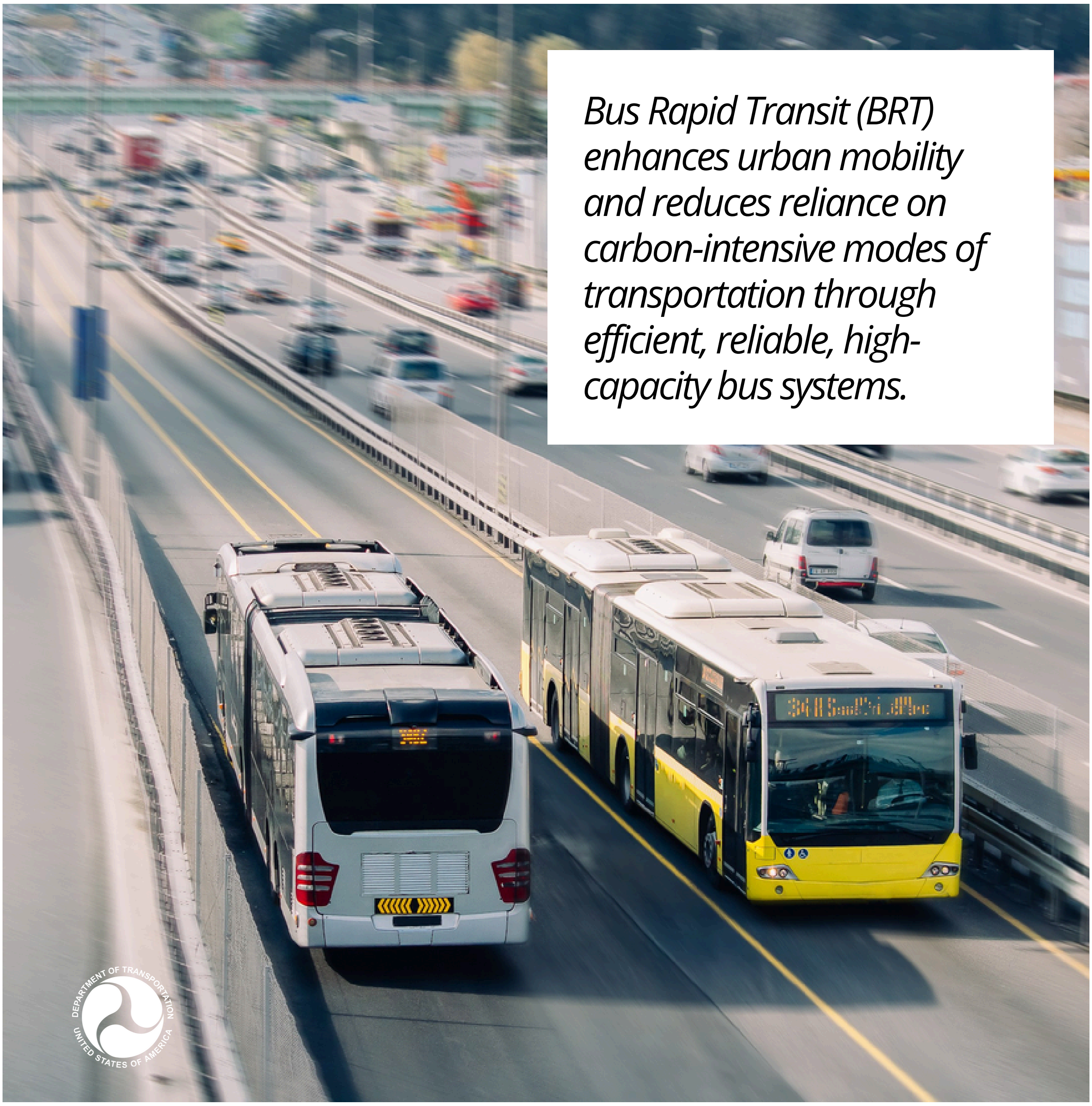
U.S. Department of Transportation, Climate Change Center
Climate Strategies that Work

BUS RAPID TRANSIT (BRT)



Bus Rapid Transit (BRT) enhances urban mobility and reduces reliance on carbon-intensive modes of transportation through efficient, reliable, high-capacity bus systems.

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OVERVIEW

Best Suited for:
Long Term & Short Term*
Urban, Suburban, Rural & Tribal*

Bus Rapid Transit (BRT) can modernize urban transportation, offering **swift, reliable, and high-capacity** bus service through dedicated lanes or rights-of-way. BRT combines the capacity and speed of a train with the flexibility, lower cost, and simplicity of a bus system. The **flexibility and lower cost** of BRT allows for greater network coverage, reaching areas that may be underserved by fixed-route bus systems. With the right combination of features, BRT circumvents common delays experienced by regular bus services, such as traffic congestion and onboard payment queues. By implementing BRT, communities can improve access to jobs, education, and essential services, fostering social equity and economic growth.

BRT systems often outperform traditional bus services in terms of schedule adherence and reliability. For example, in Port Authority of Allegheny County's West Busway Bus Rapid Transit, the Federal Transit Administration found that buses using the busway are 68% more reliable in adherence to schedule than buses operating on city and county roads.

BRT systems may incorporate features similar to a light way or subway system, including:

- Designated lane / Right-of-Way
- Off-board fare collection / All door boarding
- Bus traffic signal priority
- Sheltered waiting areas
- Platform level boarding
- Real time traveler information at stations and on vehicles shared in audible and visual formats
- Fare policies that allow free transfers between BRT and other modes

A study in Salt Lake City found that use of Transit Signal Priority systems for BRT can reduce transit time by 9% (Liu et al., 2018).

**Suitable for long-term investments, with potential for short-term benefits through phased deployment.*

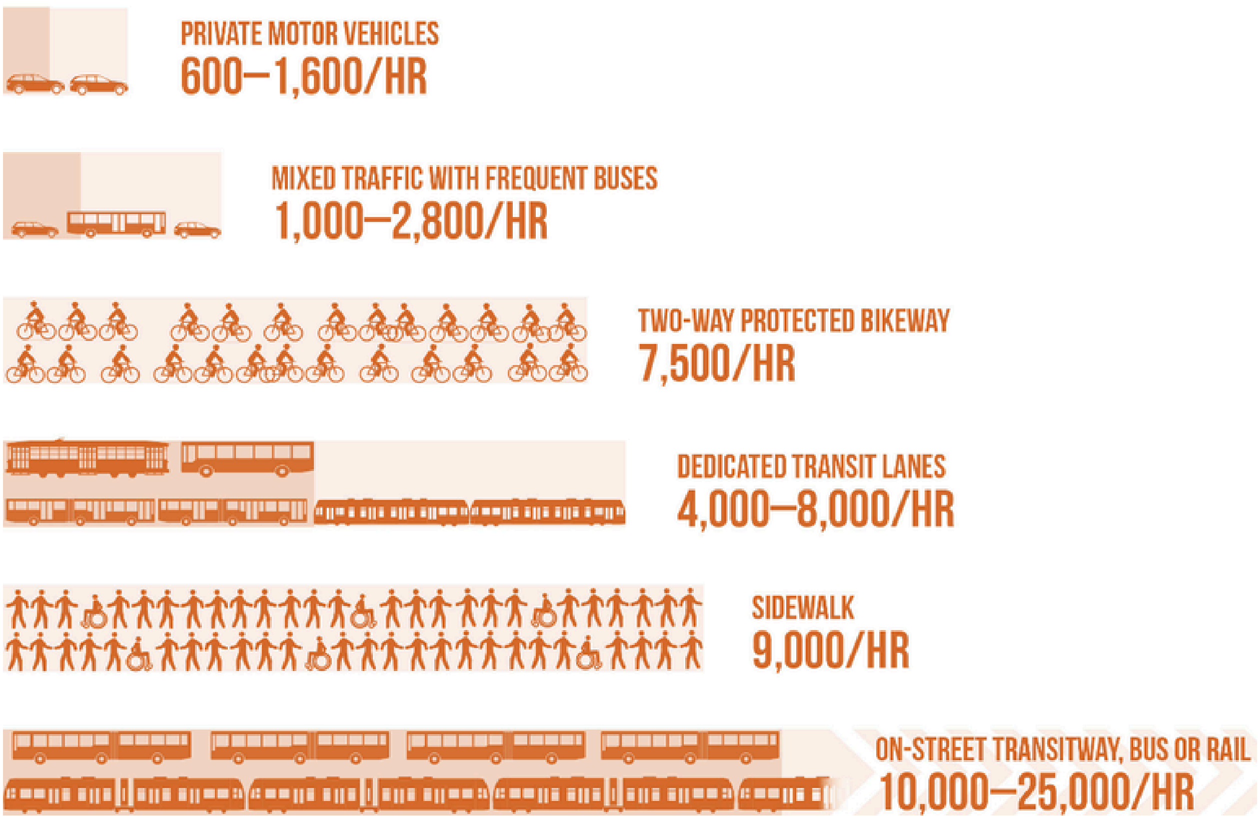
**Applicable to urban, suburban, and select rural areas, depending on population density and transit demand.*

Did you know?

Increased BRT adoption in the U.S. was inspired by a trip to Brazil in the late 1990s by then FTA Deputy Administrator, Nuria Fernandez. Learn more about the history and future directions of BRT in the U.S., here.

Capacity Improvements

While a single lane of private vehicles on a city street might handle 600 to 1,600 people per hour, a dedicated bus lane can move 8,000 passengers in the same timeframe (NACTO, 2016).



The capacity of a single 10-foot lane (or equivalent width) by mode at peak conditions with normal operations (Source: NACTO, 2016).

System Performance:

BRT systems have demonstrated travel time savings when compared to regular bus services. For example,

In Boston the Silver Line Washington Street station has experienced reductions in mean running times as high as 25%, especially in the midday and PM peak periods (FTA, n.d.).

In Los Angeles, the MetroRapid achieved travel savings as high as 40%, equally attributed to fewer stops, transit signal priority, and low floor vehicles (FTA, n.d.).

Las Vegas experienced 37% (northbound) and 43% (southbound) reductions in running times compared to pre-MAX bus services; With the implementation of BRT, travel time in the BRT corridor in Pittsburgh decreased 55% (FTA, n.d.).

A steppingstone to BRT - Urban Circulators

Urban circulator systems such as streetcars and trolley lines connect urban destinations and foster the redevelopment of urban spaces into walkable mixed-use, high-density environments. Typically, an urban circulator operates regular service within a closed loop - usually 3 miles or shorter in length. Examples include the Portland Streetcar, the Denver 16th Street shuttlebus, and the Lynx LYMMO in Orlando which is a bus-based fixed guideway. Urban circulators expand access to transit while growing businesses and developing infrastructure along major corridors. As the appetite and infrastructure for transit grow alongside downtown businesses, expansion of the system into BRT is an attractive and easy option (FTA, 2015).

GREENHOUSE GAS REDUCTION POTENTIAL

This section provides an overview of greenhouse gas (GHG) emission reductions associated with the strategy. It highlights key findings and relevant metrics from GHG modeling resources, peer-reviewed studies, and real-world applications.

BRT SYSTEMS CAPTURE CHOICE RIDERS AND REDUCE EMISSIONS

BRT systems can capture **choice riders** resulting in a mode change away from cars, thus reducing vehicle miles traveled (VMT) and traffic-related GHG emissions, noise, and air pollution.

What is a choice rider?

Individuals whose transportation decisions are based on a combination of factors including convenience, personal preference, environmental impact, cost, and access. Choice riders are distinct from captive riders, whose options may be limited due to cost, access, or physical ability (Zhao et al., 2014).

BRT reduces the overall amount of vehicle miles travelled in a city by shifting commuters to high-capacity buses that can carry up to 160 passengers at a time (C40, 2016).

A study by the California Air Pollution Control Officers Association (CAPCOA) estimates that BRT systems can reduce GHG emissions by 13.8% compared to traditional bus routes (CAPCOA, 2021).

> In 2000, the City of Bogota in Columbia launched a new BRT service, TransMilenio, with priority lanes that allow for faster bus service during peak periods. The service was estimated to have cut air pollution by as much as 40% in certain communities (Pierre-Louis, 2023).

> The TransOeste BRT system in Rio de Janeiro includes over 150 kilometers of exclusive lanes. It is expected to save a estimated 107,000 tons of carbon dioxide equivalents per year, due to fuel-efficient buses and increased share of trips made by public transit across the city (C40, 2016).

SUCCESSFUL BRT IMPLEMENTATIONS ARE LINKED TO LARGE INCREASES IN CORRIDOR RIDERSHIP AND REDUCED CAR RELIANCE

Boston's Silver Line Phase I experienced a 96% increase in weekday corridor ridership, with ¼ of new riders previously using other modes (FTA, n.d.).

On Pittsburgh's West Busway, one third of riders used an automobile previously (FTA, n.d.).

Bus routes that were upgraded to BRT in King County, WA saw an average ridership growth of 35% (Stewart, Moudon, & Saelens, 2017).

Cleveland's Euclid BRT corridor saw a 60% increase in ridership after two years of operation (compared to the conventional bus route it replaced), while Eugene, OR's EmX BRT increased ridership by 74%, and the South Miami-Dade Busway in Miami, FL increased ridership by about 50% (Ingvardson, & Nielsen, 2018).

CO-BENEFITS

This section outlines the multiple co-benefits associated with the strategy, including safety benefits, local air quality improvements, and improved accessibility. Each co-benefit presents examples that demonstrate how the strategy enhances regional or community well-being while addressing emissions.

SAFETY

Implementing BRT systems can reduce traffic accidents and fatalities due to:

- Overall reduction in VMT. Fewer drivers on the road creates a safer environment for drivers, pedestrians, and cyclists.
- Fewer bus-vehicle interactions. Dedicated bus lanes reduce interactions between buses and other vehicles, reducing the likelihood of accidents.

A C40 analysis shows that streets with BRT systems across Latin America have experienced an average 40% reduction in fatalities and injuries (C40, 2016). The Bogota, Columbia BRT system, launched in 2000, has reduced car fatalities by 92%. Soon after launch, approximately 11% of riders identified as former drivers, suggesting that BRT systems, when designed thoughtfully with accessibility elements and connections to active transportation, can influence mode choice and reduce traffic fatalities (Pierre-Louis, 2023).

BRT corridor development creates an opportunity to improve cyclist accessibility, safety, and comfort. In the case of the new M15 select bus service (SBS) in New York City, bicycling increased 18% to 177% due to bicycle safety improvements implemented in conjunction with SBS infrastructure (Beaton et al., 2012).

In the U.S., for every 100 million person-trips, one study found that fatality rates for car occupants are 23 times higher than those for bus occupants (Beck, et al., 2007). Other research found fatality rates to be 66 times greater for car occupants than bus occupants per passenger-mile (Savage, 2013).

A study of 10 bus routes in Montreal, Canada found that the rate of fatally or severely injured vehicle occupants is 6 times greater for car occupants than for bus occupants (Morency, et al. 2018[AMM3]).

The same study found that the rates of pedestrian and cyclist injuries are also significantly greater for car travel (4.1 times) than bus travel (Morency, et al. 2018).

ACCESSIBILITY AND EQUITY

BRT enhances mobility options by improving accessibility and reducing travel times, which can be especially beneficial for individuals who lack access to a car or for whom driving would be impossible due to cost or disability (Nelson & Ganning, 2015).

BRT systems can save users travel time and make every-day destinations more accessible. For example, the Metrobus in Mexico city has been shown to reduce travel times by up to 50% in high-traffic corridors, while the BRT corridors in Buenos Aires have cut travel times by 20-40% on average (C40, 2016).

> ***Thoughtful system design and amenities can help maximize the benefits of BRT. Features that can make BRT a more attractive mode choice include:*** (ELPC, 2024; C40, 2016)
>
> - Dedicated busways separated from other vehicle traffic
> - Off-board fare collection
> - Accessible and bright, inviting stations
> - Well-lit stops with shelter and heating
> - In cabin amenities, such as free Wi-Fi and charging ports
>
> The ITDP's BRT SCOPE tools shows how better BRT design can contribute to higher ridership and reduced emissions.

BRT systems with off-board fare collection can reduce travel time and improve passenger experience, especially for passengers with young children, people with disabilities, and elderly riders. In its BRT Scorecard, The Institute for Transportation and Development Policy, gives the highest scores to BRT systems with fare-free services and turnstile-controlled fare collection (ITDP, 2024).

The 9.6-mile-Silver Line in Grand Rapids, which launched in 2014, serves the highest employment concentrations in the area. It offers accessible boarding platforms, snow-melting sidewalks, bike racks, and free Wi-Fi on buses. It has helped relieve congestion in the Central Business District and reduced travel time from 47 minutes to 27 minutes (ELPC, 2024).

The Minneapolis-St. Paul's METRO BRT system runs up to 25% faster than local buses and has seen ridership increase by 115% between 2022 and 2024. The BRT stations including lighting, on-demand heat, and emergency phones and cameras (ELPC, 2024).

COST SAVINGS

Transportation is the second-largest household expense for low-income households, after housing (Bureau of Transportation Statistics, 2023). Investments in BRT can reduce transportation costs by reducing the need for car maintenance, fuel, and parking costs. Households that transition from car ownership to using public transportation, walking, and biking can save nearly $10,000 per year (APTA, 2020).

Read more here about potential savings from using public transit vs. a personal vehicle for the top 20 cities by ridership (APTA, 2023).

ECONOMIC GROWTH

BRT investments often stimulate economic development along transit corridors, creating new job opportunities and in some cases revitalizing urban neighborhoods (Nelson & Ganning, 2015).

BRT infrastructure investments have the potential to catalyze positive land development effects, fostering mixed-use development and creating vibrant, walkable communities along transit corridors. The table below details benefits seen in four different cities.

BRT Land Development Benefits (Source: FTA, 2015)

City	Benefits
Pittsburgh	$300M in development around stations
Ottawa	$700M in development around stations
Boston	$650M in development occurred along the Washington Street corridor
Brisbane	+20% gain in residential values near stations, initiation of several joint development projects

AIR QUALITY AND HEALTH

BRT systems are known to increase transit ridership and increase the number and type of options available for a local trip that might otherwise be made by single occupancy vehicles, thus reducing overall transportation-related pollutants that negatively impact human health (Carrigan et al., 2013).

BRT systems that use alternative fuel buses, including electric buses, have improved in-cabin air quality, compared with diesel buses. For example, a study of Mexico City's BRT system found that peak in-cabin PM2.5 concentrations decreased by 35 to 80% when buses were upgraded from diesel to electric versions. These air quality improvements are attributed to lower emissions and closed, air-conditioned cabins (Paniagua et al., 2023).

BRT systems that connect with active transportation infrastructure can promote increased physical activity. Features such as clearly marked pedestrian crossings, curb extensions, and dedicated bike lanes make it easier for people to use active transportation in conjunction with transit (CDC, 2023).

COST CONSIDERATIONS

COST OF IMPLEMENTATION

BRT ***capital costs can vary significantly***, some examples include:

- Franklin Corridor in Eugene, Oregon costing $4.4 million / Km (FTA, 2009).
- Orange Line in Los Angeles, California costing $16.2 million / Km (FTA, 2011).
- Purchase costs for higher end BRT vehicles can range from $370,000 to $1.6 million, depending on the size and propulsion technology (FTA, 2015).

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Costs for Intelligent Transportation Systems (ITS) BRT components can vary widely, ranging from $100,000 to more than $1,000,000 per mile. The USDOT's Intelligent Transportation Systems Joint Program Office maintains a cost database with cost estimates for ITS deployments.

> In 2022 Antelope Valley in northeastern California became the first municipality to unveil an all-electric bus fleet. The upgrade cost roughly $80 million, or about $1 million per bus, but brought significant cost savings. The transit authority notes that the electric fleet's first 10 million miles avoided $3.3 million in fuel costs (Pierre-Louis, 2023).

COST EFFECTIVENESS

Construction time for a BRT project is typically less than 18 months compared to a light rail transit (LRT) project which ranges from about 2 to 3 years, because a LRT system is more complex than BRT (Taotao & Nelson, 2010).

BRT can be a cost-effective addition to a city's transit network, requiring a lower initial investment compared to traditional rail-based systems. This characteristic can be especially important in smaller to medium size cities that are seeking to enhance their transit services but may not have the financial resources to construct a more expensive rail system (Vuchic, 2005).

BRT and light rail transit (LRT) Development Costs (ITDP, n.d.).

Based on recent BRT and light rail corridor development costs in the United States, on average, BRT can be 7 times more affordable than light rail per mile. That's 25 miles of BRT infrastructure for the same cost of less than 4 miles of light rail (Kauppila, 2016).

BRT-like design features can also be deployed to create a less expensive, yet still effective, rapid bus system under certain circumstances. For example, New York City's Select Bus Service deployed features such as bus lanes, transit signal priority, and off-board fare payments, which decreased travel times by about 20%, and increased ridership by 10-20% (NYCDOT, n.d.).

FUNDING OPPORTUNITIES

Federal Highway Administration (FHWA) Flexible Funds: In addition to FTA grant programs, certain funding programs administered by FHWA, including the Surface Transportation Block Grant (STBG) Program and the Congestion Mitigation and Air Quality Improvement (CMAQ) Program, may be used for public transportation purposes. These "flexible" funds are transferred from FHWA and administered as FTA funding, taking on the requirements and eligibility of the FTA program to which they are transferred. See 49 USC 5334(i) and FRA's Join Development Circular for more detail.

FTA's **Urbanized Area Formula Funding program** provides transit capital and operating assistance and transportation-related planning in urbanized areas.

FTA's **Grants for Buses and Bus Facilities** Program supports state and local efforts to buy or modernize buses, improve bus facilities, and support workforce development.

FHWA's **Congestion Mitigation and Air Quality (CMAQ) Improvement Program** provides funds to States for transportation projects designed to reduce traffic congestion and improve air quality, particularly in areas of the country that is or was designated nonattainment for certain national air quality standards.

FHWA's **Carbon Reduction Program (CRP)** funds projects designed to reduce transportation carbon dioxide (CO_2) emissions from on-road highway sources.

FHWA's **Surface Transportation Block Grant (STBG) Program** provides flexible funding that may be used by States and localities for projects to preserve and improve the conditions and performance on any Federal-aid highway, bridge and tunnel projects on any public road, pedestrian and bicycle infrastructure, and transit capital projects.

FTA's **State of Good Repair Grants Program** provides capital assistance for maintenance, replacement, and rehabilitation projects of high-intensity fixed guideway and motorbus systems to help transit agencies maintain assets in a state of good repair in urbanized areas.

FTA's **Capital Investment Grants (CIG)** program funds transit capital investments including new and expanded rapid rail, commuter rail, light rail, streetcars, bus rapid transit, and ferries.

FTA's **Better Utilizing Investments to Leverage Development (BUILD) Transportation Grants Program** funds investments in transportation infrastructure, including transit.

FTA's **Buses and Bus Facilities Discretionary Grants** assist in the financing of buses and bus facilities capital projects, including replacing, rehabilitating, purchasing or leasing buses or related equipment, and rehabilitating, purchasing, constructing or leasing bus-related facilities.

FTA's **Low or No Emission (Low-No) Vehicle Program** supports state and local efforts to buy or modernize buses, improve bus facilities, and support workforce development.

The Build America Bureau's **Transportation Infrastructure Finance and Innovation Act (TIFIA)** program provides credit assistance for qualified projects of regional and national significance. Many large-scale, surface transportation projects - highway, transit, railroad, intermodal freight, and port access - are eligible for assistance.

COMPLEMENTARY STRATEGIES

Enhancing pedestrian and cycling infrastructure along BRT corridors encourages multimodal connectivity and promotes healthier, more sustainable travel options.

Providing shared mobility (e.g., bikeshare, scooters) at or near the BRT stations will help improve first-/last-mile options for BRT passengers and may encourage more linked trips.

Coordinating land use planning with BRT investments facilitates compact, mixed-use development around transit hubs, maximizing ridership and minimizing sprawl.

Implementing fare integration schemes across transit modes streamlines the passenger experience.

Commuter benefits can complement bus rapid transit by encouraging more people to use public transit for their commute. Increased ridership on bus rapid transit systems can lead to greater efficiency and effectiveness of the service as well as potential expansion to serve more areas and accommodate growing demand.

View All Strategies

CASE STUDIES

EVERETT BRT (EVERETT, MASSACHUSETTS)

Source: Barr Foundation

In the Greater Boston region, the Everett BRT pilot showcased the effectiveness of bus rapid transit elements in improving transit efficiency and rider experience. By creating bus priority in Arlington, Everett, Cambridge, and Watertown through dedicated and shared bus and bike lanes, queue jumps, transit signal priority, and platform level boarding, the pilot demonstrated significant improvements in bus travel times and reliability. Additionally, the incorporation of art installations into BRT stations, such as flower bombs and curated bus shelter art, enhanced the aesthetic appeal of transit infrastructure, improving the overall rider experience and fostering community engagement with public transportation initiatives.

Source: Barr Foundation

RAPID RIDE (KING COUNTY, WASHINGTON)

King County Metro's BRT system shows significant time savings of up to 20% over previous local bus routes. Utilizing semi-exclusive bus lanes, queue jumps, and off-board fare collection, King County Metro ensures reliable service. Collaboration with local stakeholders prioritizes equity and connectivity, resulting in higher ridership and satisfaction levels, setting a benchmark for successful BRT deployment.

Source: Pace Bus

PACE SUBURBAN BUS (CHICAGO, ILLINOIS)

Pace Suburban Bus operates the Pulse BRT system in Chicago's suburban areas, where traffic congestion can be a significant challenge. To address this, the system incorporates features like Transit Signal Priority (TSP) and curb extensions to improve service reliability and efficiency. Additionally, on highways like I-55, buses utilize bus-on-shoulder (BOS) operations to bypass traffic congestion, ensuring smoother and more reliable service. These measures have led to significant improvements, with on-time performance increasing from around 65% to 92% with BOS operation on I-55, and corridor bus ridership increasing by 600%.

IMPLEMENTING BUS RAPID TRANSIT: **WHAT TO READ NEXT**

The FTA's Bus Rapid Transit Resources page provides a number of case studies on US cities that have implemented BRT systems, including Los Angeles, Las Vegas, Eugene, Miami, and Pittsburgh. This includes an overview of the costs of these systems, and some of the design considerations that go into building a BRT route.

The Institute of Transportation and Development Policy produced a report on guidelines for implementing BRT systems in US cities. The report goes over funding strategies that different cities have use to construct BRT systems, including local funding and applicable federal grants. It also provides general guidance on the timelines associated with BRT implementation.

FTA's Characteristics of Bus Rapid Transit for Decision Making report provides a variety of information on items that can be considered when designing and implementing a BRT system. This includes capital aspects of a BRT project, such as vehicle type and station designs, and operational aspects, such as fare collection and intelligent transportation systems.

With proper planning and stakeholder engagement, municipalities can expedite the deployment of BRT corridors to meet evolving transit demands. Check out the ITDP's BRT Planning Guide for more information on the BRT planning process, including project initiation, demand analysis, public participation, and cost-benefit analysis.

RESOURCES

GENERAL RESOURCES

Federal Transit Administration, Bus Rapid Transit Resources: This webpage is a comprehensive repository of BRT information, including examples, research, evaluation, and tools.

U.S. DOT, Characteristics of Bus Rapid Transit for Decision-Making: This resource provides comprehensive information for transportation planners and decision makers to develop and evaluate BRT. The resource includes the main elements of BRT, system performance measures, and system benefits. Sub-topics include travel time, reliability, identity and image, safety and security, capacity, ridership, cost effectiveness, operating cost efficiency, land development, and environmental quality considerations.

U.S. DOT, The Characteristics of Accessible Bus Rapid Transit: This white paper highlights elements of BRT that affect accessibility.

Institute for Transportation and Development Policy, BRT Planning Guide: This guide provides a roadmap for BRT planning, outlining key steps and considerations for successful implementation.

Institute for Transportation and Development Policy, BRT Planning Guide Webinar Series: This webinar series goes into specific aspects of BRT planning, expanding on the information in the guide through focused webinars.

Institute for Transportation and Development Policy, Getting to BRT: An Implementation Guide for U.S. Cities: This guide offers practical guidance specifically tailored to US cities looking to implement BRT systems.

TOOLKITS AND MODELLING APPROACHES

Institute for Transportation and Development Policy, BRT Standard: This standard is both a framework for understanding BRT and an evaluation tool for BRT corridors based on international best practices.

Clean Air Initiative for Asian Cities (CAI-Asia) and Institute for Transportation and Development Policy (ITDP), Transport Emissions Evaluation Model for Projects (TEEMP) BRT: This model can estimate the potential impact of BRT systems on transportation emissions, allowing planners to assess environmental benefits.

The American Cities Climate Challenge, Transit Priority Toolkit: This toolkit provides cities an easy-to-use resource to engage with internal staff, stakeholders, decision makers, and the public about transit priority projects.

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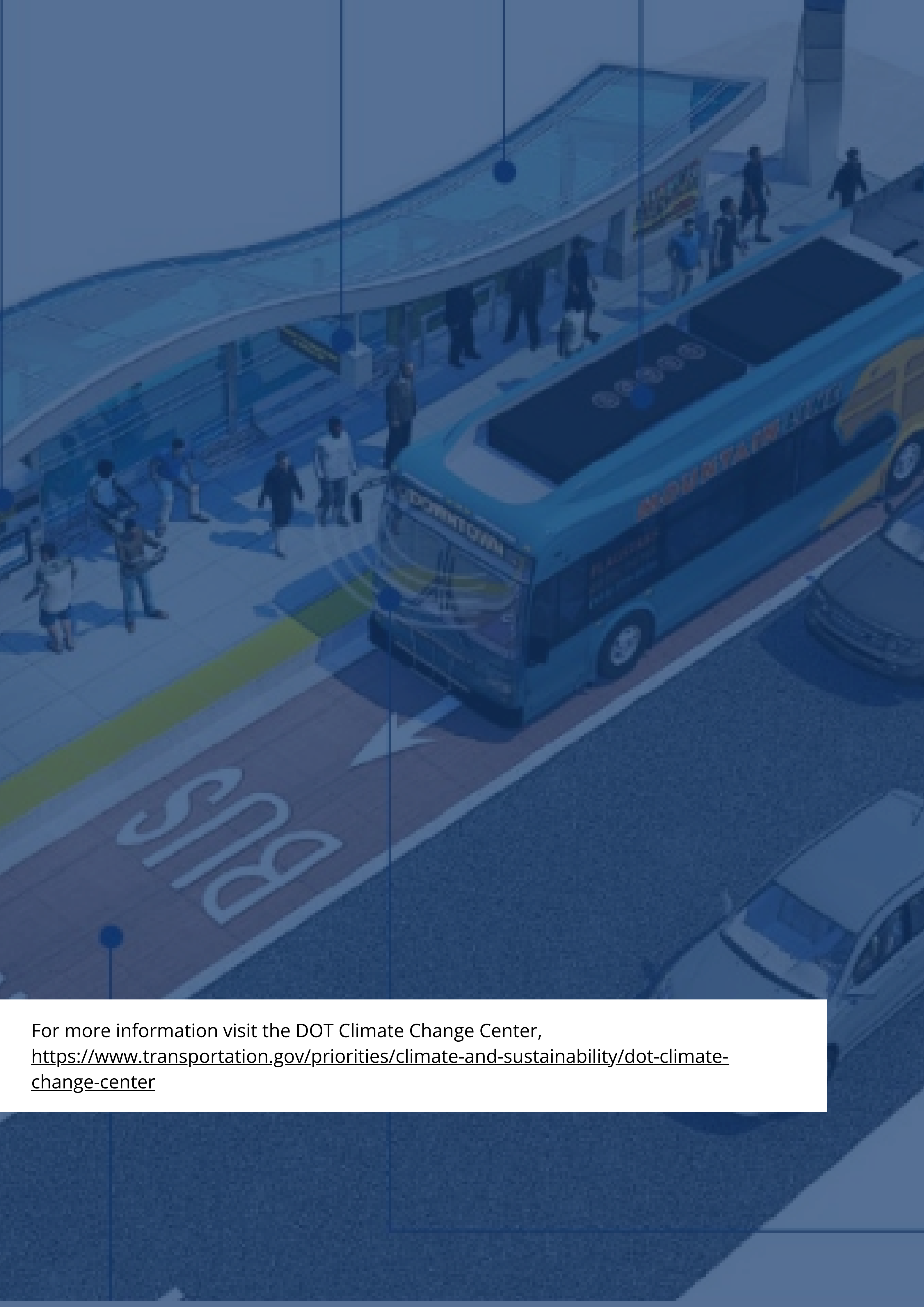

For more information visit the DOT Climate Change Center, https://www.transportation.gov/priorities/climate-and-sustainability/dot-climate-change-center