.

Vlad Gavrilovic, AICP is a principal with Renaissance Planning Group in Charlottesville, Virginia. He has been working with the Office of Intermodal Planning and Investment and VDOT in Virginia in developing an accessibility performance measure under the House Bill 2 project scoring process. vlad@ciesthatwork.com.

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