7 BEST PRACTICES

Image from Flickr, Creative Commons, Oran Viriyincy.

7 BEST PRACTICES
Introduction

This section presents best practices that provide a variety of "lessons learned" from other cities on topics relevant to the plan, including:

- Elements of Bus Rapid Transit
- Mixed Modes: High Capacity Transit and European Street Trams
- Transportation Land Use Linkages
- Local Government Standards for Transit Agencies
- City-Based Transportation Demand Management Strategies
- Congestion Pricing
- Transit-Supportive Policies and Programs
- Supporting Transit and Non-Motorized Travel Through Complete Streets
- Transit Priority Treatments
- Emerging Technology
- Adaptive Traffic Signal Systems
- Bicycle Access to Transit
- Pedestrian Access to Transit
- Capital Funding and Finance
- Financing Operations
- Center City Circulation
- Regional Governance of Transit
- Transit's Role in Meeting Greenhouse Gas Reduction Goals
- Late Night Transit Service

7 BEST PRACTICES

Elements of Bus Rapid Transit

LOS ANGELES

WHAT IS IT?

Bus Rapid Transit (BRT) is defined as "a flexible, rubber-tired rapid-transit mode that combines stations, vehicles, services, running ways, and Intelligent Transportation System (ITS) elements into an integrated system with a strong positive identity that evokes a unique image."[1] It has often been described as a rubber-tired version of light rail transit (LRT). However, BRT typically has much lower capital and operating costs than LRT. In contrast to buses, BRT is faster, more reliable, and more easily identifiable.

A permanent, integrated BRT system uses traditional buses or specialized, stylized vehicles in mixed traffic or dedicated lanes to quickly and efficiently transport passengers to their destinations. At the same time, it offers flexibility to meet transit demand and community needs. BRT can incorporate state-of-the-art, low-cost technologies that improve upon the image, speed, and reliability of a traditional bus, thereby attracting more passengers and more effectively reducing congestion.

The term most often used to describe the application of these measures to transit is "BRT"; however, rapid transit principles can also be applied to systems using other vehicle types, such as trams or streetcars, as in several European systems.[2]

1 TCRP Report 90, Volume 1: Case Studies in Bus Rapid Transit , 2003. http://gulliver.trb.org/publications/tcrp/tcrp_rpt_90v1.pdf

2 National BRT Institute; see http://nbrti.org/systems.html for examples of both U.S. and international BRT systems.

BRT uses various tools (dedicated running ways, longer distances between stations, off-vehicle fare collection, ITS, "clean" vehicles, frequent service) to produce a fast and convenient method of transportation. Following is a list of the key features of rapid transit, in increasing order of investment. These represent a continuum of enhancements that would support a rapid transit system, regardless of vehicle type:

- Unique branding
- Widely-spaced station stops with superior amenities
- Good pedestrian and bike connections
- High level of coordination with connecting services
- Frequent service—no schedule needed
- Real-time passenger information
- Sleek, attractive vehicles
- Low-floor vehicles with multi-door boarding and alighting
- Pre-payment—allows all-door boarding
- Improvements focused on speed/reliability
- Timed signals to favor transit
- Queue jumps
- Bus bulbs
- Dedicated lanes

WHY DO IT?

Comprehensive transit improvements such as light rail or BRT systems can provide large increases in transit use and attract riders who would otherwise travel by automobile. Various cities have seen increases in bus ridership with the introduction of BRT service, for example: Pittsburgh (38%), Los Angeles (40%), Brisbane (42%), Adelaide (76%), and Leeds (50%).[3] Impacts of other expansions in transit vary depending on the conditions in which they are implemented.

The advantages of BRT are:

- **Cost.** When it decided to construct a rapid transit system in 1976, Ottawa opted for BRT after discovering that capital costs would be half those of rail transit and that it would be 20% less expensive to operate.
- **Travel Times.** BRT vehicles operating on dedicated running ways can save two to three minutes per mile, while those same vehicles driven on arterial streets normally save one to two minutes per mile when compared to regular bus lines. Greater time savings are realized during peak congested hours—Pittsburgh's BRT line reports a time savings of five minutes per mile during peak hours.
- **Branding and Image.** Eye-catching branding reinforces BRT's identity as a high quality transit service and an attractive alternative to automobile travel. The most common strategy is to distinguish BRT through a stylized vehicle design. Other common elements include distinct names, logos, color schemes, typography, station signage, and marketing materials.
- **Stop Amenities.** High quality amenities at stops and stations improve the passenger experience and visibility of the system to potential riders.
- **Permanence.** Public capital investments in stops, stations, and/or dedicated right-of-way help demonstrate a public commitment to a BRT line and convey a sense of permanence, helping to leverage private investment around the line.

BRT systems have been implemented all over the world, with some of the most successful systems in Bogotá, Columbia; Curitiba, Brazil; and Adelaide, Australia. There are approximately 20 systems in the United States. Many of these systems run on dedicated rights-of-way, such as the Los Angeles Metro Orange line. Others, such as Los Angeles Metro Rapid service, run in mixed traffic.[4]

3 TCRP Report 90, Volume 1, 2003

4 http://www.metro.net/around/timetables/700-799/

Metro Rapid vehicles, which operate in mixed traffic with transit priority features, are distinguished from local buses (shown on the previous page) by their red color and the name of the service, painted on the side of the vehicles.

Source: Wikimedia Commons, Mario Roberto Duran Ortiz

Metro transitway routes, including the Orange Line shown above at North Hollywood Station, operate on exclusive right-of-way.

Source: Wikimedia Commons, Cian Ginty

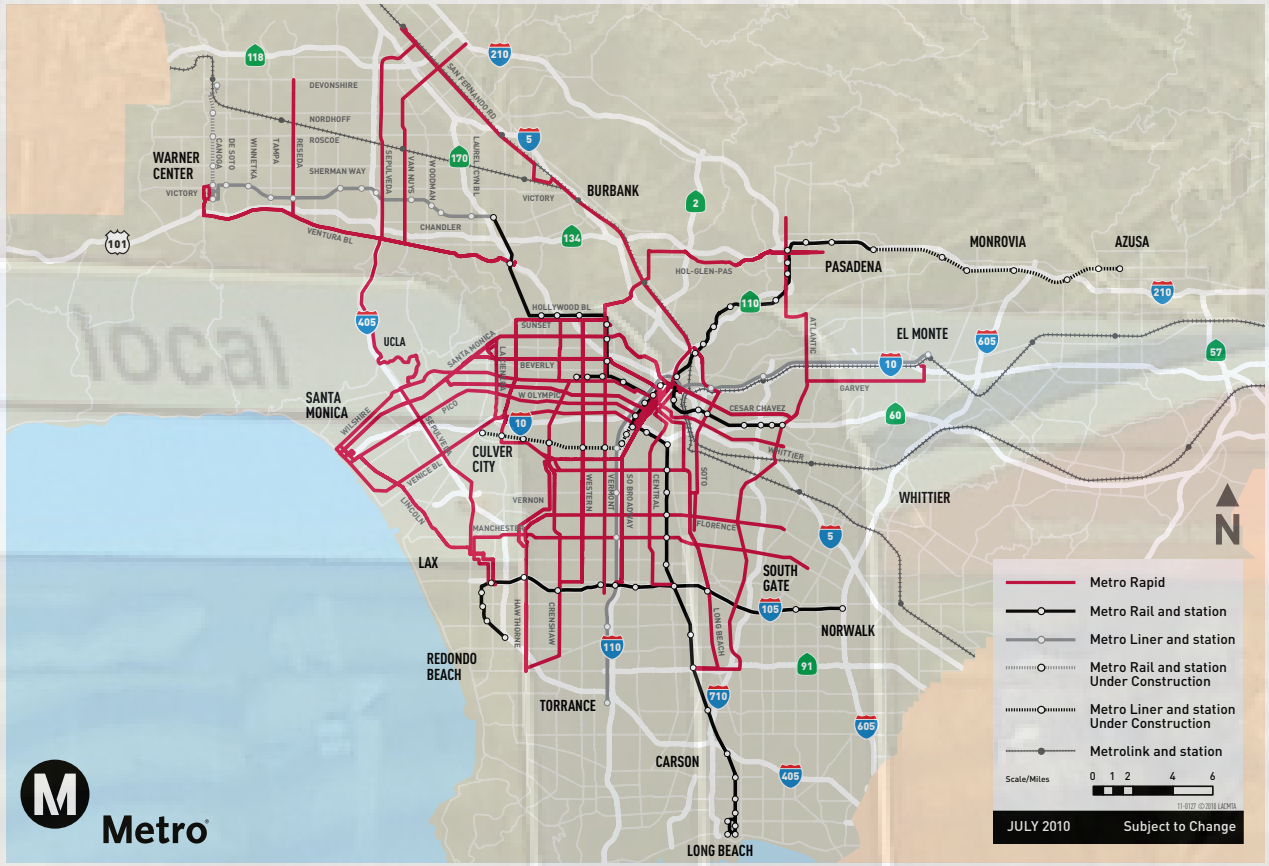
HOW WELL DOES IT WORK?

The success of BRT systems is often associated with the following conditions:

- **Branding and marketing plans.** A coordinated program to brand BRT service and all of its physical elements (vehicles, stations, signage etc.) to differentiate it from traditional bus service and promote it as a convenient and fast alternative to driving alone.
- **Multimodal connectivity.** Accessibility to BRT station area using all modes of travel, particularly walking and bicycling.
- **Competitiveness with automobile travel.** Investments in transit speed and reliability to assure that BRT vehicles can bypass congested roadways and intersections while also accessing desired destinations.
- **Transit supportive land uses.** Mixed-use developments (commercial, residential and other uses) to support high residential densities, employment opportunities and personal trip destinations near BRT station areas.

CASE STUDY: Los Angeles, California. Metro Rapid Buses

Metro Rapid service is an example of a successful, quickly deployed transit investment. This service is a partnership between the Los Angeles County Metropolitan Transportation Authority (MTA), the City of Los Angeles Department of Transportation (LADOT), and other partner cities (such as Pasadena). It is a marriage of improvements in street design to protect the speed and reliability of transit with investments in frequent service and better buses.



Metro Rapid system map

Source: Los Angeles County Metro

The key *transit* attributes of Metro Rapid service (primarily under the MTA's control) are:

- **Simple route layout**: Makes it easy to find, use and remember.
- **Frequent service**: Buses arrive as often as every 3-10 minutes during peak commuting times.
- **Fewer stops**: Stops are spaced about three-quarters of a mile apart, similar to many rail lines, and include most major transfer points.
- **Level boarding**: Low-floor buses reduce dwell times.
- **Color-coded buses and stops**: Distinctive red paint makes it easy to identify Metro Rapid stops and buses.

The key attributes of street design (primarily under LA DOT control or, in the case of the city of Pasadena, under the Transportation Department) include:

- **Bus priority at traffic signals**: Although Metro Rapid operates in mixed traffic, signal priority technology reduces traffic delay by extending the green light or shortening the red light to help Metro Rapid get through intersections.
- **Enhanced stations**: Metro Rapid stations, designed to emulate light rail transit stations, provide transit information, lighting, canopies, and "Next Trip" real-time arrival displays.

Many of these features, such as the location and design of stops, are decided and designed in partnership, with both agencies involved. The program is an example of how close cooperation between city traffic engineers (who design streets and establish street standards and performance measures) and transit planners (who route and schedule buses) can result in a major improvement in transit performance—even when relatively little funding is available.

According to the Federal Transit Administration (FTA), Metro Rapid has reduced passenger travel times by as much as 29%, with ridership increases of nearly 40%. The reduction in travel times primarily results from the bus signal priority system, which provides up to ten seconds of additional green time at traffic signals, and longer distances between stops.

Metro Rapid stops include a shelter, real-time arrival information and an informational display.

Source: Los Angeles County Metro

7 BEST PRACTICES

Mixed Modes: High Capacity Transit and European Street Trams

MONTPELLIER, FRANCE; DUBLIN, IRELAND; PORTLAND; SAN FRANCISCO

WHAT IS IT?

High capacity transit (HCT) is defined by its function: to carry high volumes of passengers quickly and efficiently from one place to another. Other defining characteristics of HCT service include the ability to bypass traffic and avoid delay by operating in exclusive or semi-exclusive rights-of-way, faster overall travel speeds due to wide station spacing, frequent service, transit priority street and signal treatments, and premium station and passenger amenities.

The transit modes most commonly associated with high capacity transit include:

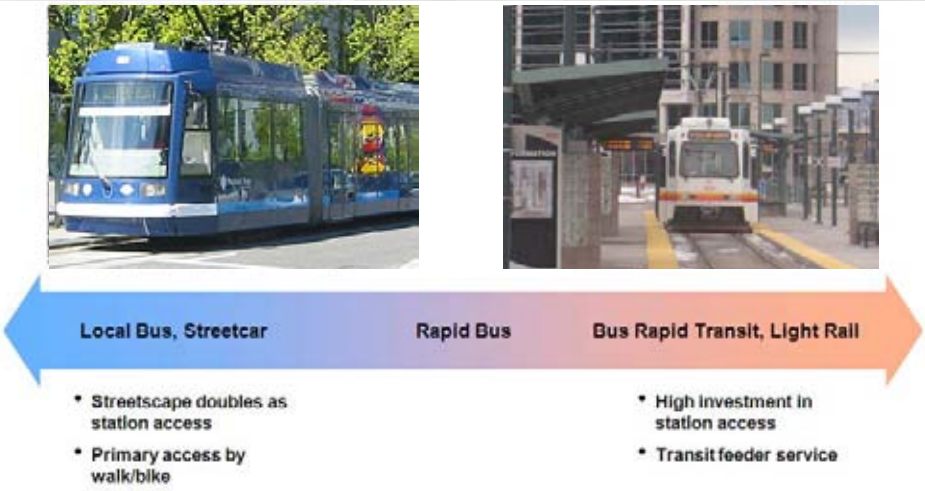
- **Light rail transit (LRT) –** light rail trains operating in exclusive or semi-exclusive right-of-way
- **Bus rapid transit (BRT) –** high-end vehicles with sculpted exteriors and interior amenities, regular or advanced, bus vehicles operating primarily in exclusive or semi-exclusive right-of-way
- **Rapid streetcar –** streetcar trains operating primarily in exclusive or semi-exclusive right-of-way
- **Commuter rail –** heavy rail passenger trains operating on exclusive, semi-exclusive or non-exclusive (with freight) railroad tracks
- **Monorail –** train cars operating on a single track system in fully exclusive right-of-way

Some cities and regions, including Seattle, use the term *intermediate capacity transit* to talk about urban transit modes that have some features of HCT service but do not operate in fully exclusive right of way and/or do not operate with high capacity vehicles such as multicar trains. As in many areas, there is a blurring

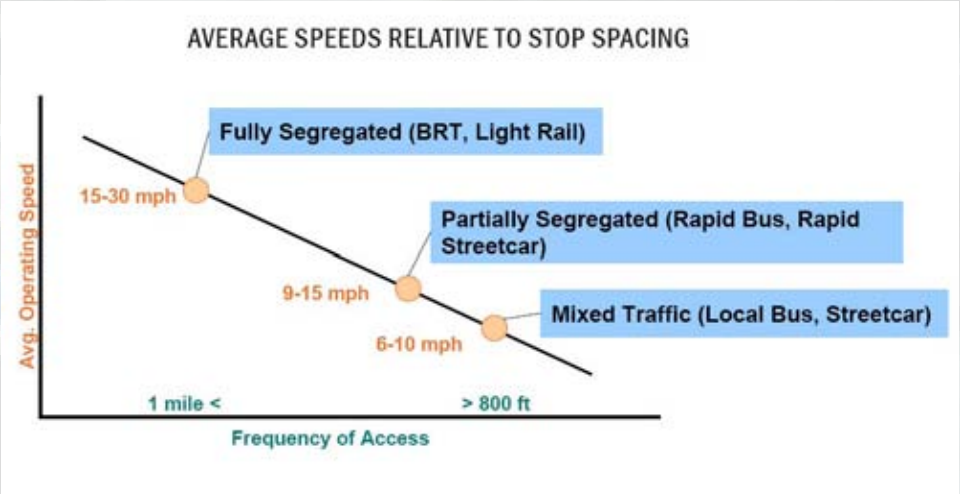
of terminology and transit product. This section emphasizes the need to pay attention to what the transit service and design deliver (the product), not just the name we give that product.

The distinction between urban streetcars – smaller trains operating in mixed-traffic with limited priority—and light rail transit, which is typically developed using exclusive rights-of-way, has been blurred in many European cities that have taken an integrated approach, combining the best attributes of each. These European street tram systems, which have been constructed in places like Lyon and Nantes, France; Dublin, Ireland; and Hanover, Germany over the past few decades, use larger vehicles with the sleek styling of a modern streetcar, but capacities comparable to a light rail train. They operate in street-running dedicated rights-of-way with traffic priority on urban streets and also stress urban integration and the placemaking value of rail transit investments.

Light rail can operate in a fashion similar to a streetcar in mixed traffic or, on the other end of the spectrum, like a completely grade-separated rapid metro service; the lines between the two are often blurred. Light rail operating with at-grade intersection crossings, as it does on Martin Luther King Boulevard in Southeast Seattle, is more similar to a mixed flow streetcar, while light rail operating in fully exclusive, grade-separated right-of-way is very similar to a heavy rail system like BART in the San Francisco Bay Area.



Source: Nelson\Nygaard



WHY DO IT?

Urban transit users have a variety of travel options, including driving, bicycling, walking, or taking transit. Each mode offers advantages, depending on passengers' circumstances. Most transit users do not expect transit to get them to their destination faster than driving, but they find benefits that make transit a desirable option.

In order for transit service to be effective, transit speed and access (meaning spacing of stops as well as vertical movements for grade separated transit services) must be balanced. In the case of high capacity transit, access is typically concentrated in a few stations that are spaced far apart; in exchange, the service is able to achieve higher travel speeds, shorter travel times, and better on-time performance. In these cases there is greater need for good access to stations by bike, foot, local bus, or automobile. There is a direct tradeoff between station spacing and operating speed; lines with fewer stops experience less delay but require people to travel farther to reach them.

Several cities in the U.S. and Europe have implemented streetcar or light rail systems that run both on separated rights-of-way and in mixed flow traffic, depending on the location on the line.

San Francisco's Muni Metro system is largely based on historic streetcar lines and operates in various rights-of-way ranging from subway to surface streets in mixed flow traffic.

Dublin, Ireland has integrated light rail into its historical context. Launched in 2004, the LUAS (Irish for "speed") system had provided over 50 million trips by the beginning of 2007 and was running a financial surplus. In 2009, LUAS provide 25.4 million trips in a single year, down slightly from its peak of 27.3 million trips in 2008. This decline is attributed to economic recession. The management agency, RPA, continues to maintain a financial surplus from operation of the light rail system.

LUAS in Dublin operates in street-running, dedicated lanes in very tight quarters.

Source: SDG

Montpellier, France, has a street tram network consisting of two lines and several parking facilities. Touted as one of the most stylish public transport systems in the world, with highly decorated cars, it is the busiest street tram system in France, carrying over 100,000 passengers a day. It uses a street-running dedicated right-of-way through the dense urban core to the outer suburbs.

The Metropolitan Area Express (MAX) in Portland, Oregon, claims the fifth highest ridership among light rail systems in the United States and is the country's most ridden stand-alone light rail system. (The busiest light rail systems—those in Boston, San Francisco, Los Angeles and Philadelphia—are integrated with heavy rail subway networks.) MAX carried 107,400 daily passenger trips (weekdays) in 2008 and has seen ridership as high as 118,200 per day during peak periods. In central Portland and Hillsboro, MAX trains run in street-running dedicated lanes on surface streets. Otherwise, MAX runs within its own right-of-way, generally either in street medians, along freeways, or on former freight railroad lines.

Where the tracks run along a street, intersections are generally controlled by traffic signals that give trains priority. Where the tracks occupy a completely separate right-of-way, level crossings are protected by automatic crossing gates.

Sound Transit's Central Link light rail, new in operation, provides a mix of operating environments. In downtown Seattle, it operates underground in exclusive right-of-way; in southeast Seattle it operates at grade along an arterial street. Central Link is a part of the city's Urban Village Transit Network, providing fast connections between neighborhoods targeted for growth while aiding circulation through downtown. Additional light rail lines could provide both urban circulation and neighborhood connections within the city.

MAX Light Rail in Portland operates in a separate right-of-way outside downtown but in street-running dedicated lanes in downtown Portland and Hillsboro.

Source: Nelson\Nygaard

The Montpellier, France street tram provides 130,000 daily trips on a two line system. Two additional lines are planned or under construction.

Source: SDG

HOW WELL DOES IT WORK?

Successful transit services deliver safe, comfortable, reliable service to passengers in a manner that pleases existing customers and attracts new customers. To the degree that a transit system or line can implement key elements of HCT (or intermediate capacity transit), it will be more successful at attracting and retaining ridership. These factors include:

- High frequency so that the rider does not need a schedule
- A long daily span (18 hours is optimal)
- Widely-spaced stops (1000 feet or more)
- A high-quality customer experience (large windows, tall ceilings, clean environment on vehicles, real-time information, clean station areas, covered waiting areas at stations)
- Mixed land uses concentrated within walking distance of stations
- A dedicated right-of-way for as much of the route as possible

Both bus and rail systems designed to include these features typically enjoy high ridership and lead to better land use decisions, with more investment in areas served by these systems.

7 BEST PRACTICES

Transportation Land Use Linkages

VANCOUVER, BRITISH COLUMBIA

WHAT IS IT?

Vancouver, British Columbia has nearly doubled its downtown population in less than two decades, sustainably accommodating regional growth while creating new, highly livable neighborhoods. This change is due to progressive land use policies coupled with supportive transportation policies.

WHY DO IT?

If planning for smart growth is to succeed, policies must include a transportation component that not only prioritizes sustainable modes of transport, but, to some extent, restricts accommodation for automobiles.

HOW WELL DOES IT WORK?

The broad strokes of the so-called "Vancouver model" are well known to American planners: develop dense, mixed-use and walkable neighborhoods in and around downtown. Many of the details of Vancouver's approach to land use, however, are less understood—including the relationship between land use and transportation policy.

Vancouver's "Living First" policy, adopted in 1991 as part of the Central Area Plan, rezoned 8 million square feet of space from commercial to residential use; since the policy was implemented, the population of the downtown peninsula has risen from 47,000 to 88,000 (in the 2006 census). However, former planning director Larry Beasley has explained that the policy's success "is not just the result of favoring housing and changing the zoning to allow it to happen. Nor is it just the result of a vibrant market...The first principle has been to limit commuter access into downtown and let congestion be an ally in a household's profound first decision to live downtown or in the suburbs. Walking, biking, and transit get priority for both space and spending."[1]

"Vancouver," writer Trevor Boddy has further explained, "is the only major city in North America without a single freeway within its boundaries. Citizen activism in the late 1960s saved Gastown and Chinatown by stopping a roadway with the Orwellian name of the 'East Downtown Penetrator,' followed by significant investment in elevated rail public transit."[2]

The growth of the SkyTrain system has helped Vancouver's downtown peninsula—which is connected to the rest of the city only by a narrow bottleneck that might otherwise be choked with traffic—to remain a major civic and commercial center, with 10% growth in employment between 1991 and 2001, even as outlying areas have continued to grow. (Downtown growth may have mitigated suburban sprawl, but the entire region is growing rapidly.) The share

1 "Living First" in Vancouver, American Planning Association's Zoning News April 2000

2 http://uskyscraper.blogspot.com/2005/09/vancouverism.html

of downtown trips made by car has remained relatively constant and even declined: from 46% of all trips in 1994, auto mode split had fallen to 40% by 1999. In 1999, transit accounted for 28% of all trips and walking accounted for 31%.

With so much residential growth downtown, trips into and out of the core are increasingly less important than trips within the downtown peninsula. Morning peak trips entirely within downtown increased from 18% of all downtown trips in 1974 to 21% by 1996; These trips were expected to reach 27% by 2021. While trips to downtown destinations from outside downtown were expected to grow by 18% by 2021, trips within downtown were expected to grow by 64%.

To accommodate the continued growth of downtown, the city's 2002 Downtown Transportation Plan built on the 1997 City of Vancouver Transportation Plan, which made explicit the following hierarchy of transportation priorities: pedestrians, bicycling, transit, goods movement, and private automobiles. The 1997 plan also made clear that "(o)verall road capacity to the downtown will not be increased above the present level." In the 2002 plan, a "Pedestrians First" policy was established, and it was further noted that:

"Over the next 20 years, the total number of trips to downtown will grow by 30%. Some kinds of trips will increase more than others. Commuter trips on foot and bike are expected to double. Rush hour transit use will rise by 50 to 60%. Car and truck trips are projected to stay about the same."

The plan anticipated doubling the total length of bike lanes downtown, on top of a twofold increase between 1994 and 1999. It projected an 85% increase in transit trips within downtown during the morning rush hour, accommodated by local bus routes. It also projected that rail would accommodate 90% of all new non-walk and bike trips into downtown. The total number of commercial parking spaces per employee, meanwhile, was expected to drop from 0.44 in 1990 to 0.32 by 2021.

With congestion declining, the plan projected a 3% increase in average vehicle speeds, with average transit speeds increasing by 14%.

Criticisms of Vancouver's downtown transportation policy have focused on its land use policy: with housing prioritized over offices and limited remaining space for commercial growth, downtown is becoming something of a "bedroom community" with increasing numbers of commute trips from downtown to outlying jobs.

Since the 2002 plan, the city has taken additional steps toward a sustainable long-term transportation policy. In 2006, the South Coast British Columbia Transportation Authority, or TransLink, implemented a parking tax on all non-residential properties of $0.78 per square meter. A "demonstration" streetcar line between the Olympic Village Canada Line subway station and the popular Granville Island shopping area opened in time for the 2010 Winter Olympics; it is the first phase of a greater downtown network. The Canada Line, the latest installment of TransLink's driverless metro system, opened between the airport and downtown just before the Olympic games. The Olympic Village area itself is now being redeveloped into a neighborhood and will be the first community in Canada to offer car-share vehicles throughout its entirety. The Southeast False Creek Plan forecasts that 60% of all trips in the area will be made without a car and that the neighborhood will generate 25 to 50% less greenhouse gas emissions than similar urban districts.

For information about density and appropriate transit modes, refer to the *Mode Analysis* section.

Well-marked bicycle routes improve navigation by bike and indicate to drivers the multimodal nature of the street.

Image from Nelson\Nygaard

A graceful mix of density and open space improves livability and encourages residents and visitors to make full use of the city.

Image from Flickr user Duane Storey

7 BEST PRACTICES

Local Government Standards for Transit Agencies

OAKLAND, CALIFORNIA

WHAT IS IT?

While most everyone agrees that quality transit service is a critical element to a world-class city, often the city itself is not responsible for the implementation of transit service. Some cities have relatively little input into transit operations within their borders, as the transit operator responds to a broader constituency. An explicit set of city standards for local transit service is one tool that can help to ensure that local transit is provided in a manner that is consistent with a city's overall mobility goals.

The City of Seattle has UVTN performance measures (see section 4 of this briefing book) that evaluate the quality of transit service from the perspective of a transit rider, e.g., service frequency and reliability, and passenger load. These indicators contrast with traditional measures from the perspective of a transit agency, such as riders per hour.

WHY DO IT?

While transit agency staff and board members should ideally work in close cooperation with representatives of the local jurisdictions they serve, the reality is often different. While the worst-case scenario is an adversarial relationship, the more common circumstance is a simple lack of coordination. Policy guidelines can clarify a city's positions on transit service and serve as a tool for reference in policy making and project design as well as provide leverage in negotiations.

HOW WELL DOES IT WORK?

Transit service in Oakland, California, is primarily provided by the Alameda-Contra Costa Transit District, or AC Transit. AC Transit is a regional district with an elected board. Meanwhile, Oakland, with approximately 400,000 residents, is the largest city served by AC Transit but has no direct representation within AC Transit.

Since 1993, AC Transit has been planning a Bus Rapid Transit (BRT) line that would operate within the cities of Oakland, Berkeley, and San Leandro and entail major reconfigurations of arterial streets and transit service within the corridor, culminating in a Draft Environmental Impact Statement/Report (DEIS/R) released in 2007. The three cities are currently developing a Locally Preferred Alternative (LPA) to be studied in the Final Environmental Impact Statement (FEIS).

In developing its LPA, City of Oakland staff drafted a policy framework addressing design and operational elements of the project within Oakland. The hope is that these policies will provide design standards for the AC Transit BRT project and maximize the benefit of the project to the city. The policies are the beginning of a multimodal performance management system that can be used to evaluate all projects, transit and other modes.

These guidelines are still under development, and in many ways are directly related to the BRT project. However, they provide an example of a set of policies that can be enforced by a city to influence mobility for all types of travel within its boundaries. Oakland's draft policies are included below:

Transit

- Transit-only lanes located in centers of roadways should be physically separated from mixed-flow lanes, using barriers such as mountable curbs, medians, or other positive separations to reduce violation rates.
- Stops should be located based on maximizing transit connectivity and direct access to major transit trip generators. Where it is necessary to shift the locations of stops from their "optimal" locations, they should not be located more than 500 feet away.
- All BRT stops should feature raised platform areas enabling level boarding of buses, regardless of whether a transit lane is provided.
- All BRT stops also used by other transit services should be at least 120 feet in length.
- All BRT stops should be equipped, at minimum, with a "baseline" package of amenities including no less than two shelters, with benches; digital displays of real-time arrival information; fare machines; route and system maps; garbage bins; ADA-standard wheelchair ramps and truncated domes along edges of platforms; and signage, clearly visible to riders aboard buses, identifying the stop location. In addition, stops located in medians should feature fences and platform "taper" areas designed to discourage jaywalking.
- Stops should be located on the far sides of intersections.
- Sidewalk stops should be located on "bulb-out" extensions, allowing buses to stop directly in their path of travel. This policy should be applied regardless of whether a dedicated lane is provided.
- BRT stops, when combined with local service, should be located no less than 1,000 feet and no more than 2,000 feet apart.
- Any restrictions on vehicle circulation should not require realignment of transit routes.
- Where stops in one direction are not visible from the nearest stop in the opposite direction, clear and prominent signage should be displayed along a high-quality pedestrian path between the stops.
- To the extent possible given design specifications (e.g., 13-inch-high platforms), median transitways should be designed to accommodate other transit services, including paratransit services. In some locations, it may be desirable to allow taxis to use transitways for travel but not for stops. Curbside transitways in neighborhood commercial districts must accommodate delivery vehicle access to sidewalk "cutout" loading spaces.
- The following hierarchy of transit rights-of-way should be applied (starting with the most desirable basic configuration): transit-only lanes in the center of the roadway that are physically separated from traffic; center lanes separated from traffic by pavement treatments; outside lanes adjacent to curbs; outside lanes between travel and parking lanes; mixed-flow lanes.
- Where it is not possible to provide dedicated rights-of-way for transit, or where needed for additional speed and reliability improvements, alternative treatments designed to reduce delay should be strongly considered. These include "queue jumps" consisting of transit-only lanes for a short distance in advance of intersections, as well as transit-only signal phases; consolidation of BRT stops; alternative alignments; and improved signal priority.

Pedestrians

- Within reason, stops should be easily accessible to pedestrians approaching from all directions. In some cases, this may mean extending a platform to a point adjacent to a nearby corner in order to provide direct pedestrian access from the "far end" of the platform.
- Where transit or private vehicles would operate in the curbside lane, and where parked cars would not provide a "buffer" protecting pedestrians on the sidewalk, lanes should be at least 14 feet wide and trees, planted strips, street furniture, or bollards should be located along the curb.
- Where existing crosswalks must be removed in order to ensure safety or reduce transit delay, a marked crossing of the street must be provided no more than one block away. If this crossing bisects a raised median, a level "cut" should be made in the median in order to allow wheelchairs and bicycles to cross at grade. (Note that this policy may be adjusted based on provisions of the City of Oakland Pedestrian Master Plan.)
- Where existing sidewalks must be narrowed, a clear space for pedestrians outside the "door zones" of adjacent buildings and parked cars must be provided no less than three feet wide. This space must also be free of street furniture. Effectively, sidewalks should be no less than nine feet wide from inside edge to curb.

- If possible, universal design principles of accessibility should be applied. Americans With Disabilities Act requirements should not be viewed as optimal design but as baselines.
- All crosswalks should be as visible to motorists as is reasonably possible, featuring at minimum white "ladder" or "zebra" markings.

Cyclists

- In order to reduce the potential for conflicts between bicyclists and motorists where Class II bicycle lanes end and cyclists are forced to merge into traffic, City of Oakland staff should, based on further discussion and consultation, develop a minimum length for Class II on-street lanes. Where this length cannot reasonably be achieved, it might be preferable to provide an extra-wide (14-foot or more) travel lane instead.
- Where Class II bicycle lanes cannot be provided, alternative design solutions such as bicycle boxes or alternative routes should be strongly considered.
- Bicyclists should be legally allowed in outside transit lanes and, in order to safely accommodate them, lanes should be at least 14 feet wide.

Autos

- Where significant reductions in parking supply are necessary—particularly in neighborhood commercial areas—parking demand management strategies should be considered in addition to more limited mitigation measures such as replacement parking and conversion of unmetered spaces to metered use. A broad range of Transportation Demand Management (TDM) measures is available.

EXISTING

PROPOSED

Illustration of existing conditions (top) and proposed BRT operations (bottom) at the location of proposed Temescal Station (49th St. at Telegraph Ave.).

Source: FMG Architects and Cambridge Systematics

- Wherever possible, existing options for vehicular circulation should be maintained.
- Where significant amounts of traffic might be diverted into residential neighborhoods, measures to calm traffic should be considered.
- Where transit lanes would be located along the outside of roadways in neighborhood commercial areas or other locations where double-parking is prevalent, design measures to discourage double-parking, such as colored treatment of transit lanes, should be considered.
- Emergency vehicle access to transit lanes should be a design priority.

Multimodal

- Mobility should be measured in terms of "aggregate delay"—the total difference between travel time in freely-flowing, uncongested traffic and actual travel time including both motorists and transit users—and not simply in terms of vehicular level of service, which does not distinguish between a single-occupant car and a full bus.
- Capacity should be measured in terms of "person throughput"—the number of people that a particular road segment carries over a specified period of time—and not just vehicle throughput.
- Benefits and impacts related to emissions reduction, land use, and other elements of sustainability and safety should, to the extent possible, be quantified and taken into account in design development.

Urban Design

- To the extent that they would not interfere with transit operations, taxis should be allowed access to transit lanes.
- In neighborhood commercial corridors where transit lanes would be located adjacent to the curb and where there would be no curbside parking, it might be necessary to provide "cutout" loading bays and to allow delivery vehicles access to transit lanes in order to reach loading spaces.
- While the BRT project is primarily a transit project, and budgetary concerns may prevent extensive reconstruction, redesign of rights-of-way presents opportunities to address "building face-to-building face" landscaping and other issues.
- Any landscaping removed by the project should be replaced in some form, preferably within the immediate area. Sidewalk elements may be substituted for lost landscaping located in medians.
- In addressing access to neighborhood businesses, it is important to bear in mind that reductions in parking supply may be offset or negated by increased availability of transit.

These policies are intended as guidelines that would still allow for negotiation to occur when it is not possible to meet all of the thresholds for all modes. By providing these policies to the transit agency, the City of Oakland is able to point to something concrete that will be adopted by the City Council to guide AC Transit in the final design. The policies, which will be publicly vetted, also provide assurance to residents and businesses that the city has considered Oakland's overall mobility and other needs in its work with AC Transit.

7 BEST PRACTICES

City-Based Transportation Demand Management Strategies

BOULDER AND CAMBRIDGE

WHAT IS IT?

A number of cities have implemented transportation demand management (TDM) ordinances that use regulatory and incentive-based strategies to reduce impacts from drive-alone auto trips. TDM strategies are an important compliment to transit service and can help to generate ridership by: subsidizing transit passes, increasing transit pass distribution through employers, improving access to information about transit services, and implementing parking management and pricing programs that discourage drive-alone travel.

WHY DO IT?

TDM strategies are inexpensive relative to infrastructure investments. Comprehensive ordinances can result in significant reductions in drive-alone mode share, traffic congestion, emissions, and collision rates, as well as in demand for parking, thereby allowing valuable space to be transferred to other uses.

HOW WELL DOES IT WORK?

Boulder, Colorado

Between 1995 and 2005, the drive-alone rate for Downtown Boulder workers fell by more than one-third, while the mode share for transit more than doubled.

Boulder's experience with TDM dates back to 1970, when the Central Area General Improvement District (CAGID) was established. The CAGID is a 30-block district in downtown Boulder that operates nine off-street parking facilities and 875 on-street metered parking spaces. In coordination with the Downtown Management Commission, CAGID offers all full-time employees in downtown Boulder an EcoPass, which allows unlimited use of local transit. Subsidy for the EcoPass program comes from parking meter revenues. Boulder's downtown parking policies are premised on the notion that "park-once" spaces should be provided around the periphery of downtown, rather than spaces attached to individual businesses.

The city of Boulder employs a number of TDM strategies within the CAGID area:

- There are no minimum parking requirements for non-residential developments. Developers who choose to build little or no parking can purchase permits for spaces in public lots for resale to employees. As of 2006, these permits cost $852 per year for garage spaces and $536 per year for spaces in surface lots, representing a substantial discount over construction costs for structured parking. Parking meter revenue is used to provide employee benefits including free universal transit passes, or Eco-Passes, available to all downtown employees (which CAGID is able to purchase in bulk at deep discount from RTD), a guaranteed ride home program, ride-matching services, bicycle parking and other amenities.
- Because meter revenue is reserved for use by CAGID, there is a strong incentive to provide additional curbside metered spaces, which offer valuable short-term parking for retail customers. Downtown businesses can bulk-purchase meter tokens or validated stamps for their customers.

Additionally, the city has experimented with reduced and more flexible parking requirements for new developments in mixed-use districts outside of the CAGID area. A single parking requirement for all non-residential uses offers flexibility for office space to be converted to use as a restaurant, for an example, without triggering requirements for additional parking.

The success of Boulder's approach to TDM is reflected in the growth of downtown's centerpiece, the Pearl Street pedestrian mall, which has been significantly expanded in recent years. A mixed-use area adjacent to the Mall was established in the 1980s but did not experience significant development until parking requirements were reduced in 1997.

The success of the policies is also reflected in the steep reduction in rates of driving downtown, accompanied by a major increase in transit use. City staff have noted the development of an Eco-Pass "culture," with close to five in six downtown workers participating in the program and transit mode share among participants of 40%, which is higher than the mode split for solo driving. About half of downtown employees now live within two blocks of a transit stop, and the additional parking that would be required to accommodate all transit users has been estimated at close to 4,400 spaces.

SKIP is one of several branded frequent bus lines operating in Boulder.

Source: Nelson\Nygaard

Cambridge, Massachusetts

Cambridge's Parking and Transportation Demand Management (PTDM) Ordinance, adopted in 1998, requires that developers reduce the drive-alone rates for new developments to 10% below the average for the census tract in which their project is located. Within two years of adoption, citywide drive-alone rates had declined even as the state of Massachusetts experienced an increase in solo driving.

The ordinance applies to new and expanding commercial, educational, and religious developments with more than five parking spaces. Developments with 5 to 20 spaces must apply three trip reduction measures. Developments with more than 20 spaces must complete a TDM plan to be reviewed annually. All developments subject to annual review must reserve 10% of parking spaces for high-occupancy vehicles and must construct parking for bicycles equivalent to 10% of the parking supply for autos. Developers who fail to implement these measures can be fined; in a worst-case scenario, their parking facilities may be shut down by the city.

National data and logic would suggest that in a more or less built-out city, an ordinance that addresses only new developments would have limited effectiveness. However, between 1990 and 2000, Cambridge experienced a reduction in its drive-alone rate of approximately 6% for residents, 1% for employees, and 23% for those who both live and work locally. Over the same period, the state saw a 2% increase in its drive-alone mode share.

Cambridge has many more cyclists than other parts of the Boston metro area.

Source: Nelson\Nygaard

Bike infrastructure such s this planned separated bike lane in Cambridge complement its PTDM ordinance by providing safe and reliable alternatives to driving.

Source: Nelson\Nygaard

7 BEST PRACTICES

Congestion Pricing

SINGAPORE, LONDON, STOCKHOLM

WHAT IS IT?

Congestion pricing uses electronic transponders in vehicles, database-linked cameras, and other barrier-free means to charge drivers as they enter heavily congested parts of the city. Congestion pricing programs can charge varying fees based on different tiers that factor in complementary benefits (those in addition to congestion relief) or address equity concerns. London, for instance, offers exemptions for electric cars, while other systems include allowances to address perceived inequities in the pricing system (e.g., pricing caps or reductions for downtown residents, persons with disabilities, low-income travelers, etc.). These systems work well in combination with public transit and can be used as a source of funding for improved public transit systems.

WHY DO IT?

Congestion pricing reduces congestion by offering an economic incentive to take transit or other non-auto means to enter central business districts. Traffic congestion in central districts degrades transit performance, delays emergency response vehicles, impedes the movement of goods, and costs residents in lost time and excess fuel usage. Congestion pricing can reduce vehicle miles traveled (VMT), an important contributor to global climate change, air pollution, and other congestion-related problems including negative impacts on the city's economic competitiveness resulting from reduced access. While it may seem counterintuitive, cities that have implemented congestion pricing have actually improved access to downtowns by balancing travel to more spatially efficient modes. In some cases, this also benefits goods movement, an industry that places high value on time. Congestion pricing can also provide a revenue stream to be used to improve transit service and enhance non-drive alone modes.

HOW WELL DOES IT WORK?

A number of European and Asian cities have successfully implemented cordon pricing, or tolls, to charge drivers when entering entire subareas of cities. These comprehensive programs limit travel to, and congestion within, large geographic areas, not just along highway corridors. Similarly, parking pricing can provide some of the benefits realized by full congestion pricing but often are limited to publicly owned/controlled facilities, limiting results. Several successful congestion pricing programs are noted here.

Singapore

In 1975, Singapore was one of the first places to implement congestion pricing though an area licensing system (ALS) that required drivers to purchase a sticker to drive into the core of the city. The ALS was very effective in reducing traffic and has since been enhanced and expanded. In 1998 the paper-based license was replaced by radio frequency identification (RFID) tags that use differential pricing—pricing that varies by time of use—on more routes. Studies have shown that traffic volume on weekdays entering the restricted zone has dropped between 20 and 24%, while average traffic speed has increased from 30 to 35 km/hr to 40 to 45 km/hr.

London

London has the most ambitious congestion pricing program to date, and it provides a success story for congestion pricing advocates[1]. Drivers are charged a fee for crossing into the central business district (CBD) by any route and can pay by internet, at retail outlets, in booths, and via cell phone.

The system is enforced by over 400 video cameras around the city. This system is much more comprehensive than previous programs, and requires no long-term commitment or investment on the part of the driver. Transport for London (TfL), the local government body responsible for most aspects of transportation in the London region, has found that congestion has fallen by 22%. In addition, waiting times for bus service fell 30% in the first year and 18% in the second year, despite a 37% increase in ridership.

1 Central London Congestion Charging, Impacts Monitoring, Fourth Annual Report, June 2006 The Stockholm Trials (www.stockholms-forsoket.se)

Stockholm

Following London's example, Stockholm implemented a similar system in 2006[2]. In this system, cameras record license plates and charge drivers without requiring driver action (this is similar to the system proposed for New York City). The cordon pricing system in Stockholm has shown initial success. Traffic in the central area has been reduced by between 20 and 25%, and emissions from automobiles have decreased 14%. There was little increase in traffic on roads just outside the cordon.

North American cities

The use of high occupancy toll (HOT) lanes is widespread around the U.S and Canada, though HOT lanes are not a tool for reducing congestion in a central area. The only two U.S. metropolitan areas currently using dynamic (variable) pricing are San Diego and Seattle. Dynamic pricing allows the congestion pricing system to vary prices based on time of day or in response to changing congestion conditions. Both San Diego's I-15 express lanes and the SR-167 HOT Lane Pilot Project are located in the suburbs . There remains an opportunity for a U.S. city to take the lead in implementing dynamic pricing to reduce congestion and maximize benefits.

2 Stockholms Stad (2006) Facts and results from the Stockholm Trial. Second Version - June 2006

LONDON

The London congestion pricing program has been in place since the beginning of 2003, covering a 10-square-mile zone of central London. The zone is approximately one-eighth the size of the City of Seattle. Congestion fees are charged between 7:00 A.M. and 6:30 P.M. Mondays through Fridays, except on public holidays. There is a flat fee of £8 ($15) per day for entering, exiting, or driving within the zone if the fee is paid by 10:00 P.M. on the same day. There is an additional surcharge of £2 if the fee is paid between 10:00 P.M. and midnight. Late payment fees are charged immediately after midnight, and amount to £50 for the first 14 days, £100 for the following 14 days, and £150 thereafter. Vehicles with three or more outstanding penalty fees may be booted or towed; this policy is effective across the entire Greater London area. The congestion charge can be paid in advance or on the same day in multiple locations.

Successes

Congestion has been reduced inside London's zone by an average of 26% since the program's introduction in 2003[3]. Congestion is defined as the excess delay above what would be experienced under clear conditions. London's pre-congestion baseline delay was 2.3 minutes per kilometer with 2005 figures showing an improvement to 1.8 minutes per kilometer. These reductions in travel times are a result of less traffic. Statistics from 2005 confirm a 17% drop in total traffic with a 31% decrease in potentially-chargeable vehicles in relation to equivalent pre-charging figures for 2002. From 2002 to 2005, the total number of car vehicle-kilometers driven fell 39%.

3 2006 TfL Annual Report

Road accidents have also decreased, with a net reduction of between 40 and 70 personal injury accidents per year. There is no evidence of adverse traffic impacts on roads surrounding the zone, and there is an overall pattern of slowly declining "background" traffic levels in inner London. London reduced greenhouse gas (GHG) emissions from road traffic by 16% within its congestion pricing area, lowered traffic, and improved transit and bicycle use. London estimates a 9% reduction in pedestrian injuries and a 20% increase in bicycle trips.

Data revealed no significant impacts on business performance; recent economic activity saw a brief decline due to the July 2005 subway bombings, but retail and business profitability have since rebounded. Overall, the congestion zone appears to have a neutral effect on business. Surveys also indicate that 78% of the charge payers are satisfied with the quality of service.

Data on financial performance shows a net benefit from congestion pricing systems. The system generated net revenues of £90 million in 2004/05 and £122 million in 2005/06 (provisional figures), which are being spent largely on improved bus service within London. The increase in revenue between the two years can to a large extent be attributed to a fee increase from £5 to £8 in July of 2005. Interestingly, the 60% increase in daily fee seems to have contributed to only a 4% reduction in entering traffic, which is towards the lower end of Transport for London's prior expectation. However, these results have yet to be confirmed. There are also additional public transport fares generated by those transferring to bus, Underground, and rail services. TfL estimates that these are on the order of £15 million per year, largely offsetting the additional costs of £20 million per year for providing additional buses. The success in the central London charging zone has prompted a future western extension of the zone.

Challenges

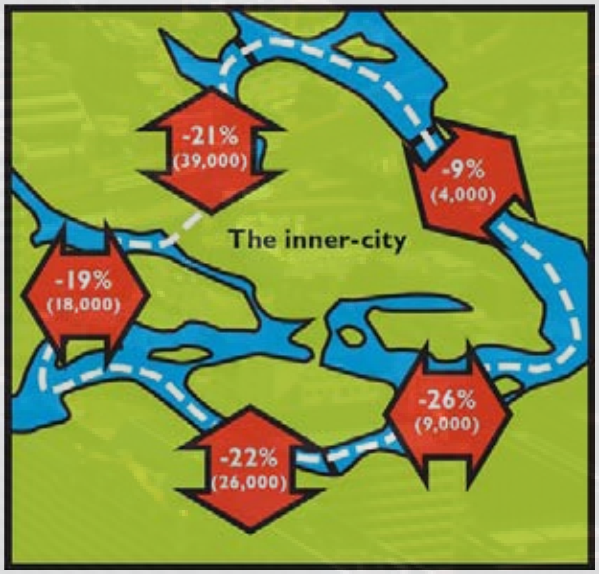
London's congestion pricing system, while successful, is not considered optimal for several reasons[4]:

- The fee is not based on how many miles a vehicle is driven within the charging area.
- The fee is not time-variable, that is, the fee is not higher during the most congested periods and lower during less congested periods.
- The fee does not vary by location. It would be more efficient to have higher rates on more congested roads.
- The system has relatively high overhead costs.
- Transit service (particularly the Tube) is crowded and unreliable, although this is changing as bus service improves and pricing revenue is used to upgrade the system.

4 Todd Litman, London Congestion Pricing: Implications for Other Cities, Victoria Transport Policy Institute (2006)

STOCKHOLM

Sweden's capital, Stockholm, recently introduced congestion charging. The Swedish government and the City of Stockholm managed a seven month trial period of a congestion tax in Stockholm between January 3 and July 31, 2006. During this period, vehicles entering or exiting any of the 18 control points into or out of the Stockholm inner city on weekdays between 6:30 A.M. and 6:29 P.M. were required to pay a congestion tax. A referendum on the permanent implementation of congestion charges held on September 18, 2006 succeeded with a 51.7% approval. The zone covering the city's core is approximately 13 square miles in size.

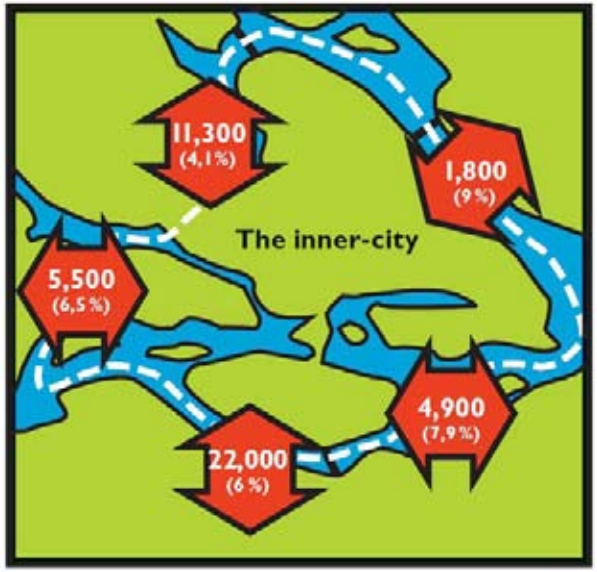


Reduction in Car Traffic

Source: The City of Stockholm, Facts about the Evaluation of the Stockholm Trial, http://www.stockholmsforsoket.se/upload/Hushall_eng.pdf.

Vehicles are registered by cameras photographing the license plates, similar to the London system. Vehicles equipped with an electronic unit for direct debit payment are also identified through this means. Traffic flow is not affected as drivers are not required to stop or slow down when passing a control point.

The cost per entrance or exit is $1.35, $2, or $2.70 depending on the time of day. The maximum amount is charged during peak hours from 7:30-8:29 A.M. and 4:00-5:29 P.M. The maximum amount payable per vehicle per day is $8. Payment must be registered within 14 days of passage. Owners of vehicles that are not equipped with an onboard unit must pay the fees at local chain stores, via credit card, on the Internet, or through Internet banks. If the tax is not paid within the 14-day time frame, the vehicle owner will receive a reminder to pay the tax within four weeks, with an additional administration charge of $9.50. If the tax and fees are not paid within the four-week period, a new reminder is sent out with an additional $70 fee.



Increases in Travel by Public Transportation

Source: The City of Stockholm, Facts about the Evaluation of the Stockholm Trial, http://www.stockholmsforsoket.se/upload/Hush-all_eng.pdf.

Exemptions

The following vehicles are exempted from the congestion tax:

- Emergency vehicles
- Buses with a total weight of at least 14 tons
- Diplomatic cars
- Taxis
- Motorcycles
- Vehicles registered abroad
- Military vehicles
- Cars that are equipped with technology for partial or total operation using electricity, alcohol, or gas other than gasoline, and are registered as such at the Swedish Road Administration
- Owners of the following types of vehicles must apply for an exemption:
  - Mobility service vehicles with total weight below 14 tons
  - Cars that are used by persons with a disabled person parking badge

Cost of Implementation

The Swedish government has budgeted $510 million to cover all the costs of implementation, including technology, transit improvements (such as 12 new express bus lines, expanded service for nearly 20 other bus lines, and new bus stops), about 1,800 new park-and-ride lots, information campaigns, and monitoring. The revenue from the congestion charge is approximately $8 million per month. If the congestion charge becomes permanent, it will yield a significant annual surplus of $75 million (after deduction for maintenance and operations). In other words, the system will be repaid in less than seven years. In addition, estimates of socioeconomic gains, due to shorter travel times, increased traffic safety, and improved health and environment, yield savings of $100 million annually.

Effectiveness and Impacts

Six months into the program the average traffic reduction across the control points between 6:30 A.M. and 6:29 P.M. was 22%, and nearly 100,000 vehicle trips per day has been removed from the roads. The reduction reached its peak during afternoon rush hours at 24%. Traffic reduction in the inner city was a bit lower than the average across the control points, showing a 15% drop in vehicle kilometers traveled. This indicates that individuals driving within the control points take advantage of the reduced traffic situation and drive more. Vehicle travel times dropped significantly within and around the inner city. The largest reductions were observed around the control points, where time spent in congestion was reduced by a third in the morning peak hour and by half in the evening peak hour. Public transport usage increased by 6% between the spring of 2005 and the spring of 2006. The congestion trial is estimated to account for 4.5% of this increase, while increase in gas prices and other external factors cover the remaining 1.5%. A conservative estimate of the effects on personal injury accidents is 5-10% reduction within the zone.

7 BEST PRACTICES

Transit-Supportive Policies and Programs

SAN FRANCISCO

WHAT IS IT?

The City of San Francisco has implemented a number of innovative transit-supportive policies and planning processes in recent years. These include:

- **The Transit Impact Development Fee**, a fee charged to non-residential developers in order to fund transit service necessary to offset the traffic impacts of their projects.
- **The Transit-First Policy**, which prioritizes transit and non-motorized modes in the development of city policies.
- **The Transit Effectiveness Project**, a comprehensive transit service audit and reorganization with a focus on identifying ways Muni, the city's transit system, can provide better service and value.
- **SFpark**, a pilot program to implement and assess the benefits of market-based pricing of on- and off-street parking. New parking meters and sensors will report parking occupancy data to city staff, allowing monthly adjustment of meter rates on each block to achieve an 85% occupancy target or at least one open space per block.

A recent, ongoing pilot that diverts cars from Market Street has resulted in increased transit speeds and levels of bicycling. Transit vehicles and bicycles have been gaining priority over automobiles on Market Street in recent years.

Source: Nelson\Nygaard

WHY DO IT?

The Transit Impact Development Fee (TIDF) is a reliable source of operating and capital revenue for the San Francisco Municipal Transportation Agency (SFMTA), which operates San Francisco's entire surface transportation network including the transit system, Muni. TIDF has generated about $120 million (including interest) since 1981. Originally a $5 per square foot fee on office developers in the downtown area, it was expanded in 2004 to encompass most non-residential projects citywide. Fees were also raised and indexed to inflation, and are now $9.07 or $11.34 per square foot depending on land use type.

The Transit-First Policy, in effect since 1973, was recently expanded to include bicyclists and pedestrians—serving a similar function to a Complete Streets policy (described in a separate Best Practices section) but with a greater emphasis on transit. The policy is routinely cited in planning and policy development processes and makes explicit the city's preference for investment in sustainable modes of transportation over improvements for automobiles.

The Transit Effectiveness Project (TEP) developed recommendations to significantly improve both the productivity and utility of the Muni transit system by reallocating resources to better meet demand. The changes made as a result of the TEP include consolidating service onto "rapid" corridors where protecting transit speeds and increasing reliability will be paramount.

The SFpark program is designed to manage the pricing of parking dynamically, adjusting rates to demand. The anticipated benefits are more efficient use of parking; fewer drivers "cruising" in search of an open parking spot, thereby reducing congestion and double-parking; and flexibility for drivers including real-time parking availability information, longer time limits and payment by credit card.

HOW WELL DOES IT WORK?

Transit Impact Development Fee (TIDF)

The TIDF[1] is a reliable, if relatively modest, source of revenue that takes advantage of the nexus between land-use development and demand for transit to justify an equitable "user fee." In short, it recognizes that transit service adds significant value to development projects and recaptures at least part of that value. It also recognizes that auto traffic generated by new development has a significant negative impact on the speed and productivity of on-street transit services.

TIDF was originally conceived as a means of providing additional peak capacity for commuter-oriented service to the downtown commercial core. It was limited to office projects with a fee of $5 per square foot. Early in its history, a legal challenge to TIDF was unsuccessful.

Recognizing that downtown office projects were not the only development projects to require and benefit from additional transit service, the city expanded the program in 2004 to include most non-residential projects citywide. Elected officials implemented a two-tiered system of fees, with some uses charged $8 per square foot and some $10 per square foot.

The gap between "justified" and actual fees is a reflection of the program's key limitation: if developers were to pay the full cost of providing additional transit service to their projects, many projects would no longer be economically viable. Unlike most impact fees, administrative costs and outlays have exceeded collections in many years. However, the program maintains a positive balance due to interest earned on the TIDF fund. Finally, as TIDF is limited to non-residential uses, collections decline during development cycles driven by residential projects.

The TIDF is one of several funding sources that San Francisco uses to fund transit capital improvements and operations.

Source: Nelson\Nygaard

Fees may be used to increase service hours or maintain the ratio between service hours and automobile and transit trips generated by uses subject to the fee, including both operating and capital expenses, as long as there is a reasonable connection to the impacts of development on transit. Expanding the fee beyond downtown office development to non-residential uses citywide allows it to be used for service outside of the peak period. Unlike other types of impact fees, there is no fixed time limit on use of fee receipts; however, the city conducts a five-year review, as required under state law[2], that orders the city to issue "findings" about the program. These findings include certifying that unexpended funds do not exceed the amount needed to make the improvements for which the funds were exacted.

Transit-First Policy

The Transit-First Policy[3] consists of 10 principles that seek to balance the "safe and efficient movement of people and goods" with promoting and prioritizing travel by public transit (including taxis and vanpools), bicycling, and walking. The third of these principles can be viewed as a summary of the overall policy:

> *Decisions regarding the use of limited public street and sidewalk space shall encourage the use of public rights-of-way by pedestrians, bicyclists, and public transit, and shall strive to reduce traffic and improve public health and safety.*

The efficacy of the Transit-First Policy has been a subject of much debate in San Francisco. Some view the policy as an empty statement; indeed, the policy has no legally enforceable "teeth." Nonetheless, it is routinely cited by policy makers in justifying decisions to prioritize sustainable transport over automobiles, such as in plans, development reviews, and allocation of constrained right-of-way. The City used the policy as leverage for its proposal to eliminate analysis of vehicular level of service from environmental review of development impacts in favor of more sustainable design standards and performance measures. A senior transportation planner for the City noted that:

1 TIDF: http://www.municode.com/content/4201/14131/HTML/ch038.html

2 California Mitigation Fee Act, http://ceres.ca.gov/planning/financing/chap4.html

3 Transit-First Policy: http://www.sfmta.com/cms/bcomm/3179.html

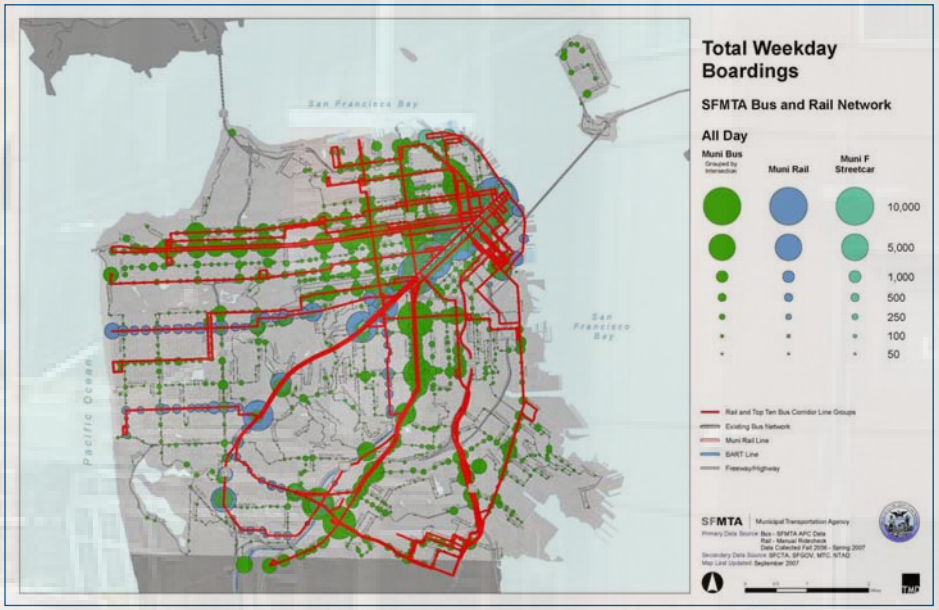
The Transit First policy of the City Charter recognizes that some short-term auto congestion is a predictable and unavoidable consequence of implementing Transit First policies, since mode shift will occur gradually as the transit, bicycle and pedestrian networks are improved. A measure of auto delay – auto LOS – is inconsistent with the Transit First policy for this reason.

Since Transit First was enacted, the City of San Francisco has implemented a strict cap on parking in downtown office developments; replaced two elevated freeways with at-grade boulevards; and decided to treat parking shortages as a "social" rather than an "environmental" impact in permitting construction of a one million-square-foot retail and office complex downtown with no new parking.

Transit Effectiveness Project (TEP)

The TEP[4] was a two-year audit and redesign of Muni service that involved extensive data collection, outreach, best practices research and technical analysis. It was initiated in response to declining transit mode share in the city and costs increasing at a faster rate than revenue, driven in part by declining Muni operating speeds and reliability. The outcome was a set of recommendations, adopted by the SFMTA board, to deploy Muni resources more efficiently. The TEP recommended a dramatic reconfiguration of the route network, including eliminating underperforming or duplicative routes or segments; expanding service on the busiest, most productive routes; and making incremental capital investments to increase speed, reliability and productivity on key transit corridors. It also grouped routes into categories based on performance characteristics such as headway rather

4 Transit Effectiveness Project, http://www.sfmta.com/cms/mtep/tepabout.htm



These maps, the results of the data-driven TEP process, helped stakeholders and the public understand issues facing the Muni system. The top graphic shows the key transit corridors that carry a high concentration of Muni ridership, as well as stops with high and low ridership (useful in determining where combining closely spaced stops may be warranted. The bottom graphic illustrates the corridors that could benefit from speed and reliability improvements.

than mode. “Rapid Network” routes, which make up less than 20% of the system but account for 75% of ridership, would be made at least 20% faster, allowing Muni to provide 20% more service to three-quarters of its riders at no extra cost.

Although the TEP resulted in improved reliability and implementation of some new routes and service improvements, it was criticized by some for its emphasis on productivity and a corresponding lack of concern for equity issues, in particular for its program of stop consolidation (combining closely spaced stops to improve operating speed and efficiency). Implementation has also been delayed by the current fiscal crisis. In fact, many TEP recommendations enacted to date have been service reductions; Muni planners drew on TEP proposals to reduce and eliminate service where such cuts would do the least harm. Muni is now moving forward with stop consolidation in key corridors to improve transit speed and reliability.

SFpark

The SFpark pilot program, 80% funded by an Urban Partnership Program grant from the U.S. DOT, launched in the summer of 2010 and will continue for two years. The pilot includes 6,000 of San Francisco’s 25,000 metered on-street parking spaces and over 12,000 spaces in city-owned garages. The pilot phase of SFpark will run for two years starting summer 2010.

7 BEST PRACTICES

Supporting Transit and Non-Motorized Travel Through Complete Streets

NEW YORK CITY

WHAT IS IT?

Since 2007, the New York City Department of Transportation, (NYCDOT) has reallocated hundreds of miles of right-of-way on the city's streets, repurposing space for autos into public plazas, protected "cycle tracks," and bus-only lanes. The initiative, called "Sustainable Streets," has established clear and detailed transportation policies aimed at improving transit and non-motorized access throughout the city. The initiative is noteworthy for Seattle because several "complete streets" projects have been completed on a trial basis, as pilot programs, with lower costs and on an expedited timeline compared to permanent projects.

WHY DO IT?

"Complete streets" are designed to safely and sustainably accommodate all users, including transit riders, pedestrians, and cyclists.

HOW WELL DOES IT WORK?

While the street-redesign projects implemented by NYCDOT have received a great deal of attention, it is the process by which they have been implemented that may be most noteworthy. In most U.S. cities, even minor street design and transit projects require extensive and time-consuming processes. Repeated rounds of public hearings, environmental reviews, and the occasional legal challenge can delay implementation and greatly increase costs. NYCDOT Commissioner Janette Sadik-Khan, however, has implemented projects on a trial basis, often using inexpensive materials that can be upgraded at a later date.

This approach offers a number of advantages. First, projects can be implemented much more quickly and cheaply. Second, and perhaps more importantly, the public is able to experience rather than merely envision a design, in real time and in the real world. This allows for a certain amount of experimentation and presents opportunities to adjust and refine before infrastructure is put more permanently in place. It also allows poeple to grow accustomed to a redesigned space, which can allay the fears of an idea in the abstract or the human tendency to be wary of change. While many of these projects have been wildly successful, others have not been well received and have been removed.

The NYCDOT approach has since been adopted by other cities including San Francisco, which has implemented a "Pavement to Parks" program to convert street space to pedestrian use.

The "pilot" approach is not without its critics. Implementing projects as pilots, they claim, is simply a way to bypass public process. However, the fact that certain contentious projects have been removed, including striped bike lanes in Williamsburg which drew concern from Hasidic community around the dress of cyclists, stresses the flexibility of low cost pilot projects.

Among the actual projects implemented by NYC DOT, three categories have attracted the most attention: pedestrian plazas and promenades; bicycle lanes, including "cycle tracks" separated from traffic; and bus-only lanes.

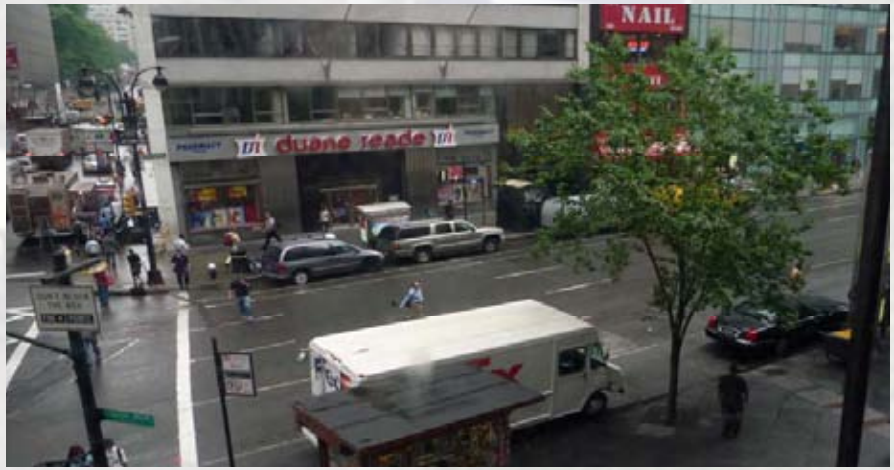
The highest profile of the pedestrian projects has been conversion of a two-mile stretch of Broadway in Midtown Manhattan into "Broadway Boulevard," a project described as "bypass surgery on the heart of New York." The project has been implemented in phases, starting with conversion of two lanes of Broadway in the Times Square area to a pedestrian promenade and cycle track, alongside the curb. Pavement was treated with an epoxy application, planters were placed next to traffic and parking lanes, and inexpensive benches, tables, and chairs were provided. The entire original project, along seven blocks of Broadway, cost just $700,000. The project has since been expanded to encompass 36 blocks of Broadway between Columbus Circle and Madison Square, with full closures of Broadway and larger plazas at key locations, including Times Square. Broadway Boulevard is a pilot project; data on traffic congestion is being collected over a six-month period. Conversion of six-way intersections along Broadway to simpler four-way intersections with longer green signal phases is expected to reduce auto travel times by as much as 37% on northbound Sixth Avenue. The project is a public-private partnership, with business improvement districts (BIDs) contributing to maintenance.

Initial public reaction has been mixed, with concerns about the safety of placing tables and chairs next to travel lanes where there are no curbs, about traffic impacts, about the quality of temporary street furniture, and about the fundamental change in the nature of Times Square, which some say feels less vibrant since cars were removed. However, newspaper articles have reported that it remains impossible to find a seat in Times Square, despite all the new seating. The Broadway Boulevard project might be viewed as a simple response to popular demand: 356,000 pedestrians a day need the space more than 50,000 vehicles.

While Broadway Boulevard is the most visible of the projects implemented by NYCDOT, it is just one among many.

BROADWAY BOULEVARD, MANHATTAN, 2008

Before



After

Smaller pedestrian projects have been implemented throughout the city, and more than 180 miles of bike lanes have been added to its streets. On Ninth Avenue on the west side of Manhattan is a "cycle track" in which the parking and bicycle lanes have been reversed, with the bike lanes placed next to the curb and a painted median and landscaped islands placed between the bike and parking lanes. Meanwhile, along 34th Street in Midtown and on Fordham Road in the Bronx, Select Bus Service now operates in dedicated curbside lanes. Unlike more expensive bus rapid transit projects in other cities, these projects have been implemented quickly and inexpensively by painting the lanes, separating them from traffic with reflective domes, and installing cameras for enforcement.

While the NYCDOT has successfully implemented several complete street projects that improve mobility for buses, it is important to note that New York City also has a fully developed subway system. In Seattle, transit operates primarily on surface streets where the needs of other modes must be balanced with transit speed and reliability. Due to geographic barriers and the resulting street network in Seattle, complete streets principles that accommodate all modes, may be infeasible and/or impractical in some corridors. In urban environments, transportation needs to be viewed as a multimodal system that balances user needs at various geographic levels ranging from the cross section of a specific street to neighborhoods to the entire city.

A CASE FOR BALANCE

The Complete Streets model has become a common approach to moving the use of our urban streets away from auto-domination and balancing the need for bicycle and pedestrian movement. The Complete Streets organization defines a complete street as one:

Designed and operated to enable safe access for all users. Pedestrians, bicyclists, motorists and bus riders of all ages and abilities are able to safely move along and across a complete street.

Many cities around the nation have adopted Complete Streets ordinances and are incorporating practices into planning and street design.

Complete Streets are important for transit because:

- The pedestrian network serves as the 'connective tissue' of the transit system. Every trip begins and ends as a pedestrian trip, and poorly planned access to bus stops is a real barrier for disabled travelers as well as a psychological barrier for all travelers. The U.S. Access Board sets minimum requirements for disabled access, but Complete Streets encourage quality pedestrian design that goes well beyond basic safety requirements.
- They encourage multiple jurisdictions to engage in important discussions about the quality of experience for all street users. A major challenge for pedestrian accessibility is the disconnect between transit operators, who are responsible for transit facilities, and departments of public works, who are generally responsible for the roadway and pedestrian facilities that provide access to transit facilities. It is important that the agencies move past the "not my problem" mentality and coordinate their activities carefully for accessible streets and sidewalks.
- Better street design encourages new and more intensive land uses, which creates more demand for top-quality transit.

Complete Streets policies can challenge transit operators because:

- Complete Streets recognize the need to accommodate transit vehicles, but overall policies are bicycle and pedestrian oriented.
- The reduction of traffic controls in favor of very slow speeds and integration can negatively impact transit operating speed and reliability, thereby reducing transit's ability to compete with the automobile. Sometimes segregating transit is the right thing to do, particularly in an urban core where a system converges and small amount of incremental delay can equate to significant operating cost and passenger delay over the course of time.
- Complete Streets advocacy is oriented toward non-motorized travel and may discount the importance of maintaining transit performance. Since a large percentage of regional trips are longer than most people will comfortably walk or bike, transit is critical in reducing use of private automobiles.
- Complete Streets advocates are often white collar cyclists that have greater capacity to organize and advocate for their agenda. As cycling grows in popularity, many communities are seeing an imbalance in advocacy for bicycle facilities when compared with transit.

For more information on bicycle and pedestrian integration with transit, see the *Accessibility in Transit for Bicyclists and Accessibility in Transit for Pedestrians* sections.

7 BEST PRACTICES

Transit Priority Treatments

OTTAWA, ONTARIO; BRISBANE, AUSTRALIA; RICHMOND, BC; CLEVELAND, OH

WHAT IS IT?

Transit priority treatments are relatively inexpensive improvements (when compared to major corridor transit projects) that reduce delay and increase speed of transit services. Effective transit priority treatments optimize management of city streets to increase transit speeds while minimizing impacts on other users of the street.

WHY DO IT?

Transit priority is about getting the most out of an existing investment. To some extent, transit priority projects represent "low-hanging fruit." In contrast to expensive, lengthy, and politically challenging infrastructure investments, transit priority upgrades can be implemented incrementally as funding becomes available. The net benefit of many small improvements can amount to more than the sum of their parts, offering significant reductions in transit travel time and improvements in transit productivity and cost effectiveness. Transit priority improvements can stand alone or work with other investments to optimize system-level efficiency; for example, feeder service can be improved to leverage larger infrastructure investments. Improvements to existing services can also build demand for more extensive investments.

Median transit lanes have been applied along the Euclid Corridor BRT route in downtown Cleveland

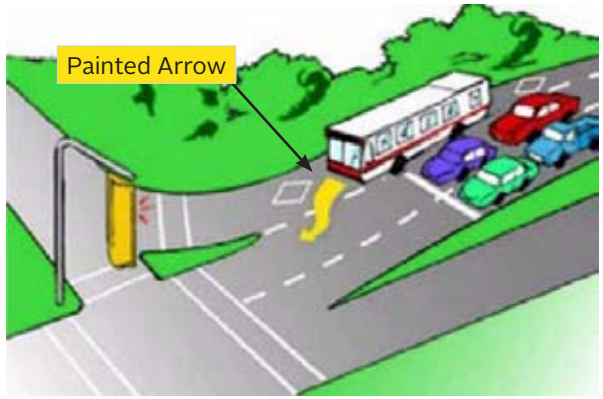
Source: Flickr Creative Commons, User So Cal Metro

HOW WELL DOES IT WORK?

This section describes the effectiveness of a variety of transit priority treatments, including queue jumps with advanced stop bars, lane striping treatments, and median transit stops.

Queue Jump with Advanced Stop Bar

Queue jumps are often paired with signal priority treatments, which give buses an early green light or extend a green light. Queue jumps enable transit vehicles to bypass long queues (or lines) at signalized intersections. An intersection with a queue jump provides an additional travel lane, which can be transit-only or shared, on the approach to a signal.



A queue jump with advanced stop bar allows buses to re-enter traffic and jump ahead of other traffic.

Source: City of Ottawa

Advanced stop bars can be used to assist transit in the following ways:

- To help buses to re-enter the traffic stream when a bus lane is ending
- To allow buses to jump to the front of a queue at a traffic signal after they have picked up passengers at a bus stop
- To assist buses in crossing lanes ahead of other traffic to reach a left-turn lane without obstructions

In situations where buses must share a right-turn lane with other vehicles, the queue jump may not function as well as possible. For example, a transit vehicle may be forced to wait to merge until the last minute and end up blocking the right-turn lane, or a transit vehicle may merge into regular traffic early and get stuck at the back of the queue, eliminating the advantage of signal priority that accompanies the queue jump. These examples are illustrated in the figure below.

Adding an advanced stop bar can create a pocket that allows buses to pull ahead of regular traffic. A stop bar may be implemented with transit signal priority to increase effectiveness by providing extra time for the bus to move ahead of stopped traffic.

Lessons Learned

An advanced stop bar was installed with a queue jump in Ottawa. Although the stop bar improved the function of the queue jump, there were several lessons that may be applicable for Seattle:

- Regular traffic did not always stop at the marked stop line, which prevented buses from jumping to the front of the queue and ahead of other traffic
- Initially, taxis and private coaches used the bus lane illegally, although violations decreased over time with enforcement
- Moving the stop bar further from the intersection in the general purpose lanes extends the length of the queue; therefore, adequate room is needed

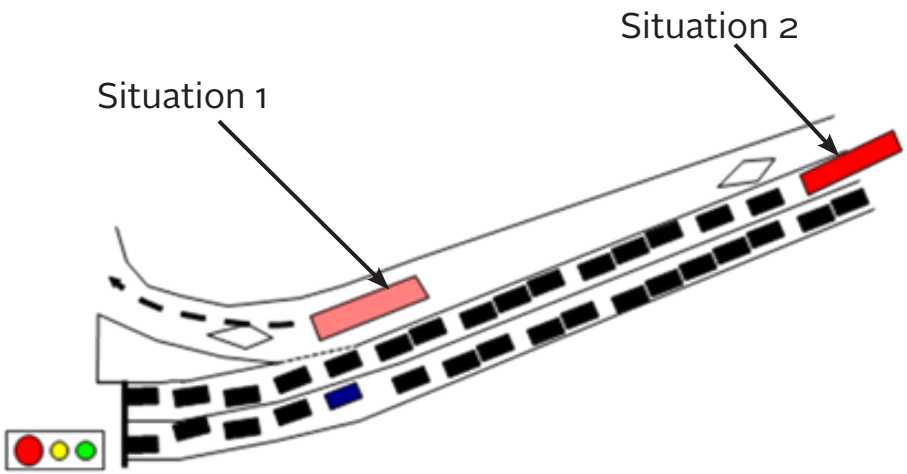
Striping Treatments

In areas where drivers do not comply with signed transit-only lanes, various striping treatments can be used to draw extra attention to the lanes. Colored bus lanes have been implemented in the U.S., Canada, and Europe, including New York City; London; Edinburgh; Ottawa; Denmark; Sydney; and Auckland.

The following highlights lessons learned from bus lane color treatment studies in Australia and New Zealand:

Brisbane, Australia - Red color applied at beginning of bus lane

In Brisbane, Australia red colored rectangular panels were installed at the beginning of bus lanes to increase visibility. This resulted in a 60% reduction in cars using the bus lane.



Source: DKS Associates

Red pavement color at the beginning of a bus lane resulted in a significant reduction in cars using the bus lane in Brisbane, Australia.

Source: City of Brisbane

Bus lane violations were reduced by applying green pavement color at the beginning of bus lanes in Auckland, New Zealand

Source: blog.greens.org.nz

Sydney, Australia reduced bus lane violations by applying a red color overlay to the lanes.

Source: Flickr user Scotticus

Sydney, Australia: Red color applied to full bus lane

Sydney, Australia applied a continuous red color overlay to bus lanes that were previously marked by pole-mounted "Bus Lane" signs and "Bus Lane" pavement markings. Surveys were conducted at three locations along the bus route after the red overlay was applied to the full lane. Results indicated that lane violations were reduced between 4% and 17%.

Auckland, New Zealand: Green pavement color applied at the beginning and end of bus lanes

Auckland, New Zealand applied green pavement color to the beginning and end of 10 miles of bus lanes. Pavement color was also applied at intermediate locations for some sections of roadway. It was reported that violations were reduced from 7% to 11% initially and were down to 2% one year after the color was applied.

Striping Treatments: Benefits and Challenges

Striping treatments have been shown to be effective at modifying driver behavior—these treatments increase compliance and lower levels of required enforcement. The effectiveness of striping is due, in part, to the additional visibility that is provided beyond regular street signage. There are also challenges with striping, primarily in terms of implementation. For example, it can be difficult to find the appropriate type of paint, and municipalities may find consistent implementation of striping treatments challenging. In addition, striping can increase maintenance costs, as the pavement color fades and requires regular reapplication.

Median Transit Lanes

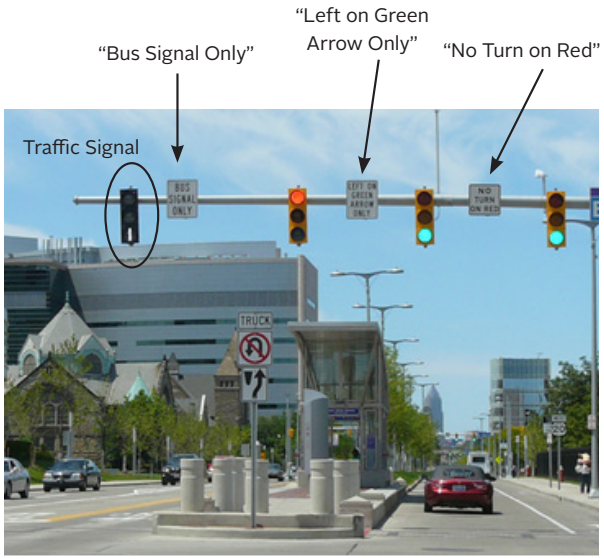
Median transit lanes allow buses to operate down the center of a roadway, avoiding the delay and potential vehicle turning conflicts associated with the curb lane. In North America, median transit lanes on arterial streets have been installed in Richmond, BC; Cleveland, OH; and Los Angeles, CA.

Richmond, British Columbia

In Richmond, median transit lanes were installed on the main commercial roadway to reduce curbside conflicts with right-turning vehicles and numerous driveways. The lanes were installed to ensure reliable service and to reduce travel times through the corridor. The median transit lanes extend 2.5 km and were created by purchasing right-of-way, eliminating a two-way left turn lane, and narrowing the general purpose lanes.

Cleveland, Ohio

Median transit lanes have been applied along the Euclid Corridor BRT route in downtown Cleveland. The median transit lanes were implemented to avoid delays associated with the curb lane, retain on-street parking, and provide more reliable transit service. The Euclid Corridor BRT (now called the "Healthline") also has low-floor buses with both right and left-side doors to allow for boarding and alighting from both sides of the bus.



A dedicated transit signal head and signage helps to direct traffic at an intersection that includes a median transit lane along Euclid Avenue in Cleveland.

Source: MetroJacksonville.com

Median transit lanes on Euclid Avenue in Cleveland include transit shelters on a median island.

Source: MetroJacksonville.com

Challenges

Challenges associated with median transit lanes include:

- Managing left turns
- Placement of traffic signals
- Increased pedestrian crossing distance and increased illegal pedestrian crossings
- Potential queuing of cross-street traffic over the busway
- Need for adequate right-of-way

Many of these challenges can be addressed with design improvements:

- Dedicated transit signal heads can help to minimize confusion over which traffic signals apply to left-turning vehicles versus transit vehicles
- Traffic control can protect or prohibit left turns
- Clear signage for pedestrians and cyclists can direct users to designated crosswalks
- Fences or barriers may discourage midblock pedestrian crossings

7 BEST PRACTICES

Emerging Technology

SAN FRANCISCO; LOS ANGELES; NEW YORK

WHAT IS IT?

In addition to roadway improvements such as adaptive transit signal systems and transit priority treatments, there are a variety of emerging technologies that can be used to speed transit delivery. Technologies that speed boarding help to reduce delays. Used effectively and in concert with other treatments, they can improve travel times and passenger experience.

WHY DO IT?

Examples of emerging technology include smart cards and mobile phone transit passes. Both allow transit passengers to speed the boarding process without the hassles of looking for money or purchasing a ticket. While smart card technology has been widely used in transit agencies throughout the country, improvements are still being made to enhance user experience. One of the latest developments in smart card technology is dual-use prepaid credit cards that can act as transit passes and as well as credit cards. Taking this concept one step further, some transit systems have been testing the use of mobile phones as transit passes. This has many advantages, as mobile phones are one of today's most widely used technologies. Transit agencies can utilize this technology by allowing passengers to purchase transit passes with their mobile phone, or even use the phone itself as a transit pass. Mobile phones take smart cards to the next level by making it easy to purchase a transit ticket via the Internet, a mobile application, or SMS text messaging.

In September 2010, the L.A. Metro system, Visa, and Ready Credit Corporation deployed the Transit Access Pass (TAP) ReadyCARD, a contactless smart card.

Image from Flickr user MetroTransportation Library and Archive

HOW WELL DOES IT WORK?

This section presents examples of two emerging technologies, dual-use contactless smart cards and cell phone transit passes.

Dual-use Contactless Smart Cards

In September 2010, the L.A. Metro system, Visa, and Ready Credit Corporation deployed the Transit Access Pass (TAP) ReadyCARD, which incorporates the transit system's "TAP" fare application (contactless smart cards) with Visa's prepaid functionality. The dual-use prepaid card allows riders to pay their fares and purchase fare products using their Visa account, while also allowing cardholders to make purchases anywhere credit cards are accepted.

In 2010, Visa also expanded its global transit initiatives by working with transit systems to provide a variety of smart card options in Kuala Lumpur, Singapore, Paris, London, and Istanbul.

One of the challenges associated with using smart cards for mass transit is a concern about privacy issues because the technology allows the mass transit operator (and the government) to track an individual's movement.

Cell Phone Transit Passes

In 2008, mobile phone transit passes were tested on San Francisco's BART system. Instead of swiping a card, passengers swipe their mobile phones over a wireless reader when entering the transit system or boarding a train. The technology, called near-field communication (NFC), allows a secure connection between the phone and the sensors.

Visa has also launched a pilot program in New York that uses payWave technology, which is based on a small electronic chip embedded in either a mobile phone or smart card. This technology is being used in a pilot program at New York City Transit, NJ Transit and the Port Authority of New York and New Jersey.

Mobile phones have been used as transit passes in Asia and Europe for a few years. Germany, for example, has been using "mobile ticketing" since 2006 and recently introduced an iPhone application. The German system allows cell phone users to buy a single ticket, day pass, or group tickets. A barcode similar to that on an airplane boarding pass is used to verify the purchase

One of the primary challenges associated with implementing mobile phone transit passes is figuring out how to incorporate the technology into a distance-based system for tiered cost by transit zone. In addition, some applications require distribution of a special chip for use in the phone.

BART tested Near-Field Communication (NFC) technology, which allows passengers to use their cell phone as a transit pass.

Source: Nelson\Nygaard

7 BEST PRACTICES

Adaptive Traffic Signal Systems

GRESHAM, OREGON

WHAT IS IT?

Adaptive traffic signal systems measure traffic conditions in the street in real time and constantly adjust the signal timing based on real-time data. They have been shown to reduce vehicle delay, travel time, and the number of stops. Adaptive traffic signal systems have been used since the early 1970s; however, their implementation has been relatively slow-paced in the U.S.

There are several different adaptive signal systems available, but four of the most prominent systems include Sydney Coordinated Adaptive Traffic System (SCATS), Split Cycle and Offset Optimization Tool (SCOOT), ACS Lite, and InSync. SCATS and SCOOT were developed through government research and sponsorship in Australia and the UK in the 1970s and are the two of the most widely implemented adaptive programs throughout the world today. The ACS Lite adaptive signal system was developed by the Federal Highway Administration(FHWA) in the 2000s and four demonstration installations were completed in 2006. InSync was developed in 2009 and implemented in several cities in the U.S. in 2010. SCATS, SCOOT, and ACS Lite can all be implemented with transit signal priority (TSP), and InSync is currently working on upgrading the system to support TSP.

The cities of Sydney and Brisbane, Australia have implemented transit signal priority with the SCATS adaptive signal system, and the Georgia Regional Transportation Authority is currently managing design and construction of the Atlanta Smart Corridor Project, which will include implementation of transit signal priority with the SCATS adaptive signal system. Additionally, the City of Bellevue, WA completed a needs assessment and evaluation of adaptive traffic signal systems in 2010, and has installed the SCATS system in the Factoria Boulevard corridor. An adaptive signal system is also being installed in downtown Bellevue, and it will be implemented with transit signal priority. The City of Portland, OR will also be implementing an adaptive traffic signal system with transit signal priority in the Powell Boulevard corridor in May 2011.

In Gresham, Oregon, travel time on the Burnside corridor decreased with the introduction of adaptive traffic signal systems.
Source: Portland Ground, http://www.portlandground.com/archives/2005/12/

WHY DO IT?

Adaptive systems decrease travel times through corridors and improve travel time reliability over conventional signal timing systems during even the highest peak traffic flows. Adaptive systems are especially effective in cases where traffic volumes are variable or have the potential to change during special events or reroutes due to closures of adjacent streets or highways. Transit systems benefit from the reduced travel times and increased travel time reliability when operating within an area or corridor with adaptive traffic signal control.

An evaluation of the existing city infrastructure as well as an assessment of the needs and requirements of a new signal system should be completed prior to implementation of an adaptive traffic signal system.

Some example criteria for evaluating whether and what type of adaptive traffic signal should be implemented include:

- What type of signal controllers and system (central system or field master) are being used?
- What type of transit signal priority is being used?
- What is the proximity of the area/corridor to freeways?
- Is the peak period variable in terms of duration and start/finish time?
- Are there special event generators in proximity to the site? How frequently are they used?

HOW WELL DOES IT WORK?

As of 2010, there are no known case studies documenting the effectiveness of adaptive signal systems specifically with respect to transit operations. However, there have been evaluations completed that document the effectiveness of adaptive signal systems in terms of general traffic operations. Transit vehicles would see the same benefits as other vehicles in the corridor from the improvements in travel time, reliability, and reduction of stops.

COVENTIONAL VS. ADAPTIVE SIGNAL SYSTEMS

Conventional Signal Timing

- **Actuated-Uncoordinated "Free" Signal Timing:** Each intersection in a corridor responds to its own need with no regard to traffic operations at adjacent intersections. The traffic signal controller adjusts the amount of time served to each phase of the intersection based on the number of vehicles detected by detector loops or video detection at that intersection.
- **Coordinated Signal Timing with Time-of-Day Plans:** Signal timing along a corridor or within a network is coordinated between controlled base upon static signal timing plans that are developed based on a sample of the average traffic volumes for the times of the week when the plans will be developed. The time-of-day plans result in a cycle length common to the group of coordinated signals, and offset in the cycle starting points between adjacent signals, a sequence of phases, and an allocation of cycle time (splits) for each phase at each signal.

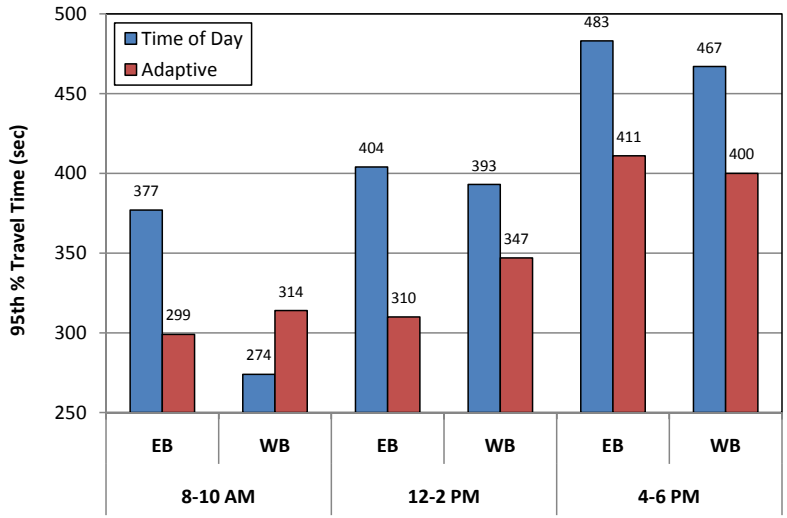
Adaptive Signal Timing

- **Adaptive Signal Timing:** Adaptive signal control systems continually refine the timings at every intersection within a corridor or network, cycle-by-cycle, as traffic conditions change. Adaptive systems monitor traffic conditions using vehicle detectors for all approaches, and often for all movements, of the intersections within the corridor. These systems adjust the signal timing based on the real-time traffic flow in the corridor.

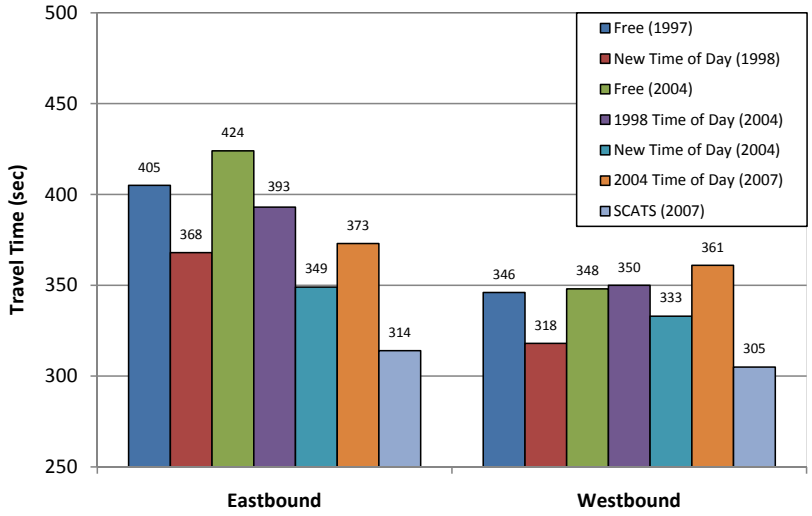
Case Study: Gresham, Oregon—Effectiveness of Adaptive Signals

The Burnside corridor is a five-lane major arterial in Gresham, OR that carries approximately 38,000 vehicles per day through the city's growing commercial and retail district. Prior to implementing the SCATS adaptive traffic signal system at 11 intersections in 2007, traffic signal time-of-day plans had been updated regularly for 10 years.

The performance of the SCATS system was compared to the newly-optimized time-of-day plans and historical records. The adaptive system showed a significant improvement over the time-of-day plan operations, and travel times on the corridor have been reduced to the lowest recorded levels. The adjacent charts show the difference in travel times during the highest traffic flows (95% flows) that occur in the corridor during the morning, midday, and afternoon peak periods for traffic volumes. During the periods with the highest traffic volumes, the travel time through the corridor with the adaptive signal timing was significantly less than the travel time through the corridor with the time-of-day plans for all but the westbound direction in the AM peak period. Not only does the SCATS system result in a reduction in travel time through the corridor over the average of the peak period, it also results in a reduction in travel time when traffic volumes in the system are highest.



Travel time on the Burnside corridor decreased with the introduction of SCATS in 2007.



Adaptive traffic signal systems resulted in significant reductions in travel time in Gresham, OR.

Source: DKS Associates

7 BEST PRACTICES

Pedestrian Access to Transit

NEW YORK, SAN FRANCISCO, PORTLAND, DENVER

The pedestrian environment is the foundation for good access to public transit and is critical for attracting new riders, increasing ridership among existing passengers, and improving the overall travel experience. Since every rider begins and ends a transit trip as a pedestrian, the quality of the pedestrian environment is an important part of the trip and can be a deciding factor when choosing whether or not to take transit at all, especially for those with the option to drive. The presence of high-quality pedestrian amenities and infrastructure is also important for supporting all forms of multimodal transportation, including biking, walking, carsharing, carpooling, etc.

Pedestrian access to transit is critical for supporting and increasing transit ridership.

WHAT IS IT AND WHY DO IT?

Pedestrian access to transit refers to the extent to which the pedestrian environment, amenities, and infrastructure support passengers in accessing transit services. The quality of these features is paramount in attracting new riders and maintaining existing ridership. Pedestrian infrastructure includes an array of amenities and improvements, including wide and textured sidewalks, platforms, level boarding features, curb ramps, benches, lighting, signage, building overhangs, travel information, wayfinding signage, and bus shelters. When well-designed, these pedestrian improvements and infrastructure can help to increase the safety, comfort, and enjoyment of the entire transit trip and promote access to transit. The quality of the pedestrian environment is also influenced by the presence of street trees and landscaping, active retail uses at street level, outdoor café seating, and public art.

Well-designed and enjoyable pedestrian infrastructure enhances public spaces and works synergistically with transit services to create active urban neighborhoods that support economic development as well as walking, biking, and transit. In line with climate protection and air quality goals, walking can replace short driving trips, reduce vehicle cold starts that create the greatest amount of pollution, and connect riders to high-capacity transit for longer trips.

How do you design a pedestrian-friendly transit streets?

Studies have shown that when pedestrians and drivers are aware of and attentive to each other's presence, the crash rate declines. There are a number of strategies that raise awareness of pedestrians and improve visibility for people driving and on foot. Improving the overall pedestrian environment is conducive to transit ridership in general, but concentrating these improvements in the vicinity of transit facilities is especially effective in improving pedestrian access to transit. These improvements include:

- **Special, colored or raised paving at crosswalks** assist in calming traffic and raise driver awareness that they are in a zone where pedestrians are expected to be crossing.
- **Pedestrian-only crossing phases** during signal cycles allow pedestrians to cross the intersection in any direction while all vehicles are stopped with a red light.
- **Leading pedestrian interval** gives pedestrians a few second head start to claim the right-of-way ahead of turning traffic.
- **Prohibiting right turns on red** prevents vehicles from turning into crossing pedestrians. Signal phases need to accommodate adequate time for through movement to reduce the urge to violate the no-turn-on-red.

- **Reducing intersection widths** improves visual contact between drivers and pedestrians and reduces crossing distances and the time needed to cross on foot.
- **"Curb bulbs"** affect crossing widths by extending a section of the sidewalk into the road at an intersection. they are often placed at the end of an on-street parking lane. Pedestrians standing on the bulb can see and be seen by drivers before crossing.
- **Road diets** reduce the width or number of travel lanes, often by converting a 4 lane street into 2 or 3-lane plus bike lane and/or a center turn lane. This reduces crossing distances, vehicle speeds, and the number of travel lanes pedestrians must negotiate when crossing. Road diets have been done on 12th Avenue in Seattle.

Over and above improving safety, each of these practices also conveys a message to both drivers and pedestrians that a street, place or neighborhood is intended to be visited on foot. Motorized traffic will be more aware and attentive to potential pedestrians, and people on foot feel more comfortable and invited to walk in an area offering multiple pedestrian-focused design elements.

Road diets, make streets more pedestrian friendly and accommodate multi-modal transportation options.

Source: Dan Burden.

What are the elements of a healthy pedestrian environment?

Elements that create additional comfort, aesthetics, and amenities contribute to a pleasant pedestrian experience. If the pedestrian environment is unpleasant, people will tend to avoid walking and spending time outside of their cars; whereas, an enjoyable pedestrian environment supports neighborhood shopping, "parking once" for the day, and increased levels of transit ridership. Developing a healthy pedestrian environment reinforces efforts to improve pedestrian access to transit.

Best practices for a healthy pedestrian environments include:

- **Active sidewalks and transparent building facades.** Buildings and streetscapes that activate the environment, such as sidewalk cafes and parks, build community and stimulate the desire to walk to reach destinations. Transparent building facades with windows at street level create interest and also open up the pedestrian realm, so people are not forced to walk beside an imposing blank wall. Land uses that attract pedestrians include pubs, grocery stores, and parks.
- **Human-scale sidewalks.** Sidewalk widths should be proportional to the height of buildings and roadway size. Where multi-story buildings and multi-lane roads are present, sidewalks must be wider in order to counteract the bulk of the buildings and create a pedestrian realm in proportion to the scale of the automobile travel lanes. First story building articulations between storefronts, tree canopies, and awnings and overhangs create a human-scale space for walking.
- **Visual interest and diversity.** Diverse environments attract people on foot. This includes diversity in land use and shop types, architecture styles, landscape designs, and people.

Colorful pavement patterns create a gateway from the building entrance to the outside pedestrian realm.

Source: N\N Archives

- **Attractive and distinctive sidewalk treatments.** Unique sidewalk surfaces are placemaking elements that add interest to the walking environment. Defined connections between buildings and the adjacent sidewalk direct foot traffic to entrances and extend the pedestrian realm from the sidewalk to the building.
- **Urban nature.** A tree canopy that provides shade and shelter and defines an "outdoor hallway" also helps achieve balance between pavement and planted areas. Grass strips, planters, and bioswales reintegrate ecological functions into the urban realm and draw visitors.

Seating, plants, and active street-level windows are attractive to people on foot.

Source: N\N Archives

- **Pedestrian furnishings** such as seating and weather protection, water fountains and trash receptacles, and street trees and other green elements invite foot traffic. These amenities create usable places for people to rest, to reflect, to have a sense of refuge, to meet and greet, and to see and be seen.
- **Wayfinding.** Street signs, maps, and unique area treatments such as historical displays and public art help pedestrians orient themselves and create interest and comfort. Streetscapes that are inherently easy to navigate invite travel by foot and make driver and pedestrian behavior more predictable and thus, safer.

What items support a comfortable and safe walking environment for people of all ages and abilities?

"Universal design" concepts seek to ensure that the transportation network serves people of all abilities, ages, and demographics. Whether a pedestrian is an adult or a child, using a wheelchair or pushing a stroller, or traveling during times of low visibility, streets that work for children, the elderly, and people with special mobility needs serve everyone better.

Americans with Disabilities Act (ADA) guidelines and requirements direct appropriate sidewalk and curb cut design and guide ramp placement at curbs and building entrances. Limiting curb cuts, leveling grades, and reducing cross-slopes can make sidewalks safer and more comfortable for all walkway users. Removing obstacles from the sidewalk, including litter, utility poles, or trash cans, creates a clear path of travel for everyone. This also includes regular monitoring and maintenance of cracks and warps. Adopting a more aggressive approach to under-grounding of utilities clears pathways and improves the aesthetic quality of streetscapes.

Ensuring the visibility and consistent placement of signage makes wayfinding systems more navigable and helpful for all people on foot and even drivers. Pedestrians of all abilities need adequate green lengths during signal cycles to allow time to cross. Importantly, when unique paving materials or raised crosswalks are used to provide a visual and tactile signal of the pedestrian environment, care must be given to ensure that any pavement treatments do not hinder movement for those using wheelchairs or canes. Attention to universal design principles throughout the downtown will promote and support pedestrian travel for all segments of the population.

Wayfinding helps pedestrians, transit users, and tourists find their way to key attractions, transit facilities, and shopping,

Source: Flickr, user: Ned Richards

HOW WELL DOES IT WORK?

Studies have shown that improving pedestrian conditions can decrease the frequency of short automobile trips and increase transit mode share. Research by the Transit Cooperative Research Program found that many pedestrians are willing to walk between 0.5 and 1 mile to access transit, longer than the traditional focus on 0.5 mile. This suggests that the pedestrian environment and conditions are important for supporting those who are able and willing to walk to access transit services.

Studies have shown a direct correlation between multiple transit options, quality of pedestrian infrastructure, density of mixed use developments, and improved health. The Victoria Transport Policy Institute released the report "Evaluating Public Transportation Health Benefits" in June 2010, showing that communities with public transit have increased levels of physical activity.

By requiring that transit facilities, infrastructure, and equipment be accessible to all people, the American with Disabilities Act (ADA) ensures that a certain baseline of accessibility must be met. However, many cities and transit authorities are working together to provide higher quality pedestrian amenities and greater levels of accessibility than required by the ADA to create transit-supportive environments. Cities have found that focusing pedestrian improvements at transit facilities and beyond can be an effective way to increase transit ridership.

Following are descriptions of programs designed to improve pedestrian access to transit service and improve overall pedestrian and passenger environment. Examples are from New York, San Francisco, Portland, and Denver.

PROGRAMS FOCUSING ON PEDESTRIAN ACCESS TO TRANSIT

Safe Routes to Transit, New York, NY

New York City Department of Transportation (NYCDOT) developed three programs under their Safe Routes to Transit Program to improve access to transit facilities. The goal of the program is to improve pedestrian and motor vehicle movement around subway entrances and bus stops to make accessing mass transit easier and more convenient. The program focused on improving pedestrian access at:

- **Bus stops under the Els (elevated subway structures):** These locations posed unique challenges as many buses were unable to get to the curb and pedestrians were forced to wait, board, and alight the bus in the middle of the street. At these locations, NYCDOT is altering the road geometry to improve pedestrian visibility, bus stops are being raised behind a new curb line and traffic navigation is being improved using signage. NYC DOT will make these improvements at 42 locations across the city will be updated.
- **Subway/Sidewalk Interface:** This will improve sidewalks, crosswalks and other parts of the walking environment around bus stops where walking is currently difficult. NYC DOT selected 23 priority subway stations to receive improvements after examining stations for narrow sidewalks and corners, inadequate signal timing, and traffic congestion.
- **Sidewalks to Buses:** This initiative implements sidewalk and other pedestrian improvements to improve access to bus stops. It includes the installation of new sidewalks, crosswalks, and bus waiting areas to facilitate walking and transit use.

Before:
86th and Bay Parkway in Brooklyn (this location was completed in 2004)

After:
NYCDOT improved the road geometry to improve pedestrian visibility and enhance bus operations near elevated subway structures in New York City

Before:
40th Street station on the 7 train, Queens

After:
NYCDOT identified 23 stations for improvements to subway stations to improve pedestrian access.

Pedestrian Access and Bus Stop Improvements, Portland, Oregon

Portland, Oregon has taken a comprehensive approach to improving pedestrian and bicycle access to its transit facilities. When adding the new MAX Green line to the Transit Mall downtown, TriMet took the opportunity to rethink transit access and how well the mall worked as a public space and how it interfaced with transit facilities and local businesses. As part of this larger, more comprehensive planning effort, the City and TriMet developed an integrated vision for enhancing access to transit through placemaking, wayfinding, and new shelters.

Placemaking improvements which include public art, wide sidewalks, storefront renovations, and lighting improvements, support the overall pedestrian environment and are critical for a pedestrian friendly, transit-supportive environment. Wayfinding improvements, which include simplified maps and signage, help to orient visitors to the Center City's attractions, shopping, and transit services. New and improved glass and steel shelters were installed along the Transit Mall and other bus stops in the downtown. The new glass and steel shelters, are well-lit and create an open, attractive, and safe pedestrian environment as well as covered space for bike parking.

TriMet installed new transit shelters and covered bicycle facilities downtown that provide weather protection and travel information.

In July 2010, TriMet revised their Bus Stop Guidelines to identify design, placement, and amenity recommendations as they work with communities to improve transit access throughout the city. The document outlines the design guidelines that maximize effectiveness of bus service, including amenities and street treatments. It acknowledges that bus stops play an important role in public spaces and are as much a part of a community as streets, pathways, parks and plazas. It also explores ways in which TriMet encourages jurisdictions, neighborhood associations and citizens to recognize the value bus stops play in the community and looks for ways to build partnerships with these entities to enhance bus stops.

TriMet initiates capital projects to make significant improvements to route efficiency, on-street and bus stop safety, accessibility and comfort. Its Transit Facilities Development Program upgrades targeted bus stops with the stated goal of "increasing transit ridership by improving the total transit experience" by focusing on on-street transit and pedestrian facility improvements". Capital Improvements are made using curb ramps, ADA landing pads, sidewalks, curb cuts, new poles and bus stop signage, as well as amenities (benches, shelters, solar LED lighting).

TriMet sandblasted vandalized glass in bus shelters to beautify bus stops, save money, deter vandalism, and improve the passenger's experience.

Source: TriMet

Improved lighting at shelters helps to provide a safe and inviting place to wait for transit.

Source: Thomas LeNgo, Flickr user

Transit Shelter Program, San Francisco, CA

San Francisco Municipal Transportaion Agency (SFMTA) was one of the first transit agencies to develop a formal shelter program in 1987. The purpose of the program was to replace old shelters in San Francisco with new shelters that provide improved travel information, seating, lighting, and weather protection and to maintain the shelters on an ongoing basis to keep them in good repair. Previously, many shelters were not well maintained and had become covered in graffiti.

The agency initiated its shelter program through an innovative arrangement with a private contractor, CBS Outdoor. Under the arrangement, the contractor owns and maintains the shelters and pays for improvements. SFMTA does not pay the contractor to manage the shelters; the contractor pays for the improvements by selling advertising, which is placed prominently in the shelters. In 2007, SFMTA entered into a 15-year contract with Clear Channel with the option of one 5-year renewal after 2017. The contract with Clear Channel requires that the company install between 1,110-1,500 new shelters over five years, replace 39 kiosks, provide 1,5000 traffic controllers, and install 3,000 solar-powered customer-information signs. It stipulates that the contractor make a one-time signing payment of $5 million and pay $500,000 for administration costs. In addition, they will make minimum annual payments to the agency during the duration of the contract—for example, they will have to pay $8.6 million to SFMTA in 2010.

Before SFMTA initiated its shelter program, many of its shelters were poorly maintained and covered in graffiti.

Clear Channel began installing new solar-powered bus shelters with LED lighting and wireless routers in 2009. The roof and steel structure are constructed from recycled materials.

Transit Access Guidelines, Denver, Colorado

Denver's Regional Transportation District (RTD) recognizes the value of pedestrian linkages to transit facilities and their importance in supporting ridership growth. While RTD makes decisions regarding the siting and design of its facilities, community access is often beyond the immediate purview or direct control of transit agencies. RTD can, however, coordinate with other parties—such as local governments and the development community—that are responsible for the development and regulation of the physical infrastructure and built environment surrounding those facilities. The impact of those parties' actions on transit suggests that RTD's interests are served by collaborating with them on access concerns.

In 2009, Denver's Regional Transportation District (RTD) released Transit Access Guidelines to ensure that transit access is improved comprehensively and consistently and to support coordination with other entities. This document provides guidelines within the agency and to other coordinating parties regarding how to design access to the various stations and stops. The guidelines outline the roles and responsibilities (RTD responsibility vs. non-RTD responsibility) for each public agency with respect to pedestrian and bicycle access improvements

Denver's RTD implemented new Access Guidelines in 2009 that support pedestrian linkages to its transit facilities.

RTD's guidelines encourage access to the transit system through a hierarchy of modes, in order of priority: pedestrians, bus riders, bicyclists, vehicles (short-term parking), and vehicles (long-term parking). Guidelines are specific to transit modes including light rail, commuter rail, and bus transit. Specific design standards such as walk speeds, platform design dimensions, access points, path distances to entrances, and sight line considerations are included. The guidelines also promote transit-oriented development principles in joint development projects and require that pedestrian-oriented design, density, and mix of land uses support transit access be considered during review.

7 BEST PRACTICES

Bicycle Access to Transit

The quality of bicycle amenities, facilities, and environment affect access to transit service. Improving bicycle access to transit supports existing ridership levels and attracts new transit passengers by providing additional connectivity to other modes and enhancing the overall travel experience. Enhancing bicycle access to transit can be a cost-effective way to affect a mode shift. Targeted coordination of policies, programs, and implementation among agencies and private entities is required to successfully integrate these modes of travel.

A high-quality pedestrian environment is also critical for a healthy bicycle environment. Such amenities and design features as lighting, shelters, wayfinding, traffic calming, and road diets support both walking and bicycling (See Pedestrian Access to Transit). Studies have found that neighborhoods with high degrees of walking have higher levels of bicycling and transit use than those that don't. This is because there is a virtuous cycle involving land use density, system transit service quality, multimodal transit options, and system integration.

Enhancing bike access to transit can be a cost-effective way to promote transit ridership.

Source: Todd Mecklem

WHAT IS IT AND WHY DO IT?

Creating a bicycling environment that is safe and comfortable for people with a broad range of skills and for all ages requires a range of bicycle programs, policies, and facilities. Careful street design is needed to provide cyclists sufficient space and visibility for safe riding; this must be balanced effectively with other street users and done in a way that navigation is clear and simple.

Improving bicycle access to transit increases urban mobility and fosters multimodal travel and can be done using relatively low levels of capital investment. Improving bicycle facilities and parking in transit corridors and at stations can bring new riders to the transit system.

HOW WELL DOES IT WORK?

Transit agencies are finding that bicyclists are more willing to take transit when the systems provide bicycle amenities and market their services directly to them. The Portland Bureau of Transportation's Bicycle Program estimates that providing improved access for bicyclists increases the capture area of transit investments twelve-fold.

Working together, transit agencies and local jurisdictions that develop a comprehensive approach to improving bicycling conditions and amenities can attract additional transit riders and decrease single occupancy vehicle trip rates at relatively minimal cost. The following sections present best practices in bicycle amenities, programs, and infrastructure in a variety of U.S. and European cities.

There are a number of street design features that cities can use to improve cycling safety and comfort, including: bicycle lanes, bicycle boulevards, cycle tracks, improved crossing treatments, signage, and traffic calming features. Additionally, education and safety training programs can help to get more people on bikes. Ultimately, getting more bicyclists on the streets is the best way to improve driver awareness and rider safety. Bicycle parking and end-of-trip facilities, such as lockers and showers, are also important to bicycle riders.

IMPROVEMENTS THAT ENCOURAGE BICYCLING TO TRANSIT

To increase the number of people bicycling to transit it is necessary to improve both perceived and actual safety of the overall bicycle network. Since the city controls street design, this is an area where it has direct influence in improving access to transit. This section presents a variety of bicycle infrastructure improvements that support system-wide bicycling connectivity and access to transit.

Bicycle Boulevards

Bicycle boulevards are low-traffic streets that have been optimized for use by cyclists. A variety of traffic calming elements and signage are used to reduce car volumes and speeds, fostering a safe bicycling environment. Bicycle boulevards often include features that allow cyclists to travel farther without stop controls or intersection treatments that allow cyclists to continue through intersections, while cars are forced to turn. Bike boulevards often make use of sharrows or shared-lane markings that communicate the presence of bicyclists to drivers.

Bicycle Lanes and Boxes

Bicycle lanes are another technique to provide dedicated space in the street for cyclists and to increase driver awareness to the presence of cyclists. Increasingly, cities are using colored pavement treatments to designate bike lanes, either by coloring the beginning of the lane or the entire lane. In a number of European countries, such as Belgium, it is customary for bike lanes to be differentiated from traffic lanes with colored pavement treatments. Colored lanes further discourage drivers from entering the portion of the right-of-way dedicated for cyclists.

Colored markings can also be used at key spots such as intersections and turn zones where cars need to cross a bike lane. Bike boxes, as shown below, allow bicyclists to wait ahead of vehicular traffic, have been implemented in Portland, Oregon.

Bicycle boulevards use a variety of traffic calming techniques and shared-lane markings to increase safety for bicyclists.

Source: Flicker user Payton Chung

Bike boxes allow cyclists to move in front of the travel lane in order to be more visible to cars and avoid turning conflicts. Politicians in Portland began advocating for an increase in bike box construction as a safety measure in the wake of cyclists fatalities at intersections.

Flickr user: Rich and Cheryl

Cycle Tracks in Portland, Oregon

In Portland, federal stimulus funds are being used to improve bicycle access to transit by establishing cycle tracks and buffered bicycle lanes on streets that feed MAX Green Line light rail stations. The development of high-quality feeder facilities is intended to bring new users directly to the transit system, while simultaneously allowing for improved conditions at locations where bicyclists cross the rail lines.

Portland's cycle tracks use a row of parked cars to separate bicyclists from auto traffic, but other cycle track designs often use a physical barrier such as a curb or a narrow median, which can be more expensive to implement.

A report prepared by Alta Planning + Design, called "Cycle Tracks: Lessons Learned", presents findings from the Portland pilot project. It found that cycle tracks have a number of advantages over conventional bicycle lanes: they reduce auto-cyclist accident rates, remove the danger of "car-dooring", and increase bicycle ridership. According to the report, cycle tracks can also present a number of potential complications, including conflicts between cyclists and pedestrians and bus passengers. Notably, since cyclists are not traveling alongside automobiles, "motorists may not be aware of their presence, leading to increased vulnerability at intersections." The report suggests that some accidents may be prevented by moving the stop line back at intersections, using protected phases at signals, and prohibiting cars from turning right on red. Portland has used bike boxes on the street to facilitate left turns for cyclists out of the cycle track.

In Portland, parked cars are used as a buffer between the cycle tracks and travel lanes.

Source: Nelson\Nygaard

Cycle tracks, as shown in Amsterdam, are bicycle lanes that are separated, but adjacent, to traffic and transit.

Sources: Nelson\Nygaard and SvR Design

Cycle Tracks

Cycle tracks are bicycle lanes that are physically separated from traffic, but are located in the roadway. Cycle tracks are common throughout parts of Europe, but only a few cities in the United States have them, including Bend and Portland, Oregon, Cambridge, Massachusetts, and New York, New York. They provide a buffer from traffic that creates a much greater level of comfort and sense of protection for cyclists. Cycle track facilities generally take two forms: paired one-way facilities on each side of the street, or two-way wider facilities on one side of the street.

External bike racks allow bicyclists to transport their bikes while traveling by bus.

Source: Flickr user RichardMasoner

USING A BICYCLE TO ACCESS TRANSIT

Once cyclists reach a transit stop or station, they are typically faced with a decision to store their bicycle or bring it with them on transit. For many, weather protected and secured parking that provides confidence that the bike is safe for an extended time is a critical system design feature. Some riders also want or need to bring their bike on the transit trip to complete the other end of the journey. If a traveler is uncertain about the presence of bicycle parking facilities at the station or whether transit can accommodate their bike on board, they are far less likely to chose a bike-to-transit journey.

King County Metro was the first transit agency in the nation to use front-loading bicycle racks on buses. Today, Metro passengers load over 10,000 bicycles per week on buses.

Bicycles Racks on Vehicles

External Bike Racks

Most transit agencies provide external bike racks on buses. Bike racks mounted on buses are most frequently located in the front of the bus. They typically flip up against the bus when they are not carrying any bikes.

Onboard Bike Racks

Commuter trains are often well-equipped to store bikes. Caltrain in the San Francisco Bay Area has multiple cars dedicated to carrying approximately 50 bikes each. The Utah Transit Authority is looking to redesign its commuter rail cars to increase bicycle capacity after finding that cars designed for hold two bikes have regularly been carrying 15 bicycles or more.

Caltrain accommodates large numbers of bike commuters using cars dedicated to bike storage.

Source: Flickr User Richard Masoner

Light rail can accommodate bikes with vertical bicycle racks.

Source: Sound Transit

Compared to commuter trains, light rail transit (LRT) and streetcars have less space to accommodate large numbers of bicycles. However, they can still accommodate bicyclists by providing onboard bicycle racks or designated spaces for bicyclists to stand with their bikes. Some U.S. light rail trains, including Link, use racks that hold bikes vertically, while some European systems use fold-up seats with a rack underneath.

Most regular transit buses don't have onboard space for bicycles given narrow aisles, but bus rapid transit vehicles may have more room to accommodate bicycles. For example, Community Transit's new SWIFT BRT vehicles have three doors and bicycles can be rolled onto the bus and stored in onboard bike racks. Installation of onboard racks protects other riders by securing bikes, provides a more comfortable ride, and possibly results in shorter dwell times at stops.

Community Transit's Swift BRT vehicles have onboard space for bicycles.

Source: Flickr user Oran Viriyincy

In Portland, the City has begun to remove on-street parking in strategic locations to provide higher-capacity bicycle parking opportunities that provide good access to local businesses and, in some cases, are located on high frequency bus stops.

Source: left, Flickr user ITDP; right, Nelson\Nygaard

Bicycle Amenities at Stations and Stops

Bike Parking

Providing bicycle parking at transit facilities is a critical element in achieving high levels of bicycle access to transit. National studies show that a lack of adequate bike parking and other related services is a major deterrent to commuting by bike. Parking that is convenient, secure, weather-protected, and plentiful provides a measure of predictability and comfort for those who want to travel by bike and transit. Wherever possible, bicycle parking should be conveniently located near bus stops; high quality bicycle storage is a must at rail stations and major transit transfer facilities.

Sheltered bike parking provides protection from the heat, snow, and rain. Where there is not adequate curb space and more plentiful parking, parking spaces can be removed to install stalls for on-street bike corrals such as the one shown below.

Secure bike parking provides an additional level of comfort and assurance to bike riders. TriMet's Bike and Ride facilities offer secure, enclosed bike parking that is accessed with a BikeLink keycard. In Long Beach, secure staffed bike parking can be found at the BikeStation, along with other amenities such as repair services, transit information, and electric vehicle recharging.

End-of-trip Facilities

Weather, be it too hot, too cold, too humid or too rainy, is a frequently cited reason people chose not to cycle. However, the problem is often not the lack of willingness to cycle in inclement weather, but the condition people end up in after biking through a rain or snow storm. Developing facilities that allow people to store bikes out of the weather and to shower and change at workplaces can help overcome this barrier.

A good way to encourage commuting in rainy areas is to provide spaces where cyclists have access to facilities at the end of their commute where they can dry off, store clothes, and shower. Ideally, such facilities will provide secure bike parking, protected from the weather. Using regulations or incentive programs, cities can play a part in encouraging or mandating the inclusion of these resources in all new office buildings.

End-of-trip Facilities

Shower and storage facilities can be established for employees of several companies located in close proximity. Examples of this type of arrangement have been organized by Transportation Management Associations in Vancouver, BC and Portland, Oregon. The City of Portland has established a public/private partnership with local fitness centers to provide local area commuters with off-site permanent clothes storage, shower facilities, and secure bike parking. Cyclists can purchase day or monthly passes and access any of the fitness centers. Public/private partnerships reduce the infrastructure investment by the city and allow for a greater geographic network of facilities available to cyclists. Portland's experience indicates that these programs require regular advertising to maintain users.

Although bicycle and rail integration extends bicycle access to transit, it does present potential safety issues that need to be addressed through education, signage and design.

Source: J.Maus

ENHANCING BICYCLE AND RAIL INTEGRATION

Bicycle corridors, be it cycle tracks, bike lanes, or trails, can be installed in or adjacent to rail rights-of-way. In Vancouver, B.C., development of the elevated Skytrain allowed for the development of trails underneath, which have subsequently been linked to a growing network of trails, bicycle boulevards and bike lanes. Installing bicycle corridors alongside rail helps to provide greater integration of bicycling with transit use; however, the systems have to be designed carefully to minimize collisions and accidents.

One potential complication of integrating bicycling with railways it that bicycle wheels can become caught in the flange gap of rail tracks. An Alta Planning and Design report, "Bicycle Interactions and Streetcars: Lessons Learned and Recommendations", stated that "bike-track crashes are a major and underreported problem for Portland-area bicyclists."

This has also been an issue in Seattle as a number of bicyclists have been injured while crossing the tracks of the South Lake Union Streetcar.

The risk of bicycle accidents associated with the flange gap can be reduced by designing the track and cycle alignments to avoid difficult crossing angles. Designing perpendicular crossings, as close as possible to 90 degrees, can be an effective approach. Another way to address this is through good signage and public education for cyclists to make them aware of the tracks and safe practices for crossing the tracks.

Other approaches to reducing potential bicycle accidents associated with bicycle and rail integration include:

- **Center Median Platforms:** Running streetcar and light rail systems along a center median allows curb lanes to be used by bicyclists. Such designs require that stations be located near signalized intersections to reduce conflicts with riders accessing the station. Center platforms also allow consolidated station designs that serve both directions of travel.
- **Expanded Bike Lane:** Expanding the bike lane and space to maneuver at angled crossings improves safety conditions for bicyclists. In Seattle, crossings of the South Lake Union Streetcar line at Westlake and Seventh avenues are aided by a widened bike lane with graphics showing how a bicycle can be maneuvered across the tracks.
- **Bridges:** As new bicycle facilities are developed along transit corridors, the use of dedicated bridges to move bikes and pedestrians across barriers (e.g., rail lines, freeways, topographic obstacles) can increase safety and comfort. However, these improvements can come at a significant cost.

Signage is important for notifying bicyclists about the dangers of riding near tracks.

Source: BikePortland.org

Designing bike paths so that they cross at perpendicular angles to rail tracks increases bicylcling safety.

The City of Portland's "See and Be Seen Campaign" encourages greater awareness of the dangers of limited visibility during winter months.

Source: www.bikeportland.org

PROGRAMS THAT PROMOTE SYSTEMWIDE BICYCLING

Developing a healthy bicycling environment and culture is an important part of supporting good bicycle access and integration with transit. Building a strong and lasting bicycling constituency requires a multi-faceted approach that not only provides required infrastructure, but makes cyclists feel they are part of a broad and growing community. There are a variety of programs and activities that can engender this community spirit toward cycling.

Conducting a Safety Campaign

Cities have limited influence on cyclist and driver behavior at night and in wet weather but some municipal programs have been established to increase awareness and education in this area. The City of Portland and community organizations initiated a public awareness campaign entitled See & Be Seen: Light the Bike. See the Bike to bring greater awareness to the dangers of cycling without proper lighting. The campaign is complemented by the local Community Center providing free lights to needy cyclists through its Get Lit! initiative. Other cities have worked to train truck drivers to look out for bikers when they turn right at intersections.

Celebrating Cycling

Great cycling communities have numerous events that celebrate those that ride, allow families to ride safely together or to pay homage to dedicated cyclists. Some common events include: organized and supported rides, Sunday Parkways activities where local streets are closed to cars and cyclists are free to ride, bike commute month (or week) where local companies can compete for the highest cycling rates, bicycle carnivals or events that showcase numerous types of cycling. All these events can help to build a cycling culture.

Bikeshare Programs

Another program that has proved to be very popular in European cities (Paris, Barcelona, Lyon, Nice, Rome and others) is a "bike share" program in which subscribers can access bicycles at parking stands throughout a city. Often, these systems are paid for, installed and maintained by private entities in exchange for a franchise (such as advertising at transit stops) throughout the project area. American cities such as Denver, Washington DC and Minneapolis are also implementing bike share programs. A primary advantage of the system is that it is flexible for the user, and can be funded privately if the appropriate franchise agreement can be reached with a provider.

Street closures, such as Sunday Streets in San Francisco, help to build a healthy bicycle culture.

Source: Flickr user dustinj

Bikesharing programs allow subscribers to access bicycles at parking stands throughout the city.

Source: Flickr, user Sletvet

7 BEST PRACTICES

Capital Funding and Finance

PORTLAND AND SAN FRANCISCO

WHAT IS IT?

Capital funding and finance is an important consideration in planning for the development of new transit services, especially those that have higher initial start-up costs such as light rail (LRT), streetcar, and Bus Rapid Transit (BRT) systems. Capital costs refer to those expenses associated with implementing service, including initial start-up costs for right-of-way (ROW) improvements, vehicle procurement, stop/station design and development, and construction of storage and maintenance facilities.

In general, streetcar and light rail trade higher capital costs for increased vehicle capacity and lower operating costs per passenger when compared to bus operations. BRT invests in ROW exclusivity and transit priority treatments in return for more reliable service. LRT and BRT can incur significant costs to fully develop station facilities while streetcar stations tend to cost less, in line with a high-amenity bus stop. Rail modes require unique maintenance facilities, necessitating additional land acquisition and construction costs.

WHY DO IT?

Transit agencies around the U.S. are increasingly focused on developing high-capacity, fixed-guideway transit lines to reduce per passenger operating costs over time and to promote walkable mixed use development in transit nodes and corridors. Federal Transit Administration (FTA) grant programs have historically funded major portions of local bus, BRT and LRT capital projects. In recent years, FTA has also supported streetcar capital costs—projects which previously had been funded primarily with local revenues and bonding. Recent adjustments to the FTA Small Starts evaluation criteria relax the emphasis on travel time benefits, opening the door for urban streetcar circulators to be more competitive. Common local funding for streetcar capital projects includes the use of Local Improvement Districts (LIDs) and/or Tax Increment Financing (TIF) to capture the anticipated benefits to adjacent property owners.

Muni used local funds to jumpstart its Third Street Light Rail Project.

Image from Flickr user Schaffner

CAPITAL FUNDING SOURCES

As U.S. cities plan major transit capital investments such as streetcars, BRT or urban light rail projects, they are faced with a decision to pursue the lengthy federal funding process or use local funds to streamline planning and construction. Many successful projects have elected not to pursue federal funding and have used only local and state funds to build streetcar alignments. It is estimated that seeking FTA Small Starts adds as many as five years to the process required to move from preliminary design to revenue service. A local/state process could take from four to seven years, while an FTA process is likely to take 10 or more.

Federal Funding

Federal Transit Administration grants, including the folowing, are a primary source of transit capital investments.

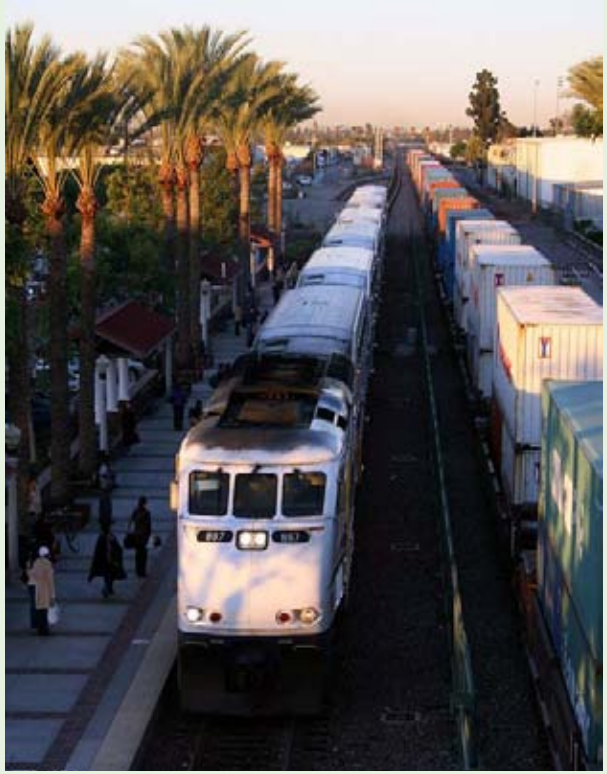
- **Section 5307 Urbanized Area Grant Program:** Formula funding based on population density and provision of transit services
- **Section 5309 Bus, Bus Facility and New/ Small Starts Program:** Competitive grant program for large projects and vehicle procurements, often involving Congressional earmarks

The Small Starts Program was established in the last federal transportation spending bill – the Safe, Accountable, Flexible, Efficient, Transportation Equity Act–A Legacy of Users (SAFTEA-LU) for requests of less than $75 million in federal funding with a total project cost under $250 million. This new category was established to foster the development of less capital-intensive transit systems, such as BRT and streetcar systems. However, recent rulemaking to define the Small Starts application review process has been perceived as biased against streetcars as standards for cost effectiveness outweigh economic development and other benefits. This program is an expansion of the FTA New Starts Program, which is the capital funding program for major transit corridor infrastructure. The FTA funding process can be lengthy, taking seven to well over 10 years from initiation of an alternatives analysis to execution of a full funding agreement. Local match requirements are 20% of the project total cost, but in recent years the FTA has been pushing recipients to pay closer to a 50% local match.

REGIONAL TAX MEASURES

Regional tax measures are a potential source of funding for large-scale transit projects and for regions planning to expand transit infrastructure relatively quickly. Recent examples of major regional tax measures include:

- **FasTracks (Denver, Colorado):** The Denver-Aurora and Boulder metropolitan area is funding its 12-year, $6.5 billion public transportation expansion plan with a combination of federal appropriations, private contributions, and a region-wide sales tax increase. Denver area voters approved the sales tax increase in November 2004. The plan calls for six light rail and commuter lines to be opened between 2013 and 2016. It also includes the expansion of existing light rail stations, the addition of a bus-based rapid transit route, and the expansion of bus routes and parking facilities at rail facilities.
- **Sound Transit 2 (Puget Sound):** Snohomish, King, and Pierce county voters passed a measure increasing the regional general sales tax in July 2008. The measure is intended to raise $17.8 billion over 15 years to pay for a variety of transit improvements, including light rail, streetcar, and commuter rail expansion as well as additional service on commuter rail and express buses (see Overview of Existing Transit Services section for more information).
- **Measure R (Los Angeles):** In November 2008, Measure R was approved by Los Angeles County voters by a two-thirds majority. It approved raising county sales taxes by one-half cent over a 30-year period to fund $40 billion in transportation projects and improvements. This includes a variety of transit projects, such as rail and bus rapid transit lines and improvements on Metrolink commuter rail. L.A.'s Mayor Villaraigosa proposes leveraging the half-cent sales tax with federal guarantees and loans secured by future tax revenues. Those guarantees and loans would allow the Metropolitan Transportation Authority to build 12 major projects specified in the measure in just 10 years rather than the projected 30.



Measure R will raise sales tax in Los Angeles County to pay for a variety of transit projects, including improving Metrolink commuter rail service.

Image from Flickr user SP8254

Housing and Urban Development Funds

While not a traditional source of support for transportation projects, funds from the U.S. Department of Housing and Urban Development (HUD) have been used to support planning and design work on transit projects. HUD earmark funds require a local match.

Local Funding Sources

Many recent capital projects in the United States have relied largely, if not solely on local funding for construction and operation. In a number of cities around the country, avoiding complex requirements associated with federally funded construction projects has allowed for more cost effective and rapid construction and implementation of service. For this reason, many projects, such as Seattle's Bridging the Gap, have funneled federal earmarks to planning and design work rather than construction.

Local Improvement Districts (LIDs)

A local improvement district is a geographic area in which real property is taxed to defray all or part of the costs of a public improvement. The distinctive feature of a special assessment is that its costs are apportioned according to the estimated benefit that will accrue to each property. In Washington, local improvement districts are governed by Chapter 35.43 of the Revised Code of Washington (RCW). It is within the local jurisdiction's discretion to determine the benefits and benefit area of a project financed by a local improvement district.

The basic principle of a local improvement district is that it creates an assessment charge for thosed property owners who receive special benefits from an improvement beyond the general benefits received by all citizens of the community. In the case of streetcar this assessment would be tied to a unique transportation service and to the positive impact of streetcar on property values.

LIDs have been a primary funding source for several recent successful streetcar projects in the Northwest, including the Portland Streetcar and the South Lake Union Streetcar in Seattle.

Image from Flickr user Seattle Municipal Archives

For example, the expansion of the Seattle streetcar network is anticipated to lead to positive changes in property values along the routes. Increased property valuation is expected from the enhancement of the local transportation network, connections with regional transit systems, improved neighborhood economics and livability, and increased property exposure and demand. These expected increases in property value can garner private sector support for the formation of a local improvement district or support the use of tax increment funding.

General Obligation Bonds (Property Tax Supported)

Bonds are a primary source of funds for constructing capital improvement projects. Voter-approved bonds are sold to fund street and other transportation projects. Transportation projects can be grouped in "bond packages," which go before the public for voter approval, or issued separately. General Obligation Bonds can be supported through the city's property tax base or through the transit district's tax base. Bonds can be backed with incremental increases in universally applied city taxes such as those on sales and property. However, it may be more politically acceptable to use a source that has a geographic or functional connection to the proposed alignment. Common sources include:

- Parking meters revenue
- Off-Street parking lots revenue

Page image from Flickr user The Courtyard

WHO'S DOING IT?

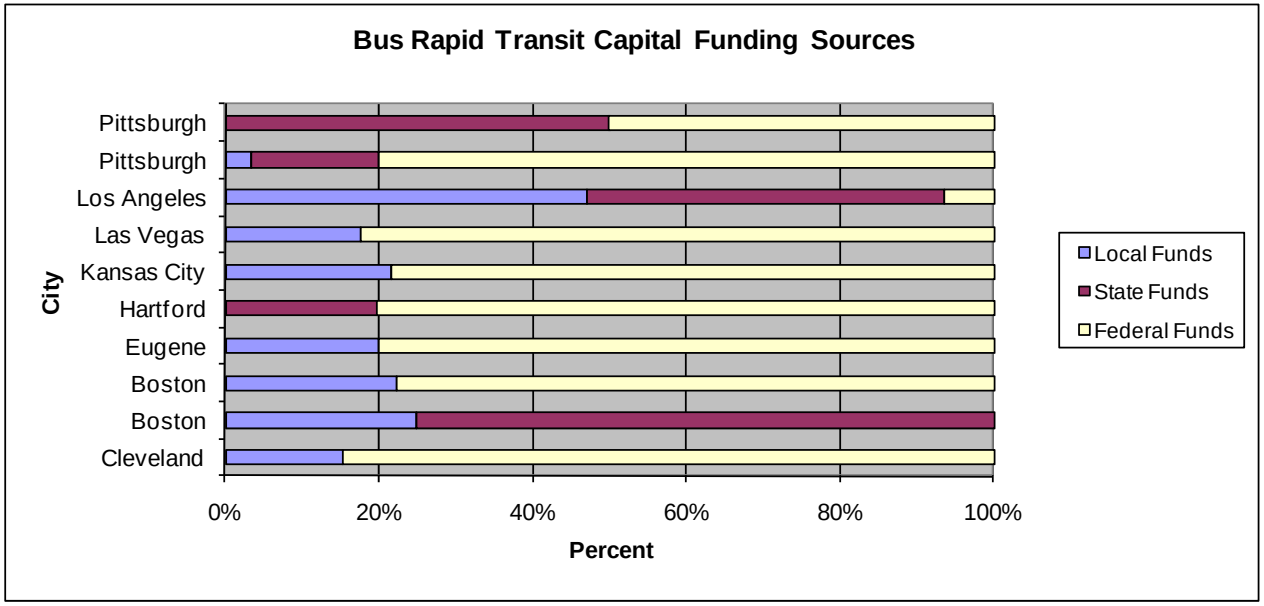
Capital funding varies substantially from state to state and even project to project. Whereas light rail and bus rapid transit projects generally use more traditional sources for capital financing, streetcar capital financing has more often been funded creatively using a variety of local funds.

Bus Rapid Transit

Bus rapid transit capital costs are typically split among local, state, and federal dollars. The percentages of each of these sources varies between projects, but federal funds often make up over 50% of capital costs. The graph on the right summarizes funding sources for various BRT projects.

Funding sources vary for BRT projects, but federal funds typically cover more than half of capital costs.

Image from Wikimedia commons, http://en.wikipedia.org/wiki/File:CAT_Irisbus_Civis.jpg

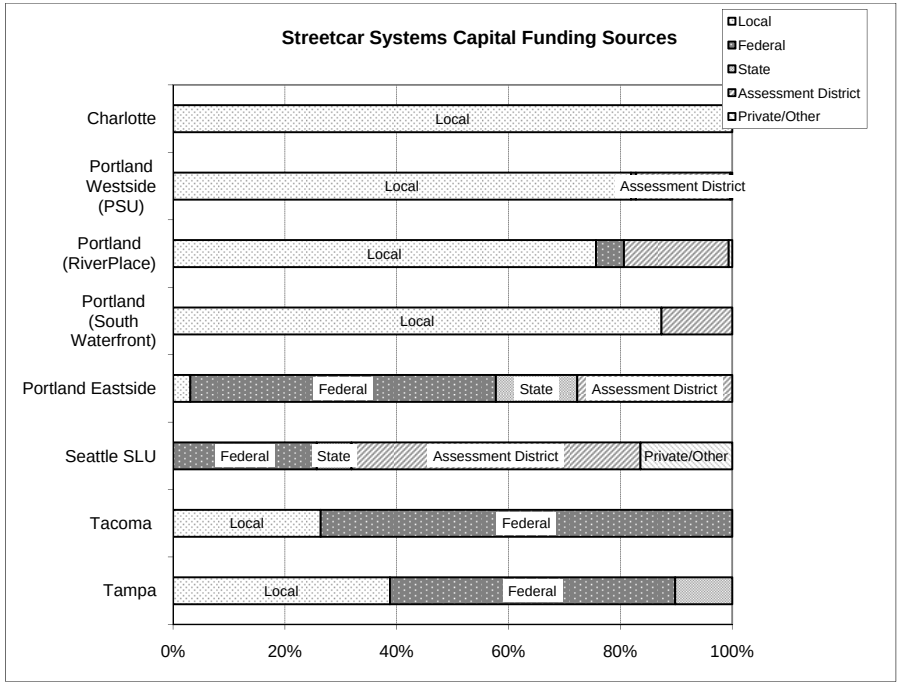


Streetcar Capital Funding

The following sections highlight innovative examples of capital funding in Portland, Oregon and San Francisco, California.

Portland Streetcar. Streetcar projects typically rely on a wide range of funding sources with strong variation even within different projects and phases in the same city. As mentioned, access to federal Small Starts funds are currently perceived as challenging for local circulator projects; however, "rapid streetcar" applications that utilize more aggressive right-of-way treatments will be strong candidates. Relying on local funding can avoid competition with other projects seeking federal funds or restrictions on their use. Key local sources of capital funds include local improvement districts (LIDs), tax increment financing (TIF), and parking revenue bonds.

Relative to the other modes, streetcar has the highest potential to attract funding from both the private and public sectors. The evolution of the Portland Streetcar provides an example of innovative local funding for streetcar development. Portland



Streetcar funding varies by city and project; Charlotte, Portland, Seattle, Tacoma, and Tampa have financed local streetcar projects using local funding sources.

Sources: Leland Consulting, Transit Agency Publications

CAPITAL FUNDING SOURCES FOR PORTLAND'S WESTSIDE AND EASTSIDE STREETCAR SYSTEM

	Westside Streetcar (in millions)	Eastside Loop (in millions)	Westside %	Eastside %
Local				
City Parking Bonds	28.6		27.7%	0.0%
Local Improvement District	19.4	15.5	18.8%	10.5%
Tax Increment Financing	21.5	27.68	20.8%	18.7%
City Funds-General Funds/Dept. Funds	5.5	6.11	5.3%	4.1%
Transportation Land Sale	3.1		3.0%	0.0%
Transportation Systems Development	2.5		2.4%	0.0%
Miscellaneous	5.6		5.4%	0.0%
Regional				
Regional Transportation Funds	10	3.62	9.7%	2.4%
State				
State Lottery Funds		20		13.5%
Federal				
Federal Transportation Funds	5	75	4.8%	50.6%
U.S. HUD Grant	1.95		1.9%	0.0%
Stimulus Funds		0.36	0.0%	0.2%
	103.15	148.27	100%	100%

Source: Portland Streetcar Inc.

Portland financed the construction of its Red Line MAX with a public-private partnership with Bechtel Enterprises.

Image from Flickr user Jason McHuff

relied on local funding sources in the three phases of its Westside Streetcar system and only applied for New Starts funding for the planned Eastside Streetcar loop.

The table below shows the capital funding sources for Portland's Westside (4.0 miles) and Eastside Streetcars (3.3 miles).

The Westside Streetcar utilized a variety of primarily local funding sources, including: city parking bonds (28%), tax increment financing (21%), and a LID (19%). Only about six percent of overall funding came from federal sources. The Eastside Streetcar, currently under construction, also used funds from an LID (10%), and tax increment financing (19%), but also took advantage of state lottery funds (14%) and federal transportation funds (50%).

Muni used local funds from the development of the Third Street light rail (Phase I) as the local match when applying for New Starts funding for Central Subway (Phase 2).

Image from Nelson\Nygaard

Light Rail Capital Funding

Light rail projects typically rely on a greater level of federal funding. The split between federal, state and local dollars varies between projects, but federal funds typically make up over 50% of capital costs. Many projects utilize FTA New Starts funding along with FTA 5307 regional formula funding, Surface Transportation Program (STP) flexible federal funding, and other federal sources.

Portland MAX Light Rail. The Portland Red Line MAX LRT offers an example of innovative financing for light rail construction. A light rail connection between downtown Portland and the airport had been part of regional transportation plans since the mid- 1980s but funding limitations kept the project from moving forward. In 1997, Bechtel Enterprises proposed a public-private partnership in which Bechtel, in return for development rights at LRT stations, would build the MAX extension along with three local government agencies—the Port of Portland, TriMet and the City of Portland. The private investment helped to extend light rail to the airport earlier than anticipated and resulted in the project not using any federal or state general fund dollars or additional local tax levies. The 5.5-mile extension opened in 2001, just four years after the initial proposal of the joint venture.

Third Street Light Rail Project. In San Francisco, Muni utilized local funds to jumpstart the development of the Third Street Light Rail Project, which connects the southeast sector of San Francisco to the rest of the city and regional transit connections. The project was divided into two phases. **Phase 1: Third Street light rail**, developed a surface line traveling north from King Street along Fourth Street, and **Phase 2: Central Subway**, will extend service using a new tunnel beginning near Bryant Street and continuing to Stockton and Clay Streets in Chinatown.

As Phase 2 involves the construction of a new subway tunnel, its budget is more than double the cost of Phase 1. Using local funding for Phase 1 allowed Muni to begin constructing the Third Street light rail more quickly and bypass the lengthy New Starts application process for this phase. This approach allowed Muni to demonstrate its commitment to the project as well as the project's viability. When it did apply for New Starts funding for Phase 2, the agency was able to use the local funds spent in Phase 1 for the local match requirement.

Most of the local funds used in Phase I came from Proposition B and K, local sales tax initiatives that raised money for transit, and regional bridge tolls. Federal funding sources included Section 5307 (Urbanized Area Formula Program), 5309 (Capital Program), and Surface Transportation funds. State funding came primarily from the Transportation Congestion Relief Program and State Transit Assistance funds.

FUNDING FOR THIRD STREET LIGHT RAIL PROJECT (MILLIONS)

	T-Third (Phase 1)	% of Total	Central Subway (Phase 2)	% of Total
Federal	$123.4	19%	$948.4	60%
State	$160.7	25%	$342.0	22%
Local	$364.3	56%	$287.9	18%
Total	$648.4		$1,578.3	

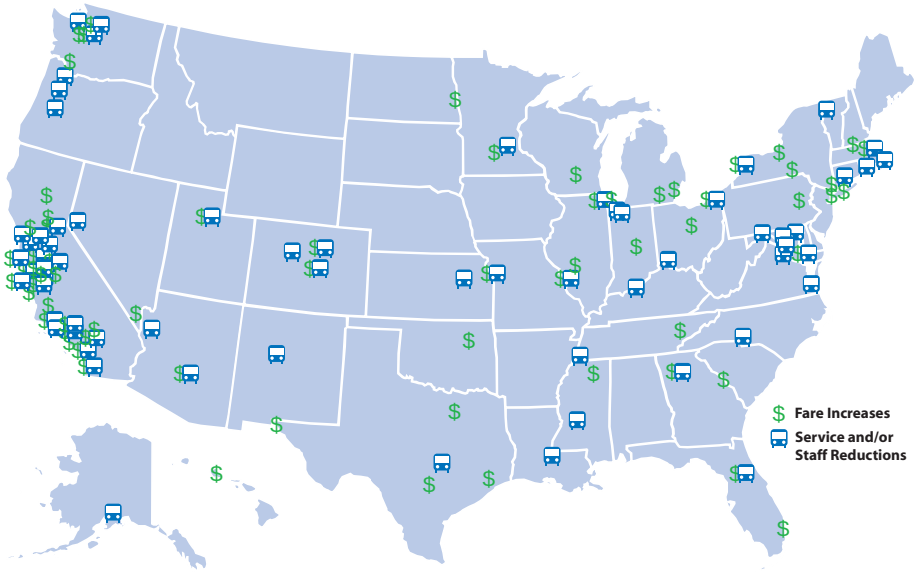
7 BEST PRACTICES

Financing Operations

PORTLAND, SAN FRANCISCO, TAMPA, WASHINGTON, D.C.

WHAT IS IT?

Transit operations include on-going expenses such as operator and administrative labor expenses, fuel/energy costs and vehicle and infrastructure maintenance. In contrast to capital funding, most financing for transit operations in urban areas is local. In Seattle, the primary local financing mechanism for transit operations is a local option sales tax that comprises 62% of King County Metro Transit's operating revenues. In Seattle and across the country, transit agencies have responded to declines in revenue with service reductions and fare increases (see map at right). Seattle voters have also passed several initiatives in recent years to fund specific sets of capital projects or service improvements through increases in dedicated transit sales taxes and limited duration sales taxes. As in other cities, declines in sales tax receipts have extended implementation timelines and/or decreased the scope of planned improvements.



In 2009, transit agencies responded to the economic downtown and declines in operating funding by increasing fares and reducing service and staff. This best practices section discusses both traditional and less widely used sources for financing transit operations.

Source: Transportation for America, Stranded at the Station, 2009

WHY DO IT?

Increased local funding for transit operations can be used to improve service frequency, hours of operation, or coverage. Increasing King County Metro operating funds has been identified as a top priority by Seattle leaders. Cities served by a regional transit provider may want to implement services that achieve goals differing from those prioritized by a regional transit agency. For example, a local jurisdiction may place more value on circulation in downtowns or short distance connections between urban neighborhoods. In addition, as congestion increases, additional buses and operators are needed to maintain even existing service levels. The reliance on sales taxes demonstrates the vulnerability of transit service to changes in economic conditions. Motivations for pursuing innovative local funding sources include:

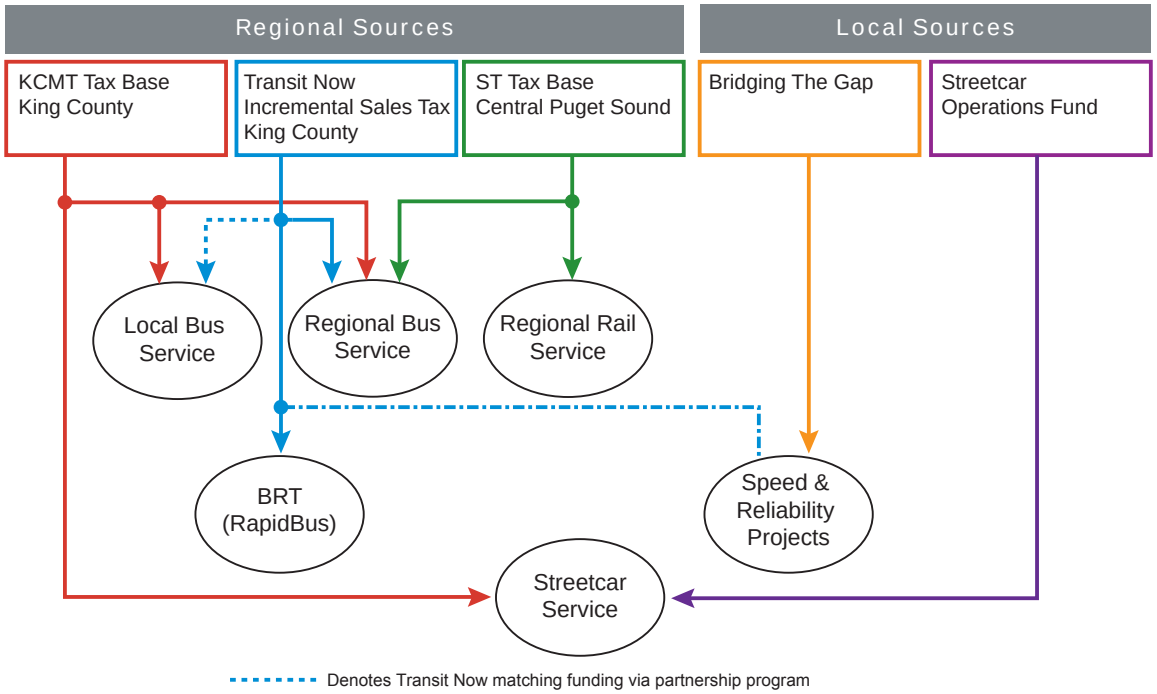
Constraints on existing funding sources. Many cities and regions, Seattle included, have dedicated taxes to fund transit, as shown in Figure 1. For transit operators in the Puget Sound, many of these taxes have reached their maximum allowed level and revenues have declined as a result of the economic downtown. The sales and use tax rate for King County Metro Transit is already 0.9%—the maximum allowed by state law within a Public Transportation Benefit Area (PTBA). In addition, King County's 40/40/20 rule limits the potential for new service investments in Seattle by requiring that 80% of new service investments be made in the South and East Subareas of the county. Other primary sources for funding transit operations are listed in Figure 1.

FIGURE 1 SOURCES OF PRIMARY TRANSIT OPERATIONS FUNDS

Source	Share of Total Transit Funding (Federal, State, and Local)[1]	Local Transit Operations Funding Examples
Fares	25%	All
Dedicated sales tax	16% (primarily local)	Seattle (King County Metro and Sound Transit), Chicago (RTA), Denver (RTD), San Francisco (Muni), Los Angeles (Metro)
General revenues	18% (primarily local)	San Francisco (Muni)
Dedicated fuel tax	14% (federal)	U.S.: Primarily federal Canada: Vancouver, B.C., Montreal, Toronto
Other sources	28%	Property tax: Minneapolis (Metro Transit), Vancouver, B.C. (Translink) Payroll tax: Portland, OR (TriMet), New York (MTA)

Source: [1] Share of total transit funding in 2000 based on analysis for TRB Special Report 235, The Fuel Tax and Alternatives for Transportation Funding, 2006.

FIGURE 2 ALLOCATION OF EXISTING SEATTLE TRANSIT REVENUES



Competition for local funds. Funds generated from current sources are already allocated to existing or planned services, as illustrated in Figure 2, making new local financing sources a critical means of enhancing or establishing new service in Seattle. The following list identifies current transit funding programs in the Seattle region:

- King County's 10-Year Transit Now program (0.1% sales tax) funds identified capital and operating improvements to "core" service as well as RapidRide.
- The City of Seattle's 9-year Bridging the Gap program (property tax, commercial parking tax, and an employee hours tax) funds transportation capital improvements, including transit speed and reliability projects. (Note: The City Council repealed the employee hours tax as of January 1, 2010, noting administrative complexities in collecting the tax and that the commercial parking tax generated more revenue than anticipated.[1])
- Sound Transit's ST2 program (0.5% sales tax increase to 0.9% total) funds capital projects including Link light rail, the First Hill streetcar and operation of commuter rail, light rail, and express bus service. Sound Transit funding also includes a motor vehicle excise tax and car rental tax.

1 Seattle Ordinance 123150; http://www.seattle.gov/rca/taxes/EmployeeHoursTax.htm

As in other regions (for example, Denver's FasTracks pf San Francisco's Measure K), voters in Seattle have demonstrated a willingness to support funding packages (listed above) for specific transportation improvements that have broad community support.

Stable and diversified funding base. Sales taxes are volatile and particularly prone to fluctuations based on economic conditions. Additional funding sources that capitalize on or capture the value of transit can create new, reliable streams of revenue.

Support competitiveness of transit. Speed and reliability improvements that increase transit efficiency (such as by transit priority features or traffic signal timing) or that make transit relatively less expensive compared to other modes can help Seattle achieve multiple goals.

WHO IS DOING IT?

Regional Transit Agency Contributions

Revenues from general transit revenue stream

To the extent a new transit service (e.g., light rail) overlays or replaces existing or planned future services, some portion of the operating cost can be transferred from the bus service that it replaces.

- Portland (OR) Streetcar: The regional transit agency for the Portland region, TriMet, is funded through a payroll tax; Oregon does not have a sales tax. TriMet contributes about two-thirds (58% in 2010) of streetcar operating funding net of fares (i.e., offset by fare revenue). This is approximately equivalent to the cost of bus service that would be required to serve new development along the streetcar alignment. Fares, sponsorships and advertising contribute about 9%. Fare revenue is low because much of the line operates in the downtown fareless rail zone, however the city is evaluating fare policy for its eastside streetcar extension, scheduled to open in late 2011.
- Seattle South Lake Union Streetcar: In 2010, King County Metro assumed responsibility for 75% of operating costs, offset (by fare revenue, which covers 37% of costs). [2] The city will then cover remaining costs, offset by sponsorship revenue and federal operating grants.

2 Seattle 2010 Proposed Budget; Draft Memorandum of Understanding, South Lake Union Streetcar Financing, http://www.cityofseattle.net/transportation/docs/slu18FINAL%20Financing%20Appendix%20C.pdf.

City General Fund

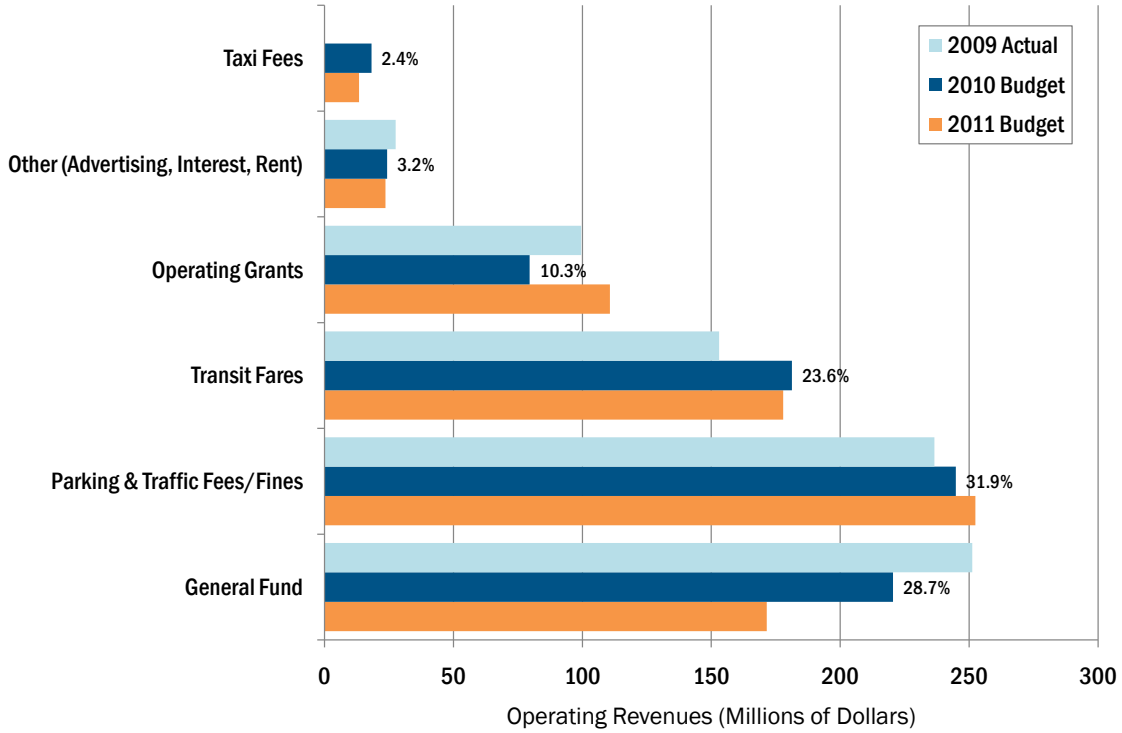
Funding from city general fund and general transportation revenues

General funds are important funding sources in cities that operate their own transit systems (such as San Francisco and Ottawa). General transportation revenues are also important in cities that are part of regional transportation districts but operate transportation services such as local streetcars or bus circulators (i.e., Washington D.C., and Portland).

- In San Francisco, where the Municipal Transportation Agency (MTA) is responsible for transit, parking, and traffic operations, the city's general fund will supply nearly 29% of operating revenue in 2010 (see Figure 3). Transportation-related fees and fines are replacing general funds in both absolute and percentage terms, including a new taxi fee. Part of the decline in general funds in 2011 is due to one-time general funds allocation to replace cuts in state operating assistance, which will be partially restored in 2011.

General transportation funding sources can include those listed in Figure 1 and sources such as parking revenues and impact fees as described below.

FIGURE 3 SAN FRANCISCO MTA OPERATING REVENUES 2009 - 2011



Source: SFMTA 2011-2010 Proposed Budget Book, April 2010

New parking meters installed under the SFpark program will include inceased time limits and pricing that adapts to demand.

Source: SFMTA

Parking Meter Revenues

Allocation of existing and new local revenues

Parking meter revenues help fund transit in a numbers of cities:

- San Francisco dedicates 80% of the total parking tax revenues collected by the City to support transit, the result of a 2007 ballot measure – doubling the previous 40% share allocated to transit. As shown in Figure 3, parking and traffic fees and fines comprise nearly 32% of the MTA operating budget. An increased share of parking revenues is expected to come from parking fees rather than fines under SFpark, a federally-funded pilot program that the city is implementing to test market-based pricing of the city's parking supply. Although the goal of the program is not to raise money, it may increase revenue due to increased prices, extended time limits, and flexibility of credit card payments.
- In Portland (OR), the City uses parking revenue to fund streetcar operations, which is run by the regional transit provider, TriMet. (See detailed case study.)
- In Washington, D.C., the Downtown Business Improvement District is advocating raising parking fees in peak periods and extending metering to Saturdays in parts of the city, using the revenues as a general source for new and improved transit service.[3]
- In Boulder, CO, parking revenues fund the ECOPass program that provides downtown employees and many residents with free transit passes. These revenues help to support a robust local bus system, which is run by the regional transit district (RTD), but carries special local branding and is designed for local circulation.

3 Downtown DC Business Improvement District, Getting From Here to There, http://www.downtowndc.org/_files/docs/leadershiptransportation.pdf

Portland (OR) Streetcar

Parking Revenue

Revenue from parking meters installed in the districts served by the streetcar, including the Pearl and South Waterfront Districts, is used to fund about a third of the streetcar's operating cost ($1.8 million budgeted for 2010). This use of revenue is justified by the streetcar's role in providing central city circulation and in helping open these areas for development, thereby generating parking meter revenue. City policy conditioned an additional $300,000 in annual operating support to a 9% increase in streetcar ridership within two years of the streetcar's extension to the South Waterfront.[1] The city's Transportation System Plan states that parking meter districts should "encourage the use of alternatives to the use of the automobile, and provide a funding source for transportation projects within the districts."

1 http://www.portlandonline.com/auditor/index.cfm?a=94581&c=38633.

Operating Endowment

One-time revenues (such as from land sales) or regular revenues steams (such as from the sale of naming rights or leases) can be used to create a fund that contributes to transit operating costs.

- Tampa (FL) created an endowment fund using proceeds from 10-year sponsorships for the TECO Line Streetcar, named after TECO Energy, which owned the historic streetcars in Tampa and purchased the naming rights for $1 million. Streetcar naming rights were sold for $250,000 and stop naming rights were sold for $100,000. Purchasers are eligible for a 50% state tax credit. Investment earnings and/or drawdown on the principal are used for operations. Tampa plans to renew the sponsorships after 10 years to replenish the endowment.
- Seattle established a South Lake Union Streetcar Operating Fund, to consist of both public and private sources. The city loaned initial operating funds which will be repaid from sponsorship revenue over time.
- King County's Transit Now program created a funding pool for matching financial contributions (or traffic improvements that improve speed and reliability) from private entities and cities. Over an 18-month period starting in September 2008, 14,000 service hours funded by partners leveraged 27,000 hours paid for with Transit Now funds. [4]

Sponsorships, Naming Rights, and Advertising

A number of streetcar and bus circulators have expanded upon traditional transit advertising revenues by allowing sponsorship of different elements of the system. While advertising is a traditional funding source for regional transit agencies, they have not made as extensive use of sponsorships and more innovative private funding opportunities as city-owned streetcar or circulator systems.

- Tampa's TECO Line Streetcar sells advertising (vehicles, farecards, and stations) and leases vehicles for private functions, in addition to sponsorships and naming rights (described above). However, in 2009 advertising and leasing (not including naming rights and sponsorships, used to fund its endowment) accounted for about 2.5% of total revenues. As part of an effort to increase advertising revenues, Tampa is considering a proposal to display messages and/or locations on flat-panel displays as the streetcar approaches an advertiser's location.
- Portland Streetcar (OR) solicits annual sponsorships at a rate of $25,000 per car, $6000 per stop, or $9000 for two stops, including audible announcements. Restaurants within 2 to 4 blocks of the route can also sponsor a listing in a brochure and streetcar map for $600 per year.
- Seattle South Lake Union Streetcar sponsorship revenues were about $500,000 annually in 2008 and 2009, although they are projected at $350,000 in 2010. Sponsors' names are featured at stops or on individual streetcars.

4 http://your.kingcounty.gov/kcdot/transitnow/partnerships.stm

Joint Development and Sale of Land or Development Rights

Joint development (in conjunction with transit facilities), land sales, or sale of development rights above transit maintenance bases are often used as part of the capital funding for transit projects. Encouraging development along a transit line helps increase ridership and fare revenue, but leases or sale proceeds could also be used to develop a revenue stream for transit operations in conjunction with an operating fund or endowment.

Cities including Los Angeles, Chicago, Tampa, and Seattle have used development rights associated with transportation maintenance facilities as mechanisms to fund transit projects. For example:

- In Tampa, a 10,000 square foot site at the TECO Line's southern terminus is reserved for future joint development. The Ybor City Station maintenance base (photo) was also built with future joint development in mind, including the second floor and a companion structure including a streetcar museum, offices, and retail.
- In Seattle, the maintenance base for the South Lake Union streetcar is on an about 32,000 square foot site with 9,000 square feet of usable space in the maintenance facility building, including 2,000 square feet of space located on a second level. An analysis conducted for the City of Seattle analyzed development potential for both commercial and residential development and concluded that selling residential development rights would have the highest yield, between $2.7 to $3.4 million.[5] The city plans to sell air rights and surplus property at the facility once the real estate market recovers.

Buildout of the second floor of the Tampa Streetcar maintenance facility is envisioned as a joint development opportunity.
Source: RailwayPreservation.com

5 South Lake Union Capitol Financing and Operating and Maintenance Plan, April 2005.

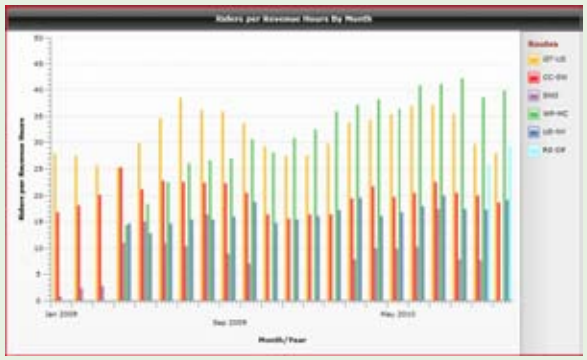
Washington, D.C. Circulator

City Transportation General Fund

The Washington, D.C. Circulator is a downtown circulator service owned by the Washington D.C. Department of Transportation (DDOT) in partnership with the regional Washington Metropolitan Area Transit Authority (WMATA), and operated by a private contractor. The circulator is funded through DDOT's general fund, consisting of revenues from a tax on parking, utility right-of-way fees, public space rental, parking meters, bus shelter advertising, and other sources.

The service uses "branded" buses and is designed to connect activity centers, filling gaps in other transit services. The initial system had two routes running east-west and north-south, contrasting with regional bus and Metro rail services that run radially from the city center to suburbs, but has since expanded to seven routes. Buses run every 10 minutes, including on weekends, with a fare of $1 per ride or $3 for a day pass. Unlike some other circulator services, it operates with limited stops.

Source: D.C. Circulator



Ridership has increased over time, with the most productive line carrying over 40 riders per hour of revenue service (range of 18 to 40 riders per hour in October 2010)

Source: http://circulatordashboard.dc.gov

Impact Fees

San Francisco's Transit Impact Development Fee (TIDF) assesses a fee on all non-residential development in the city, recognizing transit's role and added value in serving development.[6] The fee is two-tiered currently $9.07 or $11.34 per square foot (indexed for inflation), based on the level of transit demand attributable to each of the six land use categories defined in the ordinance. The TIDF generates a modest amount of revenue to fund transit service improvements—slightly over $2 million collected in 2008 and nearly $120 million in fees and earned interest between 1981 and 2008.

San Francisco's Transit Impact Development Fee (TIDF) and market-based parking pricing initiative (SFpark) are described in detail in the Transit Impact Fees and Transit First Policy best practices section.

Assessment Districts

An assessment district levies a fee on property owners benefiting from a transportation improvement. This is an additional operations funding source for Tampa's TECO Line Streetcar, however, use of such a Local Improvement District (LID) is not allowed for funding operations in Washington State. Transportation Benefit Districts (TBDs) are another type of assessment district, allowed in Washington State under a 2007 law.[7] In 2010, Seattle created a TBD and imposed a $20 vehicle registration fee, the maximum allowed without voter approval under the state law[8] A vehicle registration fee of up to $100 or other funding sources are permitted with voter approval.

Motor Fuel Taxes

Although all states have gas taxes and a number of states have local option gas taxes, 30 states prohibit their use for transit. An analysis of options for generating $1 million in local transit funding in Portland (OR) found that a gas tax had the least distorting economic effects (sales taxes were moderate).[9] A constraint affecting gas taxes is that they decline in value over time due to inflation (unless indexed for inflation, since gas tax increases are typically politically difficult) and due to increasing vehicle fuel efficiency. The limited examples of local fuel taxes used for transit include:[10]

6 http://www.municode.com/content/4201/14131/HTML/ch038.html

7 http://www.dol.wa.gov/vehicleregistration/localfees.html

8 http://www.seattle.gov/stbd/

9 James G. Strathman and Kenneth J. Dueker, Regional Economic Impacts of Local Transit Financing Alternatives, Transportation Research Record No. 1116, 1987

10 James G. Strathman and Kenneth J. Dueker, Regional Economic Impacts of Local Transit Financing Alternatives, Transportation Research Record No. 1116, 1987

- In Florida, local governments are authorized to enact a local option gas tax. Miami-Dade County has enacted such a tax.
- In both Montreal and Toronto, a portion of the provincial gas tax (1.5 cents per liter) is dedicated to transit.
- In Vancouver, B.C., Translink funding includes an 11.5 cent per liter fuel tax.

Congestion Pricing and Toll Revenue

As described in the Congestion Pricing best practices section, market-based road pricing can contribute to transit operating cost and has two primary benefits for transit operations:

- Pricing revenues can be used to fund increased levels of transit service.
- Alleviating congestion reduces transit travel times and operating cost, increasing the buying power of existing operating revenues.

These benefits have been demonstrated internationally (e.g. London) but have not yet been applied on a wide-scale in the U.S. The Seattle Variable Tolling Study[11] identified variable tolling as a potential transit revenue source.

Toll revenues have been used to fund transit operations in other states. There are restrictions for facilities receiving federal funding and in some cases their use is limited to the facility on which they were collected. The Washington State Legislature must authorize tolls and state law icludes a similar restriction[12]. Examples of more general use of toll revenues for operations include:

- In the San Francisco Bay Area, 18% of toll revenues on seven state-owned bridges is set aside for transit. This includes 5% of a 1988 toll increase targeted for transit operations and capital projects to relieve congestion. (However, since 2000 the state has funded this set-aside while making bridge improvements that are receiving federal funding.[13]) An additional toll increase in 2004 also funds regional transit operations. Tolls on the Golden Gate Bridge comprised 46% of operating revenues for the Golden Gate Transit District in the 2010 fiscal year. The district operates bus service over the bridge and ferry service between Marin County and San Francisco.
- In San Diego (CA), state law requires use of net toll revenue on the I-15 HOT Lanes (about $1.2 million or nearly 60%) to support transit in the corridor.[14]
- In New York, bridge and tunnel revenues contribute to Metropolitan Transportation Agency (MTA) transit programs.

Other Private Sources

Bulk Sale of Passes. Bulk sales of streetcar-only passes yield about $3000 annually for the South Lake Union Streetcar.

Providing Contracted Service. To the extent that transit can alleviate the need for employer-provided transit service, required under commute trip reduction ordinances in the Seattle area, employers may be willing contribute toward operating costs. In San Francisco, which operates its own transit system, some private employers have even expressed interest in consolidating employer-provided shuttles using a city-provided service.[15]

Emissions Credits

Los Angeles Metro generates Mobile Source Emissions Credits through the South Coast Air Quality Management District (SCAQMD) when it operates alternative fuel buses with engines cleaner than state requirements. These credits can be traded known as RECLAIM and sold in the district's emissions trading market.

Facility Leasing. Leasing portions of physical facilities to private operators is a revenue source for a number of large agencies. Boston and St. Louis offer examples of leasing telecommunications access rights (typically for fiber-optic cable) along rights of way; this can include free or reduced-cost use for the transit agency.

Federal

Federal funding is primarily for capital projects in urban areas. However several federal funding programs have some potential application for operations funding.

FTA 5307/5309. Seattle receives money from these programs for maintenance for the Monorail. These funds are allocated by the Puget Sound Regional Council (PSRC) using a formula based on the percentage of transit trips served.[16] A small share (less than 10%) of Seattle Streetcar operating revenues are derived from federal grants for preventative maintenance.

CMAQ (Congestion Mitigation and Air Quality). Funds under this program are limited to three years of operating support.

11 http://www.cityofseattle.net/transportation/docs/FINAL%20Tolling%20Study%20report%20revised%206.25.10.pdf

12 http://apps.leg.wa.gov/rcw/default.aspx?cite=47.56.820

13 Bay Area Toll Authority, http://bata.mtc.ca.gov/funded.htm

14 TCRP Report 129, Local and Regional Funding Mechanisms for Public Transportation, 2009.

15 Strategic Analysis Report, The Role of Shuttle Services in San Francisco's Transportation System, June 2010.

16 South Lake Union Capitol Financing and Operating and Maintenance Plan, April 2005.

7 BEST PRACTICES

Center City Circulation

DENVER – MINNEAPOLIS – PORTLAND – SAN FRANCISCO

WHAT IS IT?

Seattle Center City is the hub for regional public transportation, with rail vehicles and buses arriving from all over King County as well as Snohomish and Pierce Counties. Seattle Center City avenues have some of the highest concentrations of buses in the country at peak hours. During peak travel periods, Third Avenue becomes a limited use facility for transit and bicycles. Dedicated lanes and passenger waiting areas are needed to carry large numbers of people into and through downtown; however, these types of facilities force tradeoffs with other important right-of-way functions such as on-street parking, sidewalk space, bicycle lanes, loading zones for deliveries, and general purpose travel lanes. As Seattle grows, demand for transit to downtown and throughout the Center City will expand as well. A system that supports regional access to downtown and movement around the Center City, supports a vibrant street life, and minimizes spatial and environmental impacts is a critical and challenging objective.

Generally, Center City transit operates most efficiently when service focuses around a limited number of transit priority corridors, along a linear transit facility, or a combination of both. Seattle has these features, but spatial constraints provide little room for expansion. The geography of Seattle's Center City is compact but presents challenges for the provision of efficient transit circulation. The hourglass shape of the Center City limits north-south right-of-way

between Elliott Bay to the west and Interstate 5 freeway to the east. Furthermore, access to transit is significantly limited by the steep hills from the waterfront east to First Hill. Steep grades confine the number of corridors that can be used as feasible perpendicular transfer points. Because of these physical constraints, linear circulation is limited to a few major north-south Avenues, including the 3rd Avenue Transit Mall and the Downtown Transit Tunnel.

The city is challenged to gain more capacity from existing right-of-way while improving the simplicity and legibility of the system. King County has made significant strides in recent years to clarify its complex bus routing patterns and provide simplified public information. Still, the system is complicated and oriented toward travelers coming in and out of downtown, not those traveling within the Center City. Thinking about the distinction between these two markets is useful. Like Seattle, most major city downtowns have:

- **Inter-neighborhood or regional long-haul commute travelers** who are commuting into downtown for jobs or services. Traveling longer distances, these customers are sensitive to speed and service reliability. They often use just one or two routed services.

- **Inner-city circulation travelers** making short circulation trips within the Center City. This market includes commuters transferring to complete the last segment of their trip; downtown employees or residents running errands, attending meetings, and going to lunch or dinner; and car-free visitors to the city. Transit trips here are often short, thus travel speeds are not as important as frequency. Users demanding this type of service are more likely to be infrequent transit users, thus requiring a much higher level of transparency and user information.

WHY DO IT?

Transit is visible and available everywhere you go in Seattle Center City. But how easy is it to access, and does it provide a good alternative to walking or driving for people making short trips? A number of U.S. cities have recently re-structured downtown transit operations and invested in transit facilities that make transit more efficient and accessible. Efficient, transparent, and highly useable Center City transit will be critical for Seattle to meet its aggressive goals for growth in this area, mode shift, carbon neutrality, and economic development. Improved Center City circulation will be critical in helping Seattle to:

- **Attract more Seattle Center City commuters to transit.** Regional transit services such as Washington State Ferries and Sound Transit's Sounder Commuter Rail services get passengers to the edge of downtown. Providing attractive last mile connections to downtown and places like First Hill affects people's decision making. When Tacoma opened its short downtown streetcar circulator, regional bus ridership to the Tacoma Dome Station (the end of the streetcar line) increased fivefold.
- **Reduce very short auto trips on the city's most congested arterials.** Many cities have studied the amount of downtown traffic generated by people searching for parking and found 20-30% of all downtown vehicles are doing just that!
- In Portland, the city and business organizations have strategically located short-term public parking facilities on light rail and streetcar lines to allow visitors to drive into the downtown core, park once, and use transit to access downtown's services and amenities. Portland claims to have one of the largest 20-minute retail sheds reachable without a car in the nation.
- **Allow more residents to live car free.** As Seattle Center City residential densities continue to grow, efficient downtown transit circulation will promote car-free urban lifestyles. This in turn will reduce the overall transportation footprint in the Center City.
- **Evolve Seattle Center City as a world class tourist destination.** With the redevelopment of the Central Waterfront, Seattle will mark a significant event in the evolution of the city as a major world tourist destination. Travelers expect and desire high quality transportation options allowing travel between key Center City destinations.

During peak travel periods, Third Avenue becomes a limited use facility for transit and bicycles

Image from Oran Viriyincy, Creative Commons 2.0

WHO IS DOING IT?

In order to develop a successful center city transit environment, several key elements should be considered for implementation: service design, capital facilities development, wayfinding, and placemaking. The experience in each peer city stresses the importance of a holistic approach that addresses each of these elements. The following section discusses center city circulation systems in Portland, Minneapolis, Denver, and San Francisco.

Portland: Leveraging Surface Rail through Placemaking, Wayfinding, and Reduced Bus Volumes

Many U.S. cities are making efforts to improve transit operations and capacity in their center cities. These efforts face similar challenges: how to provide dedicated transit streets or lanes while supporting multimodal access and circulation and contributing to a vital street life. Transit priority streets designed to optimize transit speed, reliability and capacity are an increasingly common approach, and one already employed in Seattle. Transit streets can benefit from traffic signal synchronization to minimize delay as buses travel through intersections. Light rail lines can feed into linear bus facilities or provide circulation itself, which is especially useful for downtown commuters looking to complete the last mile of their trip.

In many center cities, transit streets have drawn criticism from local businesses for being eyesores, being unsafe, or reducing pedestrian circulation due to waiting passengers. When it decided to rebuild its aging transit mall to accommodate light rail, Portland and its transit agency partner, TriMet, developed a planning process that considered all these concerns and included business owners as planning and funding partners. Coupled with an integrated vision for placemaking and wayfinding, the two agencies developed the transit mall, including light rail, as the Center City's circulation centerpiece. Key challenges and approaches to this process include:

- **Challenges in Portland**
  1. Bringing new light rail lines into the Center City on surface streets.
  2. Revitalizing an aging transit mall that was a concern for businesses.
  3. Reducing the impact or negative perception associated with high bus volumes.

- **Portland's Approach**
  1. **Reduced bus volumes** in the Center City by shortening high frequency routes that run perpendicular to light rail lines. In addition, a light rail circulator was added to facilitate easy transfers. Operational re-design included increased bus and rail stop spacing in the Center City to improve transit speed, which also allowed the innovative "weave" track design and bus operating design.
  2. **Began the entire redesign process from the perspective of placemaking,** focusing on seven key nodes and conducting a great streets/great places type analysis to envision how those places would be transformed through this major street reconstruction.
  3. **Simplified wayfinding and improved route legibility** by creating a new signage program and service organization structure ("skip-stop") that associates certain stops with geographic areas of the city/region.

The Portland Transit Mall (top) vastly improved downtown travel speeds and system transparency by reducing bus volumes. Skip-stop route structuring (bottom) organized routes into easy to remember letters (A-B-C and X-Y-Z for southbound and northbound travel, respectively). Users can look up their "stop letter" on system maps to identify where their route makes stops in downtown.

Images from Nelson/Nygaard

PLACEMAKING: TURNING TRANSIT STREETS INTO ACTIVE ENVIRONMENTS

Arguably, the most important component of center city circulation is designing pedestrian-friendly transit streets. Along with the transit stop, the streetscapes that characterize transit priority streets are the user interface for transit. Thus, the importance of placemaking cannot be overstated. Urban placemaking for seven major center city nodes or intersections was the foundational element of the redesign of Portland's Transit Mall. The desire for 24-hour active streets that support retail and activities helped drive decisions to retain a general purpose traffic lane and to reduce bus volumes by routing key services perpendicular to the transit mall and providing a high-frequency rail circulator. In addition to the transit priority features in place, Portland's Transit Mall incorporates wide sidewalks with distinctive paving, a variety of seating options, well-lit and covered bus and light rail stations, and public art. Similarly, Minneapolis' Nicollet Mall provides wide sidewalks with café seating, pedestrian lighting, park benches, and continuous retail activity.

Denver has taken a unique approach to designing a primary transit street. Sixteenth Street is a transit and pedestrian-only street that elevates the transit experience by turning the street into the destination. This mixed-use pedestrian street bisects the core of Denver's Center City and offers a bevy of street activity, restaurants, and cultural events. The 16th Street Mall FREE MallRide runs every two minutes during peak hours, allowing customers to look up the street and see a vehicle approaching at all times.

In all cases, these linear transit corridors offer some level of tactility from increased accessible design and detectable warnings to textured pavement design and installation of brick pavers. As is the case in Minneapolis, Denver, and Portland, the most pedestrian-friendly corridors are synonymous with access to frequent transit service. Below is a list of components that transform transit corridors into great places:

- Active retail frontage
- Expansive sidewalks (in the range of 15 to 30 feet)
- Continuous and themed lighting schemes
- Pedestrian buffers such as trees and landscaping
- Space for café seating
- Coordinated public art program
- Curb extensions and pedestrian crossing features
- Level boarding features
- Enhanced bus shelters and stop amenities
- Wayfinding signage

New glass and steel transit shelters and covered bicycle facilities on the Portland Transit Mall provide weather protection while creating an open, inviting, and safe pedestrian environment.

Image from Nelson/Nygaard

Minneapolis: Prioritizing Transit in the Center City and Improving Passenger Experience

The focal point of Minneapolis' regional bus network is centered along four north-south transit priority corridors: Nicollet, Hennepin, Marquette, and 2nd Avenue. The light rail network runs perpendicular to the north-south corridors along 5th Street and currently terminates at the Northstar commuter rail station. Using dedicated transit lanes, restricted vehicle movements, and other transit priority treatments, the transit operating environment was re-designed to balance enhanced transit throughput with access to Center City offices, retail, entertainment, and services. The bullets below summarize the challenges posed along the four north-south transit corridors and the approaches to improving access into and circulation throughout the Center City:

- **Challenges in Minneapolis**
  1. Bringing new light rail lines into the Center City on surface streets with a need to distribute passengers to a large gridded area.
  2. Accommodating significant volumes of peak period buses destined for the Center City
  3. Providing a better passenger waiting experience and information in an adverse weather climate
- **Minneapolis' Approach**
  1. **Created new linear contraflow dual transit lanes** on Marquette and 2nd Avenue to absorb high bus volumes—largely regional express services. Each street provides two general purpose lanes for vehicle traffic (southbound on Marquette, northbound on 2nd Avenue). These facilities run perpendicular to the Hiawatha light rail line and provide significant peak period bus throughput capacity with two parallel transit lanes in each direction.
  2. **Promoted local bus lines as circulation** along the Nicollet Mall—Minneapolis' "main street." Metro Transit exclusively operates hybrid electric buses along the Nicollet Mall to reduce noise impacts and improve the image of transit. Transit service on the Nicollet Mall is free. The City of Minneapolis is currently studying feasibility of a streetcar circulator to supplement or replace bus circulation on Nicollet.
- **Enhanced the pedestrian environment** with passenger waiting areas that include dynamic signage with real-time passenger information and streetscapes with wide sidewalks, street trees, planters, and public art.

Nicollet Mall in Minneapolis offers an attractive pedestrian realm well-served by frequent transit service (top). Hiawatha light rail feeds into the Nicollet Mall (bottom).

Images from Nelson/Nygaard

Denver: Regional Transit Hubs, Surface Circulation

In Denver, the City and the Regional Transit District (RTD) have strategically located regional transit hubs—Union Station and Civic Center Station—at the fringe of the city's core and created a high frequency linear transit circulator to link the two. This approach provides a highly transparent and frequent transit circulator, running on what is otherwise a pedestrian street, while also providing convenient Center City access for commuters. While commuters may have to transfer, they never need to wait for more than two minutes for the shuttle bus. The following key mobility and access challenges were addressed in Denver:

- Challenges in Denver
  1. Accommodating heavy regional bus volume through the Center City.
  2. Improving Center City access for passengers using the rapidly growing regional light rail system.

16th Street Transit/Pedestrian Mall, Denver.
Image from Nelson/Nygaard

Sixteenth Street is a transit and pedestrian-only street that elevates the transit experience by turning the street into the destination.
Image from Flickr

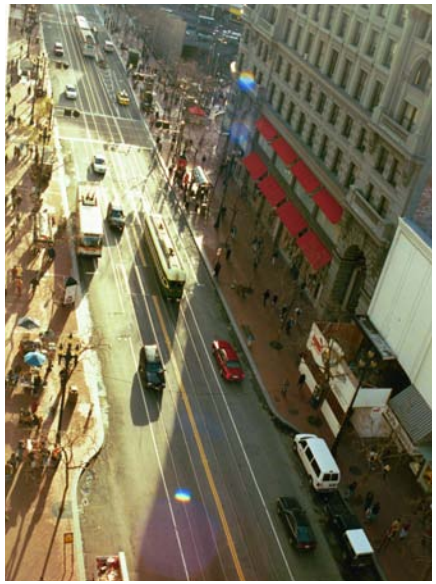
- Denver's Approach
  1. **Created the FREE MallRide along the 16th Street Mall** to connect regional transit hubs at either end of downtown. The Free MallRide is the sole transit mode operating on the 16th Street Mall offering service as frequently as every two minutes. The Free Mall Ride also uses a fleet of specially designed, low-floor hybrid electric vehicles with five-door boarding and alighting that are very clearly marketed as a free circulator. Recently developed light rail services were strategically designed to cross perpendicular to the 16th Street Mall, taking advantage of the Mall Shuttle to provide perpendicular circulation to rail-serving streets.
  2. **Funneled major capital improvements into the Center City to support its level of service and provide a foundation for growth.** This includes the development of the 16th Street Transit and Pedestrian Mall anchored by commuter transit service hubs at Civic Center and Union Stations—a major investment made in the early 1980's. RTD and the City of Denver are now redeveloping Union Station as a major transit hub to accommodate light rail, commuter rail, regional bus, and as an enhanced anchor to the 16th Street Mall circulator. This project includes the development of multilevel bus and rail bays with vertical circulation, a major rail platform, and integrated housing and office development.

San Francisco: World Class Regional Transit Hub, Streetcar Circulators

Built in 1939, San Francisco's Transbay Terminal has long been a central hub for regional transit services. In preparing for California High Speed rail and in an effort to modernize its regional transit infrastructure as a model for transit hubs around the world, the terminal is undergoing a major ($4 billion) redevelopment to serve 45 million annual passengers. The facility will serve multiple agencies including AC Transit, BART, Muni, Golden Gate Transit, SamTrans, Greyhound, and California High Speed Rail. The Transbay Redevelopment Authority was formed to develop a new urban neighborhood on and around the site, cleaning up a run down area through the redevelopment of 40 acres of land. The development is projected to include 3,400 new homes including many affordable units, as well as high rise office space. Construction began in 2008.

The construction of San Francisco's Market Street Tunnel as part of the BART system development, which took place in the 1960s, also developed underground facilities for Muni's local light rail transit. Traveling underground through the most congested areas of downtown greatly increased the speed and reliability of these services. In 1995, historic streetcars were returned to Market Street when the F Market line reopened using historic Electric Railway Presidents' Conference Committee (PCC) streetcars. These streetcars were restored and painted with designs from historic streetcar systems around the nation. The service was designed primarily to circulate tourists and for short local trips; Muni was surprised to find that many local commuters using the Muni subway services chose to travel on the slower surface streetcars. This emphasizes the value of surface rail transit, even in an environment where subway circulation is present.

- Challenges in San Francisco
  1. High regional transit ridership to a few major downtown subterranean stations (BART) .
  2. Limited highway infrastructure including recent removal of the Embarcadero Freeway.
  3. Institution of a "transit first" policy requiring transit to keep up with growth demand.
- San Francisco's Approach
  1. **Integrated the F-Line streetcar onto Market Street as downtown's circulator.** This improved frequent connections throughout downtown and the Embarcadero. Several north-south routes feed into the F-Line and Muni Metro subway options for downtown circulation.
  2. **Integrated 3rd Street Light Rail into Market Street subway operations** and will eventually route this line into a new subway tunnel to Chinatown for additional mobility to various urban neighborhoods.
  3. **Redeveloping Transbay Terminal as major civic infrastructure project.** The new Transbay Transit Center will be the central focus point of regional rail and bus travel supplemented by simplified connections to downtown circulation via the F-Line streetcar. This is a $4 billion transit investment that will create new transit-oriented communities and urban greenspace.



Market Street and the F-Line (left) will soon circulate to and from the Transbay Transit Center (right), a groundbreaking intermodal transit hub.

Images from Nelson/Nygaard (left) and Transbay Joint Powers Authority (right)

7 BEST PRACTICES

Regional Governance of Transit

PORTLAND, SAN FRANCISCO, BOULDER, GERMANY, AND SWITZERLAND

WHAT IS IT?

Quality transit services and supportive land uses are critical in meeting both local and regional goals. Local jurisdictions, counties and entire metropolitan areas rely on public transportation to address mobility, social equity, economic development, and environmental objectives. The planning for, funding of, and delivery of transit is often viewed differently by the local and regional bodies that make up a metropolitan area. Long-established governance structures have often evolved from outdated political, funding or demographic realities; however, since these structures control funding and decision making they can be very difficult to change. Since transit services often cross jurisdictional boundaries, transit governance tends to be more complicated, layered and nuanced than land use governance, for example. Furthermore, transit governance is often separated from other municipal transportation services (streets, pedestrian, and bicycle facilities), isolating decision making in a way that can be counterproductive to addressing broader land use, mobility, access, and equity goals. Transit governance in Seattle is unique in many ways. There is almost no local transit governance (Everett Transit and City of Seattle's South Lake Union streetcar are rare examples); transit is governed at the County level (King, Pierce and Snohomish Counties), except for Sound Transit, which acts as a stand-alone agency with its own governing board charged with managing regional rail and express bus service.

In Portland, the region uses major transit investments as a key tool to catalyze land use and create great neighborhoods.

Source: Nelson\Nygaard

WHY DO IT?

Major changes to transit or transportation/land use governance structures are uncommon and typically only happen when there is strong incentive for change or a new funding authority allows opportunity for growth. However, minor policy adjustments to address funding or decision-making imbalance are more common. Likewise, new layers of governance are at times added to improve cross-agency coordination and improve the effectiveness of decision making. Since transit agency staffs and local jurisdictional staff work together frequently, they often have a strong understanding of the challenges or constraints faced by a city, region, or system. Common motivation at the staff level is often too little to affect change since funding is usually tied to specific programs, geographies or service types. In an environment where staff level coordination yields little result in the board room or council chambers, staff can become disengaged or retreat to their area of influence. Action toward governance reform is often a matter of timing, requiring jurisdictions to act when political seating and funding conditions align (often a recession is a more powerful force toward change than times of economic strength). Lean economic times result in the need to prioritize and ensure equitable access to resources and services while making efficient use of available transit service and administrative staff.

The most important reason to consider governance reform should be quality of the end public service to the user, in this case transit services consumed by current or potential future users. In multi-agency transit environments there are great challenges to creating a set of services that hold together as a high-performing network with consistent information, wayfinding, tactile form, branding, fare policies, transfer requirements, accessibility policies and designs, etc. The development of the ORCA universal fare card is an example of a coordinated regional effort that benefits transit users who travel on multiple regional systems. However, many would also point to the duration of time in development, complexity, and limitations of this regional effort as a sign of the need for regional governance reform.

Portland has strived to integrate transit into the urban fabric. Here the streetcar winds through the Portland State University Urban Plaza.

Source: Nelson\Nygaard

WHO IS DOING IT?

Coordinated Regional Planning: Portland

TriMet provides bus, light rail and commuter rail service in the Portland metro area. The agency was formed in 1969 (previously Rose City Transit) after the Oregon Legislature passed House Bill 1808 allowing the creation of transit districts and providing them with the power to raise revenue through a payroll tax. TriMet's formation was, in part, an attempt to save transit in the Portland region at a time when Rose City Transit, the primary provider of transit, was facing bankruptcy and had threatened to cut all service. Shortly after the agency formed, the TriMet Board of Directors adopted a payroll tax to fund operations. Oregon has no sales tax, a common funding mechanism for transit agencies in other states. The agency is governed by a seven-member board of directors, appointed by the Governor of Oregon. Due in part to a long string of Democratic governors, the TriMet Board has seen relatively less controversy and divisiveness than other governing bodies with elected or appointed structures.

Metro, meanwhile, is an elected regional government with responsibility for planning. Metro serves as the region's Metropolitan Planning Organization (MPO), but has substantially more legislative control than a typical MPO. Metro has control over regional land use, and uses an Urban Growth Boundary (UGB) and the 2040 Growth Concept, a regional transportation and land use plan developed in the 1990s and continually updated, to manage regional land use and development. Transportation and land use decisions at Metro are guided by a complex committee structure that includes representatives from all regional cities and counties, as well as transportation providers including TriMet. To further the coordination of land use and transportation, Metro has control over planning for High Capacity Transit (HCT). HCT is formally defined in the Regional Transportation Plan as transit service operating in completely dedicated right-of-way with a high level of service quality and limited stop spacing. Metro's Corridor Planning Division has the primary responsibility of identifying future major transit corridor investments and working with the FTA, other federal regulatory agencies, TriMet, the Oregon Department of Transportation (ODOT), and local jurisdictions to develop Alternatives Analyses and Environmental Impact Statements for major transit projects. Metro works in close partnership with TriMet, which often leads design work for light rail and other high capacity transit projects. The institutional capacity and relationships with the Federal Transit Administration (FTA) that have been developed over the last two decades have been critical in the construction of over 52 miles of light rail and 14.7 miles of commuter rail transit.

This strong relationship with the FTA is boosted by having a limited set of agencies involved in all regional major transit investment projects. Portland is also respected by federal funding agencies for its ability to demonstrate a common regional vision and support for major projects. Continued advocacy for transit in the U.S. Congress and a willingness to innovate has helped Portland continue to be competitive for federal capital funding, even as national competition has increased.

In 2009, Metro (working with TriMet and all 26 regional cities and counties) developed a Regional High Capacity Transit System Plan. The intent of this effort was to build on the previous 1982 plan

Commuter's wait for MAX light rail train in downtown Portland under lighted shelters on the City's newly rebuilt transit mall.
Source: Nelson\Nygaard

by planning the next 30 years of expansion for the region's high capacity rail and bus transit network, as well as to set near-term priorities for corridor study and development. One outcome of this effort is most emblematic of how transit governance in the Portland metropolitan region is able to leverage a common land use vision to establish an effective, equitable decision making framework: the High Capacity Transit System Expansion Policy (SEP), adopted by Metro in 2009.

The SEP emphasizes fiscal responsibility by ensuring that limited resources for new HCT are spent in jurisdictions with supportive land uses, high quality pedestrian and bicycle access, management of parking resources, and demonstrated broad-based financial and political support. The purposes of the SEP are to: 1) provide a transparent process by which jurisdictions can work to advance their priorities for future HCT, and 2) establish quantitative and qualitative targets by which to guide local land use and transportation planning and decision-making. The SEP also provides a process for prioritizing regional funding for HCT in a future Regional Transportation Plan using actions taken by local jurisdictions. The SEP's key objectives are to:

- Promote transit-supportive land uses in future HCT corridors
- Promote local policies that increase the value of future HCT investments (e.g., parking management, street design and connectivity, Transportation Demand Management, etc)
- Provide local jurisdictions with a fair and measurable process for developing and receiving funding for future HCT services
- Provide Metro with a tool to allocate limited planning resources to the most supportive, prepared communities
- Ensure that transit serves low income households

Measure	Description
Density of People	Current households and jobs per net acre within ½ mile of proposed transit corridor or stations
Density of Urban Living Infra-structure (ULI) Businesses*	Number of ULI Businesses within ½ mile of proposed transit corridor or stations
Transit Oriented Zoning	Assigning values to regional zoning classi-fications within ½ mile of
Average Block Size	Density of acres of blocks within ½ mile of proposed transit corridor or stations
Sidewalk Coverage	Completeness of sidewalk infrastructure within ½ mile of proposed transit corridor or stations
Bicycle Facility Coverage	Access to bicycle infrastruc-ture measured as distance to nearest existing bicycle facility within ½ mile of proposed transit corridor or stations
Transit Frequency	Buses/trains per hour serving station area or corridor

- Urban Living Infrastructure (ULI) is a term used for neighborhood businesses that support walkable and bikable trip making for basic needs. ULI businesses include grocery stores, dry cleaners, coffee shops, restaurants, convenience stores, etc.

In coordination with its Transit Oriented Development group, Metro's Land Use and Corridors divisions have developed a regional model to measure readiness of transit investments based on these objectives. The model measures land use and market factors at a spatial level equivalent to a one-minute walk. Jurisdictions that are not currently among the region's top priorities for transit investments can work with partner jurisdictions in a corridor to improve their standing. Progress is measured using this model and comparison to a baseline (2008) evaluation. The table on the previous page lists key quantitative areas of measurement. Other qualitative measures such as local funding availability, affordable housing potential, and political readiness are also considered.

Regional Coordination of Local Transit Services: Germany and Switzerland

A verkehrsverbund, or VV, is a governance model common in Germany and Switzerland. In some ways, VVs are similar to U.S. Metropolitan Planning Organizations (MPOs): they are regional planning bodies that provide capital and some operating funding to local transit operators. However, VVs are stronger in other, key ways: they are able to coordinate and integrate fares and schedules, so that transfers between different operators are as seamless as possible. Transit vehicles operated by local providers may also carry the VV's branding, so that service provided by dozens of different operators appears, from the customer perspective, as though it were provided by a single entity.

In his book The Transit Metropolis, University of California, Berkeley professor Robert Cervero summarized the role of VVs in this way: "These umbrella organizations ensure that problems that commonly plague regional transit services—such as fare penalties for transferring, conflicting timetables, and interagency rivalries—are eliminated."

Munich's Munchener Verkehrs-und Tarif-Verbund, or MVV, is governed by an executive board including state and local representatives. The board sets service and fare policies (such as maximum headways), and it approves budgets. Day-to-day administration, however, is left to a management board consisting of staff from individual operators. This board sets actual timetables, fare zone boundaries, work rules and contract terms, and is responsible for marketing. Individual operators effectively function as contract operators, responsible for actual delivery of service.

Zurich's Zürcher Verkehrsverbund, or ZVV, coordinates service provided by more than 40 individual operators, including public agencies and private companies. Its governing Cantonal Transport Board sets minimum service standards, such as connectivity requirements, and it sets maximum budgets. It collects revenues, then distributes them to operators based on a reimbursement system that takes into account the amount of service provided as well as performance criteria. The ZVV is said to have a "watchdog role"—it manages a competitive bidding process for provision of some services. Within two years of the ZVV's establishment and introduction of a single regional fare structure in 1990, ridership on feeder buses had increased by 53%.

The potential for application of the VV model to American cities would depend to a great extent on the degree to which localities were willing to surrender control over service planning. While a board including local representatives could set policy, and while managers of local agencies could jointly maintain control over details of the implementation of those policies, ultimately, routes, schedules and fares would be set at the regional level. The VV model can be considered a structure that combines important efficiencies of a single regional transit provider with elements of local control.

Local/Regional Collaboration: Boulder, Colorado

The City of Boulder, Colorado has implemented a number of measures to increase the level and quality of transit service available to its residents above and beyond what the area's Regional Transportation District, or RTD, is able to provide, and the partnership between Boulder and RTD might serve as a model for such regional/local cooperation.

The partnership between Boulder and RTD is based on two primary components: the Community Transit Network (CTN) and the Eco Pass program.

The HOP service is one of 7 branded bus routes operating at high frequencies in Boulder.

Source: Nelson\Nygaard

The CTN is a network of seven local bus routes that is operated primarily by RTD, but that is subsidized by the City. RTD provides a baseline level of service to each city and county in its service area based on existing ridership levels; in Boulder it provides both regional and local service. Starting in the early 1990s, however, the City made a decision to pay for additional service on select local routes to offer its residents a citywide network serving major destinations with "walk-up" headways of 10 minutes or less. The intent was to attract more "choice" riders and mitigate negative impacts of parking development. Or, as GO Boulder planner Cris Jones explains: "The City gives money for a more marketable service model. It's not based on current use, but on our ability to sell to people who aren't using transit." Since the early 1990s, the average number of daily transit boardings in Boulder has increased from less than 20,000 to nearly 35,000 in 2009. Drive-alone mode share has decreased by 15%, and the number of vehicle miles traveled has remained relatively constant.

Boulder provides its share of CTN funding from a local sales tax measure. Several of the CTN routes were launched using federal grants supplemented with local matches. Boulder County and the University of Colorado-Boulder (CU-Boulder), both through its administrative budget and through student fees, also contribute funding. One of the CTN routes, the HOP (other branded routes include the SKIP, JUMP, and LEAP), is managed by the City, which "pays a premium," as Jones put it, for a dedicated fleet of vehicles with amenities including automated stop announcements.

The Eco Pass program is a regional universal pass initiative. Boulder, however, provides significant subsidies—up to 50% in the first year for a neighborhood or company that has just joined, and permanent subsidies of 25 to 30% for participating neighborhoods. (Eco Passes for downtown employees are funded by an improvement district using parking revenues, further incentivizing transit use.) The success of the program has been remarkable. More than 67,000 of those who live, work or go to school in Boulder—a city of just 100,000 people—are now Eco Pass holders, and since CU students joined the predecessor to the Eco Pass program in 1991, the number of annual transit trips taken by students has increased nearly tenfold.

Finally, the city's transportation sales tax also pays for capital improvements, including shelters, and for marketing of the city's transit services.

In Boulder, the City and local business groups have worked together to ensure that public parking and transit are well integrated, helping to promote a "park once" environment and creating one of the most pedestrian friendly downtowns in the country.

Source: Nelson\Nygaard

Local bus services in Boulder are operated by the Regional Transit District (RTD), but have a distinct look and feel from RTD buses such as this one show in Denver,

Source: Nelson\Nygaard

The DASH is another of the branded route services in Boulder.

Source: Nelson\Nygaard

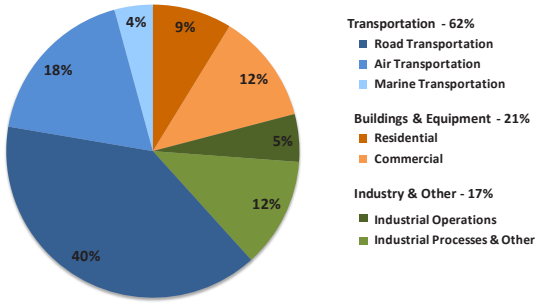
7 BEST PRACTICES

Transit's Role in Meeting Greenhouse Gas Reduction Goals

WHAT IS IT?

Cities and regions across the United States have come to accept that greenhouse gas (GHG) emissions are a chief cause of global warming. Seattle, a city known for environmental activism, has adopted goals of halting and cutting emissions levels across sectors. Reducing greenhouse gas emissions is especially important for the transportation field, which represents the largest source of emissions in Washington State and the City of Seattle. The transportation sector accounts for 62% of GHG emissions in Seattle; over 40% of total Seattle emission are from road transportation alone. For this reason, the city of Seattle has identified reduction of automobile vehicle miles traveled (VMT) as a key goal in achieving its Climate Action Plan targets.

2008 CITYWIDE EMISSIONS BY FACTOR



Road transportation accounts for 40% of total CO2 emissions in the City of Seattle.

Source: 2008 Seattle Community Greenhouse Gas Inventory (http://www.seattle.gov/archive/climate/docs/2008-community-summary.pdf)

WHY DO IT?

For anyone who has studied the probable impacts of climate change, the answer is clear. On a practical level, climate action plans, or CAPS, often contain ambitious goals but lack implementation strategy or tools for achieving them. Seattle has set a particularly ambitious goal of achieving Carbon Neutrality by 2030. Meeting this goal will require dramatically curbing GHG emissions from transportation. Research shows that new fuel technology alone will not be sufficient; demand management is critical.

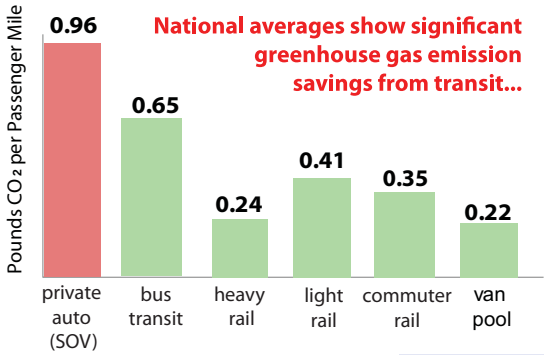
GHG Emissions by Sector*	1990	2005	2008	% Change 1990-2008
TRANSPORTATION	3,947,000	4,062,000	4,242,000	7%
Road	2,440,000	2,566,000	2,707,000	11%
Marine & Rail	278,000	300,000	291,00	5%
Air	1,229,000	1,196,000	1,244,000	1%
BUILDINGS	1,609,000	1,411,000	1,470,000	-9%
Residential	735,000	606,000	613,000	-17%
Commercial	874,000	805,000	857,000	-2%
INDUSTRY & OTHER	1,720,000	1,413,000	1,200,000	-30%
Operations	524,000	463,000	366,000	-30%
Processes	1,019,000	853,000	85,000	-26%
Waste	177,000	97,000	85,000	-52%
GHG OFFSETS		-216,000	-143,000	
City Light Offset Purchases		-216,000	-143,000	
TOTAL EMISSIONS	7,280,000	6,670,000	6,770,000	-7%
* *Metric tons of carbon dioxide equivalent (CO2e) rounded to the nearest thousand. Totals rounded to nearest ten-thousand. Sums may not equal due to rounding.*				
2012 Goal - 7% below 1990:	6,770,000			
2050 Goal - 80% below 1990:	1,460			

In Seattle, overall transportation emission have grown since 1990, while building and industrial sectors have reduced total emissions

Source: Seattle Climate Protection Initiative Progress Report 2009; http://www.seattle.gov/archive/climate/docs/CPI-09-Progress-Report.pdf

While Seattle has seen progress in reducing GHG emissions on a per capita level in every sector, transportation has seen the smallest reductions and, therefore, has increased as a percentage of total emissions since 1990.

Increasing mass transit use and reducing vehicle miles traveled is a key element of city and regional strategies for reducing transportation sector emissions. Well-utilized public transit emits far fewer emissions than auto travel, as shown in the bar chart below.



Estimated CO2 emissions per passenger mile for transit and private auto

Source: Public Transportation's Role in Responding to Climate Change, Federal Transit Administration, 2010. http://www.fta.dot.gov/documents/PublicTransportationsRoleInRespondingToClimateChange.pdf, page 1

WALK. BIKE. RIDE.

SDOT Seattle Department of Transportation

The Federal Transit Administration (FTA)'s statistics are based on average vehicle occupancy of 1.14 for single-occupancy vehicle work trips and 9.2 passengers per bus. Thus, an increase in transit ridership affects emissions reduced: a full bus carrying 40 passengers emits 83% fewer greenhouse gas emissions on a per passenger basis than one carrying the average bus load. Transit vehicles in Seattle consistently carry much higher passenger loads than the FTA estimate.

Most rail systems are powered entirely by electricity; therefore agencies purchasing electricity through clean sources—hydroelectric, wind, nuclear, solar—have a smaller carbon footprint than those using fossil fuel-produced electricity.[1] Seattle City Light uses hydropower and purchased offsets to produce a carbon neutral electric energy source for Seattleites; electrically powered transit in Seattle can claim to be as close to emission free as any service in the nation.

HOW DOES IT WORK?

As regions around the nation seek to address GHG reduction goals, they are looking to public transit providers to lead the way. A review shows that various agencies are addressing this challenge by restructuring operations to serve more passengers, selecting new vehicle technologies or retrofitting existing technologies, and working more closely with land use agencies and housing providers to optimize access to transit. Numerous national and local studies suggest that the most effective strategies fall into three categories:

- Those that focus on making more productive use of existing services and facilities.
- Those that tie any transit expansions to land use changes; together they can have a large impact on CO2.
- Those that consider cost effectiveness; some of the most politically popular means to reduce CO2 emissions are the least cost-effective, but some of the most effective measures actually earn money for the economy and the implementer.

WHO DOES IT?

This section highlights best practice examples from the San Francisco Bay Area and Portland. In the Bay Area, the Metropolitan Transportation Commission (MTC) and Bay Area Rapid Transit District (BART) have adopted methodologies for evaluating proposed investments in terms of their measurable impacts on carbon emissions. In Portland, the regional transit provider, TriMet, has focused on reducing emissions from agency operations as well as playing a role in helping local jurisdictions meet GHG reduction goals. In New York City, the MTA has undertaken similar measures to reduce internal GHG emissions.

These are just a few of the many agencies nationwide that are using transit as a key tool to address regional climate action goals and using their own operations to model low carbon business practices.

Making Better Use of Existing Facilities and Services

MTC is the Bay Area's metropolitan planning organization, or MPO. In developing its most recent Regional Transportation Plan (RTP), MTC developed a methodology for project evaluation in three areas: Economy, Environment, and Equity. Under Environment, it set year 2035 performance targets for reductions in emissions and vehicle miles traveled (VMT). These included a 40% reduction in carbon emissions and a 10% reduction in VMT from 2006 levels.

MTC then evaluated potential projects using these criteria. The "lessons learned," according to the Plan include: "Limits of infrastructure; power of pricing and land use; need for technology and behavioral change." The Plan's authors further explained: "We learned that infrastructure investments produce only modest tangible effects at the regional level, and that aggressive pricing and land-use strategies exert much greater influence than transportation projects alone in moving us toward achievement of the performance objectives."[2]

Even a "massive" investment in transit, the analysis found, would result in minimal reduction in VMT and reduction of carbon emissions: only about 10% of the reductions required to achieve the 2035 objective. Coupled with pricing and land use policies, however, transit could achieve about half of the hoped-for decrease in emissions, and about two-thirds of the necessary reduction in VMT.

BART has performed a similar cost-effectiveness analysis of different strategies for achieving greenhouse gas emission reductions. In support of BART's

1 The calculations in this fact sheet use the carbon dioxide emissions per megawatt hour for the power supplied to the electrical grid in the particular sub-region in which the transit agency operates. The data is from the U.S. Environmental Protection Agency's Emissions & Generation Resource Integrated Database (eGRID) 2006 v2.1, http://www.epa.gov/cleanenergy/energy-resources/egrid/index.html. Sub-region emission factors are used rather than state level emission factors as regional power grids do not correspond with state lines. In addition, using the eGRID sub-region data rather than the state level data is recommended by the Climate Registry General Reporting Protocol, Chapter 14, http://www. theclimateregistry.org/downloads/GRP.pdf

2 Metropolitan Planning Commission, Transportation 2035: Change in Motion. (http://www.mtc.ca.gov/planning/2035_plan/).

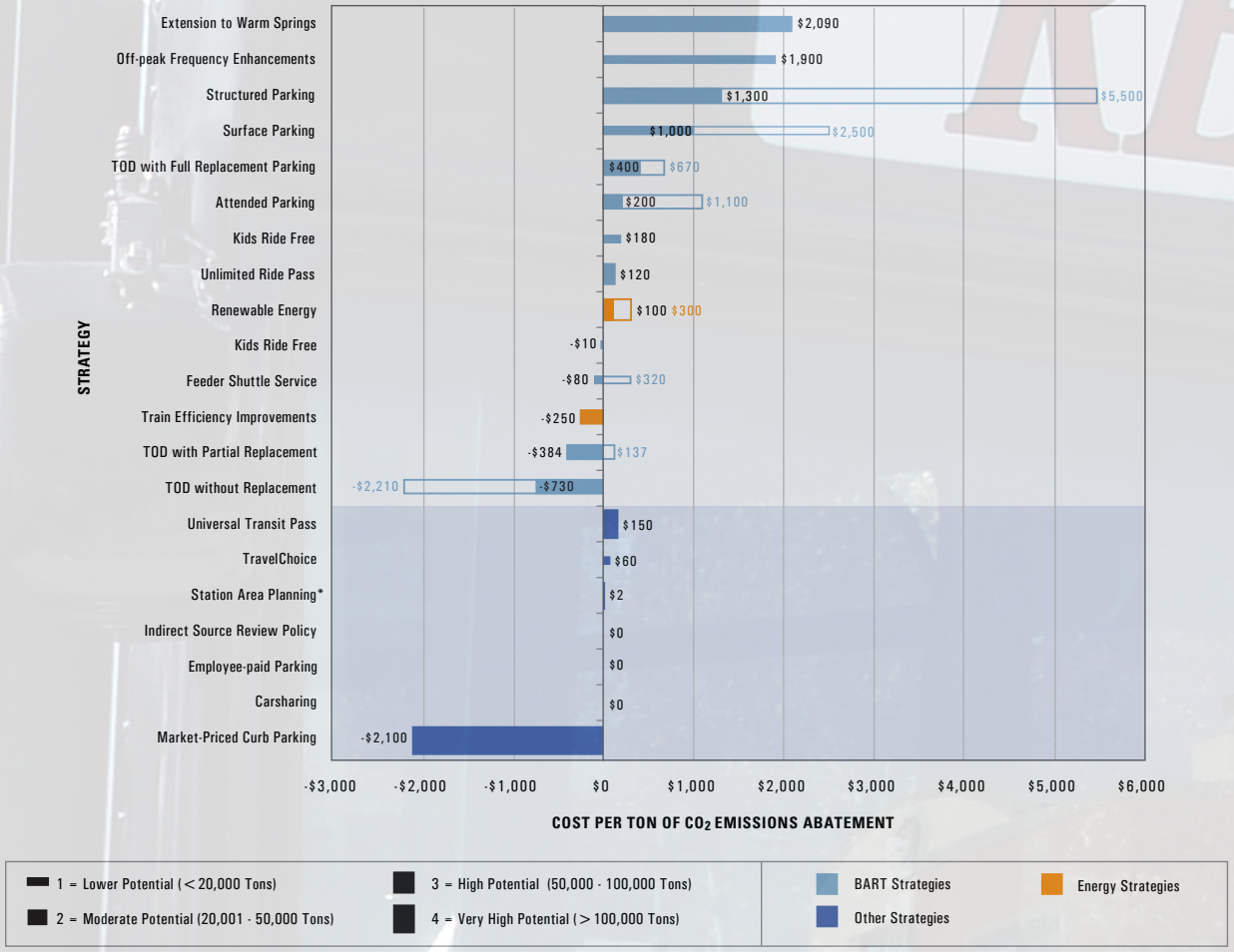
Climate Action Plan, a range of transportation and land use strategies were assessed, some of them strategies that BART itself could enact, and some requiring regional initiatives such as increased transit-oriented (TOD) development or parking management. The range of projects included a number that were capital-intensive, while some were lower cost transportation demand management (TDM) strategies. These included strategies for transit-oriented development and parking pricing at BART stations. While TOD projects were envisioned to be joint development efforts, they were assumed to be "free" to the public, as any subsidy to TOD development was assumed to replace subsidy for greenfield development in the form of utility extensions, roadways, and other costs to taxpayers.

Different performance measures and evaluation tools were then applied. These included costs per ton of emissions abatement, total emissions abatement, and co-benefits, other than emissions reduction.

BART's analysis arrived at similar conclusions to the work done by MTC. The most cost-effective strategies on a per-ton basis were found to be joint development and parking pricing, while major infrastructural investments were found to be cost-effective only to the extent that they might have long-term impacts on land use patterns. The relationship between system capacity and latent demand was also found to be an important factor; the most effective way to reduce driving over time is to manage road supply through pricing, and ultimately reduce supply.

Simple strategies such as fare incentives that fill seats at off-peak times, station area planning and station access improvements can reduce GHG emissions at relatively low costs (compared with programs in other sectors) and help meet other regional land use and transportation goals.

COST PER METRIC TON OF CO_2 EMISSIONS ABATEMENT (BY STRATEGY)



*Includes planning for land use change: does not include public or private infrastructure investment

Some strategies evaluated by BART had little to no cost per ton of CO2 reduced; some made a profit.

Source: BART Climate Action Plan. Actions to Reduce CO2: A Cost Effectiveness Analysis. Nelson\Nygaard

Fares

One main factor that people consider when making transportation decisions is cost. During times when the system has excess capacity, such as on weekends or off-peak, fare incentives may be needed to shift drivers to transit, since roadways are less congested. Fare programs must be given careful thought, however, as they may result in reduced revenue for the agency. For example, when New York City Transit introduced unlimited ride weekly and monthly passes, ridership increased but revenue fell nearly 4% because the average fare per trip went down. Agencies must make sure that growing ridership in the short term (a good GHG reduction strategy) does not threaten longer-term ability to maintain service levels.

Feeder Service for Transit

A common barrier to shifting people away from long regional trips by private vehicle is the "last mile" connections to trunk line transit service like light rail or commuter rail. Shuttle services are often the most viable option in suburban environments where pedestrian and bicycle options are limited. In the Bay Area, a number of South San Francisco employers pool resources to provide coordinated shuttle service connections to BART and Caltrain throughout the day. The ALLIANCE program allows employers to provide a high-quality service that no individual company could afford. Run by San Mateo County's Demand Management Agency, the ALLIANCE program also provides marketing and recruitment support to employers.

Better Access to Transit/Walkable Communities

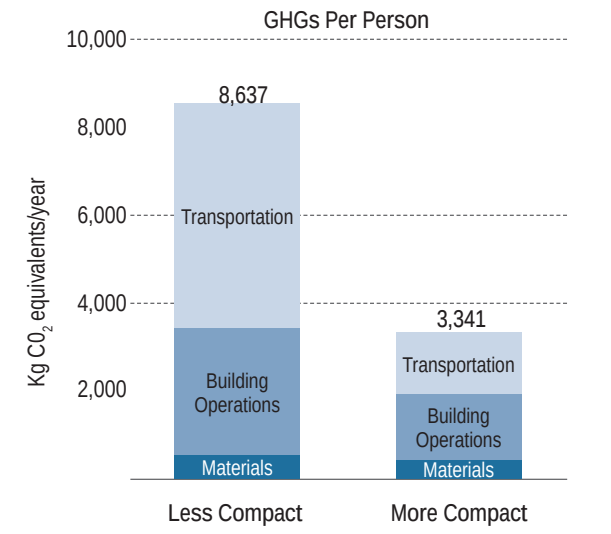
The most effective way to decrease vehicle miles traveled is building communities that are more transit oriented. As shown in the graphic at right, people living in compact developments emit far fewer kilograms of CO2.

BART's analysis concluded that transit-oriented development has the most potential to produce revenue and reduce emissions. When taking a typical BART station and implementing transit-oriented development in place of parking lots, BART could reduce emissions by 650 to 2,300 tons per project and achieve revenue gains of $600 to $1,400 per ton.[3]

3 BART Actions to Reduce Greenhouse Gas Emissions: A Cost-Effectiveness Analysis. Nelson\Nygaard. Page 16.

An ALLIANCE Shuttle.

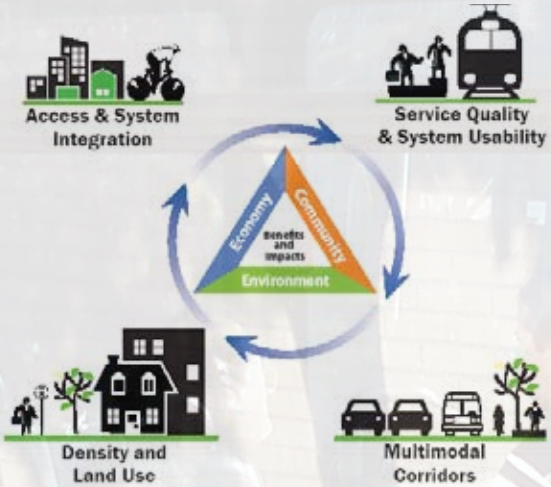
Source: Nelson\Nygaard



Source: Journal of Urban Planning and Development, Norman, March 2006

Enhancements to Existing Service

Transit service strategies that shift travelers from auto travel to transit are the primary focus of efforts to reduce GHG emissions. Simply adding service (headways) to existing high demand lines is an effective strategy, but can be expensive since much of the cost of operating services comes from operator salaries and benefits. Speeding up existing service is often a more cost-effective strategy, since it allows transit operators to get more service for the same amount of operating cost and increases transit's competitiveness with driving. There is also an important role for local agencies that operate the streets and signal systems, since they can provide the priority needed for transit to bypass traffic and speed operations such as through traffic signal priority systems, which holds a green signal to allow a train or bus to



To capture the full social and economic benefit of transit, a total system approach is needed.

Source: Nelson\Nygaard

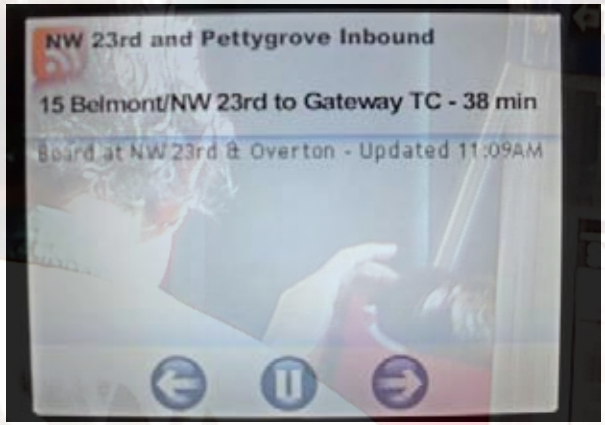
pass. TriMet is doing its part by focusing on creating a "total transit system" to attract every choice rider possible. To do this, the agency is focusing on service reliability, adequate capacity, and complete travel information for customers.

Better Passenger Information

Measures like real-time arrival information and cell phone service updates that improve customer service have a role in attracting and retaining passengers. TriMet is now providing open source data on vehicle location, allowing private individuals or companies to create better information technology for passengers (e.g., real-time cell phone applications). A local transit advocate recently released a new "transit appliance" that will, for less than $200, will allow any business or office to provide real-time transit vehicle arrival information on a digital screen using a wifi connection.

Marketing

This is a measure that costs little in relation to many other strategies, but can reap large rewards in increased ridership and ultimately greenhouse gas reduction. Measuring the effects of marketing campaigns can be difficult, but in general making sure the public is aware and knowledgeable about available transit service is a critical step in attracting riders. Marketing has the biggest effect in instances where transit is most competitive with driving in terms of price, convenience, and travel time. The BART study concluded that targeted marketing of existing transit services might be one of the most cost-effective means for reducing transportation related greenhouse gas emissions.



Screen shot from the "transit appliance" which provides real time transit vehicle arrival information using open source data from TriMet.

Source: Portland Transport Blog (http://portlandtransport.com/archives/2010/09/169_transit_inf.html)

GHG benefits of transit oriented development come not just from increased transit use, but even greater overall reduction in driving resulting from walkable urban form

Source: Nelson\Nygaard

Tie Transit Improvements to Land Use

Most detailed analyses conducted to identify cost-effective strategies to reduce transportation-related greenhouse gas emissions point to the need to increase efforts to build dense, walkable, transportation-efficient communities and neighborhoods and to transfer the real cost of parking construction and operations to users.

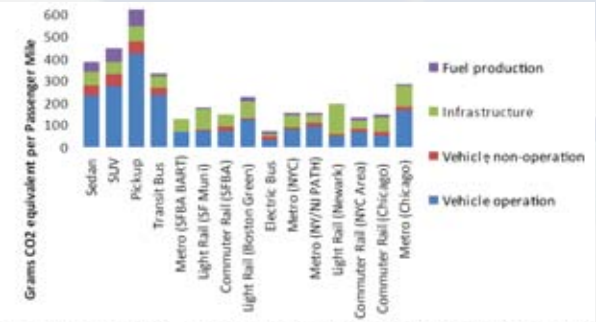
Developing new high capacity lines or extending existing lines is a capital-intensive endeavor, but one that can drastically reduce greenhouse gas emissions if carefully executed to serve or leverage transit-supportive development. A study completed for the American Public Transit Association suggests that transit service has a primary benefit from the act of substituting a mile of travel by car with a mile of travel on transit, but also causes a secondary benefit. Since transit fosters more compact and walkable communities, even those living near transit who don't

use it will still reduce vehicle miles traveled as a result of being able to accomplish errands through shorter walking and cycling trips. This secondary benefit may be as much as 1.9 times as large as transit's direct impact.[4] In Portland, planners have come to refer to these benefits as "the trip not taken."

Power Sources and Full Lifecycle Emissions

Most rail transit and some bus transit services, such as Metro's trolleybus fleet, rely on electricity for power. Those relying on electricity from low emissions sources, such as hydroelectric, have lower emission that those using electricity from coal burning power plants. Since Seattle has among the cleanest electricity in the United States, electric powered transit is an attractive option if reducing CO2 emissions is a goal.

4 ICF International for the American Public Transit Association. "The Broader Connection between Public Transportation, Energy Conservation and Greenhouse Gas Reduction." February 2008.



Lifecycle CO2 emissions per passenger mile based on average occupancy for range of vehicles and systems.

Source: Mikhail Chester and Arpad Horvath. *Life-cycle Energy and Emissions Inventories for Motorcycles, Diesel Automobiles, School Buses, Electric Buses, Chicago Rail, and New York City Rail*, 2009. http://escholarship.org/uc/item/6z37f2jr

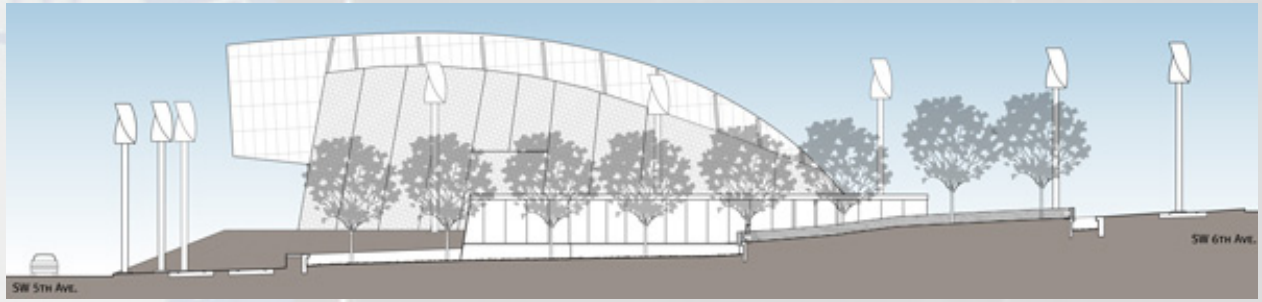


Illustration of the TriMet's South Terminus Energy Project.

Source: Used with permission from TriMet. (http://trimet.org/news/southterminus_energy.htm)

The amount of CO2 emitted per passenger mile traveled in any particular mode can be measured based on tailpipe emissions, but is probably more accurately accounted for based on a full lifecycle accounting. This includes all emissions generated over the full life of a transportation system, including those from construction and materials, infrastructure maintenance, production and use of fuels, and eventual disposal of vehicles and infrastructure. Researchers at University of California at Berkeley developed methods for analyzing full lifecycle costs of transit and private auto modes. The results of a variety of transit and non-transit modes are illustrated in the graphic below.

The chart shows that electric buses have among the lowest non-operational emissions over a lifespan, far lower than a diesel powered transit bus. For a range of rail systems, transit greenhouse gas emissions are substantially lower than those for private automobile modes when emissions from construction, manufacturing and maintenance are considered.

Reducing Emissions from Transit Agency Operations

Transit providers can change internal practices to further reduce greenhouse gas emissions, such as by making green practices part of procurement, fostering an environmental workplace, constructing green buildings and facilities, and conducting research into and implementing new technologies that can reduce emissions and energy consumption.

TriMet is currently conducting a detailed assessment of its carbon footprint according to American Public Transportation Association's recommended practice for quantifying greenhouse gas emissions. The analysis is not complete yet, but data in the 2007 National Transit Database shows that TriMet's total operational footprint was 76,000 metric tons of CO2.[5] The more detailed APTA footprint analysis will tell TriMet both its debits—the amount of greenhouse gases emitted by source—as well as its credits, or how much greenhouse gases are not emitted because of TriMet's ability to shift mode choice and foster compact development. The footprint analysis will allow TriMet to identify its biggest sources of emissions and create targets for reductions.

5 Eric Hesse, TriMet Strategic Planning Analyst. E-mail message 15 May 2009.

MAX light rail and historic trolley at the south terminus of Portland's downtown transit mall, a planned hub for alternative energy.

Source: Nelson\Nygaard

One main source of GHG emissions for transit agencies comes from traction power. TriMet trains currently have wayside regenerative braking capability, which allows power released from braking to be briefly stored in the third rail and used by another train. This measure has reduced traction power needs by 20%; however, only 50-75% of potential power released from braking is being retained. TriMet is researching on-board regenerative braking, which allows the braking train to store the energy on-board. This technology has the potential to capture 75-100% of the energy released from braking.[6] Other initiatives TriMet has undertaken include: using biodiesel blends containing vegetable oil and fats, and installing railroad ties made of recycled plastic taking from car gas tanks; and developing the South Downtown Transit Mall light rail terminus alternative energy project. This pilot project, which recently received funding from the Federal stimulus package, will include solar and wind power generators, including 22 wind turbines at the South Mall light rail terminus.

The Metropolitan Transportation Association (MTA), the state authority running transit systems in New York City, has identified several innovative measures to cut greenhouse gas emissions, including:

- Building administrative and maintenance facilities to LEED standards or higher.
- Using aluminum, which has a lower resistance than steel, for the third rail, resulting in less energy use from braking.
- For new track construction, creating humped tracks at platforms so trains can take advantage of gravity and use less power for braking and accelerating.
- Retrofitting train cars with aluminum where possible to lower the train weight and thus reduce energy needs.[7]

CONCLUSIONS

The city of Seattle will need to partner with Metro, Sound Transit, PSRC and other regional agencies to ensure transit is fully leveraged in efforts to meet GHG reduction goals. While renewable energy sources, cleaner fuels, and green technology will help to reduce GHG emissions, significant changes in neighborhood design and transportation funding priorities are needed to meet greenhouse gas reduction goals. In Seattle, the Walk, Bike, Ride initiative can serve as a blueprint for more detailed strategies; research shows that dense, mixed-use communities that allow people to travel by foot, bike, and transit are critical to climate protection.

Achieving emissions reductions requires involvement and leadership at the national, state and regional level. Many greenhouse gas emissions reduction strategies can all be undertaken by transit providers; however, some of the most important policies for reducing greenhouse gas emissions require wider, more systemic change than a transit agency can achieve on its own. New partnerships and mechanisms for prioritizing land use and transportation projects will be needed to meet state and national goals.

6 Eric Hesse. Phone interview. 15 May 2009.

7 http://www.lirr.org/sustainability/index.html?c=EnergyCarbon

7 BEST PRACTICES

Late Night Transit Service

NEW YORK, LOS ANGELES, SAN FRANCISCO, DUBLIN (IRELAND), VANCOUVER (BC), HOUSTON

WHAT IS IT?

Late night transit services refer to services that run after midnight until early morning service resumes or, at least, until 3:00 or 4:00 a.m. when most night clubs and music venues have closed. Very few U.S. transit operators provide late night transit service. While many operators run their most productive bus or rail lines until midnight or 1:00 a.m., night club patrons returning home at a late hour often have no public transit option.

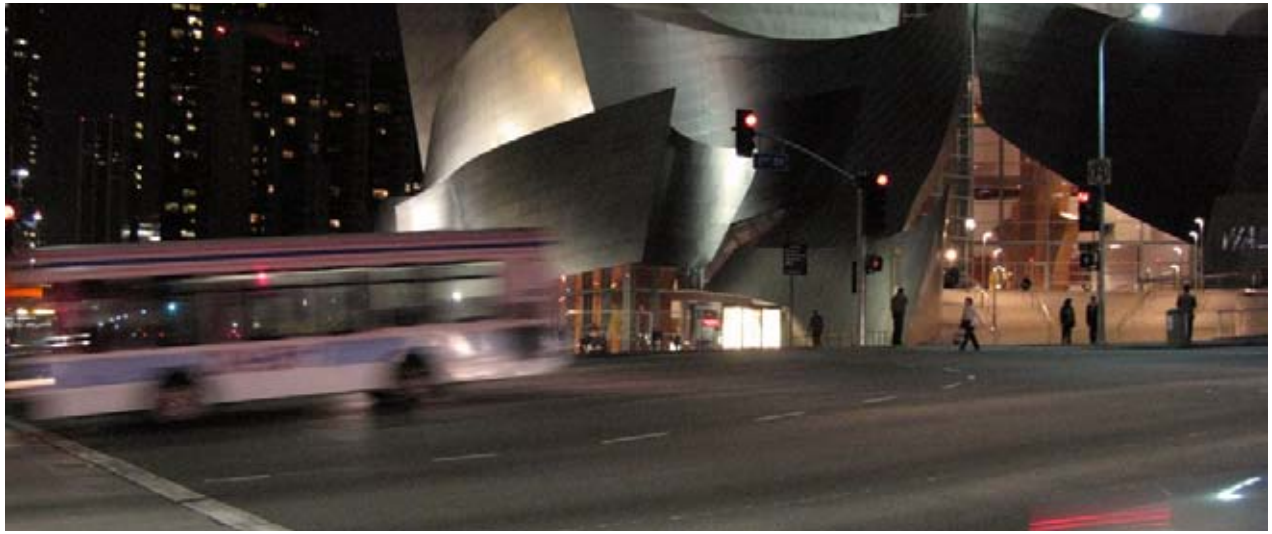


Image from Flickr user Fire Monkey Fish

WHY DO IT?

No late night transit service carries passenger loads comparable to daytime service. However, late night services provide value by:

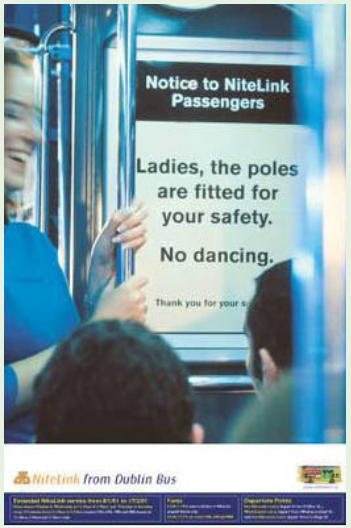
- Providing safe travel home for people that have been drinking
- Providing a travel option for workers at bars and restaurants who don't have other means of transportation or who would prefer not to drive late at night
- Increasing access to an important sector of the economy – night clubs, music venues, and restaurants – that are particularly challenged by transportation and parking issues
- Reducing parking demand in neighborhoods at peak evening and weekend times

WHO IS DOING IT?

Only a handful of U.S. cities provide quality transit service throughout night time hours. In general, cities that do are the largest and densest urban areas in the nation. In New York City, the MTA has a "full time service" schedule that uses special graphics to indicate which subway and bus stops have service 24 hours a day. In Los Angeles, a privately-sponsored late night shuttle operated by the city's Department of Transportation, called "Late Night Dash," operates during the holiday season, but not year round. Other cities that operate late night transit service in North America and Europe are described in the table on the following page.

LATE NIGHT PUBLIC TRANSIT SERVICES

City	Name	Logo	No. of Routes	Frequency of Service	Comments	Website
San Francisco	Owl Night Bus	Routes have "Owl" after number. For example Route 91 Owl.	10	30 minutes	Service runs from 1:00 a.m. to 5:00 a.m. on modified local routes and special Night Owl routes.	Owl Night bus has a simple page on the Muni site
Chicago	Night Owl		19	30 minutes	Service runs from midnight until 5:00 AM. Red and Blue line trains are included in the late night service and make connections with 7 Night Owl buses in downtown Chicago	Night Owl has a brochure in 3 languages including a system map
Dublin, Ireland	NiteLink		23	30 minutes, no Sunday service	Ad campaign was controversial and targeted 18 - 35 year olds with double entendre messages. They posted advertisements on buses (see sidebar).	Dublin Bus has a special homepage specifically for Nitelink with schedules and maps.
Sydney	NightRide	"N" prefix (none shown on website)	10	60 minutes weekdays, 30 minutes weekends	NightRide takes over CityRail service from 12:00am to 4:30am. NightRide uses the prefix "N" to indicate all night buses.	An interactive map of the service, general info and fares.
Vancouver, BC	NightBus	"N" prefix (none shown on website)	12	30 minutes	Operates until 3am every night, regional and city routes, no service between 3am and 5am. Late night service was just recently reinstated after being cancelled in 2001.	General overview of service including span of service, headways and major destinations. No maps or schedules through the NightBus page, users must go back to schedules to see times.



Dublin NiteLink

In Dublin, transit providers have used an edgy advertising campaign to attract younger riders to late night transit services. Some of the advertising messages used include:

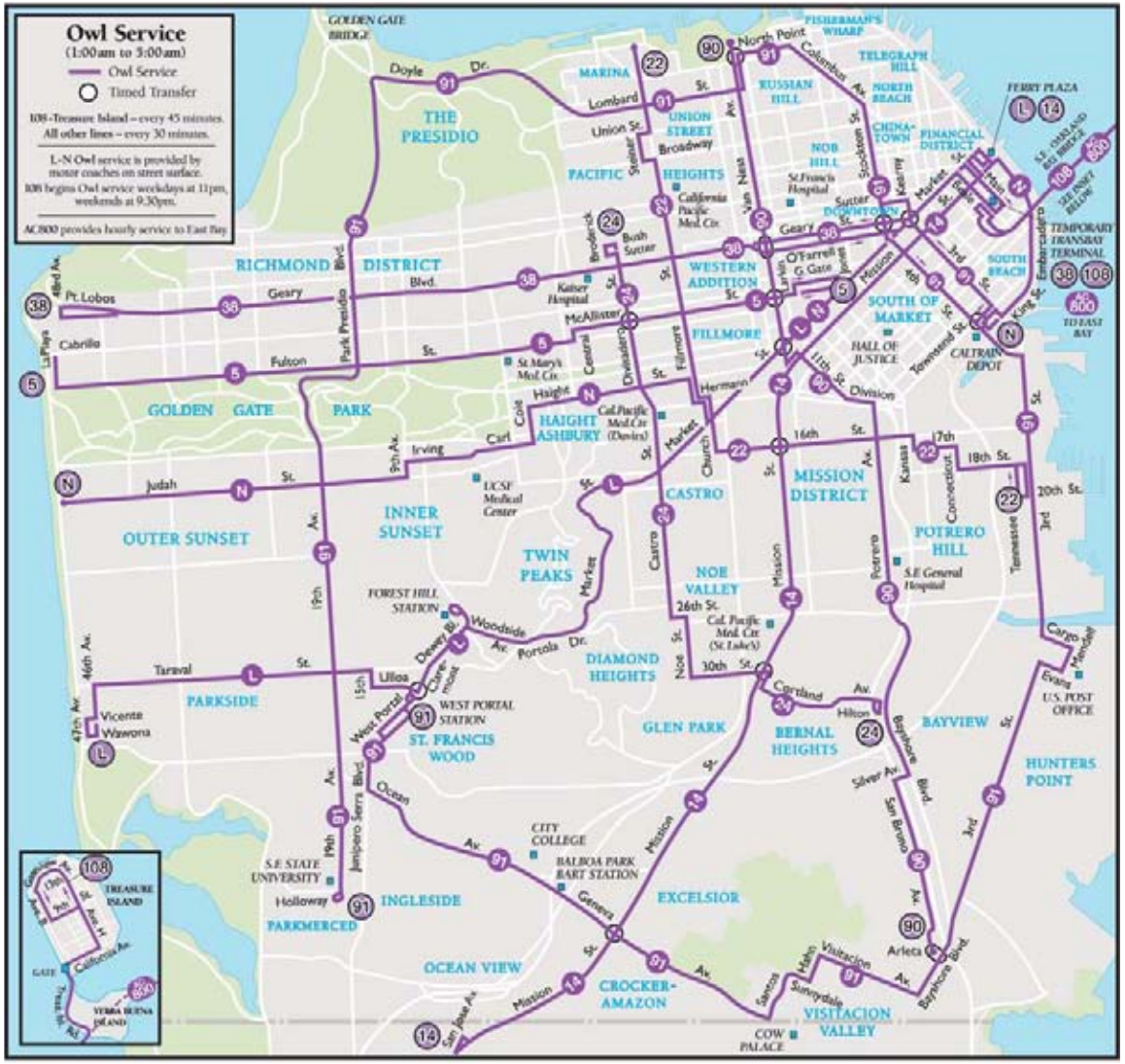
'Ladies. The poles are fitted for Your Safety. No Dancing'

'At the end of the night it's a guaranteed ride'

'Please ensure you have the correct partner before leaving the bus'"

Source: Dublin Bus website

SAN FRANCISCO OWL SERVICE MAP



San Francisco Muni provides Owl Night Bus service from 1:00 a.m. to 5:00 a.m. seven days a week.
Service on most routes runs every 30 minutes.
Source: SFMTA

Muni's L and N Owl Lines are surface bus lines covering the routes of two of Muni's L and N light rail lines; the subway in which trains operate in downtown San Francisco is closed overnight.

Image from Flickr user gingerblokey

Designated Drive Home

Strict drunk driving laws passed in British Columbia in 2010 have led to higher demand for night transit service provided by Translink on 12 bus routes in Vancouver. A program called Operation Red Nose (ORN) is helping to fill the need for late night transportation to places where transit service is not available. ORN is a free volunteer service, which provides motorists with a free ride home if they can't drive themselves. The service is expected to provide over 5,000 trips in November and December of 2010.[1]

Jitneys as Late Night Transportation

A jitney is a North American English term which originally referred to a livery vehicle somewhere between a taxi and a bus. It is generally a small-capacity vehicle that follows a rough service route, but can go slightly out of its way to pick up and drop off passengers. There are a handful of jitney services in the United States, primarily in cities such as New York and Miami. Many of these cater to specific ethnic populations and are focused on daytime transportation needs.

One U.S. jitney service is notable for its success in providing late night transportation. The Wave, is a privately operated jitney service in Houston, Texas. The Wave started as a small shuttle service for nightlife on Washington Avenue, a key nightlife street in Houston, and has grown to multiple shuttles now serving the Heights and Midtown neighborhoods. A new downtown Houston shuttle service is planned to open soon. The service is being provided will full consent from Metro, the local transit agency, which is strapped for resources to provide late night transit service. Houston recently passed a jitney ordinance, under which this service is permitted (see sidebar). There are plans to expand Wave service to other Houston neighborhoods, including Montrose, Shepherd, and Kirby. There has also been discussion about expanding the service to Austin and Dallas.[2]

The service was started by a local woman who graduated from Rice University. The service has a catchy website and offers promotional fares and programs that allow users to get discounts at local bars and restaurants. The Wave also offers $75.00 monthly passes for those that plan to use the service regularly.

The Wave offers on-demand pick-ups as well as regular stop pick-ups at designated stops. The service also provides a free remote parking service for people that want to avoid parking at peak hours in the districts served.

Houston Jitney Ordinance

Houston Code of Ordinances, Chapter 46, Article VI defines a jitney as: "a motorized passenger vehicle having a manufacturer's rated seating capacity of not less than nine nor more than 15 persons including the driver, that is operated upon a closed loop route following specified streets and highways in a specified direction, and is operated without a fixed schedule, carrying passengers from place to place in exchange for a fee."

The Wave Jitney has a catchy advertising campaign and has become a popular form of late night transportation in several of Houston's entertainment districts.

Source: Washington Wave

1 http://www.vancouversun.com/news/tough+impaired+driving+penalties+increase+demand+late+night+transit/3991488/story.html#ixzz18lax769G

2 http://houstonstrategies.blogspot.com/2010/08/houstons-first-official-jitney-service.html