



Getting to BRT: An Implementation Guide for U.S. Cities

SEPTEMBER 2019



ACKNOWLEDGMENTS

AUTHORS

Aileen Carrigan
Julia Wallerce
Michael Kodransky

The authors would like to thank Caroline Lovaglio for her valuable research and editing assistance. Joe Chestnut's site visit to Richmond, Virginia was the inspiration for the GRTC Pulse case study. Jacob Mason provided valuable insights as head of the *BRT Standard* Technical Committee. Special thanks to the content reviewers: Julian Agyeman, Joseph Calabrese, Graham Carey, Benjamin de la Peña, Aimee Gauthier, and Dario Hidalgo.

In addition, the authors appreciate the interviewees who were so generous with their time, and those people who reviewed individual case studies: Maureen Lawrence, Lisa Rivers, and Cara Radzins (Hartford); Ross Catrow and Carrie Rose Pace (Richmond); and Andrew de Garmo, Lawrence Kline, and Terra Reed (Albuquerque). The views expressed here, and any errors, are the authors'.

This guide was made possible with funding from the Barr Foundation.

CONTENT

3	Definitions Of Key Terms	80	U.S. BRT Case Studies
5	List Of Abbreviations	81	Hartford Region's CTfastrak BRT
6	Introduction	101	Richmond, Virginia's The Pulse BRT
10	What Is BRT?	121	Albuquerque Rapid Transit BRT
15	The State of BRT in the U.S.	149	Appendix A: Basic Characteristics of U.S. BRT Corridors
22	U.S. BRT Implementation Guidance	150	Appendix B: Capital Funding Sources for U.S. BRT Corridors
22	Choosing & Designing the BRT Corridor	153	Appendix C: Potential Federal Funding Sources For BRT
25	Governance for Project Delivery	156	Interviews
31	Financing BRT	159	References
46	Inclusive public engagement		
55	Branding and marketing the BRT		
58	Designing an Equitable BRT project		
65	Designing a convenient and accessible BRT system		
68	Procuring buses		
75	Managing the Economic impacts of BRT		
79	Looking ahead		

DEFINITIONS OF KEY TERMS

- **Altoona testing:** unbiased third-party testing of bus performance under typical operating requirements to assess bus safety, structural integrity and durability, reliability, performance, maintainability, noise, fuel economy, brakes, and emissions
- **Bi-directional bus lane:** a single-lane segment of a busway used by buses traveling in both directions, one direction at a time. An advanced signaling system holds oncoming buses, and the busway breaks into two directions at key points for passing. See the *BRT Planning Guide*, Section 22.2.8, *Bi-directional One-Lane Configuration*, for more information
- **BRT corridor:** a section of road or contiguous roads with dedicated infrastructure served by a bus route or multiple bus routes with a minimum length of 1.9 miles (3 kilometers)
- **BRT route:** a fixed path and schedule for bus service that serves a BRT corridor
- **Busway:** exclusive road or road space for bus traffic only
- **Buy America:** a federal provision requiring federally funded transit projects to procure American-made steel, iron, and manufactured goods. As of FY20, federally-funded buses must be comprised of 70% domestic components¹
- **Categorical Exclusion:** a class of actions that a federal agency has determined, after review by the Council on Environmental Quality, do not individually or cumulatively have a significant effect on the human environment and for which, therefore, neither an environmental assessment nor an environmental impact statement is normally required²
- **Direct service:** a BRT service model where multiple bus routes operate in mixed traffic on local streets and then continue onto the BRT corridor³
- **Fare capping:** payment system that collects user and trip information each time a passenger taps a smartcard; it calculates how much to deduct from the user's account based on their trips, to ensure that passengers pay the lowest possible fare
- **Farebox recovery ratio:** percentage of a trip's operating costs recovered through passenger fares⁴
- **Fixed-guideway BRT:** according to FTA, a bus corridor which has a separated right-of-way for at least 50% of its length during peak hours and provides weekend service with at least 30-minute headways.⁵
- **Multimodal trip:** a trip that utilizes a combination of multiple types of transportation

¹ Federal Transit Administration 2018b.

² National Environmental Policy Act 2019.

³ *The Online BRT Planning Guide, Section 6.6 Direct Services, Trunk-and-Feeder Services, or Hybrids* (ITDP 2016b).

⁴ Federal Transit Administration 2017b.

⁵ Federal Transit Administration 2016c.

- **Non-motorized transport:** also known as active transportation and human powered transportation, includes walking and bicycling, and variants such as small-wheeled transport and wheelchair travel⁶
- **Off-board fare collection:** fare payment at the station, instead of on the bus, which eliminates the delay caused by passengers waiting to pay on board
- **Open corridor:** a BRT corridor in which some bus routes continue off the corridor, reducing the need for transfers
- **Platform-level boarding:** boarding a bus where the station is level with the bus floor, which makes it quick and easy, and also fully accessible for wheelchairs, passengers with disabilities, and strollers with minimal delays
- **Proof-of-payment (POP) system:** payment system in which passengers are required to have purchased a paper ticket or tapped an electronic farecard or mobile app in the station before boarding, and an inspector in a vehicle often verifies a valid ticket
- **Reversible bus lane:** a single-lane segment of a busway, similar to a bi-directional bus lane, but only the buses traveling in the peak direction use the dedicated lane, and buses traveling in the off-peak direction run in mixed traffic
- **Sawtooth bus bay:** a bus bay design where the curb is indented in a sawtooth pattern, allowing buses to enter and exit bus bays independently of other buses, often used at terminal stations⁷
- **Shared mobility:** the shared use of a vehicle, bicycle, or other mode that enables users to gain short-term access to transportation as needed; includes various forms of bikesharing, carsharing, ridesharing, ridehailing, scooter-sharing, and on-demand shuttle services⁸
- **Traffic signal priority:** adjustment of traffic signals to give priority to a corridor with BRT system over a corridor without one, and to give priority to the BRT system over the mixed traffic within the same corridor in order to improve BRT travel time and reliability⁹
- **Transit-oriented development (TOD):** compact, mixed-use development within walking distance of high-capacity rapid transit; TOD features vibrant streetscapes, pedestrian-oriented built forms, and land use characteristics that make it convenient and safe to walk, cycle, and use public transport¹⁰
- **Trunk-and-feeder:** a BRT service model where trunk routes operate inside the BRT corridor infrastructure and feeder routes operate in mixed traffic and “feed” the trunk stations.¹¹
- **Urban arterial:** high-volume road within a city that tends to feature wider street and lane widths

6 Victoria Transport Policy Institute 2018.
7 *The Online BRT Planning Guide, Section 28.1.2 Terminals and Stations* (ITDP 2016b).
8 Federal Highway Administration 2016.
9 *The Online BRT Planning Guide, Section 24.3 Traffic Signal Priority* (ITDP 2016b).
10 *What is TOD?* (ITDP 2019b).
11 *The Online BRT Planning Guide, Section 6.6 Direct Services, Trunk-and-Feeder Services, or Hybrids* (ITDP 2016b).

LIST OF ABBREVIATIONS

ADA	Americans with Disabilities Act
ART	Albuquerque Rapid Transit
BRT	Bus Rapid Transit
BUILD	Better Utilizing Investments to Leverage Development (formerly TIGER)
BYD	BYD Auto Co. Ltd. (bus and automotive manufacturer)
CE	Categorical Exclusion
CEQA	California Environmental Quality Act
CIG	Capital Investment Grants
CMAQ	Congestion Mitigation and Air Quality
CNG	Compressed Natural Gas
CRCOG	Capitol Region Council of Governments (Hartford, Connecticut)
CTDOT	Connecticut Department of Transportation
DOT	Department of Transportation
DRPT	Department of Rail and Public Transportation (Virginia)
EA	Environmental Assessment
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
FAST	Fixing America’s Surface Transportation Act
FHWA	Federal Highway Administration
FSTIP	Federal Statewide Transportation Improvement Program
FTA	Federal Transit Administration
FTIP	Federal Transportation Improvement Program
GRTC	Greater Richmond Transit Company
HOV	High-Occupancy Vehicle
MPO	Metropolitan Planning Organization
MTC	Metropolitan Transportation Council (Bay Area, California)
NABI	NABI Bus, LLC (bus manufacturer)
NACTO	National Association of City Transportation Officials
NEPA	National Environmental Policy Act
POP	Proof-of-Payment
ROW	Right-of-Way
RTIP	Regional Transportation Improvement Program
SFCTA	San Francisco County Transportation Authority
SFMTA	San Francisco Municipal Transportation Agency
TIF	Tax Increment Financing
TIGER	Transportation Investment Generating Economic Recovery (now BUILD)
TIP	Transportation Improvement Program
TOD	Transit-Oriented Development
USDOT	United States Department of Transportation
VMT	Vehicle Miles Traveled

INTRODUCTION

While momentum in recent decades has elevated bus rapid transit (BRT) as more than an emerging mode in the U.S., this high-capacity, high-quality bus-based mass transit system remains largely unfamiliar to most Americans. In the U.S., lack of clarity and confusion around what constitutes BRT stems both from its relatively low profile (most Americans have never experienced BRT) and its vague and often conflicting sets of definitions across cities, sectors, and levels of government. As a result, many projects that would otherwise be labeled as bus improvements or bus priority under international standards have become branded in American cities as BRT. This leads to misperceptions among U.S. decision-makers and the public about what to expect from BRT. Since its inception in Curitiba, Brazil, BRT has become a fixture of urban transport systems in more than 70 cities on six continents throughout the globe.¹² Just twelve BRT corridors exist in the United States so far.

This guide offers proven strategies and insights for successfully implementing BRT within the political, regulatory, and social context that is unique to the United States. This guide seeks to illuminate the upward trends and innovations of BRT in U.S. cities. Through three in-depth case studies and other examples, the guide shares the critical lessons learned by several cities that have successfully implemented, or are in the midst of completing, their own BRT corridors. Distinct from previous BRT planning and implementation guides, this is a practical resource to help planners, and policy makers specifically working within the U.S. push beyond the parameters of bus priority and realize the comprehensive benefits of true BRT.

THE ROLE FOR BRT IN CITIES

U.S. cities are grappling with complex challenges like impacts from the climate crisis, affordability, economic growth, and road fatalities. Cities have shown leadership on climate change, setting ambitious municipal commitments and targets to reduce greenhouse gases. There is also momentum in many communities toward transit-oriented development and building Complete Streets that reallocate a city's resources and physical space from private vehicles to people—people on foot, bikes, shared mobility, and public transit. Yet transit ridership in most U.S. cities is declining. When transit service does not meet people's needs, they seek out better options, typically in private and shared cars.¹³ Turning around declining transit ridership is critical for cities to address some of their biggest social, environmental, and equity challenges. Improving transit reliability and frequency significantly influences passenger satisfaction, and satisfied customers ride transit more often.¹⁴

Ridership. To this end, high-quality BRT corridors that provide faster, more reliable service not only improve circumstances for the existing customers on the corridor, but also draw new riders to the route. BRT passengers can get where they are going more quickly, as the infrastructure is designed to reduce common causes of bus delays. Transit service that arrives at short intervals is more convenient and dependable than infrequent service. For these and other reasons, many of the BRT corridors in the U.S. experienced ridership increases after introducing new services.¹⁵

¹² BRT corridors in 71 cities have been rated with the *BRT Standard* (see ITDP 2019a). Other unrated corridors may also meet the *BRT Standard* definition of BRT. As of mid-2019, BRIData.org included information and images about bus priority systems in 170 global cities (BRT+ Centre of Excellence and WRI 2019). Some of these systems would meet the *BRT Standard's* definition of Basic BRT.

¹³ Transit Center 2019b.

¹⁴ Transit Center 2019b.

¹⁵ When comparing ridership before and after the BRT, not all of the change can necessarily be attributed to the BRT. Ideally, the ridership on the BRT corridor would be compared to the counterfactual - what the ridership would have been in the same year without the BRT. Counterfactuals are difficult to project, so before-and-after data are used instead.

- One year after launching, Richmond’s The Pulse has reduced travel times on the corridor 33% and doubled the expected daily ridership.¹⁶
- With the introduction of Hartford’s CTfastrak, travel times along the corridor were reduced by half and transit ridership more than doubled.¹⁷
- Cleveland’s HealthLine reduced travel times on the Euclid Avenue Corridor 21%. Three years after operations began, ridership on the HealthLine was 60% higher compared to the route it replaced, even during a period when city-wide bus ridership declined 30%.¹⁸

Comparative advantage. BRT offers distinct advantages over rail transportation. BRT capital costs are generally lower than rail, and their planning and construction phases tend to be less complex and therefore shorter.¹⁹ BRT service also provides more operational flexibility than rail-based modes.

Climate and energy. Finally, BRT plays an important role in the global effort to reduce transport-sector greenhouse gas emissions. By providing high-quality transit service, like BRT, that connects people with the places they need to go, cities can shift trips from private or shared vehicles onto public transit and reduce transport emissions. When people can walk and bike short distances to work, school, or shops—as they can in mixed-use urban development around BRT stations—they can avoid new motor vehicle trips and their associated emissions. Furthermore, the energy intensity of BRT trips can be improved as fleets incorporate cleaner bus technologies. See the section “Procuring Buses” for further discussion about different BRT vehicle technologies.

THE EMERGENCE OF BRT IN THE U.S.

BRT has slowly emerged as a viable public transit option in U.S. cities over the last four decades. Today, ten cities have successfully implemented 12 BRT corridors, and a thirteenth corridor, in Albuquerque, is constructed and nearing launch. In addition, dozens of bus corridor projects, some of which may turn out to be full-fledged BRT, are under construction or being planned.

The first U.S. BRT, Pittsburgh’s South Busway, opened in 1977. Over the next 27 years, only two new corridors were launched— Pittsburgh’s second corridor, the Martin Luther King Jr. East Busway in 1983, and South Miami-Dade Busway in 1997 (see Figure 1 and Appendix A). After 2000, there was more rapid growth in new BRT corridors. Many BRTs launched in the mid-2000s achieved better than Basic BRT ratings (see the section “The BRT Basics”). Between 2003 and 2008, three Bronze Standard corridors (Pittsburgh’s MLK Jr. East Busway extension, LA Metro’s Orange Line, and Eugene-Springfield’s EmX Green Line) and the first Silver Standard corridor (Cleveland’s HealthLine) launched. 2015 saw the opening of the country’s second Silver-rated corridor, Hartford’s CTfastrak busway. As of mid-2019, there are 12 BRT corridors totaling 73 miles and carrying more than 142,000 daily passengers.

¹⁶ Greater Richmond Transit Company & DRPT 2014b, GRTC 2018a, GRTC 2019e.

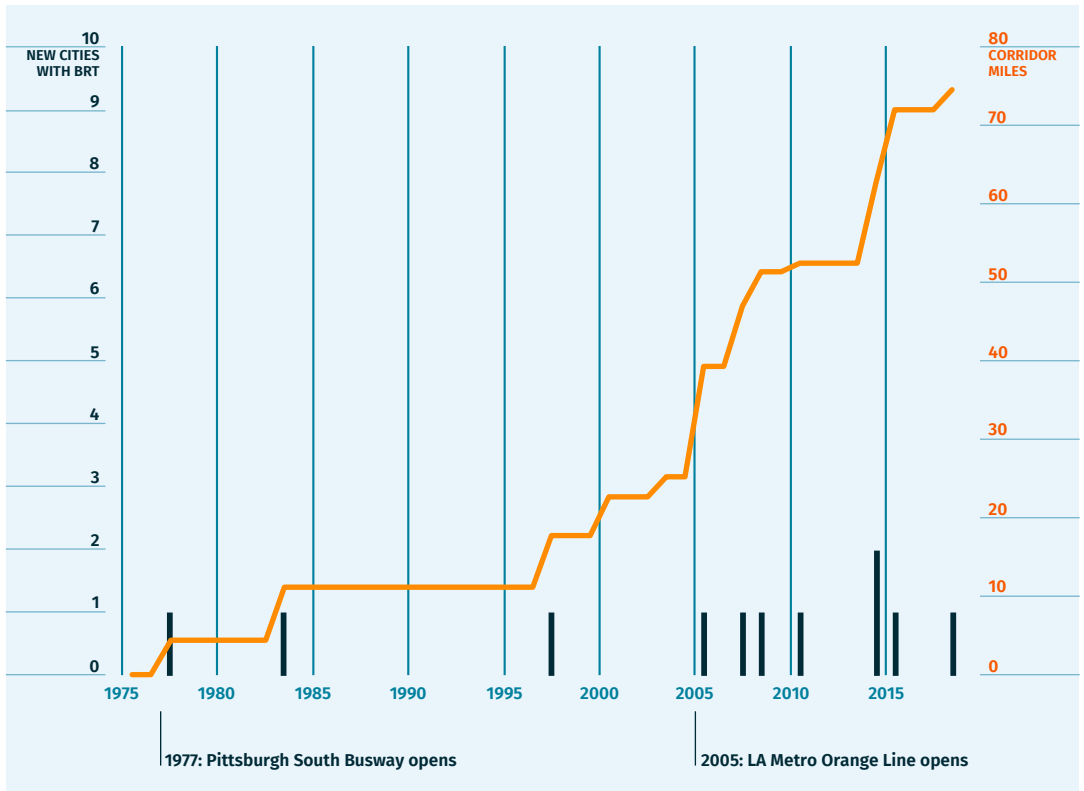
¹⁷ CTDOT 2019b.

¹⁸ Federal Transit Administration 2012.

¹⁹ Hinebaugh 2009, ITDP 2016b, National Academies of Science, Engineering, and Medicine 2003.

This is a new chapter for BRT in the U.S. Today, ten cities have succeeded in implementing high-quality BRT corridors and can showcase the positive impacts BRT can have on communities. Learning from the implementation challenges of these precedents can help streamline the process for subsequent cities and accelerate the growth of BRT in the U.S.

Figure 1:
Growth of U.S. BRT corridor miles and cities with BRT since 1975



Note: Data excludes 2012 extension of the Los Angeles Metro Orange Line.
Sources: ITDP 2016a, BRT+ Centre of Excellence and WRI 2019. Based on Hidalgo 2019.

HOW THIS GUIDE DIFFERS FROM OTHERS

This guide looks at the process of implementing a BRT corridor, from initial planning to operations, in the specific and current context of U.S. cities. It also relies on a specific and narrow definition of BRT, differentiated from bus priority improvements. The case studies and examples illuminate U.S. cities' experience implementing high-quality BRT corridors. This guide is structured in three parts:

1. An overview of BRT in the U.S.
2. A detailed implementation guide drawing on current literature and interviews with stakeholders in cities that have been through the process.
3. Three case studies offering an in-depth look at the implementation of BRT corridors that are operational or under construction.

Several preceding guides have also addressed BRT design and implementation, some with references to case studies. Each guide's approach or focus differs in some way from this current compilation:

- Rich with deep, technical content about planning and designing a BRT corridor, the Fourth Edition of the *BRT Planning Guide* is written for an international, technical audience. While it does not address the specific political, institutional, and operational challenges facing U.S. cities, it can serve as a BRT textbook when there is a specific question about some facet of BRT design, planning, or implementation.
- With funding from the Federal Transit Administration (FTA), the National BRT Institute published a 2009 update to *Characteristics of Bus Rapid Transit for Decision-Making*. While this document does target U.S. decision-makers, it has a specific focus on the initial project planning phase and utilizes a broader definition of BRT. It provides detailed information about infrastructure elements, costs, benefits, and performance to support the development and evaluation of BRT during alternatives analysis and project planning.²⁰
- In 2003, the National Academies of Science, Engineering, and Medicine's Transit Cooperative Research Program published the seminal *Bus Rapid Transit, Volume 2: Implementation Guidelines* and 26 international case studies.²¹ The guide does address the U.S. implementation context, and it includes in-depth discussion of principles for planning, designing, and operating BRT. The term "BRT" encompasses a range of interventions, from bus priority to dedicated busways. Some of the very thorough content is now outdated, and salient issues such as battery-electric buses, community engagement, and equity are not addressed.

²⁰ Hinebaugh 2009.

²¹ National Academies of Science, Engineering, and Medicine 2003

What Is BRT?

DEFINING BRT

BRT is a “high-quality bus-based transit system that delivers fast, comfortable, and cost-effective services at metro-level capacities. It does this through the provision of dedicated lanes, with busways and iconic stations typically aligned to the center of the road, off-board fare collection, and fast and frequent operations.”²²

Some confusion around BRT in the U.S. stems from the fact that other institutions have defined the mode more broadly or vaguely. The Federal Transit Administration (FTA), for example, defines BRT as “a high-quality bus-based transit system that delivers fast and efficient service that *may* include dedicated lanes, busways, traffic signal priority, off-board fare collection, elevated platforms, and enhanced stations.”²³

As a result of the different descriptions of BRT, many projects that would otherwise be labeled as bus improvements or bus priority under international standards have become branded in American cities as BRT.²⁴ This leads to confusion among decision-makers and the public at large about what to expect from a proposed BRT project.

THE BRT STANDARD

The *BRT Standard* was created to establish a common understanding of BRT, distinct from bus priority improvements. Evaluating and rating BRT corridors helps to set an internationally recognized standard for the current best practices for BRT, and ultimately to elevate the quality of BRT design. The Technical Committee of the *BRT Standard* is a group of internationally renowned BRT planning and implementation experts, convened by ITDP.

THE FIVE BRT BASICS

The BRT Basics are the essential ingredients for putting the “rapid” in bus rapid transit (see Table 1). These elements address the main sources of delay for city buses: mixed traffic, stations, and intersections. By reducing common sources of delay, BRT is more reliable, more convenient, and faster than conventional bus services; it shares some service characteristics with rail transit.

²² ITDP 2016a.

²³ Federal Transit Administration 2017a.

²⁴ Largely in Europe the concept of Buses of High Level of Service (BHLS) exists, which is distinct from BRT as defined in the *BRT Standard*. In European cities which often have established rail-based public transit networks, BHLS plays a different role than in U.S. cities. A strategic aim of BHLS is to upgrade the quality and ridership of existing bus lines; restore the reliability and operational effectiveness of bus service while enhancing the public perception of the bus. BHLS constitutes a suite of bus service and infrastructure improvements to enhance the passenger experience (Finn 2012).

Table 1:
Five basic features of BRT

BRT BASIC FEATURE	DESCRIPTION
Dedicated right-of-way	Bus-only lanes make for faster travel and ensure that buses are never delayed due to mixed traffic congestion. Physically separated, dedicated lanes earn the maximum points in the <i>BRT Standard</i> .
Busway alignment	A center-of-the-roadway or bus-only corridor keeps buses away from the busy curbside where cars are parking, standing, and turning. A two-way, center-aligned busway in the central verge of a two-way road earns the maximum points in the <i>BRT Standard</i> .
Off-board fare collection	Fare payment at the station, instead of on the bus, eliminates delays caused by passengers waiting to pay on board.
Intersection treatments	Traffic turning across bus lanes causes delays. Prohibiting such turns is the most important measure for moving buses through intersections—more important even than signal priority.
Platform-level boarding	The station should be level with the bus floor for quick and easy boarding. This also makes it fully accessible for wheelchairs, passengers with disabilities, and strollers with minimal delays.

Adapted from ITDP 2016a

WHAT IS A BRT CORRIDOR?

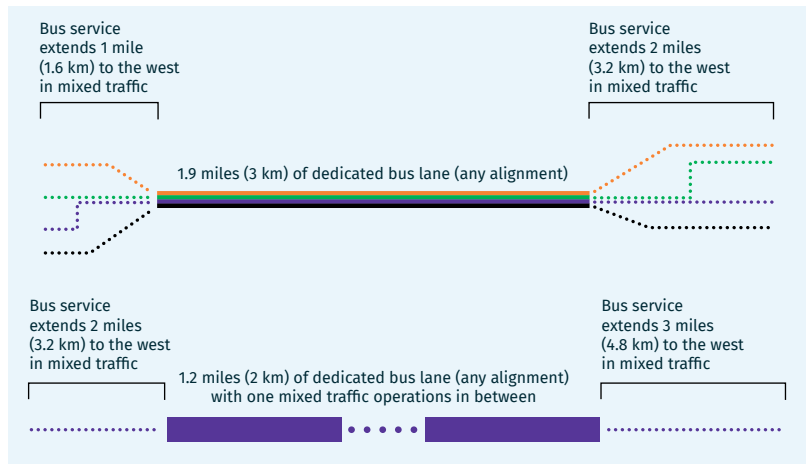
According to the *BRT Standard*, a BRT corridor is a **section of road or contiguous roads with dedicated infrastructure with a minimum length of 1.9 miles (3 kilometers) served by one or multiple bus routes** (see Figure 2).

Furthermore, the *BRT Standard* states that to qualify as BRT, a bus corridor must meet the BRT Basics requirements:

- Score 4 or more points in the dedicated right-of-way element;
- Score 4 or more points in the busway alignment element;
- Score 20 or more points across all five BRT Basics elements.

Figure 2:
What is a BRT corridor?
ITDP 2016a

To qualify as BRT, a corridor must also meet the BRT Basics



The *BRT Standard's* definition of a BRT corridor differs from FTA's. FTA distinguishes between fixed-guideway BRT and corridor-based BRT to determine funding eligibility (see the section "Federal Funding"). According to FTA, a corridor-based BRT operates in mixed traffic, while the majority of a fixed-guideway BRT must operate in a separated right-of-way dedicated for public transportation during peak periods. Other traffic may make turning movements through the separated right-of way.²⁵

This guide adopts the *BRT Standard's* definition of BRT to identify and evaluate U.S. BRT corridors. Throughout, the term BRT is only used in reference to corridors that meet the minimum definition of BRT set out in the *BRT Standard*. This includes corridors that have been formally rated as at least Basic BRT (see Table 2). Since other corridors currently under construction have not been rated as BRT with the *BRT Standard*, they are referred to here as bus corridors. Once construction is complete and operations have launched, the corridors can be formally rated and may prove to be full-fledged BRT.

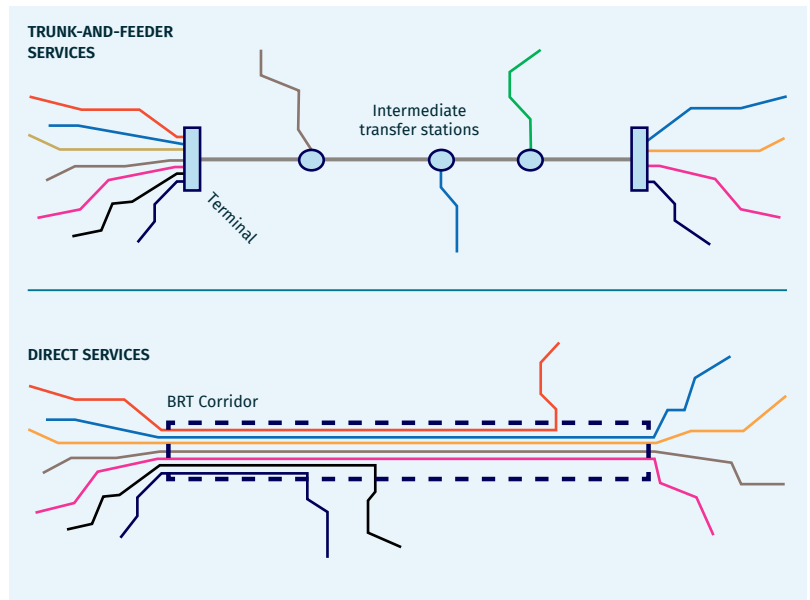
BRT ROUTES

There is an important distinction between the BRT corridor infrastructure, and the BRT services or routes operating on that corridor. Two BRT service schemes can utilize the corridor infrastructure: trunk-and-feeder or direct services (see Figure 3).

- **Trunk-and-feeder.** High-capacity buses operate exclusively in the "trunk" corridor and feeder buses may bring passengers from outlying areas to the corridor by way of terminals or transfer stations. This service model increases the number of transfers required for passengers. Many U.S. BRT corridors, including Cleveland's HealthLine, Los Angeles's Orange Line, and Eugene-Springfield's EmX Green Line operate as trunk corridors (without feeder buses).
- **Direct service.** With a direct-service model, on the other hand, buses operate in mixed traffic before entering the BRT corridor and taking advantage of the dedicated bus lane. Buses may exit the corridor and continue in mixed traffic. This configuration, used by Hartford's CTfastrak and Pittsburgh's busways²⁶, connects passengers directly to their destination without requiring a transfer.

See the *BRT Planning Guide, Section 6.6, Direct Services, Trunk-and-Feeder Services, or Hybrids* for more design guidance and tradeoffs between BRT service models.

Figure 3:
**Schematics
of trunk-and-feeder
and direct BRT
services.**
ITDP 2016b



BRT STANDARD RATINGS

The *BRT Standard* covers service design, infrastructure, stations, communications, access, and integration, all of which are essential for high-quality BRT service. The *BRT Standard* ratings rely on easily observable design and operations characteristics that are associated with high performance, rather than on performance measurements.²⁷ It is intended to complement cost-effectiveness measurements and corridor performance evaluations, such as the cost-effectiveness analysis required by FTA.

A description of the *BRT Standard* ratings and corresponding U.S. BRT corridors is listed in Table 2. Bronze, Silver, and Gold rankings all reflect well-designed corridors that have achieved excellence. Not every transit corridor is ripe for Gold Standard BRT, so cities should match the BRT design standard to the corridor context.

Table 2:
**U.S. BRT corridors by
 BRT Standard rating**
ITDP 2016a, 2019a

<p>GOLD STANDARD BRT 85 POINTS OR ABOVE</p> <p>Gold Standard BRT is consistent in almost all respects with international best practices. These corridors achieve the highest level of operational performance and efficiency while providing a high quality of service. The Gold level is achievable on any corridor with sufficient demand to justify BRT investments. These corridors have the greatest ability to inspire the public, as well as other cities.</p>	<p>Albuquerque, ART* (design score only) <i>No official Gold Standard BRT is operational in the U.S. as of mid-2019.</i></p>
<p>SILVER STANDARD BRT 70–84.9 POINTS</p> <p>Silver Standard BRT includes most of the elements of international best practices and is likely to be cost-effective on any corridor with sufficient demand to justify BRT investment. These corridors achieve high operational performance and quality of service.</p>	<p>Cleveland, HealthLine Hartford, CTfastrak</p>
<p>BRONZE STANDARD BRT 55–69.9 POINTS</p> <p>Bronze Standard BRT solidly meets the definition of BRT and is mostly consistent with international best practices. Bronze Standard BRT has some characteristics that elevate it above the minimum standard, achieving higher operational efficiencies or quality of service than Basic BRT.</p>	<p>Eugene-Springfield, EmX Green Line LA Metro Orange Line Pittsburgh, Martin Luther King Jr. East Busway Richmond, The Pulse San Bernardino, sbX</p>
<p>BASIC BRT</p> <p>Basic BRT refers to a core subset of elements that the Technical Committee has deemed essential to the definition of BRT. This minimum qualification is a precondition to receiving a Gold, Silver, or Bronze ranking.</p>	<p>Fort Collins, MAX** Las Vegas, Strip & Downtown Express (SDX) Pittsburgh, West Busway Pittsburgh, South Busway South Miami-Dade Busway**</p>

* Albuquerque's ART corridor was scored before it was operational and on design characteristics only. It has since faced some major operational challenges that, to this day, have prevented service from running. While it was preliminarily scored Gold for design, it remains to be seen what its official *BRT Standard* score will be once its service launches. See Albuquerque case study in Chapter 5 for more information on this system.

** Fort Collins's MAX BRT and the South Miami-Dade Busway have not been formally rated with the *BRT Standard*, but based on ITDP's preliminary assessment, they are referred to here as Basic BRT.

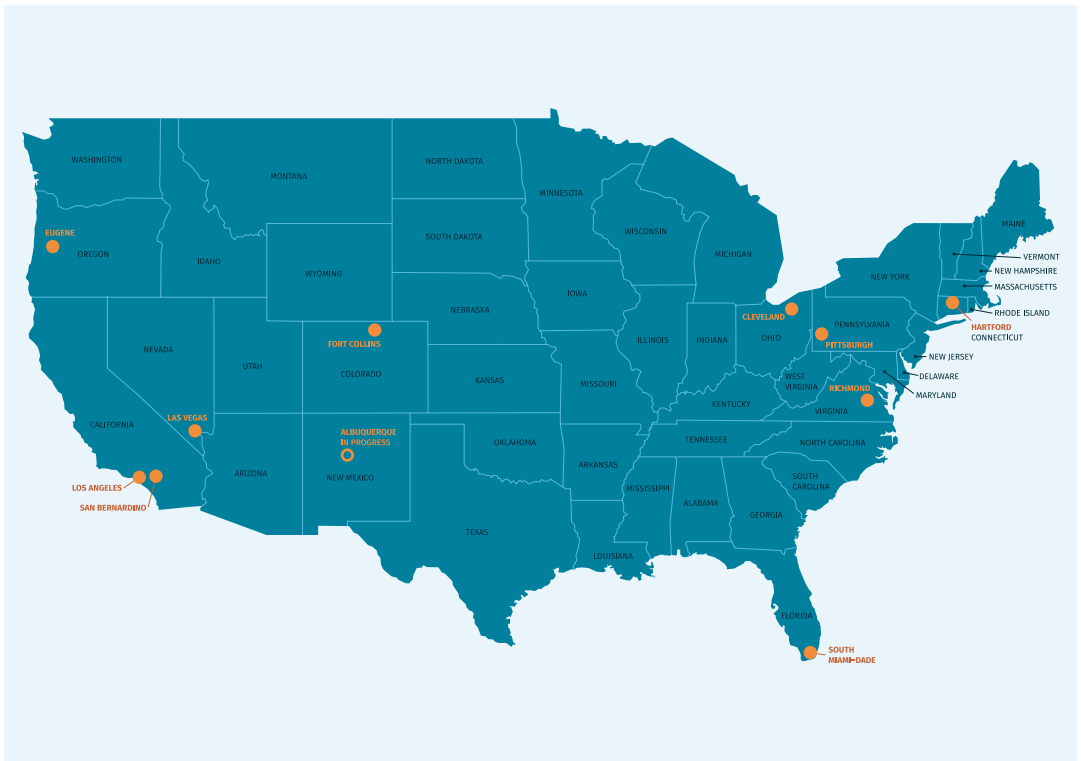
*Note: Other bus priority corridor projects currently under construction also offer some valuable implementation lessons. Since they are not completed and have not been formally assessed with the *BRT Standard*, they are referred to in this guide as bus corridor projects, and not BRT. They include San Francisco's Van Ness and Geary bus corridors; East Bay corridor along International Boulevard in Oakland and San Leandro; Indianapolis's Red, Blue, and Purple Lines; Portland's Division Transit Project; Denver's Colfax Corridor Connections; Tampa Bay's Wesley Chapel to St. Petersburg corridor; and Seattle's Madison Street.*

Source: ITDP 2016a, 2019a

THE STATE OF BRT IN THE U.S.

Ten U.S. cities—Cleveland, Eugene-Springfield, Fort Collins, Hartford, Las Vegas, Los Angeles, Pittsburgh, Richmond, San Bernardino, South-Miami Dade—have succeeded in implementing 12 BRT corridors (see Figure 4). Three of the U.S. BRT corridors are located in Pittsburgh, and Albuquerque, the eleventh city, is preparing to launch the country's thirteenth corridor soon. See Appendix A for more information about these 13 corridors.

Figure 4:
Map of the U.S. cities with BRT corridors

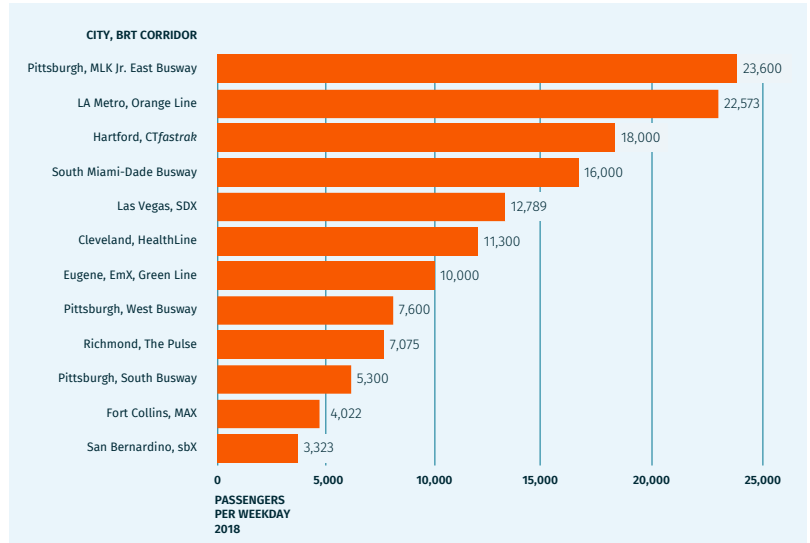


U.S. BRT PERFORMANCE AND COST

There is significant variation in daily passenger volume among U.S. BRT corridors (see Figure 5 and Appendix A). In 2019, San Bernardino's sbX corridor averaged about 3,300 passengers per day. Busways in South Miami-Dade, and Hartford carry between 16,000 and 18,000²⁸ daily passengers. Los Angeles's Orange Line and Pittsburgh's MLK Jr. East Busway carry the highest number of passengers each day—22,600 and 23,600 respectively.

28 Hartford's CTfastrak busway is an open corridor. On an average weekday, 18,000 passengers a day travel on CTfastrak and CTtransit routes in the busway. Ridership exclusively within the busway averages 12,000 passengers per weekday.

Figure 5:
**Average daily
passenger demand of
U.S. BRT corridors**



Notes: Ridership is for whole corridor, not just the BRT-rated segment.

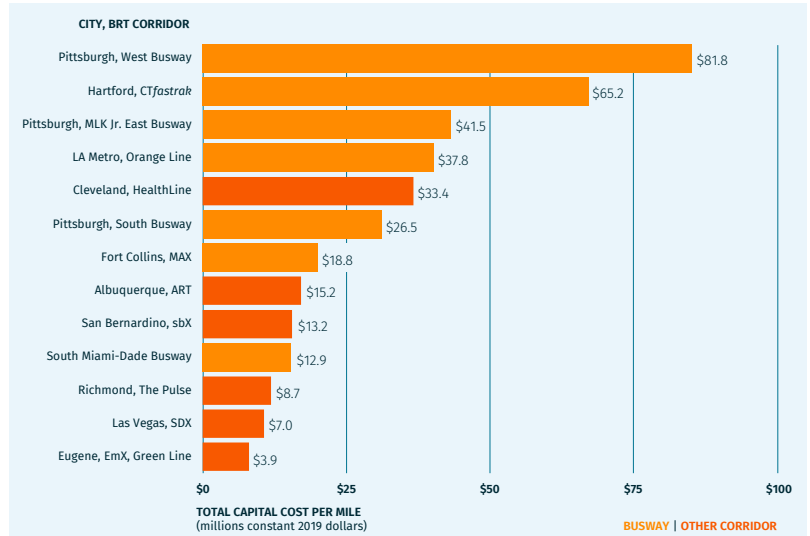
Sources: Cleveland (Schmitt 2018b); Eugene 2013 data (BRT+ Centre of Excellence & WRI 2019); Fort Collins (Coltrain 2019); Hartford 2019 data (CTDOT 2019); Las Vegas (RTC SNV 2019); Los Angeles (LA Metro 2019a); Pittsburgh (Deto 2019); Richmond 2019 data (GRTC 2019d); San Bernardino 2017 data (Omnitrans 2018); South Miami-Dade 2016 data (Miami-Dade County DTPW 2018).

Considering the capital investment per mile of U.S. BRT corridors helps illustrate the range of project complexities and costs. Figure 6 shows the total capital costs per mile, including fleet costs, adjusted to constant 2019 dollars. The least expensive corridors are implemented for less than \$20 million per mile. This group includes Albuquerque's ART, which is constructed but, as of mid-2019, not yet operational. The four most expensive corridors in the U.S.— LA Metro's Orange Line,²⁹ Hartford's CTfastrak, and Pittsburgh's MLK Jr. East and West Busways—are dedicated, exclusive busways built from scratch along abandoned rail corridors or in rail easements. The cost of acquiring the rights-of-way, or constructing or widening bridges and tunnels, contributes to their higher cost.³⁰

29 These figures exclude the Orange Line's 4-mile Canoga Extension. LA Metro opened the 14-mile Orange Line in 2005 at a total cost of \$391 million (current dollars), and then subsequently extended the line by four miles for an additional \$215 million (current dollars).

30 LA Metro purchased the right-of-way for the Orange Line more than a decade before BRT was identified as the locally preferred option. The pro-rated cost of the right-of-way acquisition is estimated to be approximately \$73 million (current dollars). This cost is included in the Orange Line capital cost figures (Flynn et al. 2011).

Figure 6:
**Capital cost per mile
of U.S. BRT corridors
(constant 2019
dollars)**



Notes: Capital costs include fleet. Costs were converted to 2019 dollars assuming launch year as year of expenditure. Total length of the constructed corridor is used which may underestimate the cost per mile of the BRT-rated segment.

Sources: Cleveland (FTA 2012, Greater Cleveland RTA 2018); Eugene (Thole et al. 2009); Fort Collins (Transfort 2014); Hartford (Frisman 2012); Las Vegas (BRT+ Centre of Excellence & WRI 2019); Los Angeles costs exclude 2012 extension, and include an estimated \$73 million (1991 USD) for prior right-of-way acquisition (Flynn et al. 2011, Perry 2017); Pittsburgh South Busway costs exclude right-of-way acquisition (Deto 2019, National Academies of Sciences, Engineering, and Medicine 2003c); Richmond (GRTC 2019f); San Bernardino (Omnitrans 2018); South Miami-Dade includes \$17 million (1997 USD) for right-of-way acquisition (National Academies of Sciences, Engineering, and Medicine 2003b).

U.S. BRT DESIGN CHARACTERISTICS

SERVICE MODEL

Most of the U.S. corridors operate as trunk corridors without specific feeder buses, including Cleveland's HealthLine, Los Angeles's Orange Line, and Eugene-Springfield's EmX Green Line. Hartford's CTfastrak and Pittsburgh's busways use a direct-service model. See the section "What Is a BRT Corridor?"

DEDICATED RIGHT-OF-WAY

Several U.S. BRT corridors operate along rail **rights-of-way**, including Hartford's CTfastrak, Los Angeles's Orange Line, Fort Collins's MAX, and Pittsburgh's West Busway. The associated right-of-way acquisition and complex civil engineering tends to result in higher capital costs (see Figure 6). More coordination is often needed when converting a rail corridor to BRT. See the section "BRT in Former Rail Rights-of-Way".

Only Pittsburgh and Hartford's corridors incorporate **station bypass lanes** that allow express bus routes, which skip some intermediate stops, to operate on the corridor.

Several U.S. BRT corridors include segments of **bi-directional bus lanes**. This is a rare lane configuration in international BRT corridors,³¹ in which buses traveling in each direction use the lane one at a time. Eugene-Springfield's Lane Transit District was the first to deploy this technique in 2007 on its EmX Green Line corridor, where two-thirds of the dedicated bus lanes are bi-directional lanes. In 2014, Fort Collins's MAX BRT opened with a short bi-directional section. Albuquerque's ART and Indianapolis's Red Line bus corridor, also include bi-directional lanes.³²

An advantage of this configuration, compared with a more traditional design with one BRT lane in each direction, is that a single BRT lane occupies less of the right-of-way. Using a bi-directional bus lane can allow cities to fit the BRT into a very narrow street or to preserve on-street parking along the corridor. A notable disadvantage of the bi-directional lane is that buses must sometimes wait for permission to use the shared lane until the bus traveling in the opposite direction has cleared the lane; this could impose some delay on passengers in the waiting bus. Importantly, the bi-directional lane also introduces a counterflow bus lane, which research has shown can significantly increase the risk of fatal and injury crashes.³³ As instances of bi-directional BRT lanes increase in the U.S., their impact on travel times and safety should be assessed.



Bi-directional BRT lane
in Albuquerque

Source: Aileen Carrigan

31 The Viva bus corridor in York Region, Ontario, which opened in 2013, utilizes bi-directional lanes.
 32 Stuehrenberg 2018.
 33 Counterflow bus lanes can increase fatal and injury crashes by as much as 83% (Duduta et al. 2015).

OFF-BOARD FARE COLLECTION

Off-board fare collection is one of the 5 BRT Basics (see Table 1) and an essential factor in reducing travel time and improving the BRT passenger experience. There are three approaches to off-board fare collection:

- **Barrier-controlled**, where passengers pass through a gate, turnstile, or checkpoint upon entering the station, at which point their ticket is verified or fare is deducted;
- **Proof-of-payment (POP)**, which requires passengers to have purchased a paper ticket or tapped an electronic fare card or mobile app in the station before boarding; an inspector in a vehicle often verifies a valid ticket;
- **Onboard fare validation**, which directs passengers to purchase tickets or fares before boarding and validate them on the bus through rapid electronic readers available at all doors.

Barrier-controlled fare collection is the most effective at reducing passenger delays, followed by proof-of-payment and onboard fare validation.³⁴ Among the BRT corridors in the U.S., there are no examples of barrier-controlled BRT stations. The Pittsburgh and South Miami-Dade busways do not use pre-paid boarding³⁵, and Cleveland³⁶ and Las Vegas³⁷ require on-board validation. The remaining six U.S. corridors are proof-of-payment (POP) systems. POP systems are not the most efficient and require fare inspectors (the use of law enforcement for fare inspection is legally problematic; see the section “Designing an Equitable BRT Project”, but this is the most common method in U.S. BRTs. POP BRT may be preferred by cities that already have POP transit systems, or if BRT routes continue past the BRT corridor so the POP system can improve travel times there as well.

LEVEL BOARDING

Docking the bus with the BRT station platform to minimize the horizontal gap between the two is challenging for many systems. Hartford’s and Richmond’s BRT transit agencies constructed prototype stations at park-and-ride facilities or bus depots for bus operators to practice their angle of approach to the station. Rubber bumpers or rub rails along the edge of the platform are common. Richmond’s GRTC has achieved very narrow horizontal bus-platform gaps on The Pulse.

FLEET

Most BRT routes in the U.S. use articulated low-floor buses with the exception of Richmond’s The Pulse which uses conventional 40-foot buses. U.S. BRT fleets include a variety of fuel and propulsion types, including clean diesel-electric hybrid and compressed natural gas, with battery-electric buses being pursued by several cities. See Table 7.

³⁴ ITDP 2016b.

³⁵ (ITDP 2019a). On Pittsburgh’s East Busway, passengers pay upon boarding in the in-bound direction, and before alighting in the out-bound direction (Lotshaw 2011).

³⁶ Greater Cleveland RTA recently eliminated proof-of-payment and require passengers to verify their tickets with the bus driver (Greater Cleveland RTA 2017). See “Constitutional fare inspection” in the section Designing an Equitable BRT Project.

³⁷ ITDP 2019a

OTHER EMERGING BRT AND BUS CORRIDOR TRENDS

Several trends are emerging among U.S. cities developing BRT or bus priority projects. Not all of these applications meet the Basic BRT definition. These recent developments reveal different ways in which cities are trying to allocate space for transit or to bundle transit improvements with other urban improvements.

BUS PRIORITY ON FREEWAYS

More communities are looking at ways to provide bus priority on freeways connecting an urban center and a peripheral area. One option is to operate buses in HOV or managed freeway lanes. Alternatively, with enabling state legislation, buses can access the right-hand shoulder lane. For instance, while not considered BRT according to the *BRT Standard*, the Flatiron Flyer express bus service between Denver and Boulder operates in managed lanes along U.S. Route 36, and if the toll lanes are congested, the bus driver can opt to switch to the right-hand shoulder lane.³⁸ Tampa Bay is exploring the use of dedicated median or shoulder lanes for a 41-mile bus corridor between Wesley Chapel, Tampa, and St. Petersburg.³⁹

Buses operating in HOV or managed lanes and exiting the freeway to access stations do not meet the *BRT Standard's* basic definition of BRT, although some communities have branded them as BRT.⁴⁰ BRT is not well suited to freeways. Other than congestion, the type of delays BRT is designed to reduce do not exist on freeways; there are no curbside activities or intersections to delay buses. Transit is most effective when connecting people and destinations, neither of which are found along freeways, which typically lack transit-supportive densities and land uses.

At the Federal Highway Administration's urging, the draft environmental impact statement for the proposed Gold Line bus corridor in Minneapolis-Saint Paul considered the option of BRT along a managed lane in I-94. The analysis concluded that the managed lane alternative did not compare favorably to arterial or busway alignments because (1) stations within a freeway median do not offer the same economic development opportunities and (2) it would not be considered a fixed-guideway BRT and therefore would not qualify for FTA New Starts funding.⁴¹

38 While on the shoulder, buses are not allowed to travel more than 15 mph faster than general traffic on U.S. 36 and cannot go more than 35 mph at any time (*The Denver Post* 2016).

39 Johnston 2018.

40 *BRT Planning Guide*, Section 5.5.2, Corridor Typology and Suitability for BRT (ITDP 2016b).

41 The final alignment of the proposed Gold Line bus corridor is a dedicated busway on the northside of I-94. Note that the project has not been evaluated to determine if it meets the BRT Standard's Basic BRT definition. (Washington County Regional Rail Authority et al. 2015).

BUS NETWORK REDESIGNS AND BRT

Cities and counties around the country are increasingly looking at redesigning their bus networks. Depending on the goal of the redesign, BRT can play an important role in the new bus network.⁴² A bus network redesign presents cities and transit agencies with an opportunity to evaluate their transit service priorities. As explained by transit planning expert Jarrett Walker, cities can prioritize service frequency (to attract ridership) or service coverage.⁴³ When working within a fixed operating budget, more ridership service means fewer resources for service coverage so decision-makers need to determine how much priority to give to each. Of the two transit service options, BRT is best suited where the priority is increasing ridership:

- **Coverage service:** A transit agency may spread low-frequency service across the city in an effort to ensure that every resident is near a very infrequent bus route. This may be considered a critical lifeline to users who do not have other transportation options, especially lower-income users, seniors, youth, and people with disabilities; or it may simply reinforce the need to own a private vehicle. Ridership will decline, since infrequent bus service is not as useful to many people. Providing thin transit coverage is not an effective application for BRT.
- **Ridership service:** On the other hand, if the goal is to increase bus ridership, a transit agency should prioritize frequent service on higher-demand corridors. This provides more passengers with better transit service. BRT contributes to the goal of increasing ridership by providing high-frequency and reliable bus service along a high-demand corridor. When a bus arrives at least every ten minutes, it becomes a more convenient transportation option.⁴⁴ People no longer have to check a schedule and can show up at the bus stop confident they will not have to wait long for the next bus. Frequent service boosts transit ridership.

Two examples of where high-frequency BRT have been incorporated into a bus network redesign:

- Marion County, Indiana is redesigning their bus network, organizing routes into a grid to provide efficient and frequent transit service without significantly reducing coverage. The Marion County Transit Plan 2012 includes ambitious goals to build approximately 48 miles of BRT across the Indianapolis metropolitan area. By investing in BRT along high-demand corridors, Marion County can increase transit frequency and boost ridership.⁴⁵
- LA Metro has a similar county-wide transit plan anchored by BRT corridors. Metro Vision 2028 aims to increase non-driving mode share, increase 24-hour transit frequencies to at least every 15 minutes, increase average bus speeds by 30%, and bypass congestion.⁴⁶ BRT is a critical part of this vision for LA County. Metro plans to convert some of its Rapid Ride bus routes to BRT and to establish new arterial and highway BRT corridors “to establish a network grid of high-frequency, high-capacity, fast bus service across LA County.”⁴⁷

42 Vock 2017.

43 Walker 2019.

44 *The BRT Standard* assesses an operational penalty for peak and off-peak service with fewer than 8 buses per hour (ITDP 2016a).

45 Stuehrenberg 2018.

46 Lee 2018.

47 Metro 2018.

U.S. BRT IMPLEMENTATION GUIDANCE

CHOOSING THE BRT CORRIDOR

Selecting an appropriate BRT corridor is essential. A well-chosen BRT corridor is one where many people would benefit from the travel time savings of BRT in the short term. It may be tempting to put a BRT corridor where there are fewer people and vehicles to reduce opposition to the project, but demand is often lower in these places. Under certain conditions, BRT may help shape urban development by stimulating transit-oriented development (TOD),⁴⁸ but BRT typically cannot induce development where there is no underlying market (see the section “Encouraging Transit-Oriented Development”). As the *BRT Planning Guide* suggests, selection and prioritization of corridors is both political and technical. Political support is essential for timely implementation of a BRT corridor; however, a political decision should follow a rigorous technical analysis that identifies the most feasible corridors. See the *BRT Planning Guide, Chapter 5, Corridor and Network Development*, for further discussion.

Once a corridor is selected, planners should objectively evaluate different transit modes that could address the needs of the corridor. This alternatives analysis will be required of projects seeking certain federal funding. Accurate information about the costs, performance, and benefits of BRT and other modes is needed to make an informed decision about the preferred mode. A detailed discussion about alternatives analysis or the costs and benefits of BRT compared to other modes is beyond the scope of this guide; other resources exist to guide that analysis.⁴⁹ This guide focuses more on implementing the locally preferred alternative.

DESIGNING THE BRT CORRIDOR

BRT corridors are most successful on downtown corridors, urban arterials, and former rail corridors⁵⁰ and can be adapted to many different urban contexts, from narrow streets in historic downtowns to wide, auto-oriented arterials. Each corridor context presents some specific implementation advantages and challenges.

BRT ON NARROW ROADS

There is a common misperception that BRT requires extremely wide rights-of-way and cannot fit on narrow and constrained streets. In fact, BRT can operate on any street that can accommodate a bus. Typically, 9.8- to 11.5-foot-wide lanes are sufficient.⁵¹ BRT could certainly operate along a transit-only street. While there are international examples of BRT on very narrow (often transit-only) downtown streets, this has not been done in the U.S.⁵²

⁴⁸ *The BRT Planning Guide* (ITDP 2016b), Chapter 5; National Academies of Sciences, Engineering, and Medicine 2003a.

⁴⁹ *Characteristics of Bus Rapid Transit for Decision Makers* (Hinebaugh 2009) provides relevant U.S. information for sketch planning and detailed alternatives analyses. See also *The BRT Planning Guide* (ITDP 2016b), Chapter 2, *Why BRT?*, and National Academies of Sciences, Engineering, and Medicine 2003a.

⁵⁰ ITDP 2016b.

⁵¹ See *The BRT Planning Guide* (ITDP 2016b), Table 25.3, *Typical elements in a cross-section* at a BRT station. NACTO's *Transit Street Design Guide* recommends widths between 10 and 13 feet for transit lanes.

⁵² Mexico City's Line 4 is a Bronze-rated BRT corridor that circulates through the historic downtown. Along several sections of the route, the BRT uses a transit-only street. The total width of the roadbed, which accommodates one bus lane in each direction, ranges from 21.3 to 25.6 feet. Along another section, the BRT operates on one-way street pairs with one bus lane and one mixed-use traffic lane; this roadbed measures 18.8 feet wide. (Ciudad de México 2011)

Richmond's
The Pulse operates along
Broad Street.



Source: GRTC

BRT ON URBAN ARTERIALS

Arterial BRT remains a common corridor typology in U.S. cities. These streets tend to be wide, in some cases providing adequate width for several BRT lanes and mixed traffic, and perhaps even for bike lanes, wide sidewalks, and planted medians. Arterials' wider street and lane widths can lead to long pedestrian crossings and high vehicular speeds. In many cities the majority of traffic crashes occur on a handful of streets, and urban arterials are often part of this high-injury crash network.⁵³ These corridors would benefit from Complete Streets improvements and traffic calming, which can be bundled with a BRT. The residential, institutional, and commercial land uses that are needed to support transit are often present along an urban arterial, which simultaneously present some barriers to transforming the corridor. With arterial BRT corridors, residents and business owners commonly have concerns about the traffic impacts of reallocating travel lanes to buses, reduced access to driveways across BRT lanes, and loss of on-street parking. In the U.S., BRTs operate along urban arterials in Richmond (Broad Street) and Cleveland (Euclid Avenue), and Albuquerque is preparing to launch one along Central Avenue. Several bus corridors in development are also located on major arterials, such as Van Ness Avenue and Geary Boulevard in San Francisco, International Boulevard in Oakland, and the Red Line bus route in Indianapolis, which serves several arterials.

⁵³ In Albuquerque, 64% of the total fatalities and injuries occur on only 7% of the city's major roads, including urban arterials like Central Avenue (Mid-Region Metropolitan Planning Organization 2019). Van Ness Avenue, where a new bus corridor is being constructed, is one of San Francisco's most dangerous roads. It is part of the City's high-injury network, the 12% of streets responsible for 70% of injuries and fatalities (SFMTA 2018).

Pittsburgh MLK Jr. East Busway was constructed along a rail right-of-way.



Source: Author – Dllu via Wikimedia Commons

BRT IN FORMER RAIL RIGHTS-OF-WAY

A BRT corridor can be constructed within an active or abandoned rail right-of-way, as has been done in Fort Collins, Hartford, Los Angeles, and Pittsburgh. Land for the busway may be easier to acquire along the rail corridor than through a developed urban area. Constructing the busway along an abandoned rail corridor may be less disruptive than doing so along a major urban arterial through a residential or commercial district. The segregated busway, especially if it is grade separated, may have fewer encroachments from driveways and intersections compared to an urban street;⁵⁴ this could increase BRT operational speeds. These advantages should be weighed against the additional coordination required (see “Rail Rights-of-Way” in the “Governance Framework” section), rail corridors’ poor pedestrian accessibility and low density, and the cost of acquiring the rail right-of-way or easement and constructing the busway. Furthermore, several U.S. BRT corridors operating along rail rights-of-way have experienced high numbers of traffic collisions at signalized intersections, especially just after service launch while motorists familiarize themselves with corridor traffic operations.⁵⁵

“It’s been a big challenge. We think of the Bay Area as a world-class area, but we are really a group of 100-plus cities, all with different concerns and ambitions. That makes it really hard to get BRT projects done.”

—Randy Rentschler, Metropolitan Transportation Commission, the Bay Area’s regional transportation planning and financing agency.⁵⁶

⁵⁴ Using an at-grade rail right-of-way does not necessarily offer the same benefit. Los Angeles’s Orange Line, which is not grade separated, has 38 signalized intersections (Flynn et al. 2011).

⁵⁵ LA Metro’s Orange Line, Eugene-Springfield’s EmX, and Hartford’s CTfastrak experienced several crashes between motorists and BRT vehicles at signalized intersections along their busways. Adjustments to signal timing and intersection control has helped reduce the frequency of crashes (Federal Transit Administration 2009, Flynn and Yassin 2012).

⁵⁶ Cabanatuan 2014.

GOVERNANCE FOR BRT PROJECT DELIVERY

WHO SHOULD BE AT THE DECISION-MAKING TABLE?

Conceiving and implementing a BRT corridor, especially one that crosses multiple jurisdictions, involves myriad stakeholders and decision-makers. These may include:⁵⁷

- Federal, state, and local public officials;
- State transportation, environment, and planning departments;
- Transit agencies and operators;
- Local planning, transportation, and economic development agencies;
- Local traffic engineering or public works departments;
- Metropolitan planning organizations;
- County congestion management agencies;
- State or local historic preservation departments;
- Public or private utility agencies;
- Private developers or major landowners along the corridor;
- Large institutions such as hospitals, universities, commercial or retail organizations, or tourism facilities;
- Nongovernmental civic organizations;
- Representatives of local business, environmental, and user groups.

WHY IS COORDINATION NECESSARY?

All of these partners have their own perspectives, priorities, and agendas, which they bring to the BRT project. Designing, constructing, and operating a BRT requires agreement among the relevant stakeholders about issues including infrastructure alignment and design, rights-of-way, fleet selection, intelligent transportation systems, fare technology and policy, regional and multimodal integration, and operations. Therefore, ensuring that all the necessary parties are at the table from the start of the BRT planning process will help streamline the project. Having people with the necessary authority present when decisions need to be made will keep the project moving forward.

Complex corridor construction, especially across multiple jurisdictions, illustrates the importance of coordinating and aligning project roles. When implementing a BRT corridor along urban streets, having the owner of the right-of-way as the construction lead agency often helps speed along permitting and construction management. This is especially crucial when the BRT project incorporates parallel utility upgrades, as many do. If the city owns the right-of-way and has authority over the public utility agency, it may be most efficient for the city to lead the corridor construction, rather than a transit agency. For instance, the East Bay's bus corridor runs along International Boulevard, which is co-owned by the City of Oakland and Caltrans, the state department of transportation. Since the regional transit agency, AC Transit, is leading the construction phase, an extra step is required to obtain the necessary permits and change order approvals from the City of Oakland. This misalignment of roles and authority has introduced some inefficiency into the construction schedule.

WHAT ARE THE ESSENTIAL PROJECT ROLES?

Stakeholders can assume different roles and responsibilities in a BRT project. There is no one correct BRT governance structure. The capacity, expertise, and authority of the partners, among other things, will make certain arrangements more appropriate. For instance, the implementing agency might be a transit agency, county, or state DOT.

- Albuquerque’s transit department implemented the ART corridor and will operate the buses. The city owns the infrastructure.
- The Los Angeles County Metropolitan Transportation Authority (Metro) developed the Orange Line corridor with the Los Angeles Department of Transportation. Metro operates the buses, and the City of Los Angeles controls street traffic operations.
- Connecticut DOT (CTDOT) implemented the *CTfastrak* busway, owns the assets, and pays for the operating costs of the service. The BRT and other bus transit services are provided by private operating companies under contract to CTDOT.

An analysis of transportation innovations in U.S. cities that reprioritized streets for people found that these projects depended upon engagement from three segments of society: nongovernmental civic organizations, bold and visionary elected officials, and agency staff willing to challenge the status quo.⁵⁸ That framework certainly applies to BRT projects as well, where political champions, practitioners, and advocates have been essential to realizing the vision for a BRT corridor. A brief description of these vital project roles follows:

Political champion. A political champion for a BRT project articulates the project vision, builds a coalition of support, and can remove obstacles to keep the project moving. This leader is willing to incur some political risk to bring the BRT benefits to the community. Political champions can be heads of transportation departments, mayors, governors, or even state representatives. Having an elected official as the BRT proponent introduces a political deadline and brings some urgency to the project (see the Albuquerque and Richmond case studies). This can help accelerate implementation, but some stakeholders may feel they get sidelined in the more expedient process. Lane Transit District officials stated that having a political champion for the EmX Green Line project in the Eugene-Springfield area would have been helpful in building public support for the project during the planning phase.⁵⁹

As was the case with Albuquerque’s ART corridor, spanning a mayoral administration transition with BRT implementation can introduce uncertainty and delay. Building a broad coalition of support outside the administration through community organizations can help shield the project from potential negative effects of the political cycle (see “Civic advocates” in this section).

[The Euclid Corridor Project]

“is a vision I have had for 30 years. This is a special day for me. There were times I thought this would never happen.”

—U.S. Senator George V. Voinovich at the 2004 opening of Cleveland’s HealthLine BRT

Agency implementers. The staff within city, regional and state agencies—the planners, engineers, operations managers, and policy directors—find a way to implement the leader’s bold vision for the corridor.⁶⁰ These implementing staff who are willing to challenge the status quo to implement a BRT project play three critical implementer roles on a BRT project:

- **Project sponsor:** The initial idea for a BRT project is formally adopted by a project sponsor, which must be a government agency or other entity that is eligible to apply for the necessary state or federal funding.⁶¹ The sponsor develops the project concept, initiates the funding request, applies for funding, and sees the project through to completion.
- **Metropolitan Planning Organization (MPO):** The MPO plays a regional coordination role and in some cases a funding role. They may support BRT project feasibility or planning studies with staff assistance or possibly funding. A BRT project’s eligibility for some federal and state funding depends on it being included in the long-range transportation plan and list of short-term project priorities (Transportation Improvement Program or TIP) developed by the MPO. (See Box 1). The MPO also has some direct financing authority, which it could use in innovative ways to support the BRT.⁶²
- **Lead planning agency:** The BRT corridor planning lead, often also the agency champion or the technical champion, should have sufficient staff capacity, as well as some experience leading multi-stakeholder transit planning projects. Having the lead planning agency be a strong proponent of transit and BRT may contribute to higher-quality BRT outcomes, since they may be more willing to push for features like dedicated, center-running lanes. For the Van Ness Improvement Project, the San Francisco County Municipal Transportation Agency (SFMTA) is the federal project sponsor, but San Francisco County Transportation Authority (SFCTA) acted as the planning lead since they had the staff capacity that, at the time, SFMTA did not. SFCTA also allocates the county’s transportation sales tax revenue; the Van Ness bus corridor had been identified as one of the original sales tax priorities, so they effectively were the initial agency champion for the project.

“Civic organizations of all kinds raise the profiles of new ideas by finding new ways of communicating them. They often reframe ideas to attract additional supporters.”

—A People’s History of Recent Urban Transportation Innovation⁶³

⁶⁰ Tsay et al. 2015.

⁶¹ For federal funding purposes, project sponsors can include transit operators, state DOTs, Air Quality Management Districts, County Congestion Management Agencies, county or city governments, or special districts. Many public entities including local governments and transit agencies are eligible to apply for BUILD grants, while Capital Investment Grants (such as New Starts and Small Starts) are typically awarded to state DOTs or transit agencies.

⁶² Transportation for America’s *The Innovative MPO* (2014) offers suggestions for ways an MPO can create innovative partnerships and funding solutions to advance BRT and other transportation projects.

⁶³ Tsay et al. 2015.

Civic advocates. Nongovernmental civic organizations can be strong advocates for a BRT corridor or program, shaping public opinion and compelling public officials to take risks.⁶⁴ These organizations may include civic planning organizations, advocates, grassroots organizers, business groups, think tanks, and research institutes. Proponents of a BRT project may be transit-adjacent advocates who reframe the benefits of the BRT, helping to build more diverse support for the project. Planners can enable community advocates by providing talking points and images of the BRT project, although this important aspect of a planner’s role is often overlooked. Several options for building civic support for BRT exist, including:

- Work through **existing community organizations** representing complementary interests, such as pedestrians, bicyclists, seniors, people with disabilities, and corridor businesses, as well as Safe Routes to School and smart growth advocates, to cultivate support for the BRT among their constituents. Albuquerque’s bicycle advocacy organization, BikeABQ, was supportive of the ART project and promoted the project to their members. The BRT project team could have enabled BikeABQ or other advocates to be even more effective by supplying them with talking points or images to share through social media and other channels. The community advocates could have amplified the city’s marketing and promotion efforts and helped to build broader support for ART.
- Form a **new partnership of existing complementary civic organizations** to advance the goals of the BRT project. Established community groups can work together under a new umbrella brand, possibly sharing some pooled funding:
 - Denver Streets Partnership is a coalition of community organizations working toward people-friendly streets. It was formed in 2017 to help advocate for transportation funding in a general obligation (GO) bond put to voters in November 2018.⁶⁵
 - The BostonBRT initiative was launched in September 2013 as a means of investigating the potential for Gold Standard BRT in the region. A study group convened by the Barr Foundation and made up of a group of stakeholders with deep ties across the metropolitan area partnered with ITDP to conduct the first ever citywide technical analysis of where BRT might make sense, based on state transit data and the city’s unique geography. The results⁶⁶ were promising, and the group concluded that there is significant potential for BRT in at least 12 corridors throughout the Boston area.
- Establish a **new transit advocacy organization**. In Richmond, Virginia, when RVA Rapid Transit grew out of the Mayor’s anti-poverty task force, their message evolved from enhancing job access to building regional transit to connect people to jobs.⁶⁷ Board members include several prominent church leaders who are well connected in the community and who helped turn out a diverse coalition of support for BRT.

⁶⁴ Tsay et al. 2015.

⁶⁵ The partners include Walk Denver, Bike Denver, Bicycle Colorado, Colorado Cross-Disability Coalition, Vision Zero Denver, and several Business Improvement Districts. One of the projects on the GO bond list was the Colfax Avenue bus corridor. (Sachs 2017a).

⁶⁶ The Greater Boston BRT Study Group 2015.

⁶⁷ Transit Center 2016.

- Convene a **citizen's advisory council**. Residents can represent community interests and concerns directly to the BRT project team, while giving project supporters on the board more legitimacy to advocate for the project. Throughout the Van Ness Improvement Project, SFCTA and SFMTA have each convened a committee of citizens (Citizens Advisory Committee and Community Advisory Committee respectively) to provide community guidance and input and the project make the project team aware of community priorities and concerns.

COMPLEX PROJECT COORDINATION

Several BRT project circumstances warrant special consideration of complex stakeholder coordination:

Multi-jurisdictional projects. A BRT corridor crossing jurisdictional boundaries, or involving several authorities, will require more complex project development, coordination, and construction. The agencies with ownership or authority over different elements of the corridor need to be involved in the project planning and decision-making. An interagency agreement may be needed to formalize the project coordination and roles.

If a BRT corridor crosses municipal boundaries, the different cities' goals and visions for the corridor need to be carefully managed and coordinated. Whenever a corridor crosses between municipalities, its design is at risk of being modified and potentially minimized, which can reduce transit benefits for passengers along the corridor:

- The East Bay bus corridor was initially proposed to originate at the University of California, Berkeley campus and run down Telegraph Avenue in Berkeley, through downtown Oakland, and along International Boulevard into the City of San Leandro. The City of Berkeley City Council voted unanimously to reject the segment of the corridor in Berkeley out of concerns about loss of on-street parking.
- In Colorado, two-thirds of a proposed bus corridor along Colfax Avenue lay within the City and County of Denver and one-third in the City of Aurora. While a 5.7-mile segment of Colfax within Denver will have median stations and dedicated bus lanes, the design changes at the boundary with the City of Aurora. Here, there will be curbside bus stops and no dedicated bus lanes, although off-board fare collection and traffic signal priority will continue through Aurora. The curbside alignment addresses the City of Aurora's concerns about the traffic impact of dedicating two lanes to transit.⁶⁸ Transit passengers riding between Denver and Aurora will not benefit from the same high-quality transit priority for the whole length of Colfax Avenue.

Rail rights-of-way. Aligning a BRT corridor within a rail right-of-way adds complexity and coordination. The BRT project team needs to negotiate corridor access with the rail authority, which often adds time and cost to the BRT project, and sometimes impacts BRT operations.

- About two-thirds of the Fort Collins MAX BRT operates in a freight rail right-of-way. On a section where the BRT lanes run adjacent to the freight tracks, the bus has to stop and wait for the train to pass, which delays passengers.⁶⁹
- One segment of the CTfastrak busway runs in a permanent easement adjacent to an active Amtrak right-of-way. CTDOT had to coordinate extensively with Amtrak to construct the busway in a shared right-of-way without obstructing rail operations. There are several at-grade crossings of the busway and Amtrak tracks. Initially, the BRT was required to stop at these signalized intersections when the railway crossing gates lowered and an Amtrak train was passing, even though the bus runs parallel with the train. CTDOT negotiated with the Federal Railway Association (FRA) to allow CTfastrak buses to proceed after pausing at the signal when the rail crossing gates are down, in order to minimize the delay for BRT passengers.

State-owned rights-of-way. The preferred BRT corridor might be a state-owned route, which adds a layer of complexity to the project governance. The BRT project team will need to assess the BRT's impact on highway performance and coordinate with the state agency early in the planning and design phase to get their approval of the corridor design. This may be the first time the state DOT has needed to consider the design and operations of a transit street. Partnering with the state may create opportunities for the project sponsor to receive state funding sources.⁷⁰

San Francisco's Van Ness bus corridor runs along a two-mile segment of U.S. Route 101 that is owned by Caltrans, the state department of transportation, and operated and maintained by the City and County of San Francisco. The introduction of BRT onto a portion of U.S. 101 set up several tensions between state and local transportation agencies.

- **BRT design approval.** Caltrans had to approve the Van Ness corridor design, but there was a disconnect between some of the proposed BRT and Complete Streets design elements and Caltrans's Highway Design Manual. This required lengthy negotiations between the lead planning agency, SFCTA, and Caltrans for design exceptions for nonconforming BRT elements. A major stumbling block was the proposed mixed traffic lane widths, as Caltrans insisted on a 12-foot width that would have required removing median trees and on-street parking.⁷¹ Eventually Caltrans agreed to 10.5-foot-wide travel lanes.⁷²
- **Performance measures.** The Van Ness Improvement Project aims to transform the corridor from an auto-dominated corridor into a multimodal facility. In doing so, the project encountered policy differences between how state highways serving regional trips function and are evaluated, versus a multimodal urban arterial. Caltrans evaluates the performance of U.S. 101 in terms of auto delays, while the Van Ness alternatives evaluation framework assessed multimodal performance and person throughput.⁷³

69 De la Rosa 2015.

70 Callaghan 2007a.

71 Bialick 2013.

72 SFCTA's negotiations with Caltrans occurred nearly simultaneously as AC Transit sought approval for the East Bay bus corridor on International Boulevard (Bialick 2013).

73 The bus priority measures on the corridor are estimated to produce

BRT GOVERNANCE RECOMMENDATIONS

- **Rely on community organizations to build support for BRT.** They can help broaden the support for the project and bring their constituents out for public hearings, meetings, and promotional events. If a transit advocacy organization does not exist locally, consider creating one or reaching out to complementary advocacy organizations that may have an interest in supporting this project. Keep in mind that an individual may be a transit advocate and work to build support across other organizations.
- **Consider convening a citizen's advisory board** to advise the project.
- **Ensure the necessary decision-makers are at the table** from the start of the project. This includes the owner of the right-of-way and any agency with authority over the corridor infrastructure, including underground utilities.
- **Formalize interagency collaboration.** The project sponsor should coordinate project roles thoughtfully, considering partner agencies capacity, funding eligibility, and authority. Interagency agreements such as a Memorandum of Understanding (MoU) may be necessary to formalize partner cooperation and responsibilities.
- **Plan for additional coordination time on multi-jurisdictional projects.** In particular, corridors that cross jurisdictional boundaries or are situated along state-owned corridors or rail rights-of-way require more extensive interagency coordination and integration.

FINANCING BRT

COMMON CHALLENGES OF FINANCING A U.S. BRT PROJECT

BRT corridors are capital-intensive projects requiring lane or busway construction, stations, traffic signal hardware, real-time information displays, fare payment systems, vehicles, and possibly new vehicle charging or maintenance facilities. Capital costs for U.S. corridors, including fleet, have ranged from \$3.9 to \$81.8 million per mile (constant 2019 dollars) (see Figure 6 and Appendix A). In addition, transit agencies need to consider funding and revenue sources for transit operations, including maintenance.

Some of the challenges to financing a BRT project include:

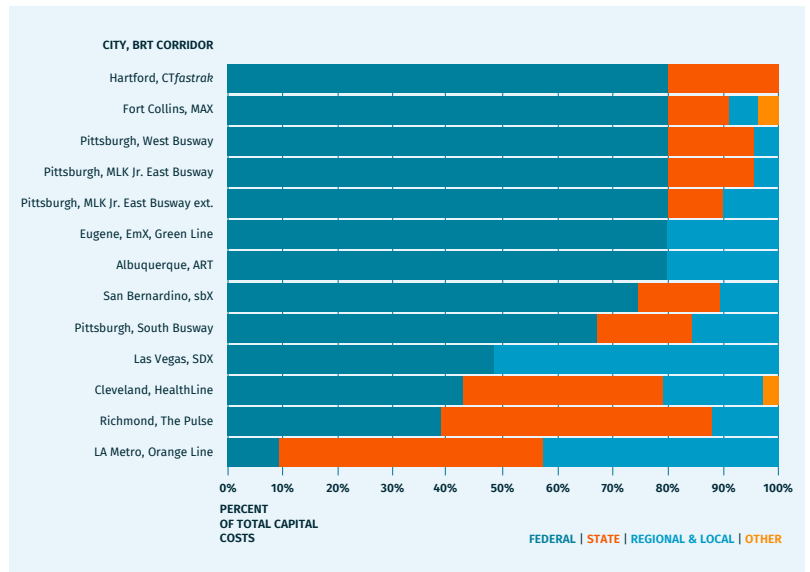
- BRT corridors often require piecing together several different funding sources.
- Federal funding for transit is highly competitive. The requests for federal funding far outstrip the available funds.
- Some funding sources may be highly uncertain.⁷⁴ Some federal grants require annual Congressional appropriation, and there can be delays in releasing funding for approved projects.
- Identifying, qualifying for, applying for, and securing funding can be a time-consuming process.
- BRT corridors that cross multiple jurisdictions can increase the complexity of financing.

⁷⁴ The application process for BUILD (formerly TIGER) and CIG grants is highly competitive and most projects will not receive funding (Doyle 2019).

HOW HAVE OTHER CITIES PIECED TOGETHER BRT CORRIDOR FUNDING?

Cities in the U.S. that have constructed high-quality BRT corridors have utilized funding from a variety of federal, state, local, and other sources (see Appendix B). The 13 U.S. corridors sourced approximately 60% of their funding from the federal government. The proportion of federal funding varies by project, with most of the U.S. BRT corridors relying on between 40% and 80% from federal sources (see Figure 7). Albuquerque, Eugene-Springfield, Fort Collins, Hartford, and Pittsburgh all financed 80% of their capital costs with federal funding, while Cleveland and Richmond relied on approximately 40%. LA Metro’s Orange Line BRT is an outlier, with federal funding covering only 9.1% of its capital costs. Cleveland and Fort Collins utilized the most diverse mixture of funding sources including private sector contributions.

Figure 7:
Mixture of funding sources used in U.S. BRT projects



Notes: Regional & Local funding sources include county, MPO, municipality, transit agency. South-Miami Dade data not available. Sources: Albuquerque (FTA 2019a); Cleveland (Callaghan 2007b, Greater Cleveland RTA 2018); Eugene-Springfield (Callaghan 2007b, Thole et al. 2009); Fort Collins (Pohl 2014); Hartford (Callaghan 2007b, FTA 2018f); Las Vegas (Callaghan 2007b); Los Angeles (Callaghan 2007b, Flynn et al. 2011); Pittsburgh (National Academies of Sciences, Engineering, and Medicine 2003c); Richmond (GRTC 2015); San Bernardino (Nisperos 2014, Omnitrans 2018, Perry 2017, Starcic 2015);

FEDERAL FUNDING

There are two types of federal transportation grants—formula and discretionary. Formula grants are allocated to states, MPOs, or cities according to established criteria and equations, and discretionary grants are awarded to the best projects in a competitive application process. For a BRT project to be eligible to receive federal funding, the MPO must include it in the region’s federally mandated long-term Metropolitan Transportation Plan (MTP) and the short-term Transportation Improvement Program (TIP). See Box 1 for a description of the process of including a BRT project in the TIP.

Federal funding sources for which BRT projects can qualify are shown in Table 3.

Table 3:
**BRT projects
may be eligible
for several federal
grants and loans**

FORMULA GRANTS	DISCRETIONARY GRANTS	LOANS
<ul style="list-style-type: none"> · Urbanized Area Formula Grants · Grants for Buses and Bus Facilities Formula Program · Congestion Management and Air Quality Improvement Program (CMAQ) · Surface Transportation Block Grant (STBG) · State of Good Repair Grants Program 	<ul style="list-style-type: none"> · New Starts · Small Starts · Better Utilizing Investments to Leverage Development (BUILD) Transportation Grants Program (formerly TIGER) · Buses and Bus Facilities Discretionary Grants · Low or No Emission (Low-No) Vehicle Program · Core Capacity · Fixed Guideway Modernization 	<ul style="list-style-type: none"> · Transportation Infrastructure Finance and Innovation Act (TIFIA) · Railroad Rehabilitation & Improvement Financing (RRIF)

Box 1:

Including a BRT project in a Transportation Improvement Program⁷⁵

To be eligible for federal funding, a BRT project must be included in the MPO's long-range MTP and shorter-term TIP. A typical journey for a BRT project from idea to inclusion in the TIP includes:

- **Project idea.** A transportation need is identified and a project idea is suggested as a solution.
- **Project sponsor.** A formal sponsor, typically a public agency, adopts the project idea and refines the project details. Project scope and cost estimates are developed.
- **Local approval.** The project will need to be approved by the relevant local authorities, such as the city council, county board of supervisors, or transit agency.
- **Long-range Metropolitan Transportation Plan (MTP).** To be eligible for certain regional, state, and federal funding sources, the project will need to be approved by the county congestion management agency and then submitted to the MPO for consideration to include in the long-range Metropolitan Transportation Plan. This federally mandated plan covers a 24- to 30-year horizon and includes projects that support the region's long-term vision. The plan identifies anticipated funding sources for projects, as only those reasonably expected to fund are included.
- **Transportation Improvement Program (TIP).** The MPO translates the long-range transportation plan into a fiscally constrained list of short-term projects. The TIP lists all regionally significant surface transportation projects for which federal funds are anticipated, or that require federal approval, as well as larger locally funded projects. In order to be eligible for federal and state funding and other essential project approvals, a BRT project must be listed in the TIP, and the TIP must conform with air-quality laws.

Once approved, the TIP is incorporated into the MPO's Regional Transportation Improvement Program (RTIP), into the state DOT's Federal Statewide Transportation Improvement Program (FSTIP), and finally into USDOT's Federal Transportation Improvement Program (FTIP).

FTA defines a fixed-guideway BRT as (1) having a separated right-of-way for at least 50% of its length during peak hours and (2) providing weekend service with at least 30-minute headways.⁷⁶ Bus service operating on high-occupancy vehicle lanes or high-occupancy toll lanes do not qualify as fixed-guideway service. A corridor-based BRT differs in that it may operate in mixed traffic and provide no weekend service (see Table 4). Under the FAST Act,⁷⁷ only fixed-guideway BRT projects are eligible for New Starts grants, while corridor-based BRT projects are limited to Small Starts funding.

Table 4:

FTA's fixed-guideway BRT and corridor-based BRT definitions

	FIXED-GUIDEWAY BRT (NEW OR EXTENSION)	CORRIDOR-BASED BRT
CAPITAL INVESTMENT GRANTS (CIG) FUNDING ELIGIBILITY	New Starts Small Starts	Small Starts
RIGHT-OF-WAY	At least 50% is separated, exclusively for BRT during peak hours; other motor vehicles are permitted to turn across the separated BRT lanes	Mixed traffic lanes
STATIONS	Defined stations, accessible, provide shelter from the weather, include schedule and route information	
TRANSIT PRIORITY AT INTERSECTIONS	1. Active signal priority in the separated guideway, OR 2. Either queue-jump lanes or active signal priority in the non-separated guideway	
WEEKEND SERVICE FREQUENCY	1. At least a 14-hour span of service, AND 2. Either (a) 15-minute maximum headways throughout the day, or (b) 10-minute maximum headways during peak periods and 20-minute maximum headways at all other times	
WEEKEND SERVICE FREQUENCY	30-minute maximum headways for at least ten hours a day	<i>No requirement</i>
BRAND	Separate and consistent brand identity to stations and vehicles	

Source: Federal Transit Administration 2016c

⁷⁶ ITDP considers 30-minute headways, even on weekends, to be very low-frequency transit service, not suitable for BRT. How often the bus comes during peak and off-peak travel times is a good proxy for quality of service. For BRT to be truly competitive with alternative modes, like the private automobile, customers need to be confident that their wait times will be short and that the next bus will arrive soon. The *BRT Standard* assesses an operational deduction to corridors that operate with headways longer than 7.5 minutes (eight buses per hour) during peak travel times and 15 minutes (or four buses per hour) in off-peak travel times (ITDP 2016a).

⁷⁷ The Fixing America's Surface Transportation (FAST) Act was signed into law in December 2015 and supports transit funding through fiscal year 2020. The FAST Act includes five years of formula grants as well as several competitive grant programs.

Table 5:

Advantages and disadvantages of common federal funding sources for BRT

FUNDING SOURCE	ADVANTAGES	DISADVANTAGES
NEW STARTS <i>Fixed-guideway BRT costing more than \$300 million, or total New Starts funding sought exceeds \$100 million</i>	<ul style="list-style-type: none"> Fixed-guideway BRT projects with higher capital costs are eligible 	<ul style="list-style-type: none"> Highly competitive, limited funds Funds few new projects Long and complex project evaluation and approval process Oversight process more suitable to large rail projects than BRT Previously funded 80% of cost, now only about 50%
SMALL STARTS FIXED-GUIDEWAY BRT AND BUS <i>corridors costing less than \$300 million and total Small Starts funding sought is less than \$100 million</i>	<ul style="list-style-type: none"> Lower-cost fixed-guideway BRT and bus corridor projects are eligible Streamlined evaluation and approval process Funds up to 80% of project costs 	<ul style="list-style-type: none"> Low overall funding level
BUILD (FORMERLY TIGER)	<ul style="list-style-type: none"> Uniquely flexible Funds multimodal and complex multi-jurisdictional projects that are difficult to fund with other federal sources Capital and (limited) planning funding Any public entity is eligible 	<ul style="list-style-type: none"> Requires Congressional appropriation, which introduces uncertainty Highly competitive, limited funding
URBANIZED AREA FORMULA GRANTS	<ul style="list-style-type: none"> Requires only 20% local match Urban areas with population less than 200,000 can use for capital or operations State, local government, and transit agencies eligible 	<ul style="list-style-type: none"> Applicants compete against other local priorities Small grants
BUSES AND BUS FACILITIES PROGRAM	<ul style="list-style-type: none"> Requires only 20% local match 	<ul style="list-style-type: none"> Small grants
CMAQ <i>Flexible highway funding through state DOT</i>	<ul style="list-style-type: none"> Requires only 11.47% local match Funds all project phases, not just capital 	<ul style="list-style-type: none"> Small grants Applicants compete against state's other air-quality projects Requires air-quality accounting measures, which can be burdensome May require partnering with state
FIXED GUIDEWAY MODERNIZATION	<ul style="list-style-type: none"> Could fund busway in rail right-of-way 	<ul style="list-style-type: none"> Almost exclusively used for rail upgrades

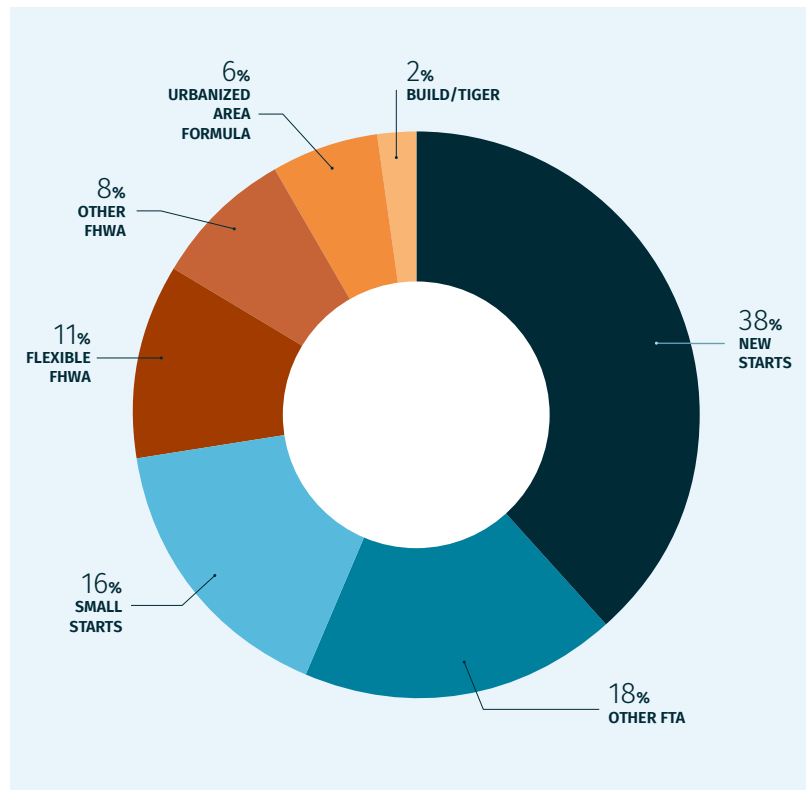
Sources: Callaghan 2007a and 2007b, Doyle 2019, Federal Transit Administration 2018a, and National Academies of Science, Engineering, and Medicine 2003a.

Table 5 highlights some of the advantages and disadvantages of the formula and discretionary grants that have been used most commonly to fund BRT corridors. A more extensive list of possible federal funding sources for BRT corridors is included in Appendix C. While a detailed review of federal transit funding sources and processes is beyond the scope of this guide, extensive summaries about each grant's history, types of eligible projects, and approval process are available from FTA and other sources.⁷⁸

FEDERAL FUNDING USED BY U.S. BRT PROJECTS.

The 13 U.S. BRT corridors relied on approximately \$1.3 billion (in current dollars) of federal funding, with New Starts grants accounting for more than one third. Small Starts provided 16% of the federal funding (see Figure 8). Other FTA grants (18%) included Fixed Guideway Modernization funding Hartford & Cleveland used, as well as Regional Surface Transportation Program funding used in LA Metro's Orange Line. Flexible FHWA funding (11%) such as Congestion Mitigation and Air Quality Improvement Program Funding (CMAQ) was utilized by several BRT projects.

Figure 8:
**Share of federal
funding sources used
in U.S. BRT projects**



Notes: Funding data for South-Miami Dade Busway unavailable. Sources: Albuquerque (FTA 2019a); Cleveland (Callaghan 2007b, Greater Cleveland RTA 2018); Eugene-Springfield (Callaghan 2007b, Thole et al. 2009); Fort Collins (Pohl 2014); Hartford (Callaghan 2007b, FTA 2018f); Las Vegas (Callaghan 2007b); Los Angeles (Callaghan 2007b, Flynn et al. 2011); Pittsburgh (Callaghan 2007b, National Academies of Sciences, Engineering, and Medicine 200c); Richmond (GRTC 2015); San Bernardino (Nisperos 2014, Omnitrans 2018, Perry 2017, Starcic 2015).

78 FTA's website provides detailed information about the [Capital Investment Grants Program](#), [BUILD Grants Program](#), and other [formula and discretionary grants under FAST Act](#). Congressional Research Service (2016) describes the Capital Investment Program legislative history, program characteristics, approval process, and the speed and cost of project delivery. Callaghan (2007a and 2007b) presents funding sources U.S. BRT corridors have used and the relative advantages and disadvantages of each source. National Academies of Science, Engineering, and Medicine (2003) includes detailed descriptions of federal, state and local funding sources, financing options, as well as possible project delivery mechanisms. Doyle (2019) highlights the unique flexibility and other benefits of the BUILD/TIGER grant program.

The following are brief highlights about a few federal funding sources that have been used frequently to finance BRT corridors:

- **New Starts:** This is a highly competitive and oversubscribed discretionary grant for transit capital improvements. New fixed-guideway BRT projects or extensions costing more than \$300 million and receiving \$100 million or more in Capital Investment Grants (CIG) funding are eligible. Very few new transit projects get funded, as commitments to existing grantees take precedent. The New Starts planning and approval process is the longest and most complex of the federal funding sources, which may inadvertently discourage cities from pursuing high-quality fixed-guideway BRT corridors.⁷⁹ BRT corridors in Cleveland, Eugene-Springfield, Hartford, Las Vegas, and Pittsburgh have utilized New Starts grants (see Appendix B and Appendix C).
- **Small Starts:** Small Starts grants fund up to 80% of lower-cost fixed-guideway BRT and bus corridor projects. New fixed-guideway projects, extensions, or corridor-based projects costing less than \$300 million and receiving less than \$100 million in CIG funding are eligible. The shorter and simpler project evaluation and approval process is intended to expedite projects. Albuquerque, Fort Collins, and San Bernardino have secured Small Starts grants for their BRT corridors (see Appendix B), as have bus corridor projects in Indianapolis, Oakland, and San Francisco.
- **BUILD / TIGER.** The widely popular BUILD (formerly TIGER) grant is uniquely flexible, making it a compelling option for funding projects that are complex and hard to finance with other sources (that is, multimodal and/or multi-jurisdictional projects). BUILD grants also have the advantage that they provide capital funding to essentially any public entity.⁸⁰ Congress has to fund BUILD through its annual appropriations process, which creates some uncertainty each year.⁸¹ Richmond utilized a TIGER grant for The Pulse BRT corridor (see Appendix B). Indianapolis has also used a BUILD grant to finance its forthcoming Red Line bus corridor.

Federal funding approval process. A major criticism of the CIG program is “the complexity, length, and expense of the federal funding approval process” whose evaluation and reporting requirements are “overly time-consuming and costly.”⁸² The New Starts program’s planning and approval process is the longest and most complex. While New Starts, Small Starts, and other CIG grants offer essential project funding for BRT corridors, involvement in these federal funding programs extends the project implementation schedule. In 2007, the CEO of LA Metro estimated “federal involvement through the CIG program added an extra one to two years to a project and 10% to 15% extra in project costs.”⁸³

79 Callaghan 2007a.

80 U.S. Department of Transportation 2019.

81 BUILD is the only major federal transportation program not authorized by the FAST Act or previous authorizing legislation. Congress has continued to fund BUILD through its annual appropriations process, including \$900 million in 2019 (Doyle 2019).

82 Congressional Research Service 2016.

83 Congressional Research Service 2016.

Federal funding for BRT planning. Most federal transit funding supports capital investments, while a few, such as BUILD, Urbanized Area, and CMAQ grants, can finance other phases of project development.⁸⁴ Congress authorized planning grants within TIGER/BUILD only four times between 2010 and 2019, and USDOT awarded a total of 64 planning grants in 2010 and 2014.⁸⁵ This funding for planning helped cities develop transit projects whose construction was eventually funded from a TIGER/BUILD construction grant or another federal source. In 2014, Indianapolis Public Transportation Corporation received a \$2 million TIGER grant to complete the final pre-construction planning of its 28-mile Red Line corridor. Federal law requires local matching funding for federally funded BRT projects, and typically the higher the local contribution, the more competitive the funding application. As federal funding dollars remain scarce, high-quality BRT projects in the U.S. have relied on a variety of state, local, private sector, and other funding sources (see Appendix B).⁸⁶

STATE FUNDING

The state government was an important funder in several BRT projects, including Richmond's The Pulse (49.3%), LA Metro's Orange Line (47.9%), and Cleveland's HealthLine (37.6%). Hartford's CTfastrak is owned by CTDOT and they contributed the 20% local match. See Figure 7 and Appendix B.

Sources of state funding for BRT projects have included, among others, gas tax revenue, state transportation funds, and bonds. Eugene-Springfield's West Eugene EmX Extension bus corridor project relied on an innovative source of state funding: \$19.4 million in Oregon Lottery bond sales proceeds.⁸⁷

LOCAL FUNDING

Most U.S. BRT projects depended on some local funding from an MPO, city, or transit agency, at least as a local match for federal funding (see Figure 7 and Appendix B). Local sales, income, and payroll taxes have been an important source of funding for capital and operating costs. Transportation use taxes or fees from property development can also be utilized in BRT projects:

- In several California communities, voter-approved **sales tax increases** supported funding for BRT.
- In November 2016, voters in Marion County, Indiana, approved a quarter-cent **income tax** to fund the county's transit plan. This revenue will help fund a portion of the Red Line bus corridor's operating costs.⁸⁸
- Lane County Transit financed their Springfield-Eugene EmX Green Line with local **payroll tax** revenues.
- Usage taxes, in the form of **bridge tolls and parking revenue**, are possible sources of local funding.⁸⁹ The Bay Area's MPO, the Metropolitan Transportation Council (MTC), allocated some revenue from the San Francisco-Oakland Bay Bridge tolls to the East Bay bus corridor project.

⁸⁴ Callaghan 2007a, Doyle 2019, and National Academies of Science, Engineering, and Medicine 2003.

⁸⁵ Doyle 2019.

⁸⁶ U.S. Department of Transportation 2014a.

⁸⁷ Russo 2016.

⁸⁸ Orr 2016, Stuehnenberg 2018.

⁸⁹ Transportation for America 2014.

- Fort Collins’s Downtown Development Authority contributed \$600,000 in **tax increment financing (TIF)** revenues towards the MAX BRT project infrastructure costs. In Indianapolis, the Metropolitan Development Corporation contributed \$6 million in TIF revenues to the Red Line bus corridor.
- By replacing a segment of its elevated Central Freeway with at-grade Octavia Boulevard, San Francisco made available some **developable land** previously occupied by the elevated freeway structure. The sale of these parcels generated \$12.7 million, a portion of which was used as funding for the Van Ness corridor improvements.⁹⁰

BALLOT INITIATIVES

In 26 states and Washington, DC, with sufficient signatures, voters can get initiatives or referendums on the ballot.⁹¹ Asking voters to approve funding for transit, including BRT, has proven wildly successful in recent years. In the November 2018 midterm elections, transportation-related ballot measures enjoyed an 85% approval rate, and over the last 20 years, public transportation measures have won more than 70% of the time.⁹²

- The \$937 million Elevate Denver general obligation bond that City and County of Denver voters approved in November 2017 included \$55 million for the Colfax Corridor Connections project.⁹³
- In November 2016, Puget Sound region voters approved Sound Transit 3 by 54%. The measure proposes bus corridors on State Route 522 and Interstate 405.
- 70% of Los Angeles County voters approved Measure M, a half-cent sales tax increase to fund transportation, including bus corridors in the San Fernando Valley, Santa Monica, and Los Angeles.⁹⁴

OTHER FINANCING OPTIONS

BRT projects in Cleveland and Richmond, as well as bus corridors currently in development, assembled funding for capital and operating expenses from alternative sources:

- **Cap and trade.** The East Bay bus corridor benefits from funding from California’s cap and trade Low Carbon Transit Operations Program.
- **Naming rights.** The Greater Cleveland Regional Transit Authority (RTA) was the first U.S. transit agency to sell a naming rights sponsorship for its assets. In 2008, two prominent local hospitals, Cleveland Clinic and University Hospital, signed a 25-year joint sponsorship agreement for \$6.25 million that primarily funded annual operating expenses. Cleveland has also sold naming rights to several HealthLine stations. Similarly, Richmond’s GRTC sold The Pulse corridor naming rights to two local hospitals for nearly half a million dollars in annual operations and maintenance funding.⁹⁵

90 SFCTA 2006.

91 Ballotpedia 2019.

92 American Public Transportation Association 2018.

93 City and County of Denver 2019.

94 Wattenhofer 2016.

95 Greater Richmond Transit Company 2018b.

- **Development fees.** San Francisco and Cleveland both relied on anchor institutions in their bus corridors to help cover some of the project costs. The new California Pacific Medical Center on Van Ness Avenue in San Francisco contributed \$5 million to the corridor improvements in the form of development impact fees. The Cleveland Clinic contributed \$2.85 million toward HealthLine corridor improvements.
- **Joint development.** LA Metro has an extensive joint development program through which it collaborates with developers to build transit stations and TOD on property owned by the transit agency, often through air rights or ground leases. LA Metro is pursuing two joint development projects along the Orange Line BRT, at the North Hollywood and Sepulveda Stations⁹⁶ (see also the section “Ways to Reduce Displacement Around BRT”).

BRT FINANCING RECOMMENDATIONS

- **Match the funding flavor to the project characteristics.** Federal funding sources have specific eligibility requirements for BRT projects. Meeting the FTA definition of a fixed-guideway BRT makes a project eligible for more sources of federal funding. Project sponsors should consider federal resources for planning, capital improvements, fleet acquisition, or TOD near BRT.
- **Anticipate that extra time and cost will be needed to access federal funding.** Plan for a longer approval process with New Starts grants than with other federal grants.
- **Secure diverse local and state sources to mitigate federal funding uncertainty.** There are very scarce federal funding sources for transit planning, and federal sources for capital investments are extremely competitive. Even if resources are available for planning a BRT, cities may hesitate to invest in a corridor if there is not a reasonable certainty of funding its construction. Securing diverse sources of funding for BRT planning and construction as early as possible will help projects move forward with confidence. An MPO can combine some federal transportation funds into a larger flexible fund.⁹⁷ Cities can also look to their state department of transportation, MPO, or local use tax revenue for possible BRT funding. Development partnerships with local universities and businesses are also a possibility.
- **Explore opportunities to leverage joint development.** This may be especially effective as a way to finance BRT terminals or TOD on publicly owned properties along the BRT corridor.⁹⁸
- **Consider asking voters to approve BRT funding.** In recent years, voters have tended to support transit funding ballot initiatives.⁹⁹

⁹⁶ LA Metro 2019b.

⁹⁷ Transportation for America 2014.

⁹⁸ National Academies of Science, Engineering, and Medicine (2003) Vol. 2, p. 9-9.

⁹⁹ National voters approved 87.5% of public transportation initiatives on the ballot in 2017 and 83% in 2018 elections (American Public Transportation Association 2017, 2018).

NAVIGATING THE ENVIRONMENTAL REVIEW PROCESS

The National Environmental Policy Act (NEPA) “establishes protection of the environment as a national priority and mandates that environmental impacts must be considered before any federal action likely to significantly affect the environment is undertaken.”¹⁰⁰ A full review of the environmental clearance process for federally funded transit projects is beyond the scope of this guide.¹⁰¹ At a high level, the extent to which a BRT project is expected to impact the environment determines which category of environmental review is required:

- **Categorical exclusion (CE).** As part of the NEPA environmental clearance process, FTA can approve a categorical exclusion (CE) for a BRT project that will not have significant environmental and community impacts.¹⁰² If FTA determines the project meets the criteria for a CE, no additional environmental review is needed beyond the environmental analysis completed for the CE application.¹⁰³ A CE significantly shortens the environmental review process, helping to accelerate implementation. Several BRT corridors have been granted CEs, including Albuquerque’s forthcoming ART and Richmond’s The Pulse, as well as bus corridor projects currently in development in Indianapolis, Portland, and Seattle. While federal courts dismissed claims that FTA inappropriately approved the CE for Albuquerque’s BRT and that a more extensive environmental review should have been required,¹⁰⁴ the exemption caused some backlash against the ART BRT project. Coupling the CE application with extensive outreach about the BRT in general and the justification for the exclusion may help reduce public misperceptions.
- **Environmental assessment (EA).** When the environmental impacts are unclear, FTA will require completion of an environmental assessment. If the preparation of a CE reveals that an alternatives analysis is necessary, then an EA should be completed instead.
- **Environmental impact statement (EIS).** When a BRT project results in significant environmental impacts, FTA will require a full environmental impact statement. This entails extensive technical analysis and public review in order to “evaluate project alternatives, identify potential social, economic and environmental impacts of the project, and designate methods to avoid or mitigate these impacts.”¹⁰⁵ If preparation of an EA reveals the project will result in significant environmental impacts, then an EIS will be required.

¹⁰⁰ Federal Transit Administration 2018d.

¹⁰¹ FTA’s website includes a detailed description of the [NEPA process for federally-funded transit projects](#) (Federal Transit Administration 2018d). See also Congressional Research Service (2011) for a summary of how the environmental review process required by NEPA contributes to project delivery challenges.

¹⁰² According to FTA, actions that qualify for CE determinations do not involve significant environmental impacts. “They are actions which: do not induce significant impacts to planned growth or land use for the area, do not require the relocation of significant numbers of people; do not have a significant impact on any natural, cultural, recreational, historic or other resource; do not involve significant air, noise, or water quality impacts; do not have significant impacts on travel patterns; or do not otherwise, either individually or cumulatively, have any significant environmental impacts.” (Federal Transit Administration 2016b).

¹⁰³ Federal Transit Administration 2016b.

¹⁰⁴ The U.S. District Court agreed that the City of Albuquerque had properly followed the NEPA guidelines given the information available at the time. (McKay 2016c)

¹⁰⁵ Federal Transit Administration 2018d.

The NEPA clearance process may lead to improvements in the project corridor or burdensome extra analysis (see Box 2). The NEPA requirements, especially the EIS, are also often considered a main source of delay in delivering transit projects such as BRT corridors. Factors contributing to this perception include the lengthy NEPA documents, time needed for agencies' review and comments, and the potential for duplicating analysis with federal funding alternatives analysis or state regulations.¹⁰⁶

Each BRT project's characteristics and context are different, so the duration of each environmental review process will vary. There are no reliable estimates of the average duration of a BRT environmental review process¹⁰⁷ (see Box 2). In general, the process for a CE is shortest, followed by an EA, and an EIS is the longest and most expensive to complete. As the Van Ness corridor EIS/EIR experience reveals, evaluating the impact of transit projects on vehicular delay using an indicator such as level-of-service (LOS) can lead to a burdensome environmental review process (see Box 3). Cities considering a BRT can look to other completed corridors with similar design characteristics and scope to gauge how long the environmental review may take.

¹⁰⁶ Congressional Research Service 2011.

¹⁰⁷ Congressional Research Service 2011.

Box 2:

A “Typical” BRT Implementation Timeline

There are no reliable estimates of the “average” amount of time needed to implement BRT. Each of the 12 operational corridors in the U.S. has different designs and contexts, which makes comparisons difficult. The following is a partial list of project delivery steps and issues that can introduce delays:¹⁰⁸

Planning

- Developing consensus about the project.
- Coordinating multiple agencies with different policies, priorities, and risk profiles.

Preliminary Design and Environmental Review

- Changing the project scope.
- Extent of the required environmental review. EIS requires the most time, CE the least.
- Traffic impact analysis. Level-of-service (LOS) analysis to evaluate traffic impacts is more time-consuming than other multimodal measures such as vehicle miles traveled (VMT).

Financing

- Getting a BRT project approved by the MPO for inclusion in the long-range transportation plan and TIP.
- Financing a BRT project with federal funding, which increases the project delivery timeline. By one estimate, involvement in the federal CIG program adds one or two years compared to other federal funding programs.¹⁰⁹
- New Starts funding, which requires the longest and most complex evaluation and approval process.
- Changes to local funding mid-project.

Final Design

- Design approval by the owner of the right-of-way, especially if the corridor is state-owned.
- A design-build contract can help improve the constructability of the final design.

Technology

- Manufacturing lead time for buses.
- Completing Altoona and on-site testing of buses.
- Intelligent transportation systems procurement and testing, including traffic signal prioritization.
- Fare collection systems, especially if new technology is required for off-board fare collection.

Right-of-Way Acquisition and Utility Relocation

- Coordinating acquisition of rights-of-way with the owner agency.
- Parallel utility upgrades, especially when encountering unexpected underground infrastructure

Construction

- Construction complexity of infrastructure design choices, such as single median stations versus dual/split stations.
- Concurrent construction of Complete Streets elements, utility upgrades, resurfacing, and traffic signals.
- Gaps between construction management and the owner of the right-of-way can increase time for permitting and approvals.

Box 3:

Transit Impacts and the California Environmental Quality Act (CEQA)

The draft environmental review, conceptual planning, and final environmental studies for the Van Ness Improvement Project required six and a half years to complete, included a 700-page final environmental impact review (excluding the nearly 500-pages of appendices), and cost \$7.6 million.¹¹⁰ This extensive process was required under CEQA because traffic impact analysis showed the Van Ness project would have a negative impact on traffic that could not be avoided or offset. At the time, CEQA assessed traffic impacts with level-of-service (LOS), a measure of vehicular delay, so SFCTA had to model traffic impacts for hundreds of intersections, which required an enormous amount of time. Subsequent to the Van Ness Corridor Improvement EIR/EIS, the City of San Francisco modified their approach to CEQA analysis, shifting from LOS to vehicle miles traveled (VMT) as a measure of traffic impacts.¹¹¹

In January 2019, California adopted revised CEQA rules, replacing LOS with VMT as the measure of a project's environmental impacts. While these new rules go into effect statewide in mid-2020, other cities, like Los Angeles, have followed San Francisco's lead and proactively switched to VMT.¹¹² These changes will reduce the burdensome environmental review for future BRT projects in California, potentially saving years and millions of dollars.¹¹³

¹¹⁰ Jaffe 2014, San Francisco County Transportation Authority 2013.

¹¹¹ In December 2018, California adopted legislation (S.B. 273) to modify CEQA to provide an alternative to LOS for evaluating transportation impacts. For transit projects, those alternative measures must "promote the reduction of greenhouse gas emissions, the development of multimodal transportation networks, and a diversity of land uses" and may include "vehicle miles traveled, vehicle miles traveled per capita, automobile trip generation rates, or automobile trips generated" (California Governor's Office of Planning and Research 2018).

¹¹² Linton 2019.

¹¹³ Jaffe 2014.

INCLUSIVE PUBLIC ENGAGEMENT

As public transportation projects on public rights-of-way, often publicly funded, BRT projects must solicit the public's opinion and garner support from a wide range of stakeholders. However, not all public outreach and engagement is created equal and, depending on how it is executed, can yield dramatically different results. A city can approach the public engagement process as a procedural "box to check" necessity, or it can leverage it as a means of connecting with the public, genuinely listening to and responding to their concerns, and ultimately building a coalition of support for the project. A well-planned engagement and communication strategy can help reduce or altogether avoid opposition to a project. Public engagement has become synonymous with public meetings, which may not be the most effective way to reach important project stakeholders and potential supporters with a vision for improved transit service.

WHY ENGAGE WITH THE PUBLIC?

The goals of BRT public outreach and engagement may include:

- Inviting public comment on publicly funded projects;
- Aligning the community's wants and needs with what planners think they want and need;¹¹⁴
- Creating awareness within the community and project areas about the BRT;
- Cultivating support for the BRT project among different stakeholders;
- Informing people about benefits and potential impacts throughout the project;
- Promoting interest in the new BRT service among current and potential riders;
- Educating people about the new BRT service and how to use it;
- Improving safety and security on the corridor through increased public awareness.

WHO IS THE TARGET AUDIENCE?

The target audience of BRT public outreach and communication efforts includes myriad project stakeholders, such as:

- Current and potential users of the corridor;
- Special user groups such as elderly people, students, and people with disabilities;
- Residents of the project area and surrounding community;
- Individual project champions (community or transit leaders who may be unaffiliated);
- Members of the community at large;
- Business and commercial interests on the corridor;
- Property owners and developers on the corridor;
- Affiliates and leadership of large institutions (such as universities and hospitals);
- Community and advocacy groups;
- Public officials.

¹¹⁴ Gwen Kash examined "vision dissonance," or the gap between the community's needs and planners understanding of those needs, and found that in the case of Bogotá's TransMilenio BRT, this vision dissonance harmed the most vulnerable users. To counteract vision dissonance, Kash utilizes qualitative research techniques to understand BRT passengers' needs (Kash 2018).

The BRT communications team should consider who else within the community may not be well represented in public forums for various reasons and seek them out.

WHAT INFORMATION SHOULD BE COMMUNICATED TO THE PUBLIC?

Communication with the public about a BRT project should be a two-way conversation: listening and talking. Early in the scoping and conceptual planning process, community engagement should aim to find out how people might want to use the corridor. What does the community want and need to improve a corridor? Is there a shared community vision for the corridor? It is important that project staff take time to hear and address people's concerns, opinions, and questions about the BRT plans, designs, and potential impacts.

To inspire interest in and support for the BRT project, the project team will need to present key messages about the BRT project in a compelling way. This includes sharing the vision for the corridor, as well as its promises or expectations. Other information shared about the project will help notify and educate the public:

- Why the project is happening and its goals and objectives;
- An explanation of BRT, since many communities in the U.S. are either not familiar with the mode or have misperceptions about it;
- Design details about the corridor infrastructure (including travel lanes, stations, and buses);
- An explanation of the new service plan, including the BRT routes, schedule, and fares;
- The project timeline, key milestones, and estimated opening;
- What to expect during construction, including road closures, detours, and delays;
- Ways to contact the project with questions and concerns.

“Provide timely information about the project during each implementation phase.”

— Greater Richmond Transit Company, *The Pulse Public Outreach Plan*

WHEN SHOULD PUBLIC OUTREACH AND ENGAGEMENT BEGIN?

Communicate early and often. The public needs to be informed early on in the planning process about the BRT project and its potential benefits and impacts. Solicit input and build buy-in for the project as early in the planning process as possible, in order to counteract any negative information that gets circulated about the project. Continue to communicate frequently during construction and early operations.

1. **During the planning and design phases**, it is important to listen to what the public needs and wants out of a potential BRT project. Seek public input early, when it is really welcome and can be addressed, not late in the process when the project is fully defined. Public and private stakeholders need to be informed of project plans and details, and a forum needs to be created for receiving diverse opinions and comments. Expect more public interest in, and scrutiny of a project, once federal funding is confirmed (see Albuquerque and Richmond case studies). See Box 4, “Are Public Meetings the Best Format for Public Engagement?”
2. **Before construction starts**, begin making businesses and residents aware of upcoming construction and any parallel utility work.
3. **During construction**, it is important to provide timely information about construction schedules, disruptions, delays, and detours. Share relevant safety messages for transit users, drivers, bicyclists, and pedestrians. Tailor construction communication materials for different audiences including the general public, tourists, merchants, delivery vehicles, and hotels. Provide several ways for concerned residents and businesses to raise their concerns during construction.
4. **Leading up to the launch of revenue service**, shift communication to promote the new service through awareness and user education campaigns.

WHERE SHOULD PUBLIC ENGAGEMENT OCCUR?

Through traditional public meetings, the BRT planning and construction leads **invite the public to come to them**, and city staff and consultants share information about a project with members of the public and gather public opinions and comments. Another approach is to **meet people where they are**, which has several benefits over traditional public meetings (see Box 4). Project staff can reach a more diverse audience by not restricting communications to one type of event and time of day (such as an evening public meeting). Going into places where underrepresented members of the community feel most comfortable and utilizing already trusted community information channels¹¹⁵ can broaden and diversify the audience for BRT communications. For example:

- Information tables, surveys and informal conversations at bus stops and within transit stations are good places to connect with current transit customers.
- Go door-to-door along the BRT corridor engaging with businesses and residents. The public engagement specialist with Richmond’s GRTC walked The Pulse BRT corridor three times, knocking on doors and leaving printed materials at every corridor business and residence. Eventually, Albuquerque’s ART team hired graduate students to canvass the corridor daily.

¹¹⁵ A study of mobility needs of senior immigrant populations in the Pacific Northwest found that members of diverse groups preferred to receive transportation information through their trusted channels, including community and religious centers (King County Mobility Coalition 2011).

- Project staff can bring project information or design queries to neighborhood and community group meetings, business association meetings, religious centers, schools and universities, and youth and senior centers.
- Provide project information and opportunities for feedback online and through social media.

Box 4:

Are Public Meetings the Best Format for Public Engagement?

Public meetings are an entrenched part of the transportation project planning and design process in the United States. Federal funding mandates that communities have an opportunity to weigh in on public projects, and as a result, the public meeting has become the de facto format for soliciting community feedback on transit projects. Seeking the public's input about proposed transportation investments is vital to building buy-in and developing projects that meet users' needs. Given the importance of engaging with citizens, it is worth asking whether the public meeting format is the most effective way to engage stakeholders and collect input, opinions, and comments from a diverse community affected by a BRT project.

The typical hour-long evening public meeting format is flawed, as it presents a number of barriers that systematically exclude certain community voices:

- **Time of day:** Late afternoon and evening meetings can preclude certain groups of people, such as caregivers with small children, shift workers, and university students with evening classes.
- **Inconvenient location:** Downtown locations are not accessible for all demographics, especially people living outside the urban core.
- **Public facility and host:** A meeting held at a government office or organized by a civic authority may be intimidating to non-native English speakers, recent immigrants, people with disabilities, or those unfamiliar with the public meeting process.
- **Contentious discussions:** If a BRT project is particularly divisive, community meetings may devolve into heated exchanges. This hostile environment may repel newer, less experienced community voices.
- **Self-selection:** By relying on the same public engagement method, BRT project staff run the risk of hearing from a very small number of regular attendees. In this case, the public meeting becomes an echo chamber and not a tool to collect a representative sample of public opinion.

Several strategies can help improve the effectiveness of the typical public meeting format, ensuring that a diverse cross-section of the community can share their opinion, concerns, and questions about the BRT project:

- Hold meetings at **different times of day** (morning, midday, evening) and on weekends.
- **Offer childcare.** Even if participants do not take advantage of the childcare, knowing that it is available may make caregivers with small children feel welcome.
- **Provide food,** especially if meetings coincide with mealtimes.
- **Translate** written and verbal information into all relevant local languages.
- **Bring the public meeting to the community** affected by the BRT project. The BRT planning and outreach staff can design more mobile information sessions by bringing drawings and maps to the places that community members and future BRT passengers frequent. For instance, staff can talk about the BRT project at libraries, senior centers, or recreation centers. Information tables can be set up in transit stations, near medical facilities, or on university campuses. BRT planners can interview bus passengers waiting at a bus stop or on board the vehicle.

In all cases, it is essential to consider which voices are not being heard through the existing public outreach format (such as youth, students, families, seniors, people of color, minorities, people with disabilities, and lower-income residents) and make a conscious effort to reach them.

HOW TO CONNECT WITH THE PUBLIC ABOUT A BRT PROJECT?

Take decision-makers and key partners on a study tour to experience other BRT corridors. Early in a project feasibility and conceptualization phase, a BRT study tour to experience an operational BRT corridor can be an effective way to develop a shared vision for a BRT corridor. Seeing a full-featured corridor and witnessing the high-quality user experience at first hand can help illustrate the potential of BRT to those unfamiliar with it and build support for a local project. Officials and project partners from Cleveland, Hartford, and Los Angeles found inspiration in Curitiba.¹¹⁶ ITDP sponsored a delegation of city staff, advocates, and elected officials from San Francisco to experience Mexico City's Metrobús BRT during the Van Ness and Geary bus corridor planning phases. Domestic study tours have been effective as well, with officials from Pittsburgh and Albuquerque reportedly visiting Cleveland RTA and its HealthLine.

Several strategies can be helpful to reach residents, business owners, and other community members throughout BRT planning and implementation:

- **Develop a communication strategy** or public outreach plan to keep the community and local jurisdictions informed about the project's progress, milestones, and unforeseen developments. The strategy should specifically address crisis communications and how to respond to negative press in addition to a proactive communication strategy that promotes the positives.
- **Use a variety of communication channels to reach different segments of the community.** These could include digital channels like email and social media; print materials; and in-person interactions (see Table 6).
- **Get to know the corridor on foot.** The most effective outreach approach is walking the corridor to speak with individuals and following up on their questions and concerns. This is labor-intensive and requires dedicated staff and funding. Richmond's GRTC got state funding to bring in dedicated marketing and communications staff for its The Pulse BRT project. The construction contract also specified a dedicated person for outreach (mostly to businesses).
- **Inventory the corridor businesses.** Create or update a database and map of corridor businesses, with contact information, communication preferences, and concerns. This tool will help ensure that communication reaches the right people and that the project is responsive to the businesses' questions and feedback.
- **Collect and track corridor data to communicate changes and impacts.** Data collected over time (including before construction, during construction, and during operations) about corridor trip patterns, travel times, traffic safety, and other parameters will enable BRT impact analysis. Some of these data will be necessary for any required alternatives analysis or environmental review.
- **Explain the project's goals and benefits for a lay audience.** Distill technical details into easy-to-understand information for a non-transit audience. Rely on infographics and images where possible to convey concepts. Interactive planning tools can help the public understand the tradeoffs between design constraints.¹¹⁷
- **Public-facing materials should be on-brand.** If the BRT brand guides all visual information and communication materials, they will be consistent.
- **Coordinate between project partners.** Cross-functional teams with members from project partners or stakeholder representatives can help streamline and coordinate information. Richmond convened a team of partner representatives, including the Public Information Officer Team, each agency partner, and the Design-Build Team, at least monthly to keep open and streamlined communication throughout the project.
- **Build prototypes to gather public feedback about BRT design elements.** Some cities have installed prototype BRT stations to build interest among the public and work out the design details before signing off on the final design. Albuquerque's station architect designed a small model of the station that people with disabilities could touch and familiarize themselves with. Albuquerque also developed a virtual-reality ART station to simulate the experience of waiting and walking in the new BRT stations.¹¹⁸ AC Transit in Oakland

¹¹⁷ Researchers at MIT have developed an interactive public transit planning tool, Collaborative Accessibility-Based Stakeholder Engagement for Public Transportation Planning (CoAXs). The open-source, online tool enables users to test public transportation scenarios in real-time. A map aids spatial understanding of the possible impacts (for example, increased access to jobs) of a public transport project such as a proposed BRT corridor alignment (<http://coaxs.scripts.mit.edu/home/>).

¹¹⁸ McKay 2016d; Video of the virtual reality tour of the Bryn Mawr ART station: <https://youtu.be/cbyvIRAW0y4>

convened stakeholders with disabilities to test out the International Boulevard corridor’s new ADA-compliant ticket vending machines. A video simulation of Eugene-Springfield’s EmX Green Line corridor proved an effective way to communicate the BRT concept and design of the stations and busway with the community.¹¹⁹

- **Teach potential customers how to use the BRT service to reduce anxiety about a new system.** Transit agencies in Fort Collins and Richmond offer **travel training** on their BRT corridors.

Table 6:
Three BRT public communication channels

DIGITAL	PRINT OR ANALOG	IN PERSON
<ul style="list-style-type: none"> • Email notices • Newsletters • Website • Social media • Advertisements • Photography • Videos • Blogs • Press kits • Television and radio interviews 	<ul style="list-style-type: none"> • Articles • Advertisements • Letter mailings 	<ul style="list-style-type: none"> • Face-to-face interactions • Presentations • Tours and site visits • BRT study tours, exchanges, and trainings • User training • Games, songs, and improv with kids • Prototypes, pilots, or demonstrations

COMMUNICATING WITH BUSINESSES

Businesses along a BRT corridor are often an organized and vocal group of constituents. Securing their buy-in on the project is critical to its success. Anticipate that businesses’ concerns will likely relate to how changes to on-street parking and travel lanes will affect their operations. This may include temporary changes during construction of the BRT corridor or permanent reconfiguring of the roadway to accommodate the BRT lanes and stations. Businesses are important stakeholders whose support is crucial to delivering a BRT project with reasonable public acceptance. Working with business leaders and owners to (a) address their concerns and (b) make them aware of the benefits of the project for the community and business will be crucial to the success of a BRT project. They are an important constituent group that warrants a specific communication strategy.

Engage with businesses during planning and design. It is worthwhile to develop business-specific outreach and communication materials for BRT corridors through commercial areas. During project planning and design phases, business engagement will likely focus on how changes to the travel lanes, turn lanes, and on-street parking will affect customer access and business revenue. Suggested approaches include:

- Educate the business community about the **economic benefits of BRT**. A spokesman for San Bernardino’s transit agency, Omnitrans, said it pays to educate business owners and political leaders of the potential of BRT to attract business and even help with economic development. “You can’t convince everyone it’s a good project, but you have to keep in mind what is the greater good.”¹²⁰

- Provide a **BRT business forum**. SFMTA convenes a monthly Business Advisory Committee for the Van Ness Improvement Project “to provide recommendations and advice on ways the City can support businesses on Van Ness during construction. The committee oversees development of marketing support for businesses on the corridor, while also providing a forum for business owners or representatives to resolve issues related to construction.”¹²¹
- **Address parking concerns block-by-block**. Take time to hear concerns about turn restrictions and parking changes along each block. Developing specific solutions with the businesses can go a long way to cultivating support. Richmond’s GRTC worked block-by-block to address concerns about parking losses. They came up with specific proposals, such as where parking spaces could be added on cross streets.
- **Inventory corridor-adjacent parking**. Some business stakeholders’ concerns about changes to on-street parking may be fueled by a lack of awareness of where and how much other parking is nearby. An inventory of the free and paid parking near the proposed BRT corridor may help alleviate some businesses’ concerns about losing parking right in front of their shop and inform customers of where to park when driving to the corridor.
 - Richmond’s GRTC created and shared aerial maps of The Pulse BRT corridor showing nearby paid and unpaid parking. This activity served a dual purpose: reducing business owners’ concerns about loss of parking on Broad Street, and addressing customers’ concerns about where to park when driving downtown.
 - SFCTA and SFMTA staff learned some lessons from the Van Ness project that they applied to improve their engagement with Geary Boulevard corridor businesses. The Geary project has made up time on Van Ness despite merchant opposition to removing parking and concerns over traffic. Planners are working with merchants to develop parking and loading zones.
- **Consider how customers currently access corridor businesses**. Survey data showing which modes of transport people currently use can inform communication strategies to promote alternative ways to access shopping besides driving and parking.

Support businesses during construction disruptions. Leading up to and during construction of the BRT, engagement should shift to help minimize disruptions to businesses. BRT construction causes noise, may slow or divert traffic and close sidewalks or bike lanes, and may temporarily or permanently reduce parking and commercial loading. Businesses on the corridor may suffer if the BRT construction dissuades customers from patronizing their shops. Nighttime construction noise might be particularly disruptive to hotels on the corridor, and many businesses will be impacted if commercial loading spaces are removed (temporarily or permanently) during construction. Suggestions for communicating with businesses and managing the impacts of the BRT construction include:

- Remind residents and visitors that **businesses along the BRT corridor remain open during BRT construction**.
- **Wraps to hide construction** from view can double as promotional space.
- Plan to **relocate commercial loading spaces** for corridor businesses, either temporarily during construction or permanently for BRT operations. This might include designating commercial loading spaces in parallel service alleys or on perpendicular streets.

- **Regularly update businesses** about construction’s impact on roads and utilities. Richmond’s GRTC distributed an informational pamphlet about construction updates, effects on parking, access, and utilities to all affected businesses at least two weeks prior to any work in the area. GRTC’s BRT team engaged specifically with hotels on the corridor to keep them updated about nighttime construction so the hotels might relocate guests to quieter rooms.
- **Provide financial or technical assistance to businesses** along the corridor as a lifeline during disruptive construction. Oakland and AC Transit created a business assistance program to provide financial support and guidance to businesses along the East Bay bus corridor. This might include grants for additional signage during construction or assistance temporarily relocating commercial loading parking spaces. Similarly, Albuquerque’s Economic Development Department created a small assistance fund to support about 30 small businesses on the ART corridor during construction. The city provided training on business fundamentals such as bookkeeping or social media. It also helped to promote the small businesses through different marketing campaigns to attract customers to Central Avenue during the BRT construction.

PUBLIC OUTREACH RECOMMENDATIONS

- **Get to know the corridor.** Get to know the businesses and people using the corridor. Learn about their pain points and how the project will affect them personally. The most effective outreach approach—walking the corridor to talk with residents and businesses—is labor-intensive. Dedicated outreach staff and funding may be needed.
- **Ask for public feedback before the project design is locked in.** Seek community input early in the planning stages, when the corridor design can still be responsive to their suggestions and concerns.
- **Build buy-in early, especially from the business community.**
- **Look beyond the public meeting.** Holding public meetings does not guarantee buy-in. The public meeting may have drawn a crowd of 20, but they might not be the right 20 people to build support for the BRT project. Find more effective ways to reach community connectors.

BRANDING AND MARKETING THE BRT

“Our customers deserve good design. It enhances their experience and attracts new riders. Metro’s numbers bear it out. We’re experiencing the highest levels of customer satisfaction and new rider growth in history.”

— Matt Raymond, former Chief Communications Officer, LA Metro¹²²

A good brand matters. A BRT project, with its 60-foot buses, dedicated lanes, and station architecture, is an enormous, highly visible representation of the city’s brand. Failing to design a great brand for a BRT is a huge missed opportunity for the city. A good BRT brand enhances the customer’s experience, attracts new riders, and increases the transit agency’s public reputation.¹²³

Allocate design and marketing staff and budget from the project start.

Most transit agencies don’t have an in-house design studio like LA Metro’s, and certainly not one with a nearly \$6 million production and media budget.¹²⁴ Cities planning to implement a BRT project should carve out funding for design and marketing services, whether done in-house or through outside consultants. Scope out all the elements of the infrastructure and communications collateral that need to be designed. Many transit agencies’ internal marketing teams will need additional staff to help with the huge task of branding, marketing, and launching a new BRT service.

Fort Collins’s MAX BRT brand is modern and sleek.



Source: City of Fort Collins via Flickr

¹²² Shapiro 2006.

¹²³ *From Here to There: A Creative Guide to Making Public Transit the Way to Go* (Weber et al. 2011) elaborates on eight principles of marketing and branding public transit, including BRT.

¹²⁴ Shapiro 2006.

Design the BRT brand. A BRT brand embodies how people perceive and feel about the transit service. A good marketing and branding professional will uncover what is unique about a city and the BRT service and develop a system brand that embodies those qualities. They'll begin by articulating the BRT project's values. What does the BRT represent to the community? Is it modern, efficient, new, fast, safe, convenient? What impact will it have on people's lives? These values form the basis of the BRT brand and inform the design of all the BRT elements.

New or familiar brand? BRTs are unlike most other transit services in a city's network. BRT is not like the existing bus service, nor do people use it exactly like a metro. The BRT project team has the choice to either closely associate the BRT brand with an existing transit system or to differentiate it entirely. This will depend in part on the public perception of the existing transit system and how the BRT service fits in with the suite of transit service offerings in the city. Unfortunately, there is often a very negative stigma plaguing buses and the people who ride them, particularly in U.S. cities. A BRT's brand values will likely need to intentionally counteract this bus stigma.

Hartford's CTfastrak is closely associated with CTDOT's other transit service offerings, CTtransit and CTrail. Each of the modes or services shares a similar logo, differentiated by different colors. The intention was to position CTfastrak as another great option within a regional transit network. Similarly, LA Metro's Orange Line BRT's brand closely resembles the system's other colored rail corridors and is drawn on the metro network map alongside the other rail lines.

Albuquerque, on the other hand, differentiated the ART from the existing city bus service. The retro design represents something fresh, new, and cool on Central Avenue while still connecting with the deep history of Route 66. Studio Hill Design, who developed the ART brand, chose colors, fonts, and styles that evoke the retro history of Route 66, including neon, diners, and motel marquees. The modern designs of the stations, signage, and buses signify something fresh and new for customers. The ART brand is differentiated both from ABQ RIDE's existing local bus service and from its Rapid Ride express bus routes. The BRT is also distinct from the regional transportation authority's Rail Runner commuter rail.

Branded BRT elements. All aspects of the BRT system should be branded consistently, from stations and buses, through paper tickets and smartcards, to printed materials and the website.¹²⁵

“This is design with a purpose, design that moves people. It can impart information and still be bright and engaging.”

— Neil Sadler, Art Director, LA Metro¹²⁶

LA Metro Orange Line's
North Hollywood Station



Source: EMBARQ Brasil | WRI Brasil Cidades

BRT stations are a symbol of the system. The BRT stations are the most visible and visceral part of the system—where the BRT system interacts with the city and its people. Their design needs to embody the BRT brand values since, by virtue of repetition, the stations become a symbol of the system. The tensile fabric roofs on Albuquerque's ART stations look modern and clean, consistent with the BRT brand values. Richmond's The Pulse stations are designed in keeping with the city's more historic architecture, and Hartford's CTfastrak stations have high-quality design finishes and details that help elevate the customer experience.

Use the marketing budget early to sell the public on the BRT. A critical early use of the BRT marketing resources is to promote the BRT to the community. If the project team and supporters do not communicate the merits of the BRT to the public and promote a new vision for the corridor, then negative stories will inevitably fill that void.

In Albuquerque, groups who opposed ART were well organized and established negative stories in the media about the project before the city began actively promoting benefits of the BRT. This put the BRT team on their heels, reacting to negative press, instead of proactively putting out positive messages.

Educate the public about BRT. Most U.S. communities would benefit from an introduction to BRT. One function of the BRT marketing is educational, to teach people about the BRT. Informing people how to drive, bike, scooter, or walk in the BRT corridor and how to adapt to left-turn restrictions may be helpful. Passengers may welcome a how-to guide on ticket vending machines and proof-of-payment. Some examples of this type of outreach:

- Richmond's GRTC created educational videos explaining The Pulse's fare payment system.
- Albuquerque's team created an illustrated transit guide depicting how people and vehicles will move through an intersection on the BRT corridor.
- Fort Collins's Transfort agency hosts regular transit trainings to help people understand how to use the MAX BRT system.

Promote the BRT to build ridership. The marketing campaign should also have the goal of selling the BRT service to potential customers to boost ridership. These ridership campaigns can sell people on what life will be like with the new BRT and how they will benefit. Promoting the places the BRT can connect people to can also be effective.

- Richmond’s GRTC promoted different things customers could do with the time they saved by riding The Pulse, such as shopping or time with friends and family.
- Cleveland’s HealthLine ads showed key city destinations the BRT corridor could connect people to, like the Natural History Museum and hospitals.
- CTDOT found their CTfastrak outreach was more effective when they focused less on telling people what they were building—busway infrastructure—and more on what people could do with the BRT. For instance, they visited senior centers and talked with residents about how they could use CTfastrak to reach medical appointments or social engagements downtown.

DESIGNING AN EQUITABLE BRT PROJECT

A city’s most disadvantaged citizens—low-income people, youth, seniors, immigrants, refugees, and people with disabilities—often depend heavily on its bus transit. A BRT project that is designed with these vulnerable populations in mind can provide significant accessibility, safety, and health benefits. Since BRT projects are typically publicly funded, ensuring that their impacts and benefits are distributed equitably across the community is crucial. Doing so is also complicated.

Title VI of the landmark 1964 Civil Rights Act protects people against discrimination based on race, color, and national origin in programs and activities receiving federal financial assistance. To this end, FTA requires its funding recipients to comply with Title VI by **evaluating any major service change and all fare changes to understand if those changes will have a discriminatory impact based on race, color, or national origin.**¹²⁷ Implementation of a BRT corridor would certainly qualify as a major service change. Cities will need to ensure that the BRT impacts are not discriminatory and are distributed equitably to **minority and low-income populations. FTA also requires that minority, low-income, and non-English speaking communities have an equal opportunity to participate in the BRT public engagement process.**¹²⁸

“We can’t do our best work if we continue to narrowly focus on what we view as the most common user, as the most important or ‘normal user.’... We have to think about gender nonconforming people and older folks and kids and people with disabilities and people of color—the full spectrum.”

— Tamika L. Butler, Esq., Director of Equity and Inclusion, Toole Design¹²⁹

¹²⁷ A major service change includes any modification that exceeds the transit provider’s major service change threshold (Federal Transit Administration 2018c).

¹²⁸ Federal Transit Administration 2018c.

¹²⁹ Riveron 2019.

These are important policy requirements. A new BRT project must be implemented equitably and without discrimination. This is especially important in cities with a history of discriminatory urban policies such as redlining, urban renewal, and expansion of the interstate system through low-income and minority communities.¹³⁰ A public transportation investment like a BRT project should be intentional about equity from the beginning, by clearly and transparently stating the equity outcomes it is aiming to achieve and how progress toward those goals will be measured.¹³¹ Furthermore, an equitable BRT project will be rooted in equitable and just planning and funding decisions.¹³²



San Bernardino's sbX

Source: Omnitrans

Special attention should be paid to specific aspects of BRT project planning and design, such as public outreach and proof-of-payment policies, which can be problematic in cities experiencing increased tensions between law enforcement and communities of color. Several strategies during project planning, design, and operations can help improve the BRT outcomes for all users. These strategies include:

- Equitable distribution of the public benefits of BRT;
- Inclusive public outreach and engagement;
- Corridor alignment and station locations in underserved communities;
- Fair fare policies.

¹³⁰ Foxx 2018.

¹³¹ Carter et al. (2013, Figure 7) present a set of sample transportation equity metrics.

¹³² Researchers from the University of Southern California's Program for Environmental and Regional Equity provide a succinct definition of transportation equity (1) Equitable access to quality, affordable transportation options and, therefore, employment, services, amenities, and cultural destinations; (2) Shared distribution of the benefits (such as jobs) and burdens (such as pollution) of transportation systems and investments; and (3) Partnership in the planning process that results in shared decision-making and more equitable outcomes for disadvantaged communities, while also strengthening the entire region (Carter et AL 2013).

“Infrastructure designed to serve the needs of some can limit the physical and economic mobility of others. When infrastructure is built without regard to place or community, urban highways sever a city, runway expansion displaces a neighborhood, [and] crosswalks, bus stops, and railroad crossings become an afterthought.”

— The Honorable Anthony Foxx,
U.S. Secretary of Transportation from 2013 to 2017¹³³

EQUITABLE DISTRIBUTION OF BRT BENEFITS

A 2013 study of the social, environmental, and health impacts of international BRT systems found that BRT projects can benefit low-income populations, if they are designed intentionally.¹³⁴ Important design considerations include station locations and access to the BRT stations for lower-income populations, as well as affordable fares. The equity of a potential BRT investment can be estimated in advance and the project adjusted if necessary to be more in line with social, environmental, and mobility justice goals. Transportation models can assess the BRT outcomes for different groups of people, including low-income, zero-car, and transit-dependent households. During their Van Ness corridor feasibility study, the San Francisco County Transportation Authority (SFCTA) did just that. To measure the equity of different design concepts, SFCTA’s models compared the share of project benefits that would be experienced by low-income and transit-dependent households to the share of benefits experienced by households that are not low-income and those that have access to a car.

INCLUSIVE PUBLIC OUTREACH AND ENGAGEMENT

A starting point for any BRT project is in reaching out to the local community to gather their input and opinions about potential plans. Where possible, BRT corridor plans should respond to the needs and concerns of members of the community. Public outreach efforts should be planned in such a way to include as diverse a group of stakeholders as possible. Suggestions include paying careful attention to how, where, and when public meetings and outreach events are held, in order not to disenfranchise community members who may feel uncomfortable or may be unable to attend a meeting at a government agency’s office (see Box 4 for a discussion of alternative formats to public meetings). Engaging with residents through community organizations they already trust and making project information available in multiple languages can also help reach a diverse audience. These outreach strategies are discussed further in the section “Inclusive Public Engagement.”

¹³³ Foxx 2018.

¹³⁴ Carrigan et al. 2013.

BRT ALIGNMENT AND STATION LOCATIONS

Where the BRT stations are located with respect to lower-income neighborhoods affects how well the BRT serves vulnerable users. If the corridor does not pass through and stop in their neighborhood, lower-income residents may feel that the BRT is for others but not people like them. When selecting the corridor for BRT, communities may be under public pressure to direct the investment toward neighborhoods that are underserved by transit, rather than improving a corridor that already has high transit demand. While the decision to prioritize transit frequency or transit coverage must be made by the transit agency, BRT's frequent, reliable service is best suited to a corridor where many transit passengers are experiencing slow and unreliable service.

Stop consolidation that leaves large segments of a minority neighborhood without a BRT station may send a message that the new service is trying to skip over that neighborhood's residents in order to provide express bus service for more affluent users. This was the sentiment in Albuquerque's International District, in East Richmond, Virginia, and along Oakland's International Boulevard bus corridor. Planners should work closely on the station spacing with communities along the BRT corridor to balance BRT speed with transit access.

In some cases, public investment in a BRT corridor may lead to gentrification or displacement of current residents, especially the most vulnerable populations. See "Limiting Displacement near BRT" in the section "Managing the Economic Impacts of BRT" for suggestions on how to minimize this risk.

FAIR FARE POLICIES

One of the basic elements of BRT is off-board fare collection. Allowing passengers to pay their fare at the station rather than on the bus dramatically speeds up boarding. There are essentially two ways to ensure that BRT passengers pay their fare: (1) closed stations requiring fare payment at turnstiles or gates to gain entry, or (2) open stations with proof-of-payment (POP) zones. While common with international BRT stations, closed stations are uncommon in the U.S.; most U.S. BRT systems rely instead on open stations and POP zones.

Transit agencies with POP systems often institute fare validation and inspection policies to discourage fare evasion. Research has shown that while these efforts do not always reduce fare evasion rates, fare inspection policies disproportionately target low-income users and passengers of color, discouraging them from using transit.^{135,136} Fare increases, fare inspection, and fines for fare evasion combine to have "social and financial consequences, especially for working-class communities of color who depend on public transit for access to work, school, quality health care, food, and recreation."¹³⁷

¹³⁵ POWER, DataCenter, and Urban Habitat 2012.

¹³⁶ Transit Center 2019a.

¹³⁷ POWER, DataCenter, and Urban Habitat 2012.

For BRT systems with off-board fare collection, three aspects of transit fare enforcement are critical for providing an equitable transit service:

1. Decriminalization of fare evasion;
2. Constitutional fare inspection;
3. Equitable fare policies.

Decriminalization of transit fare evasion. Transit fare evasion in many cities is a criminal offense. When getting caught not paying the bus fare leaves one with a criminal record, the punishment is out of proportion to the offense. Kids who hop a transit turnstile could end up paying large fines, serving time in juvenile detention, and having a criminal record. A fare evasion arrest could even expose a passenger who is an undocumented immigrant to the risk of deportation.

Recent public awareness of the criminalization of low-income people and minorities has shone the light on some cities' inequitable fare evasion policies.¹³⁸ And across the country, transit agencies, cities, and states are deciding to decriminalize transit fare evasion:

- San Francisco decriminalized fare evasion for adults in 2008.
- In 2011, Cleveland instituted an administrative fee waiver, where first-time adult offenders could pay \$25 to RTA to avoid criminal charges.¹³⁹
- In the Seattle Metropolitan area, King County decriminalized fare evasion for youth in 2015.
- California decriminalized fare evasion for minors (under 18) in 2016.

Launching a new BRT system presents an opportunity for reforming fare policy and decriminalizing fare evasion.

Constitutional fare inspection. Many BRT systems with open stations and off-board fare payment operate as POP systems. Fare inspectors may ask passengers to produce a paper ticket, receipt, or validated smartcard or app as proof that they paid their fare. Using uniformed and even armed police officers as BRT fare inspectors is an aggressive fare-enforcement tactic that introduces more policing into the transit system.¹⁴⁰ This approach increases confrontations between law enforcement and transit passengers, and may be racially biased.¹⁴¹ Police or uniformed fare inspectors of any kind may incite fear among marginalized customers and passengers of color, discouraging them from using transit altogether.

¹³⁸ Schmitt 2017a.

¹³⁹ Allard 2017.

¹⁴⁰ National Association of City Transportation Officials 2017.

¹⁴¹ A 2010 ACLU study of Cleveland's HealthLine BRT found that 9 out of 10 passengers police cited were black. Cleveland's RTA disputed the findings, stating the fare evasion citation demographics were proportional to riders' demographics (Breckenridge 2010).

In 2017, a Cleveland municipal court judge ruled that subjecting every bus passenger to fare inspection by police officers amounted to an unconstitutional search.¹⁴² Greater Cleveland RTA's response to the ruling was to transfer fare inspection responsibilities to bus operators, negating the time savings of pre-paid boarding and effectively eliminating all-door boarding.¹⁴³ However, the judge did not rule POP unconstitutional, just RTA's approach to fare inspection. Constitutional fare inspection for BRT systems does not require eliminating off-board fare collection, all-door boarding, or POP. The judge in the Cleveland case suggested two alternative approaches to fare inspection:

- **Targeted inspection when there's reasonable suspicion of fare evasion.** Uniformed police stopping one passenger who was reasonably suspected of evading fares would be constitutional (but might introduce racial bias).
- **Civilian fare inspectors.** Onboard inspection of all passengers by people other than law enforcement officers would also be an acceptable approach since it buffers passengers from police, preventing "arbitrary and abusive police encounters."¹⁴⁴ A community enforcement approach to fare inspection would make a POP BRT system more welcoming to the most marginalized members of the community. Transit fare inspectors should be required to undergo anti-bias and discrimination training.¹⁴⁵

"Transit systems can train and deploy proof-of-payment fare inspectors to ensure consistent inspection across routes and time of day. Fairness and the safety of both inspectors and riders is paramount; criminalizing riders will not result in an equitable transit system."

— Alex Engel, National Association of City Transportation Officials (NACTO)
Communications Program Manager¹⁴⁶

Equitable fare policies. BRT fare changes must not be discriminatory and must be distributed equitably to minority and low-income populations. Under Title VI, the communities affected by the fare change must have an equal opportunity to participate in the public engagement process before the fare change is determined.

¹⁴² On July 13, 2017, two uniformed Greater Cleveland RTA police officers on board the HealthLine cited Ronald Williams for failing to produce proof of payment. He received a \$25 ticket and represented himself in Cleveland Municipal Court. The judge ruled that RTA's fare enforcement policy violated the Fourth Amendment of the Constitution, because officers demand proof of fare payment from all passengers without reasonable suspicion that an individual might have cheated (Cleveland v. Williams 2018-Ohio-2937, Schmitt 2017b, Segall 2017).

¹⁴³ Schmitt 2017a, Greater Cleveland RTA 2017.

¹⁴⁴ Cleveland v. Williams, 2018-Ohio-2937.

¹⁴⁵ Transit Center 2019a.

¹⁴⁶ Schmitt 2017a.

Three ways to establish more equitable BRT fare policies are to include discount fares, fare capping, and payment methods for phoneless and unbanked passengers:

- **Discount fares for low-income users and youth** can improve transit equity. The introduction of youth passes can lead to higher transit usage and more accessibility for users. Hartford's *CTfastrak* offers a discounted fare for youth aged 5 to 18.
- **Fare capping** allows users to benefit from multi-ride pass discounts even if they cannot afford the up-front cost of the pass. *CTfastrak's* new GO CT smartcard uses a fare capping system, ensuring that passengers pay the lowest possible fare.¹⁴⁷ Whenever a smartcard is tapped within the transit system, data about the user and trip are recorded. At the end of the day, the data can be reviewed and the lowest eligible fare can be deducted from the user's account. BRT systems utilizing smartcards or mobile apps are well positioned to implement fare capping.
- **Payment methods for phoneless and unbanked passengers.** As more transit agencies implement mobile ticketing applications on their BRT corridors and across their transit services, these new technologies raise some equity concerns. Socio-economically disadvantaged people without smartphones, or sometimes bank accounts, will be left out of these new ticketing solutions. Equitable BRT fare policies and technologies will accommodate passengers who do not own smartphones and the unbanked.¹⁴⁸

DESIGNING A CONVENIENT AND ACCESSIBLE BRT SYSTEM

Integrating a BRT corridor into the city or regional transportation network can help improve the overall passenger experience. Providing convenient connections between the BRT and other modes like bicycling, shared mobility, and other transit can improve first- and last-mile connections, simplify transfers, and facilitate multimodal trips. Making BRT service information readily available to passengers and in real time also contributes to a more seamless transit experience.



Pedestrians crossing Cleveland's HealthLine corridor

Source: EMBARQ Brasil | WRI Brasil Cidades

WALKABLE BRT CORRIDOR

Most transit trips begin and end as walking trips. Designing safe, convenient, and comfortable pedestrian connections to the BRT is critical to encouraging transit usage and multi-modal trips. Walkable BRTs include pedestrian-friendly infrastructure in the neighborhood around the BRT stations and access to the stations across the corridor. High-quality walking conditions will reflect good pedestrian design principals: safety, security, directness, legibility, comfort, and universal accessibility.¹⁴⁹

INTEGRATING THE BRT CORRIDOR WITH BICYCLING

Cities can make it easy for passengers to link bike and BRT trips by allowing passengers to take their bike on the bus, providing bike parking at stations, or co-locating shared bikes (or scooters) with BRT stations. High-quality bike infrastructure that connects with the BRT corridor can also encourage bike trips to or from the BRT stations.

Bikes on board BRT buses. Several U.S. BRT systems accommodate bicycles on the buses. Richmond GRTC's The Pulse and LA Metro's Orange Line each have a fold-down rack on the front of the vehicle that can hold up to three bikes. In Fort Collins, the 60-foot MAX BRT buses can accommodate four bikes inside the bus: two bikes can stand in a rack and two more in a hanging rack inside the rear door.¹⁵⁰ The smaller MAX buses can accommodate three bikes on the front of the bus, plus a fourth bike inside, behind the driver. Eugene-Springfield's EmX and Hartford's CTfastrak BRT buses each have racks for three bicycles inside the back door. A bicycle icon on the station platform or rear bus door can signal to passengers with bikes which bus door to board through. Richmond's GRTC and Eugene-Springfield's Lane Transit District produced educational videos explaining how to bring bikes on the BRT.

Bike parking at BRT stations. Instead of bringing their bike on board the BRT bus, passengers could park their bike at racks or lockers in or near the BRT station. Convenient and secure bike parking at BRT stations can encourage the use of bikes for the first and last mile of a round trip. Fort Collins and Richmond provide bicycle racks at their BRT stations.

Shared bikes (and scooters) at BRT stations. With some planning, shared bikes and scooters can act as feeders to and from the BRT stations. Cities or transit agencies can provide space for station-based or dockless bikes and scooters adjacent to a BRT station. In Richmond, two RVA Bike Share stations are adjacent to The Pulse BRT stations along Broad Street.¹⁵¹ When Indianapolis transit passengers step off the new Red Line bus corridor, they may have the choice of unlocking a Pacers Bikeshare from a nearby station or hopping on board one of the ubiquitous Lime or Bird e-scooters.^{152, 153} Fare integration between the transit and shared mobility service makes the intermodal connection more seamless. Once San Francisco's Van Ness bus corridor is completed, passengers will be able to pay their fare with a tap of their regional Clipper card, which also provides access to the regional bikeshare Bay Wheels.¹⁵⁴

Bike infrastructure along BRT corridors. Some BRT corridors also incorporate bike lanes, which can encourage bike and multimodal trips. In other instances, a bike or multi-use path runs adjacent to a BRT corridor.

- In Los Angeles County, the 18.1-mile Orange Line Bike Path is a segregated rail-trail running parallel to the BRT corridor through the San Fernando Valley from North Hollywood Station to Chatsworth Station.¹⁵⁵
- As part of the CTfastrak environmental impact mitigation, CTDOT constructed a 4.4-mile multi-use trail parallel to the busway between New Britain and Newington Stations.¹⁵⁶

150 Transfort 2019.
 151 RVA Bike Share 2019.
 152 Orr 2018.
 153 Briggs 2018.
 154 Lyft 2019.
 155 Trail Link 2019b.
 156 Trail Link 2019a.

The 18.1-mile Orange Line Bike Path runs parallel to the LA Metro Orange Line



Source: Gary Leonard courtesy of LA Metro

INTEGRATING THE BRT CORRIDOR WITH OTHER TRANSIT SERVICES

Transit fare integration across a local or regional transportation network is a great way to facilitate transfers between modes and services. Free transfers between the BRT corridor and other bus or rail services are particularly helpful for passengers with long journeys, since paying a transfer penalty may discourage them from using transit. Likewise, when customers can use a single fare card to board the BRT and other transit services, a disparate corridor becomes part of a network. While there are not currently any shared bikes along Los Angeles's Orange Line BRT, the Metro TAP card can be used across the regional transit system—rail, BRT, bus, and two bikeshare systems¹⁵⁷—allowing for seamless transfers.

PROVIDING REAL-TIME AND INTEGRATED TRANSIT INFORMATION

One of the advantages of frequent BRT service is that passengers do not have to check a schedule or app to know when the next bus is coming. They can be assured that whenever they arrive at a station, they will not wait long for a bus. Nevertheless, sharing real-time BRT data with third-party developers allows a transit agency to put service information at passengers' fingertips. Providing access to real-time transit information has been shown to increase customer satisfaction and boost transit ridership.¹⁵⁸ Furthermore, opening BRT data to third-party developers means customers benefit from improved trip planning, and real-time information at no cost to the transit agency.

Real-time information about BRTs in Hartford, Pittsburgh, Los Angeles, and San Bernardino is available in apps like Transit. CTfastrak even ensured their real-time data were available when the BRT service launched.¹⁵⁹

¹⁵⁷ LA Metro Bikes operate in downtown Los Angeles and Santa Monica. Bike Share Connect merges Beverly Hills Bike Share, Breeze Bike Share, WeHo Pedals Bike Share, and Bruin Bike Share in Santa Monica, Beverly Hills, West Hollywood, and UCLA campus (See <http://bikeshareconnect.com/>).

¹⁵⁸ Brakewood et al. 2015.

¹⁵⁹ Transit App 2015.

“What’s even more impressive is that the CTfastrak team gave us access to their data months in advance, and worked with us to ensure real-time information was available on day 1 of service.”

— Transit¹⁶⁰

PROCURING BUSES

BRT FLEET REQUIREMENTS

Specific buses, distinct from the existing fleet, are typically needed for a BRT route, for several reasons:

- Center-aligned BRT station platforms require buses with left-hand doors, whereas curbside bus service requires buses with right-hand doors.
- If the BRT buses will need to serve both center-aligned stations and curbside bus stops (for instance, in a direct-service model) buses may need left- and right-handed doors. Eugene-Springfield’s Lane Transit District found it challenging to procure buses with doors on both sides.¹⁶¹
- The height of the bus floor must match the height of the BRT station platform (that is, low or high platforms).
- To speed passenger boarding, BRT buses require multiple doors.
- High-capacity 60-foot articulated buses can carry more passengers per hour than conventional 40-foot buses.
- The aesthetics of the existing fleet may not be consistent with the BRT brand.¹⁶²

Transit agencies often want to avoid a sub-fleet of buses for BRT routes. This may create a situation where long-term infrastructure design decisions are driven by a relatively short-term fleet lifetime. For instance, the decision to use bilateral stations¹⁶³ on San Francisco’s Van Ness corridor was driven, in part, by the desire to use Muni’s existing fleet with right-hand doors, and not acquire new buses with doors on both sides.¹⁶⁴

¹⁵⁹ Transit App 2015.

¹⁶¹ In the end, Lane Transit District partnered with Greater Cleveland RTA, who was implementing the HealthLine at the time, to bulk-order New Flyer buses with doors on both sides (Federal Transit Administration 2009).

¹⁶² LA Metro was the first U.S. agency to use aesthetics as a fleet procurement evaluation criterion (Flynn et al. 2011).

¹⁶³ Bilateral stations are in the central verge, but at the outer edge of the busway. One station platform serves each direction of travel (ITDP 2016b).

¹⁶⁴ Currently, four cities utilize BRT buses with doors on both sides, while most use right-hand doors (see Table 7).

Eugene-Springfield's EmX Green Line diesel-electric hybrid buses have doors on the left and right



Source: Wolfram Burner via Flickr

A BRT vehicle should be selected based on the system's long-term operational needs. There are many factors to consider when specifying the BRT fleet requirements, such as purchase and maintenance costs, capacity, reliability, safety, operations, emissions, and noise.¹⁶⁵ Furthermore, fundamental technical design choices needed to be made about the vehicle's size, chassis and body configuration, interior layout, fuel and propulsion technology, aesthetics, and docking.

FUEL TYPES AND PROPULSION TECHNOLOGY OPTIONS

Most U.S. BRT systems utilize compressed natural gas or diesel-electric hybrid vehicles (see Table 7). Several operate clean diesel buses, and there is increased interest recently in battery-electric articulated BRT buses.¹⁶⁶ There are trade-offs between these different fuel and propulsion technologies. Municipalities and transit operators should weigh the following factors when selecting a vehicle technology:¹⁶⁷

- **Costs:** the lifecycle costs, including initial purchase, operations, and maintenance;
- **Emissions:** local and global emissions during operations, and also full fuel cycle from well-to-wheels;
- **Infrastructure requirements:** fuel storage, refueling or charging infrastructure, maintenance facilities.

¹⁶⁵ *The BRT Planning Guide* includes a vehicle technology decision matrix (Table 20.1) (ITDP 2016b).

¹⁶⁶ Center for Transportation and the Environment 2019; IndyGo 2019; St. John 2018; Schmitt 2018c.

¹⁶⁷ ITDP 2016b. The World Resources Institute's "Cost and Emissions Appraisal Tool for Transit Buses" aids transit agencies in evaluating the financial and environmental benefits of cleaner vehicle and fuel technologies.

A detailed explanation of the trade-offs between different BRT vehicle fuel technologies is beyond the scope of this guide. Characteristics of four common BRT fuel and vehicle technologies are briefly summarized:¹⁶⁸

- **Clean diesel** is a mature technology familiar to many transit operators. The buses are comparatively durable and competitively priced. The extent and nature of their tailpipe emissions will depend on fuel quality and emissions-control technologies.
- **Compressed natural gas (CNG)** can reduce tailpipe emissions, but its lifecycle greenhouse gas emissions are often significant. CNG buses require onboard storage cylinders, refueling infrastructure, and specialized maintenance. In certain driving conditions, CNG buses may have insufficient power.
- **Hybrid-electric buses** (diesel-electric or CNG-electric) can provide excellent fuel economy and lower noise. The emissions-reduction potential of electric hybrids depends on the driving conditions.
- **Newer battery-electric** bus technologies eliminate tailpipe emissions, although the source of the electricity determines the overall environmental benefits. Battery performance depends on driving conditions and is not yet reliable. Procurement costs of battery-electric buses tend to be higher than other technologies. See “Electric BRT Buses” below.



Las Vegas's diesel-electric hybrid articulated buses have doors on the right side.

Source: Tomás Del Coro via Flickr

FEDERAL FLEET FINANCING RESTRICTIONS

Established in 1982, the **Buy America** provision requires federally funded transit projects to purchase American-made steel, iron, and manufactured goods (including buses). The 2015 FAST Act modified the Buy America terms, increasing the required percentage of domestic components in rolling stock to 65% for FY18 and 70% for FY20 and beyond.¹⁶⁹ For buses costing more than \$300,000 each, American-produced steel or iron used in the bus chassis or body counts toward the Buy America requirement, even if the

¹⁶⁸ *The BRT Planning Guide* includes an extensive summary of BRT bus fuel and vehicle technologies in [Chapter 20, Vehicles](#) (ITDP 2016b).
¹⁶⁹ Federal Transit Administration 2018b.

rest of the chassis or body was not produced in the U.S. Final assembly of the buses must be done in the U.S. as well. In rare cases, FTA may waive the Buy America requirement if, in the case of buses, including domestic buses will increase the cost of the overall project by more than 25%. Typically, the bus procurement contract would stipulate that the bus manufacturer must provide a Buy America certificate for the city or transit agency.

In addition to the Buy America clause, any bus model purchased with federal funds must complete performance testing known as Altoona testing.¹⁷⁰ These are not pass-fail tests, but rather an unbiased third-party test of bus performance under typical operating conditions. The Altoona tests assess bus safety, structural integrity and durability, reliability, performance, maintainability, noise, fuel economy, brakes, and emissions.

Federal funding cannot be used for procuring BRT buses unless the bus model has completed Altoona testing. A city can order new, so far untested buses for their BRT project, and expect to receive the necessary Altoona test documentation before accepting the first vehicle.¹⁷¹ In this case, the city should **allow ample time in the project timeline for the Altoona testing before receipt of the first bus**. The duration of Altoona testing for new buses varies depending on the expected service life of the vehicle.¹⁷²

Identifying a BRT vehicle model that meets the federal Buy America and Altoona testing requirements as well the city's performance specification can prove challenging.

- Seattle would prefer operating 60-foot articulated electric trolley buses with two left-side and three right-side doors on its hilly Madison Avenue bus corridor. Only one manufacturer, New Flyer, meets the Buy America required percentage of American-made components. However, New Flyer says that manufacturing a 60-foot electric trolley to meet Seattle's specification will take significant time and budget.¹⁷³ And FTA will not release the \$60 million of Small Starts funding expected for the project until the city finalizes its vehicle specification. This has contributed to a two-year project delay.¹⁷⁴ In March 2019, Seattle DOT and King County Metro agreed to switch to diesel-electric hybrid buses for the Madison Avenue corridor in order to launch service by 2022.
- When Albuquerque cancelled its electric bus procurement contract with BYD, it looked for another electric bus to replace them with, since the environmental benefits of the electric buses were part of the project's selling points.¹⁷⁶ The city could not find another American manufacturer of articulated, electric buses with left- and right-handed doors who would meet their battery range specification, so it opted for clean diesel buses from New Flyer for the corridor.¹⁷⁷

¹⁷⁰ Altoona testing takes place at Penn State University's testing facility in the Altoona suburb of Duncansville, PA.

¹⁷¹ Test results are compiled into a test report given to the manufacturer. This test report is expected to be provided to the city/transit agency before the city/transit agency accepts the first vehicle (Federal Transit Administration 2016a, Penn State University 2019b).

¹⁷² For a 500,000-mile, 12-year service life, Altoona testing requires 128 test days (Penn State University 2019c). A manager at Albuquerque's bus testing facility estimated Altoona testing of diesel buses typically required 13 months and testing electric buses may require additional time to recharge the batteries (City of Albuquerque Office of Inspector General 2018).

¹⁷³ Lindblom 2018.

¹⁷⁴ Lindblom 2018.

¹⁷⁵ Seattle DOT 2019.

¹⁷⁶ Knight and Hayden 2018; Dyer 2018.

¹⁷⁷ Dyer 2018.

Table 7:

U.S. BRT fleet characteristics

CITY, BRT CORRIDOR	FUEL/PROPULSION	FLOOR HEIGHT	LENGTH AND CONFIGURATION	DOOR LOCATION	MANUFACTURER	ESTIMATED COST PER VEHICLE (CURRENT USD)
Albuquerque, ART	Clean diesel	Low	60' articulated	Left & right	New Flyer	\$870,000
Cleveland, HealthLine	Diesel-electric hybrid	Low	63' articulated	Left & right	New Flyer	\$989,000
Eugene-Springfield, EmX Green Line	Diesel-electric hybrid	Low	63' articulated	Left & right	New Flyer	\$989,000
Fort Collins, MAX	Compressed natural gas (CNG)	Low	60' articulated	Right	North American Bus Industries (NABI)	\$800,000
Hartford, CTfastrak	Clean diesel-electric hybrid	Low	40' conventional 45' over-the-road coach 60' articulated	Right	New Flyer, Gillig	Varies
Las Vegas, SDX	Diesel-electric hybrid	Low	62' articulated	Right	Wright	\$1.3 million
LA Metro, Orange Line	CNG	Low	60' articulated	Right	NABI	\$885,000
Pittsburgh, busways	CNG, Diesel	High	35' & 40' conventional 60' articulated	Right	Various	Unavailable
Richmond, The Pulse	CNG	Low	40' conventional	Right	Gillig	\$940,000
San Bernardino, sbX	CNG	Low	60' articulated	Left & right	New Flyer	Unavailable
South Miami-Dade Busway	Various	Step low	Various including articulated	Right	Various	Unavailable

Notes: Eugene-Springfield's Lane Transit District and Greater Cleveland's RTA bulk-ordered their diesel-electric hybrid buses from New Flyer (Thole et al. 2009). Hartford's CTfastrak also uses twelve 30-foot buses as circulators that are branded as part of the BRT system but do not operate on the busway. LA Metro plans to electrify its Orange Line fleet by 2020 (Schmitt 2018c).

Sources: Albuquerque (Dyer 2018); Cleveland & Eugene-Springfield (Thole et al. 2009); Fort Collins (Coltrain 2019; CPTDB Wiki 2019; Transfort 2014); Hartford (CTDOT interviews); Las Vegas (CPTDB Wiki 2019); Los Angeles (CPTDB Wiki 2019, Flynn et al. 2011); Pittsburg (Hinebaugh 2009, National Academies of Sciences, Engineering, and Medicine 2003c); Richmond assumes 10 buses purchased for \$9.4 million (GRTC 2018a; GRTC & DRPT 2014b); San Bernardino (OmniTrans 2018); South-Miami Dade (Hinebaugh 2009, National Academies of Sciences, Engineering, and Medicine 2003b).

ELECTRIC BRT BUSES

Using electric buses on a BRT corridor can have environmental and public health benefits. Although their overall environmental benefit depends on how and where the electricity is generated, electric buses do eliminate tailpipe emissions. This helps a city reduce its greenhouse gas emissions and make progress toward its climate change goals. Electric buses also reduce local air pollution, which can have positive health impacts.

Despite the benefits of electric buses, there are some barriers to their wider adoption among U.S. cities:

- **Lack of policies and incentives.** The negative externalities associated with conventional buses (noise, air pollution, and greenhouse gases) are not priced, so there is little financial incentive to pull cities away from conventional buses. Likewise, there are few policy measures to push cities toward electric buses.¹⁷⁸
- **Rate of return analysis.** Articulated battery-electric and hybrid electric buses tend to have higher procurement costs (\$850,000 to \$1.3 million), compared with clean diesel (\$450,000 to \$870,000) or CNG (\$800,000 to \$940,000).¹⁷⁹ They require additional charging infrastructure and more space at depots, although federal funding can be used for this. Over the longer term, electric buses offer cost savings on operations and maintenance, since they have lower fuel costs and fewer parts to maintain and replace.¹⁸⁰ Cities need to assess how quickly the up-front cost of electric buses can be offset by savings in fuel and maintenance on a traditional fleet.
- **FTA funding formulas typically favor short-term cost efficiencies** over long-term innovation, and the newer alternative-propulsion buses are not the cheapest buses. The transit funding formulas were not established to advance a policy goal, such as incentivizing the uptake of electric buses.¹⁸¹
- **New driving and maintenance procedures.** The battery life and performance of electric buses depends on driver behavior, including how the accelerator and brakes are applied. Introducing electric BRT buses into a city whose bus drivers are not well versed in operating electric buses will require additional training. Likewise, maintenance procedures for electric buses differ from diesel and compressed natural gas (CNG) buses and may require additional training related to vehicle diagnostics, use of software, digital maintenance, and working with high-voltage electricity. These changes may be met with some opposition from transit labor representatives.

¹⁷⁸ Schmitt 2018c.

¹⁷⁹ See Table 7, as well as Aber 2016 and Dyer 2018.

¹⁸⁰ The two electric buses the Chicago Transit Authority (CTA) added to its fleet saved the agency more than \$24,000 annually in fuel costs, and \$30,000 annually in maintenance costs, when compared to the fleet's diesel buses (Chicago Transit Authority 2018). CTA expects every electric bus to save \$237,000 over its lifetime because e-buses have 30% fewer parts and no exhaust systems and do not require oil and other fluid changes (Schmitt 2018c).

¹⁸¹ Schmitt 2018c.

- **Recent performance concerns.** Transit systems in Albuquerque, Indianapolis, and Los Angeles have encountered performance issues with their battery-electric buses (articulated and conventional), including insufficient battery range and in some cases other manufacturing and safety concerns.¹⁸² Albuquerque returned their 15 BYD electric buses and reordered new clean diesel buses from a different manufacturer, which has set the project launch back 18 months. The recent performance issues and procurement delays that several cities have experienced offer valuable lessons for others to consider when contracting with bus manufacturers for still-evolving technology like battery-electric buses. Altoona testing simulates up to 500,000 miles of operation or 12 years;¹⁸³ bus life cycles beyond 12 years are not tested.
- **Battery range performance.** Electric bus battery range, the distance the bus can travel before needing to recharge its batteries, has steadily increased over time as battery technology has improved. The actual battery range of a bus is a function of several factors, including the weight of the bus and passengers, outside temperature, HVAC usage, topography, and how the driver accelerates and brakes. Running the bus's heater or air conditioner plays a significant role, reducing the battery range by 20%–30%.¹⁸⁴

While there are barriers to electric buses, there have been notable commitments to electrify bus fleets and BRTs. After initial performance issues with their electric buses, Indianapolis's IndyGo developed a solution to extend the battery range, and launched their all-electric Red Line corridor in September 2019.¹⁸⁵ The Oakland area's AC Transit is exploring a zero-emission bus transition plan, which could potentially include the International Boulevard corridor.¹⁸⁶ The City of Los Angeles has committed to going fully electric by 2030; to that end, LA Metro has budgeted \$188 million for purchasing 125 electric buses from New Flyer and 60 from BYD, in order to electrify their Orange Line BRT corridor and other bus routes beginning in 2020.¹⁸⁷

For cities considering purchasing electric BRT buses, there is eligible federal funding through FTA's Low or No Emission (Low-No) grant program. Eligible uses of Low-No funding include buying or leasing buses with advanced propulsion technology such as hybrid or battery-electric engines, as well as related infrastructure like charging stations.

¹⁸² Knight 2018a; Knight and Hayden 2018; Schmitt 2018a; St. John 2018.

¹⁸³ Aber 2016.

¹⁸⁴ Hill 2015.

¹⁸⁵ IndyGo embedded two wireless inductive charging points in Red Line bus lanes. The electric buses will re-charge their batteries en route which appears to sufficiently extend their battery range (IndyGo 2019).

¹⁸⁶ Center for Transportation and the Environment 2019.

¹⁸⁷ Schmitt 2018c.

ELECTRIC BRT BUS PROCUREMENT RECOMMENDATIONS

- Begin with testing in a **controlled environment**.
- **Define the battery range spec** for the climate and terrain of the proposed BRT corridor.
- Preliminarily confirm that there is at least one, ideally multiple, **Buy America-qualified models** available that have **completed Altoona testing**.
- Expect that **FTA will not release any federal funding** to the project until the fleet has been specified.
- Build some cushion into the project launch schedule to allow for testing the electric buses on the corridor.
- Plan on additional electric bus **driver and maintenance training**.

MANAGING THE ECONOMIC IMPACTS OF BRT

BRT AND ECONOMIC DEVELOPMENT

BRT corridors are often championed because of their potential to bring jobs and development to cities. Albuquerque Mayor Berry’s goal was to use BRT as a tool to revitalize Central Avenue. Connecticut Governor Malloy saw in CTfastrak a shovel-ready project that would bring construction jobs to an economy hard-hit by the recession. BRT systems can facilitate economic development when (1) they improve access to jobs, and (2) there are opportunities for redevelopment along the corridor.

“Transit is a market enhancer, not a market maker. If underlying market conditions are strong, transit will be a catalyst for transformative redevelopment.”

— Sean Northup, Deputy Director, Indianapolis MPO¹⁸⁸

The economic development impacts of Cleveland’s HealthLine are well documented. With its property-line-to-property-line street upgrades, the HealthLine has delivered more than \$9.5 billion in economic development to the Euclid Avenue corridor. This includes 23 million square feet of new development and 13,000 new jobs.¹⁸⁹ The BRT leveraged more new investment per dollar of public infrastructure investment than any other surface transit system—\$29 of new investment for every dollar of public infrastructure investment, and \$118 of new investment for every dollar of transit investment.¹⁹⁰ The BRT contributed to the redevelopment of two of Cleveland’s biggest employment centers, downtown and University Circle, while also helping to lift up the struggling Midtown District in between. An added benefit of the new development along the Euclid Avenue corridor was the increased tax base, the revenue from which helped the city weather the 2008 economic crisis better than its peers.¹⁹¹

188 Bolton 2018.
 189 Greater Richmond Transit Company & Virginia Department of Rail and Public Transportation 2014a.
 190 Hook et al. 2013.
 191 Hook et al. 2013.

Cities are cautioned to not put unrealistic expectations on a BRT corridor, as there are limits to its economic development potential. For instance, when the underlying development market is weak, BRT investments are not sufficient to catalyze economic development.¹⁹² In a sluggish economy like Hartford, Connecticut's, expectations of CTfastrak alone to induce a great deal of new development should be tempered.

A reasonably strong market can respond to BRT if the built environment around the stations is development-ready with short block lengths, pedestrian connections, and upgraded utilities.¹⁹³ Development near the BRT stations can be coaxed with planning regulations and development incentives. Planning around BRT stations helps signal to the market that there are development opportunities here. Development incentives like height or density bonuses help reduce the cost of (re)development near the BRT stations, ensuring the development does not locate where it is cheaper to build but with higher economic, environmental, and social costs.



Cleveland has attracted significant TOD to its HealthLine corridor

Source: EMBARQ Brasil | WRI Brasil Cidades

ENCOURAGING TRANSIT-ORIENTED DEVELOPMENT

Planning and zoning regulations. Transit-supportive land use and zoning along a BRT corridor can encourage new development around the stations. In conjunction with the BRT corridor development, cities should review their zoning regulations and update them if necessary. Eliminating parking requirements near the BRT can reduce the cost of construction and help encourage people to shift driving trips to transit. Offering extra height or density to development projects if they locate near a BRT station can be an attractive incentive that makes a development project's financials more favorable.

¹⁹² Nelson & Ganning 2015.

¹⁹³ Bolton 2018.

- Albuquerque updated its Comprehensive Plan and Integrated Development Ordinance while the Central Avenue BRT was being constructed. The revisions identified BRT station areas as premium locations for new and infill development, offering development bonuses for locating near BRT stations and along Central Avenue. These include up to a 50% reduction in the required parking minimum, with no parking minimums downtown. Developments can earn a height bonus for locating along the BRT corridor and additional height bonuses for building structured parking and workforce housing.
- Hartford's award-winning zoning code revision eliminates parking minimums citywide and adds parking maximums in some places. The new zoning code also permitted more height and density near transit and includes a Complete Streets policy as well.

FTA launched a transit-oriented development (TOD) pilot funding program in 2018, offering cities technical assistance for implementing TOD near their federally funded transit corridor.¹⁹⁴ The technical assistance has included assessments of local development capacity and potential along a corridor, recommendations for reducing regulatory barriers to TOD, and suggestions for expanding financing strategies (such as TIF) to support TOD. Indianapolis's IndyGo received \$320,000 to support TOD planning along the Blue Line bus corridor, and Cleveland's RTA was awarded \$336,000 to plan for TOD along its HealthLine.¹⁹⁵

LIMITING DISPLACEMENT NEAR BRT

An unintended consequence of transit investments and TOD may be the displacement of low-income residents and the gentrification of working-class neighborhoods (see Box 5).¹⁹⁶ Communities of color and those with large renter populations are most at risk of displacement and gentrification.

Public investment in transportation infrastructure shapes displacement. There is a risk that a new BRT corridor will result in displacement, "pushing out rather than improving the lives of existing (and often historic) residents."¹⁹⁷ It is not just the public investments in transportation and infrastructure that can accelerate gentrification and displacement, but the planning of those investments as well. As the BRT corridor is planned, the anticipation of it can lead to increased divestment or investment, both of which can displace residents.¹⁹⁸

Once the BRT corridor is constructed, property values in the area typically increase. There is generally an expectation that public investment in a transit corridor will lead to positive changes in a neighborhood, driving up property prices. There can be a time lag between the transit investment and the subsequent gentrification and displacement.

194 FTA also sponsors the TOD Technical Assistance Initiative, which provides online and on-site technical assistance to support transit-oriented development. The program, administered by Smart Growth America, includes an online portal with TOD resources: <https://todresources.org/>.

195 Federal Transit Administration 2019c.

196 Zuk & Chapple 2015a.

197 Railvolution 2018.

198 Zuk & Chapple 2015a.

AC Transit’s East Bay bus corridor runs along International Boulevard through several communities including East Oakland, a predominately Black, Latino, and lower-income community. Some East Oakland residents have opposed the transit investment for fear of displacement. Meanwhile, the more affluent city of Berkeley rejected a planned segment of the bus corridor out of a resistance to losing on-street parking and potentially increasing traffic congestion. The new route will replace nearly all existing local bus service along International Boulevard. This stop consolidation gave the impression to some that the project was “trying to skip over” local communities of color and of lower incomes while providing rapid transit service for newer residents commuting to high-paying tech jobs.¹⁹⁹

“We used to (and still do) spend a lot of time responding to NIMBY folks out in the suburbs... and the NIMBY conversation has gotten really strange and different in the last few years because it has come back into the core cities, like Oakland, Berkeley, and Richmond, and there are people who are saying ‘not in my backyard’ who are people who have actually had their neighborhoods suffer from disinvestment for decades, and those neighborhoods are now starting to look really attractive again. And those people, quite rightly, are saying, ‘this can’t happen without some community investment, without some community engagement.’”

— Gloria Bruce, Executive Director, East Bay Housing Organizations²⁰⁰

Box 5:

Understanding Gentrification and Displacement²⁰¹

Displacement occurs when housing or neighborhood conditions actually force people to move. It can be physical or economic. It might push households out or prevent them from moving in. Displacement, whether physical or economic, may result from disinvestment as well as investment.

Gentrification is the process of neighborhood change when an influx of capital and higher-income, higher-educated residents move into lower-income neighborhoods.

Gentrification may not precede displacement. Gentrification is often assumed to be a precursor to residential displacement, yet in many cases, displacement precedes gentrification. The two processes often occur simultaneously.

¹⁹⁹ Wirtschafter 2017.

²⁰⁰ Cash & Dow 2017.

²⁰¹ Adapted from Zuk & Chapple 2015a, 2015b.

WAYS TO REDUCE DISPLACEMENT AROUND BRT

Somewhat ironically, a transit investment project that threatens to displace residents can also create the possibility of mitigating that displacement.²⁰² Several strategies can be used during BRT project implementation to help reduce displacement along the corridor.

Subsidized housing. A large and stable supply of subsidized housing can reduce displacements. Cities can increase their subsidized housing stock by (a) building more affordable housing and (b) preserving the affordability of the existing housing:

- **Build more affordable housing.** Cities can set aside vacant public land for affordable housing. LA Metro set a goal of 35% affordable units in its joint development portfolio.²⁰³ Reducing parking requirements, especially near BRT stations, can help reduce the cost of development and make including more affordable units financially feasible. Albuquerque's development ordinance provides a height bonus for projects near the ART BRT stations that include workforce housing.²⁰⁴
- Change local zoning to **protect existing affordability** in the transit corridor. In San Francisco's Chinatown, building height and use effectively protect the existing single room occupancy and low-income housing.²⁰⁵

Enact tenant protections for both residents and commercial in the neighborhoods most at risk for displacement and gentrification. These might include rent control and just-cause eviction ordinances.²⁰⁶ Often there are some processes for protection of residential tenants, but not small businesses and commercial spaces.

Engage grassroots community organizers to mobilize around the transit investment. Create a transit advocacy organization if one does not already exist. They can help spread the word about the BRT and, with enough advance notice, can turn out their members at public events to show support for the project. Community organizing is also strongly linked to preserving affordable housing in neighborhoods. A study of Bay Area cities found that neighborhoods with strong tenant protections also had strong community organizing (including San Francisco's Chinatown and Mission), while places without protective housing policies lack strong community organizers (such as Redwood City).²⁰⁷

LOOKING AHEAD

The experience of the U.S. cities who have been through the process of planning, constructing, and launching a BRT corridor is invaluable to others. The lessons learned from these projects will help guide more cities to deliver fast, reliable, efficient, and equitable BRT corridors. Albuquerque will bring the count of U.S. BRT corridors to 13 once ART launches. Indianapolis launched their Red Line bus corridor in September 2019, and are implementing two additional corridors. Median-aligned bus corridors under development in Denver, Oakland, Portland, and San Francisco are also worth watching. These new bus corridors may eventually be rated as BRT and offer additional lessons and precedents.

202 Zuk et al. 2015b.

203 LA Metro 2019b.

204 Dovey 2017.

205 Zuk et al. 2015b.

206 Zuk et al. 2015a.

207 Zuk et al. 2015b.

U.S. BRT CASE STUDIES

The U.S. BRT case studies were chosen from among a set of high-quality candidate BRT corridors that included operational corridors rated at least Bronze according to the *BRT Standard* and corridors currently under construction that provisionally meet the Basic BRT requirements. The selection criteria emphasized diverse urban contexts. Consideration was given to including BRTs in different-sized cities and with a variety of BRT ratings, corridor typologies, and daily ridership.

1. **HARTFORD REGION'S CTFASTRAK BRT** (page 81)
2. **RICHMOND, VIRGINIA'S THE PULSE BRT** (page 101)
3. **ALBUQUERQUE RAPID TRANSIT (ART) BRT** (page 121)



1463

CT **fastrak**

CASE STUDY: HARTFORD REGION'S CTFASTRAK BRT FROM ABANDONED RAIL CORRIDOR TO REGIONAL BRT

OVERVIEW

Connecticut's CTfastrak is a state-owned busway, nearly 20 years in the making. The 9.4-mile long, Silver-rated bus rapid transit (BRT) corridor is a dedicated busway. Half of its guideway is along a former rail right-of-way, and the other half is built on a permanent easement from Amtrak. Costing more than half a billion dollars to implement, CTfastrak is one of Connecticut's most expensive public works projects to date, as well as its first New Starts grant project. The BRT service between New Britain and downtown Hartford launched in March 2015, and currently, an average of 18,000 passengers a day benefit from the improved efficiency of the busway²⁰⁸. Some of the municipalities on the corridor have aligned the BRT investment with zoning changes to encourage transit-oriented development (TOD). (A few new developments have taken advantage of these zoning changes.) CTfastrak implementation offers some valuable lessons about governance, corridor design, economic development, and public engagement.

Notable aspects of the project include the following:

- **CTfastrak is owned and was planned by the Connecticut Department of Transportation (CTDOT).** Governor Dannel Malloy was the political champion who prioritized the project implementation. The BRT provides regional transit service between four local municipalities: Hartford, West Hartford, Newington, and New Britain. The State of Connecticut contributed 20% of the capital costs and now contributes more than \$20 million in annual operating subsidy.
- **At just over a half-billion dollars, CTfastrak is one of the most expensive BRT corridors in the United States.** The total capital costs for the project totaled \$567 million (current dollars).²⁰⁹ The high costs, which are consistent with other busways in the United States (e.g., Pittsburgh West Busway, Los Angeles' Orange Line), reflect the additional costs of acquiring the right-of-way and complex civil engineering. A challenge for the project was selling the regional merits of the project—transit benefits and economic development in greater Hartford—to statewide taxpayers.

²⁰⁸ It would be misleading to claim all CTfastrak riders were enticed by the new system, because a bus service existed in the corridor between New Britain and Hartford prior to it. On an average weekday, 18,000 passengers travel on CTfastrak and CTtransit routes in the busway. In comparison, on the routes that existed prior to CTfastrak, ridership was between 8,000 and 9,000 passenger trips on an average weekday (CTDOT 2019b).

²⁰⁹ Frisman 2012. All costs are presented in the case study in current dollars.

- **The CTfastrak busway illustrates some of the advantages and disadvantages of operating BRT in a former rail corridor.** The choice of a rail corridor for the busway meant that CTDOT planners did not have to negotiate with other on-street uses for the bus lanes. Along the busway, the BRT has a fully segregated right-of-way, with few delays from signalized intersections or turning vehicles.²¹⁰ The busway operates as an open corridor, meaning some bus routes continue off the BRT corridor, which reduces the need for transfers. The construction costs for the busway were higher than for typical on-street segregated bus lanes because of the complex civil engineering involved and the acquisition of the right-of-way. Also, since the CTfastrak stations are within the rail right-of-way, which passes through suburban and rural areas, they are not as well integrated into the urban fabric as stations on an urban corridor would be. The Amtrak tracks may also pose a barrier to pedestrians and bicycles trying to access the BRT stations.
- **The Silver-rated BRT corridor incorporates high-quality BRT elements that contribute to travel time savings for riders.** In addition to the dedicated busway, CTfastrak includes platform-level boarding and off-board fare collection, which speed up passenger boarding. Customers can pay their fare with a Go CT smartcard (and soon through a mobile app), and a fare capping policy ensures users pay the lowest possible fare. Real-time CTtransit information was available from day one through third-party transit apps.²¹¹ The ten BRT stations are open, well lit, and comfortable year-round thanks to motion-activated heaters. Fine details like wooden benches, well-designed route maps, and variable message boards enhance the customer experience (see Figure 13).
- **CTfastrak was prioritized not only for its transit benefits but for its potential to spur economic development.** After the Great Recession of 2008, Governor Malloy was looking for shovel-ready projects to bring jobs and economic development to Connecticut. He became a champion for the CTfastrak BRT, which ended up creating 4,000 construction jobs and more than 100 permanent jobs. The economic development impact of the BRT on the former industrial corridor is still maturing.²¹² The cities of Hartford and West Hartford changed the zoning around their BRT stations to incentivize, respectively, higher density and mixed-use development, and some affordable housing developments have been built near the stations in New Britain and West Hartford.
- **Over time, communication about the project evolved into more creative public engagement.** While educating the public about the forthcoming project, the team changed its tactic from talking about what CTDOT was building to what people could do with the BRT. CTDOT also made an effort to reach more potential customers by taking information about the project to public locations such as community centers, local markets, and festivals. The CTfastrak team participated in over 100 promotional events in the year prior to the start of BRT operations.

210 It took CTDOT three years to negotiate with Amtrak for an allowance for concurrent operations at at-grade crossings. This means that when the rail signal gate lowers for a passing Amtrak train, CTfastrak buses may continue parallel to the tracks after a brief pause at the signalized intersection.

211 Transit 2015.

212 WSP 2016.

PROJECT BACKGROUND & DESCRIPTION

STAKEHOLDERS

CTfastrak was a complex regional transit project involving many stakeholders, including four municipalities, two regional planning agencies, CTDOT, three branches of the U.S. Department of Transportation, transit providers, businesses, residents, transit customers, and advocates.²¹³ Since the busway runs through Hartford, West Hartford, Newington, and New Britain, CTDOT coordinated extensively with those municipalities (see Figure 9), as well as with the Capitol Region Council of Governments (CRCOG) and the Central Connecticut Regional Planning Agency (CCRPA). CTDOT worked closely with federal funders FTA and FHWA, and coordinated with the Federal Rail Administration (FRA). One segment of the busway runs in a permanent easement adjacent to an active Amtrak right-of-way, and in another segment, it uses an abandoned railroad right-of-way. Design and construction of the BRT required coordination with the Connecticut Department of Energy and Environmental Protection and the U.S. Army Corps of Engineers.

CTtransit is the brand name for the CTDOT-owned bus service, and *CTfastrak* is the brand name for the BRT system. While CTDOT owns the assets and pays the operating costs for both *CTtransit* and *CTfastrak*, the services are provided by private operating companies under contract to CTDOT.²¹⁴

CTfastrak Timeline²¹⁵

1997	Local officials' study tour to Curitiba, Brazil.
1998	CRCOG Long Range Transportation Plan identifies BRT as a possible alternative to the congested I-84 corridor.
2000	Project approved to enter preliminary design.
2001	Draft environmental impact statement (EIS) prepared.
DEC 2001	Final EIS completed.
OCT 2006	Project entered final design.
DEC 2009	CTDOT submitted Full Funding Grant Agreement request to FTA.
APR 2011	Governor Malloy announces his full support for the busway.
NOV 2011	FTA approves \$275 million Full Funding Grant Agreement with CTDOT.
MAY 2012	Construction begins.
2015	Construction completed.
MAR 2015	<i>CTfastrak</i> service begins.
OCT 2018	Go CT smartcard launched, improving off-board fare collection and enabling fare capping.

²¹³ Cowdrey 2012.

²¹⁴ HNS Management Company, Inc. operates *CTtransit* service in Hartford and *CTfastrak*. CTDOT contracts with First Transit to manage three divisions of *CTtransit*. First Transit provides a general manager, several assistant general managers, and a corporate board of directors. HNS Management Company, Inc. (d/b/a *CTtransit*) is a subsidiary corporation of First Transit, Inc., established as the legal entity to perform a management contract with the State of Connecticut.

²¹⁵ Compiled from *CTtransit* (2019), Eucalitto (2016), and ITDP (2017).

PLANNING & DESIGN

Corridor Selection. The idea for BRT in the region took root during a 1997 study tour, when local officials traveled to Curitiba, Brazil, to experience its BRT. Soon afterward, the *Hartford West Major Investment Study* by CROCOG, CTDOT, and CCRPA highlighted BRT as the most cost effective way to mitigate traffic congestion on I-84 without widening the freeway.²¹⁶ An environmental impact statement was completed in 2001, and over the subsequent decade, revisions were made to the overall scope and design. After years of analysis and discussion, it was Governor Malloy who finally decided to build the BRT in 2011. In the wake of the recession and the need to create jobs, the BRT was a shovel-ready project that would become one of the most significant public works projects in the state.

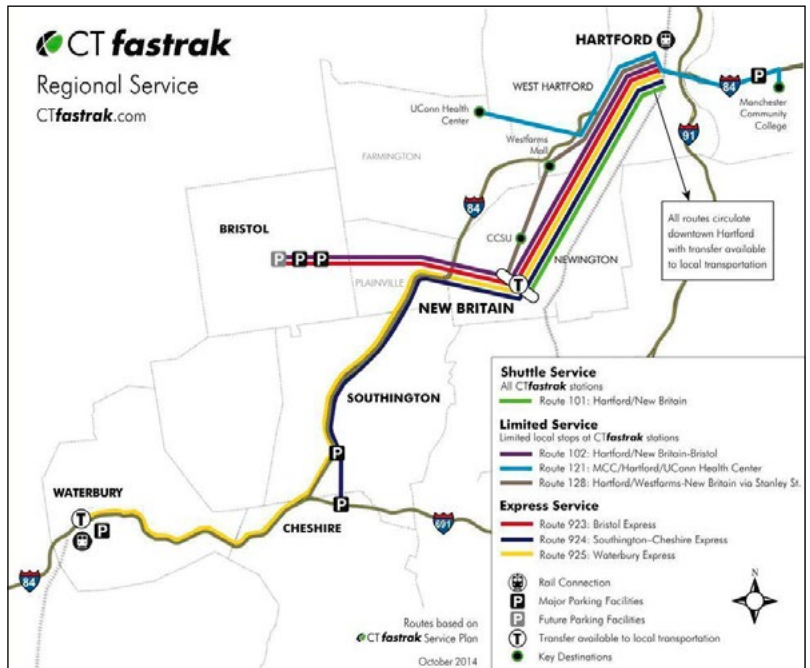


Figure 9: CTfastrak, the Hartford region's first rapid transit system.

Source: CTDOT

216 The cost of widening I-84 was estimated at \$1 billion. Other options considered included high-occupancy vehicle lanes, commuter rail, and light rail (Prozzi 2014).

“The selection of BRT service in the abandoned ROW and along the active rail corridors allowed ConnDOT to avoid the costs of widening the I-84 corridor, which were estimated to be well over \$1 billion in the highly urbanized area.”²¹⁷

Rail Right-of-Way. Five miles of the Hartford-end of the corridor run along an Amtrak rail right-of-way. The right-of-way originally had four sets of tracks, and CTDOT purchased a permanent easement to occupy the space of the northern two sets of tracks. So through this section, the BRT operates adjacent to active Amtrak tracks. South of Newington Junction, the busway uses a former freight rail right-of-way that CTDOT bought in the 1980s and land banked for future use. Much coordination was needed to construct the busway in a shared right-of-way with several at-grade crossings; for example, the adjacent active Amtrak tracks had to be kept clear during construction of the BRT.

In 2018, CTDOT launched the *CTrail* Hartford Line, a commuter rail service between New Haven, Connecticut, and Springfield, Massachusetts, which runs along Amtrak’s New Haven–Springfield corridor parallel to the BRT. Connections between *CTfastrak* and *CTrail* can currently be made at downtown Hartford’s Union Station (see Figure 10). A new *CTrail* station is planned across from the Flatbush BRT station.



Figure 10: System map of *CTrail* shows *CTfastrak* corridor connections in Hartford.

Source: *CTrail*

Stations. Most of the ten CTfastrak stations are bilateral stations aligned curbside within the busway, with passing lanes at each station (see Figure 11).²¹⁸ The terminal station at New Britain has sawtooth bus bays to maximize the number of buses it can accommodate and to minimize delays when buses pull out.

The stations also have high-quality customer amenities, like heating, glass windbreaks, wooden seating, and lighting (see Figures 12 and 13). There are real-time information displays, corridor maps, and station area maps. The quality of the station design helps offset any stigma potential customers might associate with bus systems. The clean and modern station architecture emphasizes that the BRT is something fresh and new.

Figure 11:
Parkville station site
in 2012 (left), CTfastrak
station in 2015 (right).



Source: CTDOT

Figure 12:
Parkville station site
in 2011 (left) and
CTfastrak station
in 2015 (right).



Source: CTDOT

²¹⁸ Within the *BRT Standard* rating, bilateral stations—stations aligned curbside within a busway—receive no points in the Center Stations category. This type of station makes transfers between the two directions of travel more difficult, which becomes more important as the BRT network expands. Center stations with one platform serving both directions of travel also typically reduce construction costs and require less right-of-way (ITDP 2016).

Figure 13:
High-quality station
design and bicycle
racks at Flatbush
Avenue station



Source: Pi. 1415926535 via Wikipedia

Integration of Nonmotorized Transportation. Bicycles are well integrated into the CTfastrak corridor in some regards. The project's National Environmental Policy Act commitments enhanced modal integration along the BRT corridor. For example, CTDOT implemented a 5-mile separated multi-use trail parallel to the busway. For passengers who want to connect bicycle and bus trips, there are bike racks at each station and two bike racks are available inside the CTfastrak buses (see Figures 13 and 14). Many stations are "adjacent to infrastructure that serves as a physical barrier for connections to the station."²¹⁹ Good bicycle infrastructure does not always continue beyond the CTfastrak station areas, making first- and last-mile connections more challenging. Similarly, the quality of the pedestrian environment tends to degrade beyond the CTfastrak stations, hindering walking connections to nearby shopping areas and workplaces.²²⁰ There are also nicely designed station area maps in the BRT stations, but they face away from passengers disembarking from the bus, making them less effective as wayfinding guides.

219 WSP 2016.

220 Transport Hartford, an advocacy organization, shared a photo essay of the walk from the CTfastrak Cedar Street station to the Central Connecticut State University campus, a short distance away. https://www.facebook.com/pg/TransportHartford/photos/?tab=album&album_id=999563980247672



Figure 14:
Two bikes are allowed
through the rear door
of the BRT buses.

Source: Aileen Carrigan

Fleet. The fleet of 48 buses was purchased for \$20.2 million. The BRT service uses twelve 60-foot, low-floor articulated, clean diesel–electric hybrid buses on the corridor. Twelve 30-foot buses are also used for circulators, which are branded as part of the BRT system but do not operate on the busway. Eighteen 40-foot buses, and six 45-foot over-the-road coaches also serve the corridor.

Docking the buses within an acceptable gap from the station platform takes practice. CTfastrak stations have a curb bumper for the bus tires to rub against and a customized rubber piece, called “fingers” along the edge of the station platform. These fingers compress horizontally when the bus rubs against them, filling the gap between the side of the bus and the station platform edge. They are stiff enough for passengers to step on when boarding and alighting. To help drivers practice docking, CTtransit built a temporary wooden station platform at a park and ride lot.

“What’s even more impressive is that the CTfastrak team gave [Transit] access to their data months in advance, and worked with us to ensure real-time information was available on day 1 of service.”²²¹

Real-Time Data. While CTDOT recognized the potential value to customers of real-time transit information, it did not have the resources to develop or maintain an app in house. CTDOT staff was reluctant to share the BRT transit data, doubtful that any developer would want the data. With the help of the project consultant, the IBI Group, CTDOT created and published a Google transit feed before launch, which has been picked up by the transit information app Transit.²²² CTDOT has since worked with Transit to customize how its routes are displayed in the app (i.e., matching the green label of Route 101 to the green of the CTfastrak buses), and Transit provides CTDOT with monthly usage statistics.

FINANCIALS

Costs. Capital costs for CTfastrak reached a high of more than half a billion dollars, making it one of the most expensive BRT corridors in the United States.²²³ The high capital costs were due in part to the complex busway construction, the right-of-way acquisition costs, and the complex design and high-quality finish of the stations.²²⁴ Of the total \$567 million, 67% was spent on infrastructure, while 4% (or \$20 million) was spent on 48 buses (see Table 8).

Table 8:
**CTfastrak
Capital
Costs**

COST CATEGORY	MILLIONS CURRENT USD
Construction	\$ 342.41 (60%)
Professional Services	\$122.823 (22%)
Right-of-Way Acquisition	\$45.12 (8%)
Fleet Acquisition	\$20.46 (4%)
Contingency	\$23.25 (4%)
Finance Charges	\$12.97 (2%)
TOTAL	\$567 (100%)

Source: Frisman 2012

The annual operating costs were \$25.1 million in 2018. Since CTfastrak generates \$3.2 million in ticket revenue, or about 13% farebox recovery, the system requires an annual operating subsidy of \$21.9 million. This operating subsidy has grown from an initial estimate of \$7.5 million per year,²²⁵ which has generated some public backlash against the project.²²⁶

²²² The CTfastrak transit feed is also available in Google Maps and Apple Maps.

²²³ In the case study, all costs are presented in current dollars. The section "The State of BRT in the U.S." and Appendix A list the capital cost per mile, \$65.2 million, in constant 2019 dollars to facilitate comparison with other corridors.

²²⁴ The busway construction included bridges, tunnels, and retaining walls. There were geotechnical issues and challenges due to working in environmentally sensitive areas.

²²⁵ In 2012, CTDOT projected that it would need an annual operating subsidy of \$7.5 million. In its first year, CTfastrak required \$17.5 million in state subsidy (Frisman 2012; HBJ 2015).

²²⁶ Fasano 2018.

Funding. CTfastrak was funded with approximately 80% federal funding and 20% state resources. Federal funding included \$275.3 million through FTA's New Starts program, and \$48.12 in other FTA funds. FHWA funding totaled \$44.85 and included flexible funds through CMAQ and the Surface Transportation Program. Connecticut contributed \$112.27 million towards the project.²²⁷

The New Starts project was required to complete an environmental impact statement, and a rigorous project evaluation and approval process. After the project was approved to enter Preliminary Design, it was eleven years before the Full Funding Grant Agreement was signed, and fifteen years until construction was completed.

PUBLIC OUTREACH & COMMUNICATIONS

Proponents & Critics. The BRT corridor was championed by Connecticut's governor, who committed to implementing the busway after it had languished under years of indecision. Governor Malloy saw the infrastructure project as a way to generate local jobs, and CTDOT leadership promoted the busway as a way to reduce congestion and wear and tear along the I-84 corridor.²²⁸ Other supporters were generally proponents of improving public transit and regional mobility, especially for transit-dependent households. While Connecticut has high car ownership rates in general, in pockets of Hartford and New Britain there are very low rates of car ownership, especially among low-income households. Some supporters got behind the BRT for its potential to attract development along the Hartford–New Britain corridor.

Arguments against the CTfastrak project fell into several general categories:

- **Small government and low taxes.** CTfastrak opponents included people who preferred smaller government and less public spending. Some did not want the state to accept federal funding or commit \$122 million in local match, at least not for a single bus project.
- **Project costs.** There was some backlash against the project's high capital cost and annual operating subsidy, especially since the cost estimates increased significantly over time.²²⁹ Others felt the BRT funding would have been better spent on other statewide transportation priorities, like bridge repair.
- **Equity.** Another argument against the BRT was that, through state taxes, everyone in the state paid for the BRT, but not all would benefit from the service.
- **Anti-transit sentiment.** Some people were generally opposed transit and asked why a car-centric state like Connecticut should spend a half-billion dollars on public transit. Busway critics considered it unnecessary or less desirable than rail.²³⁰ Others perpetuated stigmas about people who ride buses and expected the BRT to increase crime in their neighborhoods.

The project team faced the dual challenge of (1) explaining the merits of the BRT to people who did not typically use buses and (2) promoting, to a statewide audience, the BRT's potential as a catalyst for regional economic development and a service transit-dependent residents can depend on.

²²⁷ Frisman 2012.

²²⁸ Frisman 2012.

²²⁹ The final environmental impact statement in 2001 put the capital costs at \$145 million, and by 2007 an FTA report estimated the total costs to be \$458.8 million. In 2005, FTA stated that the project was "not recommended" because of rising capital costs and slow progress (Frisman 2012).

²³⁰ Frisman 2012.

Outreach & Engagement. The BRT project proposed increasing transit service in the corridor by more than 10%, triggering a Title VI review.²³¹ Therefore, CTDOT was required to complete a service equity analysis and hold public hearings to ensure that the transit increase was equitably distributed. The public hearings were generally scheduled in locations along the BRT route during bus service hours, but they were not well attended. This may have been because, at that point, there was little opposition to the project since CTDOT was simply expanding service for its riders. Resistance later increased, especially as it became clear that the busway would actually be constructed. There was never a public referendum on the project, so when the opposition became heated at times, there was no affirmative public vote to deflect some of the naysayers.

The CTfastrak outreach approach evolved and improved over time. At first, the team reported what CTDOT was designing and building. Later, the team's focus shifted to explaining what people could do with the BRT. Instead of expecting the public to come to them, the CTfastrak team started going out to meet their customers. CTDOT attended a variety of events, particularly at destinations the BRT would serve, and targeted their outreach to specific audiences. For instance, the team went to community senior centers to speak with seniors about how they could use CTfastrak and CTtransit buses to get to their medical appointments and social activities in downtown Hartford. CTDOT's open houses were hands-on events, with trip-planning tools available on laptops and prototype ticket vending machines for attendees to try out. The CTfastrak team held 50 outreach events in the year leading up to the March 2015 launch, and another 100 engagement events in the first year of operations.²³²

Marketing & Branding. Toward the end of construction, the marketing effort for the new BRT service accelerated. In the first year of operations, the CTfastrak team participated in over 100 promotional events. Some of the tactics included:

- Hosting a 9.4-mile running race down the busway from the New Britain station to downtown Hartford. Over 750 people participated in the race on May 3, 2015.
- Constructing a CTfastrak kiosk, which was put on display at a high-end regional shopping mall that would be served by CTfastrak. The kiosk included comfortable bus seats, a system map, a tablet that shoppers could use to search for CTfastrak schedules, and a monitor showing a video about the system. CTDOT staff had "table events" next to the kiosk on busy shopping days. The customer service staff at the mall were trained to answer questions about the system and wore "Ask me about CTfastrak" buttons.

²³¹ Title VI is a federal statute that provides that no person in the United States, on the grounds of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving federal financial assistance (www.transit.dot.gov/title6).

²³² CTfastrak 2016.

OPERATIONS

Ridership. Before CTfastrak, the corridor carried approximately 8,500 passengers per day. Now, the total ridership on all the CTfastrak routes, as well as the CTtransit routes that use part of the corridor, averages nearly 18,000 passengers on a weekday. Ridership on CTfastrak routes that only operate on the busway averages 12,000 passengers per weekday. The station in front of the Travelers Insurance building in downtown Hartford is the system's busiest, with an average of 25% of all CTfastrak passengers boarding or alighting at the station daily.

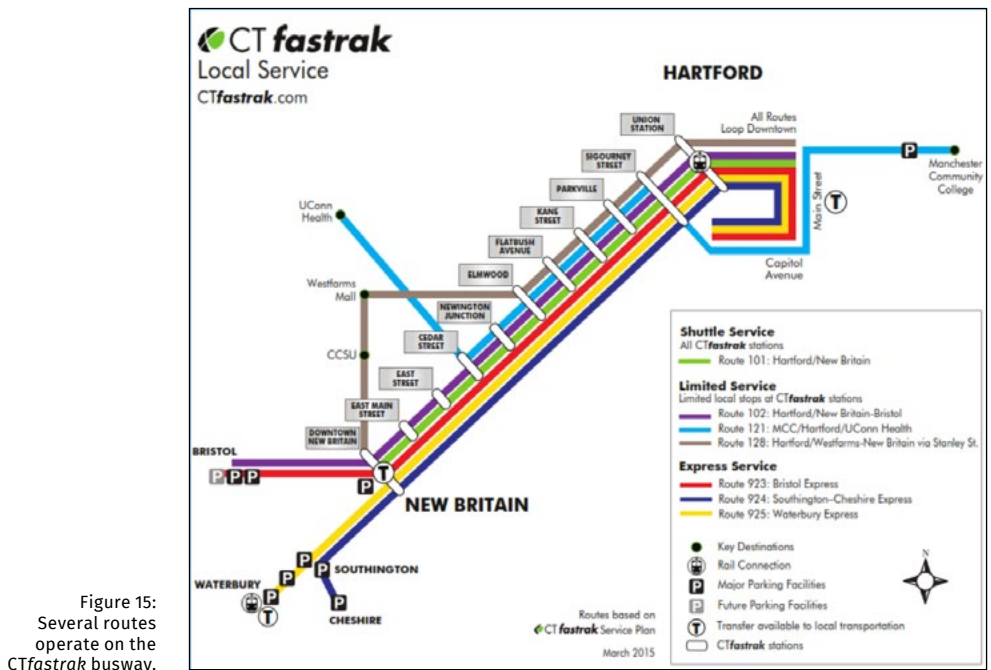


Figure 15:
Several routes
operate on the
CTfastrak busway.

Source: CTtransit

Service. The CTfastrak busway is an open corridor. This means that some routes operating on the busway continue off the corridor to other curbside bus stops.²³³ The workhorse of the system is Route 101, which stops at all CTfastrak stations between New Britain and downtown Hartford (see Figure 15). There are three limited service routes, which stop at some of the CTfastrak stations. The station bypass lanes enable three express service routes, which originate off of the busway and bypass most of the stations before stopping in downtown Hartford. The BRT has reduced travel times between Hartford and New Britain from 52 to 26 minutes.²³⁴

CTfastrak runs 7.5-minute headways during peak hours and 12-minute headways during off-peak hours. Operating at these high frequencies has partly contributed to CTfastrak's high operating costs and subsidy.

²³³ Buses that continue off the BRT corridor must be compatible with existing curbside bus stops. The CTfastrak corridor was designed with low-platform curbside BRT stations, so low-floor buses with right-side doors can operate along routes on and off the busway.

²³⁴ ITDP 2017.

Fares. Fares for *CTfastrak* are the same as for *CTtransit*, and *CTtransit* multi-ride tickets and passes can be used on *CTfastrak*. There are also three-, five-, and seven-day, as well as monthly, *CTtransit* passes. *CTfastrak* uses a distance-based fare structure, in which the fare between two zones is \$3.20 and across all five zones is \$6.

Youth between the ages of five and 18 are eligible for a discounted fare of \$1.35. Seniors and persons with a disability can ride for half-fare with a state-issued ID card or a Medicare card. There are free transfers between *CTfastrak* buses and other *CTtransit* buses, but no fare integration yet between the BRT and the new *CTrail* Hartford line.

CTDOT released the Go CT smartcard for *CTtransit* and *CTfastrak* in 2018, two and a half years after launching the BRT. Initially, staff from CTDOT and the *CTtransit* operator signed up customers for a free smartcard at promotional events, but now customers can purchase or reload their cards at customer service centers or several local retailers. CTDOT is currently beta-testing a mobile ticketing app, but *CTfastrak* customers can still purchase a paper ticket at ticket vending machines. All buses also have fare boxes that allow riders to pay with cash.

CTfastrak is a proof of payment system, so customers have to be able to show onboard fare inspectors a paper ticket, a validated smartcard, or a mobile app to avoid a citation and a \$75 fine. Fare inspectors board buses at random and inspect every passenger's ticket in order to reduce the potential for racial bias in randomly selecting passengers to inspect.²³⁵

The new Go CT system uses fare capping, ensuring that passengers pay the lowest possible fare.²³⁶ Each time a passenger taps a smartcard, the fare validator stores user and trip information. At the end of the day, the fare collection system calculates how much to deduct from the user's account based on their trips, ensuring the lowest fare is paid. For example, if a passenger makes all their trips for the day within two hours, they are charged a fare of \$1.75. In this way, the Go CT smartcard acts like a virtual two-hour pass. If the passenger makes additional trips outside the two-hour window, they are charged a full day pass.²³⁷ If the passenger rides the bus for three or more consecutive days, they receive a discount equivalent to the three-, five-, or seven-day pass.

Students from the University of Connecticut (UConn) and the many other state colleges and universities are frequent users of *CTfastrak*. CTDOT worked with UConn and the Connecticut State Colleges and Universities to develop a UPass program where, for a fee of \$20 per student per semester, students have access to unlimited rides on all Connecticut public transit, including *CTfastrak*. The student fee is low because the fee is charged for every enrolled student, but only 25% of students actually pick up a UPass. UPass users make 16,000 trips per month on *CTfastrak*.

²³⁵ *CTtransit* fare inspectors cannot detain people. Connecticut State Police are called in when inspectors encounter a fare evader or as part of a fare evasion crackdown at a particular station. Involving the State Police in the transit proof of payment system criminalizes fare evasion and may escalate confrontations with passengers.

²³⁶ *CTtransit* 2018.

²³⁷ The cost of a full-day pass depends on the number of zones traveled through. It is \$6.40 for a two-zone day pass and \$12 for a five-zone day pass.

“Bus rapid transit systems like CTfastrak bring fast, high-frequency service for riders and serve as a catalyst for economic development.”

—Acting Federal Transit Administrator Therese McMillan.²³⁸

TRANSIT-ORIENTED DEVELOPMENT

Economic Development. Hartford’s regional economy is sluggish, and Connecticut is a slow-growth state. In the mid-2010s, the Greater Hartford region experienced one of the fastest population losses in the country, and jobs grew by only 0.2%.²³⁹ Governor Malloy championed the CTfastrak project during the Great Recession of 2008 partly because it would create much-needed construction jobs. It is estimated that the BRT project generated 4,000 construction jobs and 100 permanent jobs²⁴⁰, and with CTfastrak, jobs within the metro region are now more accessible to residents.²⁴¹

Parking Supply. There is not much TOD around CTfastrak yet, so many passengers drive to the station and park for free in nearby lots. Preserving this free surface parking near the CTfastrak stations is not conducive to encouraging more TOD and walkable neighborhoods, which can strengthen transit ridership. There may need to be a combination of some paid park and rides at CTfastrak stations, as well as denser station area development. Downtown Hartford in particular has an abundance of surface parking lots, which creates a disincentive for people to leave their cars at home and ride the BRT downtown.

Figure 16:
Flatbush station site
in 2012 (left) and
CTfastrak station
in 2015 (right).



Source: CTDOT

Transit Supportive Zoning. Many of the CTfastrak stations are surrounded by industrial, and auto-oriented land uses (see Figure 16).²⁴² That is slowly starting to change in some locations. Adjacent to the Elmwood BRT station, a new mixed-income complex called 616 New Park has taken advantage of a new TOD zoning overlay. This was possible because West Hartford changed its zoning in 2015, in conjunction with the BRT implementation, to allow mixed-use development along the CTfastrak busway. The success of TOD in West Hartford remains uncertain; while the 616 New Park development was a TOD success, other recent developments near the BRT stations have not been transit supportive.

²³⁸ FTA 2018f.

²³⁹ Lee 2017.

²⁴⁰ Connecticut Main Street Center 2015.

²⁴¹ After the introduction of the BRT, Hartford showed the ninth biggest improvement in accessible jobs between 2015 and 2016. Accessibility was measured as the number of jobs that could be reached by transit and walking within one hour (University of Minnesota 2016).

²⁴² WSP 2016.

TOD zoning overlay. This was possible because West Hartford changed its zoning in 2015, in conjunction with the BRT implementation, to allow mixed-use development along the CTfastrak busway. The success of TOD in West Hartford remains uncertain; while the 616 New Park development was a TOD success, other recent developments near the BRT stations have not been transit supportive.²⁴³

Hartford also overhauled its zoning code and implemented a more transit-supportive form-based code in parallel with the BRT implementation. This award-winning revision of the zoning code eliminates parking minimums citywide, adds parking maximums in some places, and permits more height and density near transit.²⁴⁴ The changes are expected to make it easier and cheaper for developers to redevelop downtown.²⁴⁵

Local Development Capacity. A local development entity with the funding capacity to build projects can be helpful in developing a BRT corridor. In the Hartford area, that entity is the Capital Region Development Authority (CRDA), which has bonding authority. CRDA is more focused on Hartford redevelopment than on TOD per se but has implemented several projects near CTfastrak stations.



Figure 17:
Construction of transit-oriented development, Columbus Commons, across from the CTfastrak station in New Britain

Source: CTDOT

²⁴³ Two new developments include a gas station and a drive-thru fast food restaurant. The new gas station, the second one at an intersection near a West Hartford CTfastrak station, was zoned as a by-right development (King 2016).

²⁴⁴ Hartford eliminated parking minimums for new downtown developments in 2015 (Schmitt 2017c).

²⁴⁵ Schmitt 2017c.

Affordable Housing. In 2016, Connecticut’s Competitive Housing Assistance for Multifamily Properties (CHAMP) program issued \$28 million in grants across the state to expand TOD and support affordable housing for veterans and people with disabilities. Some of the funding was funneled into the CTfastrak corridor to help developers finance more affordable housing units near transit. Two projects near New Britain’s BRT stations received funding:²⁴⁶

- **Columbus Commons** received nearly \$2 million for the construction of 14 mixed-income townhouse rental units within the 160-unit complex (see Figure 17).
- Friendship Service Center’s **North Street Apartments** received \$2.145 million to build 11 efficiency and one-bedroom apartments. The project will prioritize renting to the chronically homeless and to veterans, who can receive supportive housing services onsite from the Friendship Service Center. The City of New Britain has also committed more than \$250,000 to this project.

West Hartford’s 616 New Park project, developed by a subsidiary of the West Hartford Housing Authority, is the first development in town to take advantage of the TOD zoning overlay allowing for mixed-use developments in an industrial zone.²⁴⁷ Adjacent to the Elmwood CTfastrak station, 616 New Park is a 54-unit, mixed-income complex with 43 affordable homes,²⁴⁸ including 13 supportive housing units for veterans. The ground floor includes 3,000 square feet of commercial space, including a coffee shop and a second location for BiCi Co., the bike shop and education center of Hartford’s transportation advocacy group. The \$23.5 million development received \$11 million in federal low-income housing tax credits, \$5 million from the state’s Affordable Housing Program, and \$2.1 million for brownfield remediation of a former car dealership.²⁴⁹

Another community along the busway, Newington, has not been as receptive to affordable housing or TOD. Newington’s Planning and Zoning Commission voted against a proposed 108-unit affordable housing development near one of the town’s CTfastrak stations, citing safety concerns.²⁵⁰ As of early 2019, Newington was also considering imposing a three-year moratorium on new affordable housing.²⁵¹

NOTABLE CHALLENGES TO IMPLEMENTATION

Complex Construction. The busway construction required close coordination with Amtrak and four other adjacent construction projects. Other construction challenges included overcoming geotechnical issues at some stations caused by unstable clay soil, constructing 17 bridges and more than 60 retaining walls²⁵², and working in environmentally sensitive areas²⁵³—not to mention through a cemetery (see Figures 18 and 19). Despite this complexity, construction was completed on time, by early 2015.

²⁴⁶ Sanchez 2016.

²⁴⁷ Kimura 2018.

²⁴⁸ For people earning 60% or less of the area median income: \$37,000 for individuals and \$52,000 for families (Kimura 2018, Porter 2018).

²⁴⁹ Porter 2018.

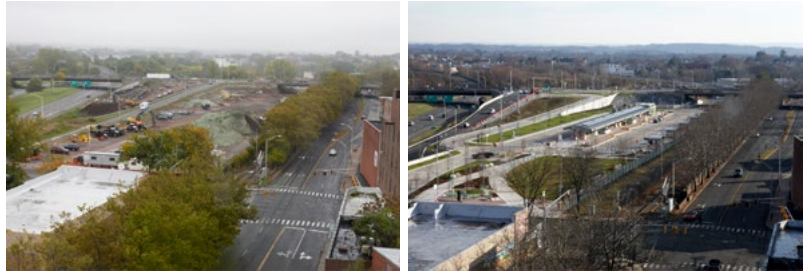
²⁵⁰ Cooper 2018.

²⁵¹ Drzewiecki 2019.

²⁵² AASHTO Journal 2015.

²⁵³ Gennett Fleming 2015.

Figure 18:
Downtown New Britain
station site in 2012 (left)
and CTfastrak station
in 2014 (right).



Source: CTDOT

Figure 19:
Elmwood station site
in 2011 (left) and CTfastrak
station and new overpass
in 2015 (right).



Source: CTDOT

Jurisdiction over Local Streets. The BRT implementing agency, CTDOT, does not have jurisdiction over the downtown Hartford streets where the BRT routes operate. The separation between the implementing agency and the local authorities at times impacted the project's effectiveness and passenger experience. For instance, after the dedicated busway terminates outside downtown Hartford, the BRT buses complete a loop of the city center in mixed traffic lanes without traffic signal priority. The quality of the BRT service degrades downtown, where travel demand is highest. During project planning, segregated bus-only lanes through the downtown loop were discussed but abandoned. The City of Hartford, which has jurisdiction over the streets, was not able to cultivate sufficient public support for dedicated bus lanes through downtown, especially where they would have necessitated reductions in on-street parking. Hartford's traffic signal system was also outdated and could not support traffic signal priority.

Multiagency Coordination. Implementing CTfastrak was a complex regional transit project involving many stakeholders, including four municipalities, two regional planning agencies, the state department of transportation, three branches of the U.S. Department of Transportation, transit providers, businesses, residents, transit customers, and advocates.²⁵⁴ CTDOT coordinated extensively with four municipalities along the busway as well as with CROG and CCRPA. CTDOT also worked closely with federal funders FTA and FHWA. Coordination with FRA was necessary as one segment of the busway runs in a permanent easement adjacent to an active Amtrak right-of-way and another goes through an abandoned freight right-of-way. Design and construction of the BRT required coordination with the Connecticut Department of Energy and Environmental Protection and the U.S. Army Corps of Engineers.

LESSONS OFFERED BY CTFASTRAK

- **Picking the right corridor is essential.** This corridor already had high transit ridership, and the alignment connected key jobs and housing centers.
- **Political champions help get projects done.** Governor Malloy decided to sign off on the extensive public works project, and first New Starts grant project, for its potential job creation and economic benefits. CTDOT completed the BRT corridor during Governor Malloy's second term.
- **BRT alone cannot spur economic development.** Several new projects along the busway have taken advantage of TOD-supportive revisions to local zoning codes.
- **There are advantages and disadvantages to relying on federal funding.** As a fixed-guideway, CTfastrak was eligible for a New Starts grant. This required a full environmental impact statement and an extensive project evaluation and approval process.
- **Taking outreach into the community can be an effective way to build broad support.** Instead of asking people to come to them, CTDOT canvassed door-to-door along the corridor and went out and met people at events and destinations.
- **Telling the public how they can use the BRT makes a compelling message.** CTDOT's messaging shifted from describing the busway infrastructure to talking about the types of things people would be able to do with the BRT service.

WHAT'S NEXT FOR CTFASTRAK?

CTfastrak Expansion. An April 2016 CTDOT study examined the potential of expanding CTfastrak and CTtransit services east of the Connecticut River. The initial recommendations suggest that service improvements to the highest ridership routes should be implemented before infrastructure investments are made. There are currently no plans to construct a dedicated busway in East Hartford, but transit service there could share I-84 high-occupancy vehicle lanes.²⁵⁵ It is not clear that there is an urban corridor with high transit ridership and declining speeds that would be a good candidate for BRT.

Integration with CTrail. As new CTrail stations open adjacent to the CTfastrak stations on Flatbush Avenue, it remains to be seen to what extent the two transit services will be integrated. Will the station designs enable convenient pedestrian transfers? Moreover, can the fares and fare payment media be seamlessly integrated to improve the user experience in the Hartford region?

I-84 Hartford Viaduct. Through the I-84 Hartford Project, CTDOT is looking at ways to address structural concerns on a segment of I-84 that includes a 980-meter-long viaduct through downtown Hartford. The elevated section crosses the rail tracks and CTfastrak busway in two places. CTDOT is exploring the idea of replacing the viaduct with an at-grade roadway segment or tunnel. With a goal of preserving CTfastrak operations during the I-84 construction, design alternatives are being considered to relocate the rail tracks and the CTfastrak busway north of the new surface road to avoid crossing I-84. This relocation has an estimated cost of \$150 million. Depending on the final alignment and design selected, CTfastrak may continue serving Union Station in downtown Hartford with a curbside bus stop as it does today, or with a station more integrated into Union Station.

CTfastrak Before & After Study. As a requirement of the New Starts grant, CTDOT is preparing a before and after study to document the actual outcomes of the project and to evaluate the accuracy of, and the lessons learned from, the predictions of those outcomes made during planning and development of the project. CTDOT is preparing its “after” study now.

CONCLUSION

Transforming an abandoned rail corridor into the Silver-rated regional busway required CTDOT to coordinate complex planning, engineering, and construction over the course of 20 years. The quick travel times, frequent service, and high-quality user experience help attract passengers. Several municipalities’ zoning changes to allow denser, mixed-use developments may attract the type of TOD needed to shift more local and regional trips onto the busway. Extending bus priority into downtown Hartford, where travel demand and congestion are high could make the CTfastrak service even more attractive to users.



CASE STUDY: RICHMOND, VIRGINIA'S THE PULSE BRT THE REGION'S FIRST RAPID TRANSIT CORRIDOR.

OVERVIEW

“Richmond is one of the few remaining metro regions in the country that has more than a million residents, yet lacks a local travel option that’s competitive with driving – something like commuter or light rail, or bus rapid-transit. Today, we’re solving that issue by increasing access to jobs and quality of life.”

—Former U.S. Transportation Secretary Anthony Foxx, announcing Richmond’s TIGER Grant, September 2014²⁵⁶

A 2014 Transportation Investment Generating Economic Recovery (TIGER) Grant from the U.S. Department of Transportation (USDOT) enabled project partners in Richmond, Virginia, to implement the region’s first mass transit corridor, the Greater Richmond Transit Company (GRTC) Pulse bus rapid transit (BRT). Back in 2008, the population and employment densities and transit-supportive land uses justified developing plans for a BRT along Broad Street through downtown Richmond and into Henrico County. Compared with other U.S. examples, Richmond’s system is a low-cost and high-quality BRT route. The BRT route cost approximately \$65 million (current dollars),²⁵⁷ which is among the lowest BRT construction costs in the country, and the 2.6-mile BRT corridor it includes has recently been rated Bronze according to the *BRT Standard*.²⁵⁸ The BRT route serves one of the region’s densest residential and commercial corridors. Other notable aspects of the GRTC Pulse implementation process include:

- **Community advocates built a diverse coalition** of support for the GRTC Pulse project. Proponents considered the Broad Street corridor as the foundation for a future regional transit network.²⁵⁹
- **Richmond launched the new BRT corridor and a redesigned bus network simultaneously.** The GRTC Pulse project sparked a broader discussion about the effectiveness and equity of the existing transit service, which led to frequency and coverage changes across the network.
- **GRTC found vital partners** in the City of Richmond, Henrico County, and major institutions on the BRT route. Two local hospitals signed a joint naming rights sponsorship for the Pulse, and passengers from Virginia Commonwealth University (VCU) have boosted ridership.

256 USDOT 2014b.

257 This is the cost of the entire 7.6-mile BRT route, including the 2.6-mile BRT corridor. In the case study, all costs are presented in current dollars.

258 ITDP 2019a.

259 RVA Transit 2019c.

PROJECT BACKGROUND & DESCRIPTION

STAKEHOLDERS & GOVERNANCE

Implementing the Pulse BRT route along Broad Street in Richmond, Virginia, required coordination with local, state, and federal partners, as well as public and private stakeholders. GRTC is the transit agency responsible for planning and operating the BRT route and was the grantee for FTA funding requirements. It is a nonprofit jointly owned by the City of Richmond and Chesterfield County. In addition to FTA, funding partners included the Commonwealth of Virginia, Henrico County, and the City of Richmond.

Virginia's Department of Rail and Public Transit (DRPT), with GRTC, developed the *Broad Street Rapid Transit Study*, which gave rise to the locally preferred alternative.²⁶⁰ DRPT, along with the Virginia Department of Transportation (VDOT), contributed funding and supported policy- and decision-making.²⁶¹ VDOT took over responsibility for the semifinal and final design phases, as well as construction oversight during the design-build process. The City of Richmond manages parking on city streets and therefore was an important partner in developing and implementing the corridor parking management plan. Richmond's City Council had to approve the City to enter into a partnership agreement with VDOT and the metropolitan planning organization, which identified roles and responsibilities during construction. Construction of the corridor involved underground utility work, which necessitated agreements with public and private utilities. Richmond Regional Transportation Planning Organization (RRTPO), the area's metropolitan planning organization, adopted the BRT into the short-term transportation improvement program's list of projects in 2011.

The project had an additional layer of federal oversight: this TIGER grant-funded project was assigned an FTA project management oversight contractor (PMOC) to monitor the project implementation.²⁶² The project team had regular project management meetings with leaders and staff across multiple jurisdictions and agencies.

Broad Street through downtown Richmond is lined by two- and three-story, late 19th- and early 20th-century commercial buildings. Minimizing the impact of the BRT stations and lanes on the historic district was of paramount importance, so the Virginia Department of Historic Resources was a project stakeholder.

Community advocates for better transit, smart growth, and racial equity played a critical role in cultivating support for the BRT project and advancing a vision for an improved regional transit system.²⁶³

²⁶⁰ DRPT 2018.

²⁶¹ DRPT is a state agency that reports to the Virginia Secretary of Transportation and focuses on rail, public transportation, and commuter services. DRPT advises, supports, and funds public transportation programs statewide. VDOT is responsible for building, maintaining, and operating the state's roads, bridges, and tunnels.

²⁶² The PMOC evaluated the grantee's capacity and capability to implement a major transit project and monitored the project budget and timeline. FTA typically assigns a PMOC to all New Starts, and TIGER grant recipients (Comé 2012, GAO 2010). FTA generally does not assign a PMOC for Small Starts or Very Small Starts projects unless they "have a total cost over \$100 million, are technically complex, or have less experienced sponsors, among other reasons" (GAO 2011).

²⁶³ RVA Transit 2019b, 2029c.

The Pulse Timeline²⁶⁴

MAY 2008	GRTC recommends further study of rapid transit on Broad Street through Richmond.
JUL 2008	DRPT and GRTC initiate Small Starts process.
JUN 2009	Broad Street Rapid Transit Study begins. Alternatives analysis and environmental analysis initiated.
FEB 2010	First public meeting held.
JAN 2011	Environmental analysis process begins.
MAR 2014	Draft environmental assessment published.
APR 2014	Broad Street Rapid Transit Study completed; FTA determined project meets the requirements for a categorical exclusion; project endorsed by the City of Richmond and Henrico County; GRTC submits TIGER grant application to USDOT.
MAY 2014	Public meetings to present BRT project begin.
JUN 2014	GRTC's board approves Broad Street BRT as locally preferred alternative.
SEP 2014	FTA awards GRTC \$24.9 million TIGER grant; preliminary design phase begins; branding and public outreach begin.
JUL 2015	Preliminary engineering phase completed.
NOV 2015	Semifinal design phase completed.
SEP 2015 TO APR 2016	Design-build procurement process undertaken.
JAN 2016	GRTC bus network redesign project begins.
FEB 2016	Richmond City Council approves development agreement with project partners, enabling construction to proceed.
AUG 2016	BRT construction begins.
MAR 2017	Final bus network redesign plan published.
JUN 2018	BRT construction completed.
JUN 24, 2018	BRT revenue service and bus network redesign launched.

PLANNING & DESIGN

Corridor Selection. Richmond's Broad Street has a long history of passenger transportation, initially accommodating a railroad and later a streetcar. By the late 1990s and early 2000s, Broad Street developed into the economic center of the region, and over time, congestion on the corridor increased as commuters traveled to jobs, VCU, and several major medical centers. Today, one-quarter of Richmond's population and two-thirds of its jobs are within a half-mile of the BRT route.²⁶⁵

In its 2008 *Regional Mass Transit Study*, the Richmond Area Metropolitan Planning Organization identified Broad Street as the best location for the region's first BRT corridor because of its high existing and forecast population and employment densities; it also had the most transit-supportive land uses.²⁶⁶ Between 2010 and 2014, GRTC and DRPT managed the Broad Street Corridor Rapid Transit project, which evaluated different options for introducing BRT to Broad Street.

²⁶⁴ Compiled from GRTC & DRPT 2014a, GRTC 2019a, GRTC 2019b.

²⁶⁵ City of Richmond and RRTPO 2017.

²⁶⁶ GRTC 2015, Parsons Transportation Group & Michael Baker 2014.

Environmental Assessment. Since the project started out in the Small Starts Project Development phase, an environmental assessment (EA) had to be completed for the project.²⁶⁷ Completed in March 2014, the EA evaluated two project alternatives—(1) no improvements and (2) the BRT route—and concluded that the BRT alternative would have minimal impacts to the natural environment and would not result in significant negative changes to Broad Street.²⁶⁸ The analysis that went into the EA helped to clearly demonstrate that the Broad Street BRT route met the requirements of a categorical exclusion (CE). FTA approved the CE in April 2014, exempting the project from a more detailed environmental analysis under the National Environmental Policy Act.²⁶⁹ By June 2014, the GRTC Board of Directors approved the BRT route design as the locally preferred alternative for the corridor.

Figure 20:
Pulse construction in
Richmond's historic
business district.

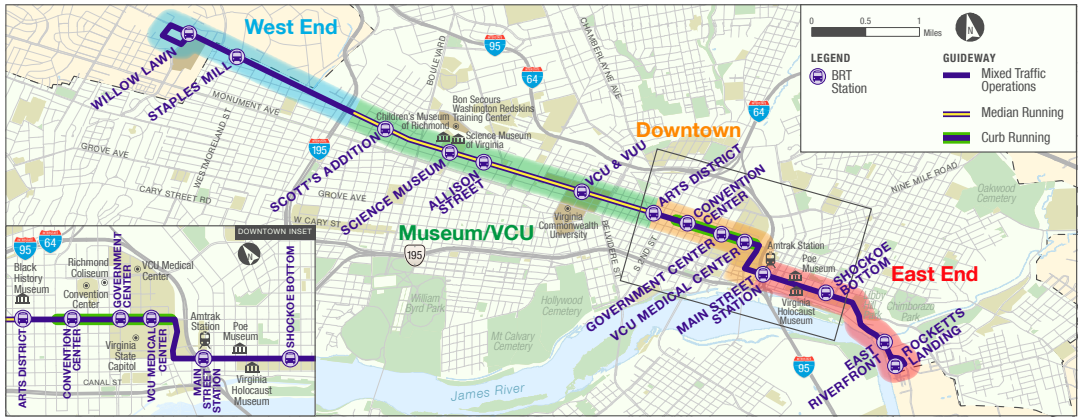


Source: GRTC

Historic Preservation. The corridor encompasses 12 blocks of a historic business district in downtown Richmond, listed on the Virginia Landmarks Register and the National Register of Historic Places (see Figure 20).²⁷⁰ Planners partnered with the Virginia Department of Historic Resources early on in the project to determine whether the BRT lanes, stations, and viewshed would have a significant impact on the historic landmarks. They reported that the BRT would not have a significant impact.

267 Parsons Transportation Group & Michael Baker 2014.
268 IBID.
269 FTA 2016b. GRTC 2019a.
270 DHR 2018.

Figure 21:
The Pulse corridor map
showing the BRT segment
and curbside bus lanes.



Source: GRTC

BRT Corridor & Route. The 7.6-mile BRT route connects the City of Richmond with Henrico County to the west. Traffic signal priority at each intersection and left-turn restrictions at about one-third of the intersections help minimize delays for the BRT passengers. The configuration and alignment of the BRT lanes vary along the length of the route (see Figure 21). Notable aspects of the route include:

- **Center-running BRT corridor.** BRT buses enjoy median-aligned, bus-only lanes for 2.6 miles through the Museum District and adjacent to VCU (see Figures 21 and 22). Along this section, the number of general travel lanes was reduced from three to two in each direction. This BRT corridor was rated Bronze with the *BRT Standard*.²⁷¹ The BRT buses continue off the corridor for an additional 5 miles.
- **Curbside bus lanes.** For 0.6 miles through downtown Richmond, the BRT buses and local buses serving Broad Street all operate in a dedicated, curbside bus lane (see Figures 21 and 23). These bus-only lanes are not physically separated from mixed traffic but are demarcated with a painted line, and right-turning vehicles are permitted to use them.²⁷²
- **Mixed traffic.** On the west and east end of the corridor, the BRT route operates in mixed traffic. On these segments, providing dedicated bus lanes would have necessitated the elimination of on-street parking.

Figure 22:
The Pulse center-running
BRT corridor.



Sources: left Beyond DC via Flickr, right GRTC

271 ITDP 2019a.

272 "With both a greater volume of pedestrians making connections between buses in this section and a higher volume of vehicles, it is logistically more efficient and safer to facilitate curbside bus connections, rather than utilizing median stations here" (GRTC 2015).

Figure 23:
Curbside bus lanes
and stations.



Source: GRTC

Stations. The Pulse BRT route includes 14 stations. The two terminus stations have a single platform that serves both directions of travel. Five stations along the median-aligned BRT corridor are split, with separate east- and westbound platforms (see Figure 22). This not only reduces the street width needed for the stations, but allows right-door boarding.²⁷³ The remaining seven are curbside stations with platforms built into the sidewalk.²⁷⁴ The low-floor Pulse buses dock level with station platforms with very little horizontal gap between the vehicle and the platform edge. Training the bus operators to drive the bus tires against a rubber curb was critical to minimizing the gap.²⁷⁵

The Pulse station design incorporates traditional red brick bases with more modern angled steel and wooden canopies. In some locations, the visually striking stations are juxtaposed against architecturally diverse, nationally registered historic buildings (see Figure 24).²⁷⁶ The back of each station is glass and doubles as a map of the corridor; a QR code at each station shown on the map provides information about nearby amenities (see Figure 25). Real-time bus arrival information is visible on digital displays and heard through audible announcements. Also, a green light moves up a totem sign as the bus gets closer (see Figure 26).

²⁷³ Malouff 2018; This is an alternative to a single center platform serving both directions, which requires bus doors on the left- and right-hand side. Since Pulse buses operate curbside on part of the corridor, the right-hand median stations mean that only right-side bus doors are needed, rather than doors on both sides. This reduces the cost of the buses.

²⁷⁴ Some of the curbside stations are walk-through stations that occupy most, or all, of the sidewalk. Pedestrians have to walk through the open stations to continue along the corridor (GRTC 2015).

²⁷⁵ In a park and ride lot in Henrico County, GRTC constructed a prototype station platform with a rub rail for drivers to practice docking the bus. Operators were taught how to approach the station at a less acute angle to minimize collisions and the gap between the bus and the platform. Test docking with the prototype station also revealed that the station design needed a longer rub rail to prevent the bus from scraping the brick wall.

²⁷⁶ Slipek 2018.



Figure 24:
The brick and steel Pulse
stations juxtaposed against
diverse architecture.



Source: GRTC

Figure 25:
A map adorns the back wall
of the stations. The QR codes
link to information about
station-area destinations.



Source: GRTC

Figure 26:
Digital message boards
and a light totem
indicate when the next bus
will arrive.



Source: GRTC

Integration of Nonmotorized Transportation. Pedestrians benefit from general safety improvements that were implemented along the BRT route including wider sidewalks, new curb bulb-outs, and more visible and protected crosswalks. There are also bike racks at Pulse stations, and the front of the buses have a fold-down rack with capacity for three bikes (see Figure 27). Two stations near the VCU campus have RVA bikeshare stands close by.

Fleet. The Pulse service utilizes 40-foot, low-floor, compressed natural gas buses manufactured by Gillig. The fleet's Pulse branding makes it visually distinct from the other GRTC buses.

Figure 27:
The Pulse CNG buses can
carry three bikes.



Source: Beyond DC via Flickr

CAPITAL INVESTMENT

Capital Costs. Total capital costs of the Pulse were \$64.9 million, including \$9.8 million for vehicles and \$11.5 million for construction.²⁷⁷ For the 7.6-mile route, the capital costs were one of the lowest among U.S. BRT projects.²⁷⁸ The actual project costs exceeded initial estimates by about \$10 million, due in part to higher than expected construction bids, and VDOT helped cover the additional costs.²⁷⁹

Funding. The Pulse relied on 38.4% federal funding and 61.6% funding from state and local sources. In September 2014, FTA awarded GRTC a \$24.9 million TIGER grant. State matching funds from VDOT and DRPT totaled \$32 million and included \$3.2 million in Surface Transportation Program funds. The City of Richmond contributed \$7.6 million, and Henrico County gave \$400,000.²⁸⁰

PUBLIC ENGAGEMENT & COMMUNICATIONS

Proponents & Opposition. Supporters cast the Broad Street BRT route as a modern transit service for the city, and a necessary first step toward building a more robust regional public transportation system.²⁸¹ As part of a regional transit network, the BRT route could help reconnect the segregated city.²⁸² People who supported the project, especially current transit users, did so in part because it promised faster and more reliable connections to destinations on Broad Street. Others were interested in the potential for the BRT investment to transform the corridor into a more walkable, transit-oriented place. Former Virginia Governor Terry McAuliffe and State Secretary of Transport Aubrey Layne were also project advocates and encouraged project partners not to delay critical decisions and risk losing the federal funding.²⁸³

²⁷⁷ (GRTC & DRPT 2014b). In the case study, all costs are presented in current dollars. The section "The State of BRT in the U.S." and Appendix A list the capital cost per mile, \$8.7 million, in constant 2019 dollars to facilitate comparison with other corridors.

²⁷⁸ This is the capital cost for the entire 7.6-mile bus corridor, including the 2.6-mile BRT segment.

²⁷⁹ Zullo 2016a.

²⁸⁰ Only a small portion of the BRT route is in Henrico County, and Richmond needed to partner with a neighboring municipality in order for the project to be eligible for a TIGER grant (Rojas 2018).

²⁸¹ Lazarus 2015, Robinson 2018a, RVA Transit 2019c.

²⁸² Campbell 2017.

²⁸³ Governor McAuliffe spoke out ahead of the February 2016 Richmond City Council meeting to urge the city not to delay the project and risk losing the very competitive federal funding (and its state match). He also wanted to see the service running before he left office in early 2018 (Lazarus 2015).

Like every BRT project, Richmond's plans faced opposition. While various entities had been exploring the concept of BRT on Broad Street since 2008, public interest and scrutiny seemed to increase after 2014, when GRTC secured the \$24.9 million in federal funding and the state matching funds.²⁸⁴ Several themes emerged among project opponents:

- **Parking impacts.** Wealthier neighborhoods and small businesses were concerned about the loss of parking on the corridor.
- **Economic development potential.** Some were dubious about the economic development potential of the Pulse, partly because of prior economic development initiatives from Mayor Jones that had not met expectations.²⁸⁵
- **Transit equity.** A group of constituents opposed the Pulse, claiming it catered to more affluent riders rather than serving transit-dependent residents, such as those in the lower-income East End neighborhood. African American residents were among those voicing concerns about the poor state of the existing bus service, and they questioned whether the sizable public investment should be used to improve a single corridor rather than enhance the whole bus system. The president of the Richmond branch of the NAACP said: "this plan does not do enough to expand service to citizens who do not currently have access to public transit."²⁸⁶ Inequality was an argument against the project leading up to the February 2016 Richmond City Council vote, and part of the impetus for the City and State to overhaul the bus network.

Outreach & Engagement. Public outreach about the BRT project began with five public meetings held during the EA process between 2010 and 2013. As the Pulse entered the design phase, GRTC's communications team discussed ways to address opponents' concerns and deployed a variety of approaches to engage the public, especially those who did not attend the public meetings. GRTC had to continually put out information about the Pulse and correct misinformation that was spread by word of mouth. The GRTC director of communications often spoke with the media to share positive messages about the project and counteract negative information. The outreach team cold called residents and businesses, and mailed project information, but found face-to-face interactions to be the most effective form of outreach. GRTC staff walked the corridor, engaging with every address three times and revisiting areas that needed special attention. They also rode buses and spoke with passengers about the BRT route. These in-person meetings enabled a conversation that helped GRTC build trust with the public.

²⁸⁴ Oliver 2016.

²⁸⁵ Such as a minor league baseball stadium (Transit Center 2016).

²⁸⁶ Robinson 2016.

This was a very hands-on approach to engaging people affected by the project at a very personal level. It was also labor intensive, so GRTC secured some state funding from DRPT to hire new, dedicated staff for BRT public outreach and communications. This full-time staff person walked the corridor, kept a detailed database of interactions with residents and businesses, and followed up on any concerns. This boots-on-the-ground approach continued through the winter of 2017/18, when construction began to wind down. The GRTC marketing team then shifted their attention to creative and educational promotions ahead of the service launch.

Grassroots Advocacy. Local transit and smart growth advocates played a critical role in cultivating support for the Pulse. RVA Rapid Transit, a transit advocacy organization,²⁸⁷ and the Partnership for Smarter Growth (PSG) were instrumental in cultivating the public support and votes needed for Richmond City Council to approve the project in February 2016.²⁸⁸

RVA Rapid Transit and PSG had supported the BRT route for several years.²⁸⁹ When several weeks before the critical City Council vote to approve the BRT, it seemed the project did not have the support it needed, these advocates strengthened their outreach.²⁹⁰ They sent out hundreds of emails and spoke at length with the public and media about the merits of the project. With some funding from Transit Center, the advocates hired a community organizer for the meeting, who helped turn out a diverse coalition of people, both young and old, from different ethnic and religious backgrounds “in favor of this big first step toward modern transit in the underserved Richmond region.”²⁹¹ Thirty people spoke in favor of the Pulse, and only ten spoke in opposition.

“All of the positive movement leading up to the vote came from advocacy. It was critical that the story was not one-sided, that we demonstrated a balance of opinion and ... significant support for going ahead with Pulse.”

—Stewart Schwartz, Executive Director, Partnership for Smarter Growth²⁹²

Marketing. Two months before the Pulse service launched, GRTC’s marketing efforts transitioned from public outreach to promotional and educational content.²⁹³ A series of videos promoting the BRT as a time saving travel option showed a myriad of activities Pulse passengers would have more time for (e.g., family, friends, shopping, exercise). Other educational videos instructed people how to access stations, purchase a ticket, and bring a bike on the Pulse.

287 RVA Rapid Transit is a community advocacy organization that developed from the Mayor of Richmond’s anti-poverty task force in 2013. “Transit came as a natural complement to its discussion among churches and other institutions about access to jobs” (Transit Center 2016). Board members of RVA Rapid Transit include several prominent African American and religious leaders who are well connected in the community and helped turn out a diverse coalition of support for the Pulse.

288 Richmond City Council voted in February 2016 on whether to authorize the City to sign agreements with GRTC and VDOT to move forward with the construction. The vote was a critical decision point in the project, and if it had failed, the region would have had to turn down the federal and state transit funding that had been secured. In the Council’s last opportunity to vote on the project, the BRT project received seven votes in favor, one opposed, and one abstention.

289 PSG 2019, RVA Transit 2019b.

290 Transit Center 2016.

291 IBID.

292 Transit Center 2016.

293 See www.youtube.com/user/ridegrtc/videos

One of the pre-launch educational messages reminded people how to safely use median-segregated bus lanes. After the infrastructure was complete, but before the bus operations began, the median lanes were open but unused. This seemed to confuse some drivers, who were unsure whether they could drive in the lanes or how to make a left turn across the center bus lanes. Some bicyclists and skateboarders took to riding in the bus-only lanes. For about one month before the launch, GRTC emphasized that the BRT lanes were for buses only.

Figure 28:
The Pulse logo reflects
the heartbeat of the city
and region.



Source: GRTC

Branding. The Pulse brand signifies it is the heartbeat, or pulse, of the city and region (see Figure 28). A secondary goal in choosing the brand was to pick a corridor name that would appeal to a variety of possible sponsors because the GRTC Board hoped to secure a corridor sponsor similar to Cleveland's Healthline.²⁹⁴ Bon Secours Richmond Health System and Virginia Commonwealth University Health System (VCU Health) signed on as joint sponsors, and opted to keep the the Pulse name. Both institutions had been looking to work together on a community effort, and public transit aligned well with their missions since their clients had long identified transport as a critical need. Bon Secours and VCU Health have placed advertisements in the stations and on the outside of all Pulse buses. They also have the option to include audio advertising, such as public service health messages, in the vehicles. Together, the two naming rights sponsors contribute \$425,000 per year toward operations and maintenance.

CONSTRUCTION

The Pulse was a highly visible project with a political deadline, so VDOT, whose teams were experienced in managing construction and design-build contracts, took over responsibility for the project before construction. VDOT's expertise contributed to the project being completed on time and freed up GRTC staff to focus on preparing for revenue service, safety, security, and marketing. Separating construction oversight responsibilities from launching and operating the revenue service introduced some inefficiencies when design changes needed to be made to improve operations.

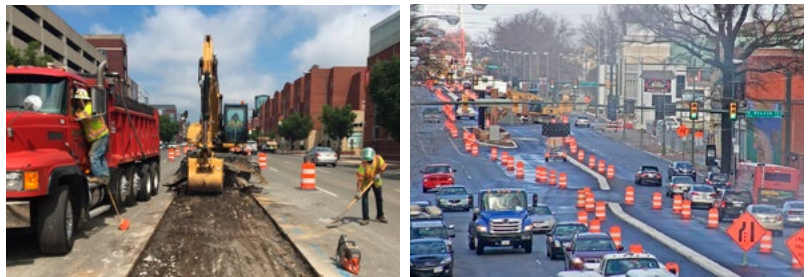
²⁹⁴ GRTC even hired the same naming rights sales agency that inked Cleveland's deal, The Superlative Group, to create a corporate sponsorship marketing program for the Pulse. Superlative conducted a market analysis of the route and potential partners, pitched the value of sponsoring the BRT, and negotiated the Pulse sponsorship deal with the two hospitals (GRTC 2018b, The Superlative Group 2019).

A design–build contract was used to pass along some of the schedule and cost risks to the contractor, who would complete the final design and construct the corridor. The design–build contract included financial incentives to complete the construction early and penalties for delays beyond the June 30, 2018, deadline.²⁹⁵ The contractor completed the corridor in June of 2018, before the deadline, but Pulse construction lasted 22 months overall—eight months longer than GRTC and the City of Richmond had expected.

Construction Impacts. GRTC tried to mitigate the construction impacts by keeping businesses informed about work schedules and providing a 24-hour hotline for the public to register concerns or complaints. Naturally, 22 months of construction on a primary corridor through Richmond had some impact on the businesses along the corridor, ranging from being a minor nuisance to impacting their bottom line. Traffic detours and changes to parking spaces were frustrating for some businesses (see Figure 29). Nighttime construction work was particularly bothersome to downtown hotels, whose guests complained about the noise.²⁹⁶ Some businesses felt misled by the City of Richmond and GRTC, who they believed underestimated both the construction impacts and schedule. Several Broad Street businesses attested that the corridor construction negatively impacted their revenue.

Not all businesses on the route spoke out against the construction. Some were decidedly more optimistic and patient with the infrastructure investment. Taking a longer view, some business owners could see past the construction nuisance to the benefits that the BRT route would bring to the city, and they hoped that the rapid transit service would bring them more customers. The owner of a boot shop on Broad Street recognized the inconvenience of construction as part of doing business in the city but acknowledged that the upside was better infrastructure.²⁹⁷ Several enterprises along the corridor continued to thrive during construction: a coffee shop’s revenue continued to grow (albeit not at the same rate as before construction), and a pawn shop owner said he noticed Pulse construction workers coming in to browse his collection of tools.²⁹⁸

Figure 29:
Construction of the
corridor caused temporary
disruptions.



Source: GRTC

²⁹⁵ The design–build contract included several milestones and incentives for early completion that were ultimately not enough to accelerate construction. These incentives included \$2.25 million for meeting two interim milestones (in September and October 2017) and \$1 million for completing construction before December 31, 2017, the end of Governor McAuliffe’s term. For every day beyond the end of 2017 that the construction was not complete, the incentive decreased by about \$22,000. A penalty of \$4,450 per day would have been incurred had the project not been completed by June 30, 2018 (GRTC 2015).

²⁹⁶ Nighttime construction noise had a specific impact on hotels, but it was not a widespread complaint. GRTC informed the hotels in advance of night work so they would have the opportunity to relocate guests’ rooms.

²⁹⁸ Zullo & Oliver 2017.

²⁹⁷ Zullo & Oliver 2017.

Business Assistance Program. Two funds were set aside to support businesses along Broad Street during construction. When construction began in 2016, Virginia and the City of Richmond jointly funded a business assistance program, to which the State contributed \$100,000 and the City provided \$100,000 in funds or in-kind services. The funds from this very modest program supported an advertising campaign promoting the businesses on the route, a construction update website, and promotional videos about the corridor.²⁹⁸ Some business owners who claimed the BRT construction negatively impacted them felt that the promotional assistance was inadequate and wanted the City to do more.

After the Pulse service launched, at the request of a council member representing some of the corridor businesses, Richmond City Council approved a \$280,000 special fund for parking and beautification projects to aid businesses affected by the project's construction.²⁹⁹ The source of the funding was local funds that the City Council had previously appropriated to GRTC for Pulse operating costs during the eight-month construction delay.³⁰⁰

OPERATIONS

Launching Service. GRTC launched the Pulse service on Sunday, June 24, 2018, to great public interest. During the first week, when fares were free, nearly 57,000 passengers rode the new BRT route.³⁰¹ Some of GRTC's preparedness for revenue service can be attributed to having been assigned a PMOC by FTA, who evaluated GRTC's readiness for revenue service, helping to avoid last-minute testing or unexpected operational issues.

Ridership. The BRT route has averaged 37,000 passengers per week since its first, free week.³⁰² Daily ridership is approximately 7,075 passengers, and while this is low compared with other U.S. BRT routes, it is double the forecasted ridership of 3,500 passengers per day.³⁰³ In March 2019, trips on the Pulse accounted for nearly one-third of all trips across GRTC's network.³⁰⁴ Trips on the redesigned bus network have increased by 17%.³⁰⁵

BRT Service. The BRT buses operate every 10 minutes during peak hours and every 15 to 30 minutes during off-peak hours.³⁰⁶ These headways have only been possible because GRTC consolidated existing bus routes on Broad Street during the bus network redesign, which has helped reduce bus congestion and delays at the curbside bus stops on the BRT route.

The Pulse service begins at 5 a.m. on weekdays and 6 a.m. on weekends, and runs until 1 a.m., seven days a week. According to GRTC, the average end-to-end travel time with the Pulse is 35–37 minutes, achieving the stated goal of reducing the corridor travel time by 33%.³⁰⁷ The average commercial speed of the BRT buses on the corridor is approximately 12 mph, which is relatively slow for a high-quality BRT corridor.

²⁹⁸ This business assistance program focused on promoting corridor businesses during construction, but it did not provide tax breaks, grants, or other forms of financial relief to offset revenue losses attributed to the construction (Robinson 2018b; Zullo & Oliver 2017).

²⁹⁹ At the time, proposed projects included power-washing sidewalks and installing planter boxes to beautify the corridor businesses (Robinson 2018b).

³⁰⁰ Robinson 2018b.

³⁰¹ GRTC 2019d.

³⁰² GRTC 2019d.

³⁰³ WTVR 2015.

³⁰⁴ RVA Rapid Transit 2019a.

³⁰⁵ GRTC 2019e.

³⁰⁶ The *BRT Standard* deducts points for corridors with frequencies less than eight buses per hour (i.e., headways of 7.5 minutes) (ITDP 2016a).

³⁰⁷ GRTC & DRPT 2014b, GRTC 2018a.

Fares. The general fare on the Pulse is \$1.50—the same as a regular fare on other GRTC bus routes. At fare machines located in each station, passengers can purchase a ticket with cash or credit, or validate a fare using a smartcard or mobile app. The BRT is the only proof-of-payment route in the GRTC network. Uniformed security officers periodically inspect passengers' tickets onboard the buses and issue citations if necessary.³⁰⁸

The Pulse is Richmond's first experience with a proof-of-payment system, and it caused some initial confusion. GRTC produced several educational videos to inform people how to buy a ticket and what proof-of-payment is. The agency has found that station attendants help reduce passenger confusion about tickets and is looking to have an attendant working in each of the busiest stations. Even with the educational efforts, fare evasion was a problem initially, especially since there was not a fare inspector on every bus to deter passengers from skipping the fare.

Student Transit Passes. GRTC offers two school transit passes. The City of Richmond funds a transit ridership program for high school students in the city's public school system, through which students receive unlimited rides at no cost to them.³⁰⁹ During the first half of 2019, GRTC and VCU piloted a university transit pass that provided unlimited rides for faculty, staff, and students on all GRTC routes. VCU paid the transit agency \$1.2 million for unlimited trips during the pilot and issued 55,000 chip-enabled VCU Go Passes to faculty, staff, and students. VCU affiliates have boosted the BRT ridership.³¹⁰ In March 2019, VCU pass holders made 43,000 trips on the Pulse, or about 27% of total BRT route trips that month. As of mid-2019, GRTC and VCU were negotiating a new service agreement beyond the pilot.³¹¹

Operating Costs. GRTC's estimates of the Pulse operating costs fluctuated several times during the project planning phase, and some Richmond City Council members expressed concern over approving construction without a clear understanding of how much of an operating subsidy the service would require.³¹² In 2019, the City of Richmond subsidized the GRTC operating budget by \$15.1 million, or about 26%.³¹³ Despite the higher than expected Pulse ridership, GRTC is forecasting a budget shortfall because fare revenue is not keeping pace with projections. This is attributed to two factors: fare evasion, and the cost of VCU ridership exceeding the transit pass fee.³¹⁴ City Council members have suggested that GRTC should reduce fare evasion and increase revenue rather than asking the City to increase the operating subsidy.³¹⁵

308 While they are not police officers, the fare inspectors do have ticketing power. After a passenger's third fare evasion offense, an inspector may issue a \$75 ticket.

309 GRTC 2019c.

310 Each VCU Go Pass chip has a unique ID identifying it as a VCU card, enabling GRTC to track university ridership and travel patterns.

311 Given the high VCU ridership, the university is effectively paying a reduced fare of \$1.20 per ride. During renegotiations of the transit pass, GRTC is seeking a larger annual fee from VCU to cover their operating costs; VCU wants to continue offering its faculty, staff, and students unlimited trips for the original fee of \$1.2 million (Rojas 2019a).

312 Oliver 2016, Rojas 2019a, WTVR 2015.

313 Rojas 2019a, 2019b.

314 IBID.

315 Rojas 2019b.

“There is immense economic development potential along the Pulse BRT corridor, especially in Scott’s Addition.”

—Andrew Clark, Director of Government Affairs,
Home Building Association of Richmond, December 2016³¹⁶

ECONOMIC DEVELOPMENT

Proponents touted the Pulse’s potential to stimulate new development and jobs in the corridor, city, and region.³¹⁷ Drawing on case studies of other U.S. BRT corridors, such as in Cleveland and Eugene-Springfield, a 2014 economic impact analysis estimated that the Pulse could generate \$41.5 million in regional spending and create about 400 regional jobs during the construction phase.³¹⁸ The Pulse was also expected to increase property values along Broad Street from 11.4% to 12.6% over 20 years, resulting in increased tax revenues for the City of Richmond and Henrico County.



Figure 30:
Zoning changes permit TOD
around Pulse stations such
as Scott’s Addition.

Source: GRTC

Transit-Supportive Zoning. During the semifinal design phase for the BRT corridor, the City of Richmond and the Richmond Regional Planning District Commission started developing a plan for corridor land use and development. *The Pulse Corridor Plan* recommends changes to promote transit-oriented development (TOD), streetscaping, and multimodal improvements, as well as to incentivize affordable housing and historic preservation. The Richmond Planning Commission and City Council approved the BRT corridor plan in early 2017, roughly midway through the Pulse construction.

³¹⁶ Spiers 2016.

³¹⁷ GRTC & DRPT 2014a, Robinson 2018a.

³¹⁸ The study concludes that Cleveland’s Euclid Avenue corridor, “operating from the Central Business District to East Cleveland and serving prominent educational and healthcare institutions, is perhaps the most comparable to Richmond’s Broad Street Corridor” (GRTC & DRPT 2014a).

In September 2017, Richmond City Council approved zoning changes in a rapidly changing neighborhood at the western end of the route to achieve the land use goals set out in the *Pulse Corridor Plan* (see Figure 30). The changes to the code notably created a new and “unabashedly urban” TOD zoning designation around Pulse stations that permitted a variety of land uses and buildings up to 12 stories and encouraged active, pedestrian-friendly streetscapes.³¹⁹ Parking requirements were eliminated for most uses in the TOD zone and in the central business district.³²⁰

NOTABLE CHALLENGES

Parking Changes. Parking changes on the Broad Street corridor were a significant concern for the public. Businesses, in particular, were anxious about losing both customer parking and commercial loading spaces. Part of the issue was a lack of awareness about some existing parking areas: for example, drivers typically overlooked parking off of Broad Street. GRTC focused on communicating the location of the parking that would remain available near the corridor to allay concerns about parking reductions. The communications team also published aerial maps of all the free and paid parking within several blocks of the BRT route on the project website, and the GRTC brought printed maps to every public meeting and provided them to nearby businesses to display for their customers.

The BRT project team worked, block by block, with businesses to understand their customer parking and loading needs and to look for alternative parking solutions within the block. For instance, they looked into providing additional commercial loading on streets perpendicular to the BRT route.

Construction Delays. Construction was initially slated for completion by October 2017, but it continued until June 2018—eight months later.³²¹ The delay exacerbated some of the public’s frustration with the construction impacts.

BRT-Inspired Regional Transit Redesign. Discussion about the BRT and its limited reach into transit-dependent communities led to a broader, more in-depth discussion about regional transit service and equity, which ultimately led to changes to both the BRT and the existing bus network.³²² Advocates RVA Rapid Transit and PSG, as well as the Richmond Council member representing the lower-income East End neighborhood, persuaded GRTC to connect the East End to the Pulse with new circulator bus routes. DRPT also committed state funds to a GRTC bus network redesign that would adjust bus routes to connect with the Pulse more efficiently and improve transit service for transit-dependent users. The revised plan simplifies the bus network and includes more direct and frequent routes on major corridors in Richmond. The City and GRTC made trade-offs between service frequency and coverage.

319 Spiers 2017.

320 Robinson 2017.

321 Robinson 2018b.

322 Oliver 2015.

Simultaneous Launch of BRT and Bus Network Redesign. The bus network redesign began in January 2016, at the start of the BRT construction, and the plan was published in March 2017. With a tremendous amount of strategic planning and coordination going on behind the scenes, the City of Richmond and GRTC worked to implement the proposed networkwide changes while simultaneously managing the construction and launch of their first BRT route. For example, every route name and number in the existing bus network, and all bus stop signage, was changed at once.³²³ The bus network redesign and new BRT route were both launched on Sunday, June 24, 2018. While GRTC attempted to communicate the changes in advance, inevitably, some passengers were confused and frustrated when the new services were rolled out.³²⁴

Criticism of Off-Board Fare Collection. A year after the Pulse launch, the off-board fare collection and proof-of-payment system is being questioned by City officials instead of being recognized as an integral part of the BRT that contributes significantly to quicker travel times on the corridor. GRTC has been criticized for allowing passengers to board the bus without paying, and Richmond City Council has urged the agency to crack down on fare evasion with aggressive informational campaigns.³²⁵

LESSONS OFFERED BY THE PULSE

- **Face-to-face engagement is essential.** GRTC found that the most successful way to build trust and connect with people about the BRT project was one-on-one conversations. A boots-on-the-ground approach is labor intensive, and funding should be secured to hire dedicated outreach staff.
- **A detailed parking management plan should be created.** GRTC and the City of Richmond developed a detailed, block-by-block assessment of parking impacts and tailored solutions, with input from residents and businesses. It helped allay concerns about BRT impacts.
- **A BRT corridor can anchor a new vision for regional transit.** Public engagement events about the Pulse led to productive and substantive discussions about how to improve the citywide and regional transit networks. With financial support from DRPT, GRTC completed a bus network redesign in parallel with the BRT implementation.
- **Community advocacy organizations are vital partners.** Grassroots organizers and transit advocates played a vital role in building a diverse coalition of Pulse supporters.
- **The BRT team needs an effective communicator.** An effective communicator is integral to helping explain project trade-offs (i.e., costs and benefits) to the public in a clear and nontechnical way. The GRTC's director of communications being an Emmy-winning communicator was a great help in the Richmond project.

³²³ To facilitate changing all of the bus stop signage at once, GRTC replaced signs at all bus stops and then covered the new signs with laminated bags that had the old (and still current) bus stop information printed on the outside. The GRTC team then removed the bags from 1800 bus stops for the launch on Sunday, June 24, 2018.

³²⁴ King & Belcher 2018.

³²⁵ Roldan 2019.

WHAT'S THE FUTURE OF BRT IN RICHMOND?

GRTC has plans to add more BRT corridors in the Greater Richmond Area. In December 2016, DRPT released the Greater RVA Transit Vision Plan, which proposed better transit connectivity between Richmond and the seven surrounding counties. The plan proposed adding five new BRT routes spanning 80 miles.³²⁶

Some Richmond City Council members are hopeful that the economic development success of the Pulse will inspire surrounding counties to explore ways that transit can be used to densify and redevelop some of their own underutilized corridors.³²⁷

CONCLUSION

GRTC and their local, state, and federal partners succeeded in bringing a high-quality BRT corridor, the region's first rapid transit service, to the Greater Richmond Area. Outreach staff who repeatedly canvassed the corridor and engaged community advocates were essential to building a coalition of project supporters. GRTC and the City of Richmond addressed local concerns about parking impacts with a block-by-block parking management plan. Today, the Pulse is exceeding ridership forecasts in part because it eliminates common causes of delay, and provides a high-quality passenger experience. It remains to be seen to what extent GRTC, the City of Richmond, and the region can build upon the success of the Pulse and expand frequent transit service into underserved neighborhoods.

³²⁶ The plan is not binding and does not specify funding sources or implementation steps (Zullo 2016b).
³²⁷ Zullo 2016b.



CASE STUDY: ALBUQUERQUE RAPID TRANSIT (ART) BRT REINVENTING ROUTE 66

OVERVIEW

Eighteen years after bus rapid transit (BRT) was first suggested along Central Avenue, the City of Albuquerque, New Mexico, is in the process of transforming the auto-oriented historic Route 66 byway into a more walkable and transit-oriented street, with an 8.8-mile-long BRT corridor. Albuquerque Rapid Transit, or ART, is expected to improve transit speed and reliability on an important transit corridor that serves a lot of lower-income residents, while also helping revitalize the corridor by attracting new development. Central Avenue bus routes currently carry 17,000 daily passengers, nearly 42% of all the city's transit trips, partly because 24% of Metro Albuquerque's jobs are within a half-mile of the corridor. Eighty-five percent of transit users in the city earn less than \$35,000 annually, and one-fifth of households within a half-mile of the BRT have incomes below the federal poverty line. These and other passengers are expected to benefit from a 15% reduction in travel times with the BRT. The City aligned its BRT implementation with a revision of its comprehensive plan to encourage more density and walkability along the BRT corridor. Construction of 9 miles of dedicated bus lanes and 19 median stations was completed in 2018. This infrastructure is ready for BRT service as soon as all of the buses arrive.

Like most transformational infrastructure projects, ART has faced obstacles from vocal opponents; it has also faced two lawsuits, mayoral and federal administration transitions, and electric bus performance issues. The way the City of Albuquerque developed the ART corridor and addressed its various challenges reveals important BRT implementation lessons for other U.S. cities related to effective public outreach, business engagement and support, electric BRT bus procurement, and transit-oriented development incentives.

Notable aspects of the ART project include:

- **High-quality BRT design elements.** The ART corridor includes long sections of median-aligned lanes and stations, as well as prepaid and level boarding, and traffic signal priority, which should all help minimize delay for the BRT passengers. That the City was able to provide dedicated BRT lanes for about 90% of the corridor length is a noteworthy accomplishment given the public pressure from residents and businesses not to reallocate road space from private vehicles to transit. These design decisions are part of the reason the corridor was preliminarily scored Gold for design characteristics only.³²⁸ The retro ART brand and marketing is also award-winning, having scored two of the American Public Transportation Association's AdWheels awards. The brand helps distinguish the BRT as something fresh and new, while also connecting different neighborhoods along Central Avenue into one cool corridor.

- **Delayed transit benefits.** Any city that implements a major transit infrastructure project like BRT trades some short-term inconvenience (e.g., construction impacts, change of travel lanes, reduced parking) for longer-term benefits (e.g., increased transit speed and reliability, pedestrian improvements, economic development). The residents and businesses of Albuquerque have endured the disruptive BRT construction and the reduction of travel lanes and on-street parking, but have not yet benefited from the transit service improvements since the BRT is not operational. Pedestrians walking along Central Avenue are benefiting from the wider sidewalks, improved lighting, new signalized pedestrian crossings, and new landscaping. A few new infill developments are beginning to crop up along the corridor. However, the full benefits of Albuquerque's infrastructure investment will only be realized once the ART service begins, and that may end up being 18 months after construction ended.³²⁹
- **Nationally visible setback for electric buses.** The City returned 15 electric buses to the manufacturer, BYD, claiming they had manufacturing flaws and did not meet the contractual battery charge range specification. Since Albuquerque could not find another U.S. electric articulated bus manufacturer to meet their battery range requirements, they had to postpone their plans for an all-electric ART and order replacement clean diesel buses. This case, along with others in Indianapolis and Los Angeles, illustrates that the market for electric buses, particularly 60-foot articulated battery electric buses, is not yet fully mature. Cities, like Albuquerque, remain interested in electrifying their bus fleet, and continue to work with manufacturers to improve BRT bus design so that performance matches ambition.
- **Door-to-door canvassing to counteract vocal opposition to and misinformation about the project.** Opponents criticized several aspects of the project, most notably that the dedicated BRT lanes would encumber private vehicles. While there were long-standing supporters, negative press dominated at times, and a lot of misinformation circulated. Through many face-to-face conversations, the project team was able to inform people of the actual BRT plans and correct misunderstandings about the project. This was a labor-intensive approach.
- **Courts blocking an injunction against the project.** Opponents of ART claimed, among other things, that the project would have significant environmental impacts and so should not have been granted a categorical exclusion (CE). Courts upheld the position of the City and FTA that the Central Avenue BRT project would not cause significant negative impacts on the human environment and had met the requirements for a CE under the National Environmental Policy Act (NEPA) environmental review process.
- **Project implementation spanning two mayoral and federal administrations.** There was a push to launch the BRT before the end of Mayor Berry's second term, so the City held a soft launch before the electric buses were fully tested and ready. A mayoral transition and corresponding change in some project staff introduced some project delays. Likewise, the ART implementation spanned two federal administrations, which may have impacted the efficiency of federal funding cycles.

PROJECT BACKGROUND & DESCRIPTION

STAKEHOLDERS

Implementing the BRT corridor along historic Route 66 through Albuquerque required coordination with local and federal partners and stakeholders. The ART project spanned two City of Albuquerque mayoral administrations. Mayor Richard Berry served two terms from December 1, 2009, to December 1, 2017. Mayor Berry championed ART as a key initiative of his administration because it was the foundation of his visions for a revitalized Central Avenue. The corridor's soft launch occurred days before his second term ended, and he was the project's political champion, helping secure the necessary federal funding and local political support. Mayor Berry's successor, Tim Keller, who campaigned against certain aspects of the BRT corridor, has had to see the project through to completion. Mayor Keller received the final tranche of federal funding for the project and led the City's response to the electric bus performance issues.

The City of Albuquerque's transit department, ABQ RIDE, is the transit agency responsible for operating the city's bus service. The agency implemented the BRT planning, oversaw the construction, and was the sponsor for the federal funding. ABQ RIDE and the Mayor's Office worked closely with the federal funding partners, FTA and FHWA, across two federal administrations. The Mid-Region Council of Governments, home to the municipal planning organization in the Albuquerque metro area, also worked with the City to try to secure other federal funding in addition to the Small Starts grant within the Transportation Improvement Program.³³⁰ Albuquerque City Council turned to their Senators and Representatives for help urging the U.S. Department of Transportation to release the Small Starts grant disbursement after some delay.³³¹

The ART along Central Avenue is part of the decommissioned Route 66 scenic highway and passes through several state-registered historically significant neighborhoods, so New Mexico's Historic Preservation Office was an important stakeholder and reviewer of the corridor design.

The BRT corridor serves several institutions that were also key stakeholders. The University of New Mexico's main campus, with its nearly 28,000 faculty, staff, and students, is served by two ART stations.³³² Presbyterian Hospital is also situated on the ART corridor and served by a station.

330 OIG 2018.

331 KRQE Media 2018; Sapin 2017.

332 UNM 2019.

ART BRT Timeline³³³

2001	<i>Middle Rio Grande Connections</i> report commissioned by Middle Rio Grande Council of Governments and the state DOT first mentions BRT and identifies Central Avenue from Coors Boulevard to Louisiana Boulevard as a "proposed high-capacity transit corridor."
2002	City Council instructs Transit Department to pursue New Starts funding for the Central Avenue transit corridor.
2003	<i>The Rapid Transit Project</i> report examines options on Central Avenue and recommends both light rail transit and BRT for further evaluation.
NOV 2011	City-commissioned Central Avenue dedicated bus lane feasibility study examines whether BRT can physically fit on the corridor. Report concludes BRT warrants further study.
NOV & DEC 2012	City begins public meetings to get feedback on possible Central Avenue BRT.
NOV 2013	Re-elected Mayor Berry says in State of City address that Albuquerque will pursue BRT on Central Avenue.
FEB 2014	FTA approves Albuquerque BRT for Small Starts project development phase.
MAR 2015	Revised locally preferred alternative adopted.
MAY 2015	City Council approves a \$49 million bond package including \$13 million for Central Avenue BRT. City estimates project cost of \$100 million. Service launch projected for September 2017.
JUL 2015	City submits Small Starts application and CE application.
AUG 2015	CE approved by FTA. City submits an application for a rating to qualify for \$80 million in federal funding.
FEB 2016	FEBRUARY 9, FTA recommends \$69 million Small Starts grant for the project, which is included in President Obama's FY17 budget proposal. FEBRUARY 10, first lawsuit filed. Project now estimated to cost \$119 million. Central Avenue businesses begin displaying project opposition signs. FEBRUARY 24, a public meeting devolves into shouting as opponents of the project are increasingly concerned about the loss of travel lanes and impacts on businesses. ³³⁴
MAR 2016	City Council votes 7-2 to authorize acceptance of nearly \$70 million in federal funding. Small Starts grant not yet approved, but City officials confident they'll get it because Obama included it in his budget recommendation.
APR 2016	Bus procurement contract awarded to BYD.
JUN 2016	Group of residents and business owners file motion with U.S. District Court for a preliminary injunction to halt the ART project.
JUL 2016	ABQ RIDE initiates preconstruction under a letter of no prejudice. ³³⁵ Federal judge refuses to issue preliminary injunction to stop the project, but opponents appeal days later.
AUG 2016	U.S. 10th Court of Appeals issues a temporary injunction, putting preconstruction on hold, and then lifts the injunction several weeks later, allowing construction to proceed.
SEP 2016	City signs construction contract stipulating completion in 16 months, and construction commences.
DEC 2016	10th Circuit Court of Appeals affirms lower court ruling in favor of FTA and the City, allowing ART to move forward.
APR 2017	Federal budget deal includes \$50 million for ART. Remaining \$25 million expected in subsequent fiscal year.
AUG 2017	Mayor Berry unveils ART's first all-electric bus.
SEP 2017	In his final State of the City address, Mayor Berry says ART is 80% complete and ahead of schedule.
NOV 2017	The ceremonial first electric bus ride occurs. City announces ART is partially operational, seven buses are operating, and the whole fleet will be ready by year's end.
DEC 2017	Mayor Tim Keller takes office. Keller tells community leaders FTA funding has not yet materialized and begins to hint at problems with ART.
JAN 2018	Mayor Keller holds press conference to reveal significant problems with ART electric buses and offers no prediction on when operations will start.
AUG 2018	FTA announces \$75 million grant agreement with ABQ RIDE.
NOV 2018	The City cancels the electric bus procurement contract with BYD and returns the 15 buses BYD had delivered. The City orders 20 clean diesel buses from New Flyer.
JUN 2019	First clean diesel ART bus arrives.

³³³ Adapted from A. de Garmo & L. Kline (personal communication May 28, 2019), FTA 2019a, Salazar 2018.

³³⁴ McKay 2016b.

³⁴⁵ "The LONP permits a Project Sponsor to incur costs on a project using non-federal resources with the understanding that the costs incurred after the LONP may be reimbursable as eligible expenses or may be eligible for credit toward local matching share if the project is approved for federal funding at a later date" (FTA 2015b).



Figure 31:
Center-running BRT on
Albuquerque's Route 66.

Source: Aileen Carrigan

CORRIDOR SELECTION

History of Central Avenue & Route 66. In other parts of the United States, Route 66 was established in 1926 as part of the original U.S. Highway System. Central Avenue through Albuquerque was designated as Route 66 in 1937.³⁴⁶ Eventually bypassed by the Interstate system, Route 66 was decommissioned as an official U.S. Highway in 1985, and FHWA has since designated it a National Scenic Byway.³⁴⁷ Through the City of Albuquerque, Central Avenue is a main street connecting important neighborhood nodes like Old Town, Downtown, Nob Hill, and the University of New Mexico campus.

Public Transit Service on Central Avenue. Beginning with a horse-drawn streetcar, there was center-running public transit on the corridor for 48 years—just as long as the corridor's Route 66 history. The City of Albuquerque began looking to reintroduce a streetcar or light rail about 20 years ago.

ABQ RIDE operates local bus Route 66 along Central Avenue and in 2004 introduced Rapid Ride Route 766, an express bus route operating in mixed traffic and serving curbside stations. Rapid Ride was an interim measure to test the demand for faster and more reliable public transit on Central Avenue. In the ten years following the introduction of Rapid Ride, transit ridership on Central Avenue doubled. At the same time, transit speeds slowed as congestion and dwell times at busy bus stations increased.

³⁴⁶ Before 1937, Route 66 followed a different route than present-day Central Avenue.
³⁴⁷ NPS 2019.

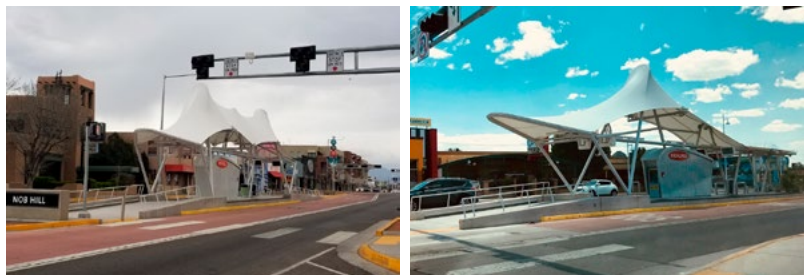
Central Avenue is a major urban arterial through Albuquerque and an important transit corridor for several reasons:

- Central Avenue carries 40% of ABQ RIDE ridership, on the Rapid Ride and local bus Route 66.
- Within a half-mile of the corridor, 20% of households have incomes below the federal poverty line.
- Twenty-four percent of Metro Albuquerque’s jobs are located within a half-mile of the corridor.
- Albuquerque has a jobs–housing imbalance, with most of the housing on the west side and most of the jobs to the east. Therefore, east–west streets like Central Avenue are crucial commuting corridors.
- Central Avenue is one of only six Rio Grande crossings within the city. It becomes very congested because of the aforementioned spatial imbalance between jobs and housing.

Central Avenue BRT. The history of transit priority on Central Avenue and preference for BRT dates back nearly 20 years to the early 2000s. BRT on Central Avenue was first mentioned in a 2001 report that proposed Central Avenue between Coors Boulevard and Louisiana Boulevard as a high-capacity corridor. A 2003 rapid transit study recommended both light rail and BRT for further evaluation. The same year, the City Council adopted the “major transit corridor” designation for Central Avenue in the comprehensive plan, giving transit priority on the corridor in the hierarchy of modes. A 2011 feasibility study examined whether BRT could physically fit within Central Avenue and concluded it warranted further study.

BRT, with buses separated from traffic and prepaid all-door boarding, seemed like a remedy for the declining speed and reliability of the Rapid Ride service and with a lower cost than light rail. Moreover, economic development had become a priority of Mayor Berry’s, and other cities had demonstrated that BRT could help revitalize a corridor like Central Avenue. In his State of the City address at the start of his second term in November 2013, Mayor Berry stated that the City would pursue BRT on Central Avenue. By February 2014, FTA had approved Albuquerque’s application to begin the Small Starts project development phase.

Figure 32:
Examples of tensile fabric
roofs on ART stations.



Sources: Aileen Carrigan left, ABQ RIDE right

PLANNING & DESIGN

Stations. Of the 19 stations along the corridor, 15 are median stations, while four downtown are curbside.³⁴⁸ The ART stations are topped with tensile fabric roofs,³⁴⁹ which are more cost-effective than metal or glass and help protect passengers from the weather (see Figure 32). The modern stations were designed by local architecture firm Dekker Perich Sabatini to evoke movement along the corridor. Neon lights on the edge of the tensile roofs reflect the history of neon signs along Route 66 and can be programmed to display different color patterns. Each station features a station pylon with a neon-lit ART logo. There are wheelchair accessible ticket vending machines, real-time information displays, and pedestrian-scale lighting.

The station architects, Dekker Perich Sabatini, created a miniature station model for public presentations (see Figure 33). People with visual impairments could touch the model and get a sense of the station design. Before construction, the designers also developed a virtual reality tour of a station so the public could immerse themselves in the new design and become more comfortable with the idea of median stations, compared with curbside bus stops (see Figure 33).³⁵⁰

Figure 33:
3-D Model of ART station
(left); Screen-capture
of virtual reality tour of
median-aligned ART station
(right).



Sources: left Aileen Carrigan, right Albuquerque Journal 2016

Corridor Design. The 8.8-mile BRT corridor runs along Central Avenue from Coors Boulevard in the west, across the Rio Grande, through downtown Albuquerque, past the University of New Mexico campus, and terminates at Louisiana Boulevard in the east.³⁵¹ The two ends of the corridor are characterized by low-density, auto-oriented development, whereas the middle runs through denser urban development along narrower streets.

Approximately 90% of the corridor includes dedicated BRT lanes, physically separating and protecting the ART buses from mixed traffic, which will help improve service reliability. The configuration of the BRT lanes varies along the length of the corridor as the street width changes. Along narrower segments of the street, planners had to prioritize the needs of different users. Namely, they had to balance the need for dedicated transit lanes with public concerns about reducing travel lanes and on-street parking.

³⁴⁸ A 20th ART station is planned at Central and San Pedro Avenues in the International District.

³⁴⁹ All but three of the stations have the tensile fabric roofs. The state Historic Preservation Office determined that the fabric roof detracted from the historic character of the Highland, West Central, and Old Town neighborhoods. Stations in these neighborhoods have no canopy; they are just platforms (see Figure 5).

³⁵⁰ McKay 2016d; Video of the virtual reality tour of the Bryn Mawr ART station: <https://youtu.be/cbyviRAW0y4>

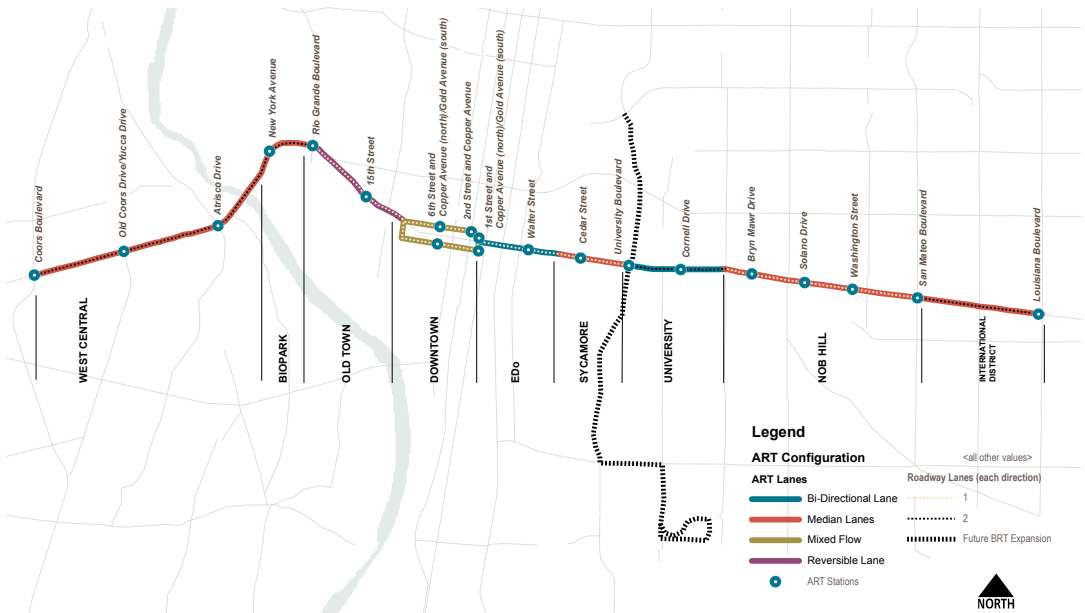
³⁵¹ There is a distinction between a BRT corridor and a BRT route. Albuquerque's BRT corridor with mostly median-aligned, dedicated lanes and stations essentially runs along Central Avenue from Coors Boulevard to Louisiana Boulevard. ART bus routes will continue off of both ends of the corridor (see Figure 12).

The ART corridor design includes four BRT lane configurations (see Figure 34):

- **Median-aligned BRT lanes.** These segments typically occur where Central Avenue is the widest, allowing one BRT lane in each direction. There are two mixed-traffic lanes in each direction at either end of the corridor and one lane per direction through narrower segments in the Sycamore and Nob Hill neighborhoods (see Figure 35).
- **Bidirectional BRT lanes.** In two places, East Downtown and near the University of New Mexico campus, Central Avenue narrows (to 80 feet) and could not accommodate two BRT lanes plus on-street parking. To preserve parking in these neighborhoods, two median BRT lanes collapse into one center bidirectional lane. Buses traveling in opposite directions will share the center BRT lane at staggered times, with one bus held at a signal while the other bus passes through the bidirectional lane (see Figure 36).
- **Reversible BRT lane:** Central Avenue narrows through Old Town, just west of Downtown, and includes one traffic lane in each direction and a median BRT station. There is a single dedicated, median-aligned BRT lane (see Figure 37). In the morning peak, the eastbound buses will get priority and use the dedicated lane while the westbound buses will operate in mixed traffic and then merge back into the BRT lane at the station. The reverse will happen in the evenings.
- **One-way street pairs.** Through downtown, the eastbound and westbound BRT lanes are on parallel one-way streets one block from Central Avenue. Here, the right-of-way is 40 feet wide and the BRT operates curbside in mixed-traffic lanes (see Figure 38).

The median, bidirectional, and reversible lanes dedicated for BRT buses are colored red and separated from mixed-traffic lanes by a rumble strip. ART also includes traffic signal priority and level boarding with off-board fare payment. These elements should help minimize delays for BRT passengers as well as for drivers along the corridor.

Figure 34: ART corridor schematic showing stations and different BRT lane configurations.



Source: Studio Hill Design

Figure 35:
Median-aligned BRT
lanes are colored red and
separated from mixed traffic
by a rumble strip.



Source: ABQ RIDE

Figure 36:
Just after West Downtown
station the BRT
lanes collapse into a
bidirectional lane.



Source: Aileen Carrigan

Figure 37:
Through Old Town
Albuquerque there is a
reversible BRT lane



Source: Aileen Carrigan

Figure 38:
ART buses operate in mixed
traffic through downtown
Albuquerque.



Source: ABQ RIDE

Pedestrian Improvements. Changes to Central Avenue for the ART project also improved the corridor's walkability and safety. Previously, in some places, the corridor had no sidewalks. With ART, pedestrians benefit from wider sidewalks, often separated from traffic by landscaping, curb ramps with proper geometries, and improved street and sidewalk lighting (see Figures 39 and 40). Central Avenue has one of Albuquerque's highest traffic crash rates, and BRT proponents expect that slowing vehicle speeds and improving pedestrian infrastructure will help reduce traffic injuries and fatalities.³⁵² The safety impacts of the corridor's midblock crossings³⁵³ and bidirectional and reversible bus lanes, which are new to Albuquerque, remain to be seen.

Figure 39:
Streetscape improvements
along the ART corridor
through the Nob Hill
neighborhood. Before (left)
and after (right).



Source: Dekker/Perich/Sabatini

Figure 40:
Streetscape improvements
along the ART corridor.
Before (left) and after (right)
along the south side of
Central Avenue between Bio
Park and Old Town stations.



Source: Dekker/Perich/Sabatini

352 Most of Central Avenue, where the ART operates, forms part of Albuquerque's High Fatal and Injury Network, the street segments and intersections with the highest rates of traffic injuries and fatalities. Sixty-four percent of the total fatalities and injuries occur on only 7% of the city's major roads, including urban arterials like Central Avenue. (MRMPO 2019).

353 Midblock pedestrian crossings were first used in Albuquerque on the BRT corridor. Several midblock crossings in the Nob Hill neighborhood have high-intensity activated crosswalk signals to help make pedestrian crossings safer. They are new traffic control devices in the city, which may take drivers and pedestrians some time to get used to.

ENVIRONMENTAL REVIEW

ABQ RIDE staff demonstrated that ART qualified for a CE, an established part of the NEPA environmental clearance process, by documenting that the project would not have significant environmental or community impacts.³⁵⁴ In August 2015, FTA determined that the proposed ART project met the criteria for CE, and so no additional environmental review, beyond the environmental analysis submitted with the CE application, was needed.³⁵⁵

The CE gave some opponents the misperception that the City was trying to shortcut the environmental review process to expedite the project.³⁵⁶ The two lawsuits filed to halt the project claimed FTA inappropriately approved the CE and a more extensive environmental review of ART should have been required.³⁵⁷ The Courts found that the City had properly followed the NEPA guidelines given the information available at the time.



Figure 41:
ART construction on Central
Avenue east of downtown.

Source: Samat Jain via Flickr

³⁵⁴ According to FTA, actions that qualify for CE determinations do not involve significant environmental impacts. "They are actions which do not induce significant impacts to planned growth or land use for the area, do not require the relocation of significant numbers of people; do not have a significant impact on any natural, cultural, recreational, historic or other resource; do not involve significant air, noise, or water quality impacts; do not have significant impacts on travel patterns; or do not otherwise, either individually or cumulatively, have any significant environmental impacts." (FTA 2016b).

³⁵⁵ FTA 2015a.

³⁵⁶ According to the Federal Code (23 CFR Part 771.118), actions that may normally be classified as a CE require FTA review and approval if they will result in significant environmental impacts or substantial "controversy on environmental grounds." A question on the CE application asks whether the project is likely to generate intense public discussion, concern, or controversy, even among a relatively small subset of the community. The City responded no, indicating that their public outreach efforts at that point had brought up questions and concerns; it did not "identify intense public concern" about ART (ABQ RIDE 2015). When the City submitted the CE request to FTA, the opposition to ART was just emerging. A few op-eds against the project had been published, and in the summer of 2015, many businesses along the corridor voiced their objection to the left-turn restrictions. While opposition to ART would become more intense, during the few years prior to the CE application submission, ABQ RIDE staff had not heard significant public concerns about ART.

³⁵⁷ McKay 2016c.

CONSTRUCTION

The City awarded an \$82.6 million construction contract to local firm Bradbury Stamm.³⁵⁸ The general contractor had to guarantee a maximum price and agree to pay late fees if they did not finish construction in 16 months (i.e., the end of 2017).

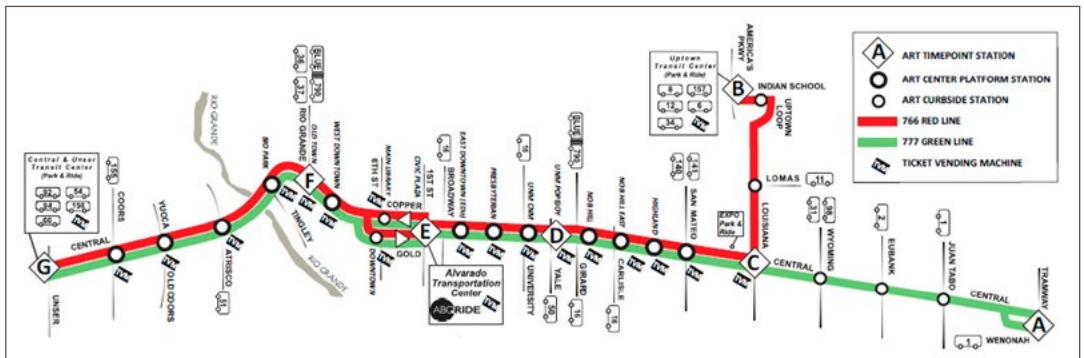
The lawsuits to halt the project delayed the BRT infrastructure construction by several months.³⁵⁹ Given the political deadline to complete the project before the end of Mayor Berry’s second term in November 2017, the construction schedule had to be accelerated once the Courts cleared the City to move forward with ART. The compressed schedule was achieved partly by working on the whole length of Central Avenue simultaneously, rather than in phased sections as planned (See Figure 41).³⁶⁰ This resulted in more intense construction impacts for businesses, transit users, and community members than perhaps people expected. The construction was substantially completed by April 2018.

(PLANNED) BRT OPERATIONS

ART service will replace the existing Rapid Ride routes on Central Avenue (766 and 777), while the local Route 66 will continue. ABQ RIDE is planning two BRT routes that will operate along the Central Avenue corridor and then continue in mixed traffic off of the corridor (see Figure 42). ART 766, the Red Line, will turn north at Louisiana Boulevard and continue to the Uptown Transit Center, whereas ART 777, the Green Line, will continue east to the Tramway Park and Ride at the end of Central Avenue.

On the BRT corridor, buses are expected to arrive every 7.5 minutes between 6:30 am and 6:30 pm, and every 15 minutes off-peak.³⁶¹ BRT service hours will end at 9:30 pm on weekdays, 9:00 pm on Saturdays, and 7:30 pm on Sundays.

Figure 42:
Two BRT routes will continue off of the Central Avenue corridor.



Source: ABQ RIDE

358 All costs in the case study are presented in current dollars. Bradbury Stamm was one of two contractors that responded to the request for proposals (City of Albuquerque OIG 2018).

359 In parallel with the BRT infrastructure construction, some utilities were also upgraded. This included installing new water and sewer lines, burying power lines, and laying fiber-optic cable for high-speed communications. Some of the utility construction was able to begin while the cases against ART were heard by the Courts, but not the major corridor construction for the BRT lanes and stations.

360 The initial construction plan had been to complete one 2,000-foot section of the corridor every two months (McKay 2016).

361 Off of the BRT corridor, route 766 and 777 buses will operate at approximately 15-minute headways. Therefore, on the BRT corridor, the interlaced routes combine to provide 7.5 minute headways.

CAPITAL INVESTMENT

Costs. ART's total capital costs, including the BRT corridor infrastructure, utilities, and buses, were approximately \$133.7 million.³⁶² The design and construction of the corridor infrastructure, excluding utility upgrades, totaled about \$104 million.³⁶³ The original BYD electric buses cost \$22.9 million, or about \$1.2 million each, whereas the replacement clean diesel New Flyer buses cost about \$870,000 each.³⁶⁴ To guard against cost overruns, the general contractor had to guarantee a maximum price and work schedule.

Funding. ART relied on 80% federal funding and a 20% local match. ABQ RIDE received an FTA Small Starts grant for \$75.04 million and nearly \$20 million in other FTA funds.³⁶⁵ The agency also used \$12.07 million in Congestion Mitigation and Air Quality funding from FHWA to incorporate a planned upgrade to the Central Avenue and Lomas intersection into the BRT corridor construction. The local funding match consisted of \$17 million in municipal bonds and \$6.4 million in transportation infrastructure tax revenue.³⁶⁶

Small Starts grants are reimbursable grants, meaning transit agencies or cities receive funding periodically after incurring project costs. In Albuquerque's case, there was a longer-than-expected amount of time between when the costs were incurred and when the federal reimbursement was received, which contributed to negative cash flow for several years.³⁶⁷ There was a lag of at least 18 months between when Albuquerque expected to receive its Small Starts grant and when the City actually received the funds.³⁶⁸ In addition, to try and meet the aggressive implementation schedule, the City took a calculated risk and initiated the ART corridor construction before the Small Starts grant agreement was in place.³⁶⁹ The City incurred the corridor construction costs up front, as expected, but the federal reimbursement arrived much later than anticipated. This delay gave rise to concerns about the contingency plan for how the City would cover the liability of the ART costs if the federal funding never materialized.³⁷⁰ The corridor construction was substantially completed in April 2018, and the Small Starts grant agreement was only approved by FTA in August 2018. The City of Albuquerque expected to receive the \$75 million in Small Starts grant funding in two installments by 2020, about two years after construction was completed.³⁷¹

³⁶² In the case study, all costs are presented in current dollars. The section "The State of BRT in the U.S." and Appendix A list the capital cost per mile, \$15.2 million, in constant 2019 dollars to facilitate comparison with other corridors. The utility work completed in parallel with the BRT corridor construction included upgrading water and sewer lines, burying power lines, and installing fiber-optic cable for high-speed communications (FTA 2019a; City of Albuquerque OIG 2018).

³⁶³ ABQ RIDE.

³⁶⁴ Dyer 2018.

³⁶⁵ Albuquerque received \$15.66 million in \$5307 Large Urbanized Area Formula funds, \$121 million in CMAQ, \$3.4 million in Bus and Bus Facilities Formula Funds under MAP-21, and \$0.77 million in Bus and Bus Facilities funds under SAFETEA-LU (FTA 2019a).

³⁶⁶ In 1999, residents voted to impose a 0.25% municipal gross receipts tax for ten years to fund transportation improvements. Of this TransTax, as it was named, \$6.4 million supported ART (City of Albuquerque 2013).

³⁶⁷ The total unreimbursed amount from FTA reached \$96.7 million at one point. Since Albuquerque had to pay the costs up front, before receiving the federal reimbursement from the Small Starts grant, the City had to cover the ART expenditure with other funding sources. In a 2018 report, Albuquerque's Office of the Inspector General recommended that the City not allow expenditure on a project without an executed grant agreement. The Office of the Inspector General also reported that the City's practice of using a pooled cash account rather than a separate account for each fund made it difficult to determine if other bond monies had inadvertently covered ART's negative cash flow (City of Albuquerque OIG 2018).

³⁶⁸ Albuquerque anticipated having an FTA grant agreement in place by mid-2017, and FTA only announced the \$75 million grant agreement on August 31, 2018 (FTA 2018e, 2019a). The transition between presidential administrations and the lawsuits against the City may have also contributed to the delayed Small Starts grant agreement.

³⁶⁹ The City received three LONPs from FTA: December 2015 for \$20 million for vehicle procurement, July 2016 for \$59 million for construction activities, and July 2017 for \$33 million for additional construction activities. These LONPs indicated that the costs the City incurred during vehicle procurement and construction could be eligible for reimbursement if a grant agreement was approved but did not themselves guarantee grant funding would be approved for ART. In the July 2017 LONP, FTA included the statement "Please note that the President's Budget for FY 2018 proposes no funding for new projects, and thus ABQ Ride acknowledges that it is undertaking additional work at its own risk which may not receive Capital Investment Grants funding" (City of Albuquerque OIG, 2018).

³⁷⁰ City of Albuquerque 2018a.

³⁷¹ KRQE Media 2018.

PUBLIC OUTREACH & ENGAGEMENT

Proponents & Opposition. People who supported the BRT project tended to want better transit and more walkable urban areas in Albuquerque. They supported leveraging the federal funding to bring more efficient transit to the Central Avenue corridor, as well as attract new jobs and development.³⁷² Supporters tended to be younger people, urban professionals, transportation advocates, and real estate development and land use planning associations. Many proponents remained supportive of ART throughout the backlash and vocal opposition, and some showed their support with “I’m On Board” buttons, posters, and tee-shirts.

Like many major transit investments, Albuquerque’s BRT plans encountered public opposition. Groups opposing ART were perhaps more vocal and organized than in other cities, eventually filing lawsuits against the City to try to block the project. Small business owners along Central Avenue made up the majority of the opposition. The Restaurant Association formally voted against the BRT, small business opponents organized a letter-writing campaign, and a small business owner organized others to display anti-BRT signs along the corridor. The ART opposition grew over time, especially as the project appeared to become more certain (i.e., after the federal funding was approved) and as construction started to impact communities along the corridor. Several themes emerged among the arguments against ART:

- **Loss of priority for private vehicles.** A key argument against ART was that it prioritized street space for transit over private automobiles. Among the biggest nay-sayers were those opposed to reductions in on-street parking, believing corridor businesses depended on it.³⁷³ Residents and business owners alike were concerned that the conversion of mixed traffic lanes to bus-only lanes would increase congestion. Many businesses disliked the restriction on left turns across the bus lanes, fearing that it would reduce their customers’ access.³⁷⁴ To some, preserving Route 66’s recent history as an auto-oriented corridor was more important than improving transit and walkability along Central Avenue.³⁷⁵
- **Anti-transit and anti-bus sentiment.** Some voices against ART were generally opposed to public transit, while others simply did not think people would choose to ride the bus and would rather the City invested in rail. As in many U.S. communities, a stigma exists in Albuquerque against bus transit and its passengers, and these stereotypes may have influenced opposition to ART.
- **Small government and limited spending.** Some opposed the project because they preferred small government and limited public spending. Others felt there were more effective ways to leverage \$75 million in federal funding for economic development in Albuquerque.
- **Transportation equity.** Some constituents argued that ART did not do enough to serve lower-income residents. This was partly because of stop consolidation, which left certain neighborhoods without convenient access to the BRT.³⁷⁶ Other opponents wanted the BRT service area changed or expanded to include lower-income areas of the city, not adjacent to the Central Avenue corridor.

³⁷² UrbanABQ 2016.

³⁷³ Some on-street parking was removed, especially where the design needed to accommodate wider sidewalks at stations.

³⁷⁴ Along the BRT corridor, signalized intersections with protected left turns and U-turns are provided every quarter-mile.

³⁷⁵ McKay 2016e; The corridor’s history as Route 66 is more recent, but Central Avenue had center-running transit for as many years as it was a car-oriented byway. The auto-oriented history of Route 66 was considered by some ART opponents to be more worthy of preserving.

³⁷⁶ City Council member Pat Davis, representing the International District, reluctantly supported ART on the condition that a station be added to the predominantly lower-income neighborhood. He agreed to contribute to the cost of constructing a station at San Pedro and Central Avenue with his own district funds (McKay 2016f).

- **Gentrification and displacement.** There was also a concern that if the transit investment catalyzed economic development along Central Avenue, the corridor would gentrify and displace existing communities.
- **Construction impacts.** Commercial establishments worried that traffic delays, detours, loss of on-street parking, and noise during construction would deter customers from coming to Central Avenue. Residents wondered how they would access their streets during construction and whether reducing travel lanes on Central Avenue would divert traffic into their neighborhood.
- **Loss of landscaped medians and trees.** Some objected to the loss of street trees from Central Avenue’s existing medians to make space for the BRT lanes and stations.³⁷⁷ While the ART corridor plan called for new trees along the sidewalks, opponents countered that the existing median trees were older and therefore provided better shade than newly planted trees could, at least in the short term.

“Progress invites controversy, but if we shy away from progress and improvements to our city simply because we don’t have the stomach for controversy, we’re going to shortchange our city, our citizens and our future.”

—Albuquerque Mayor Berry, February 2016³⁷⁸

ABQ RIDE’s approach to public outreach and engagement evolved over time, shifting from traditional public meetings to more intensive door-to-door canvassing by the time construction began.

Initial Public Meetings. Eighteen months before FTA approved the project’s entry into Small Starts project development, ABQ RIDE began public outreach. Initially, the agency adhered to the City’s administrative rules for public input, thinking that would lead to adequate public feedback about a potential BRT on Central Avenue. The City’s rules only required ABQ RIDE staff to notify the 50 neighborhood associations along the BRT corridor. Starting in late 2012, staff held 20 public meetings with neighborhood associations about a possible BRT on Central Avenue. They followed a traditional public meeting format with a presentation and a small group discussion, which was marginally effective.³⁷⁹ Transit planners recounted that early public feedback was mostly ambivalent toward the project, and a necessary stakeholder group, the corridor businesses, did not attend those early meetings.

³⁷⁷ Station architects went to some lengths to address public concerns about reductions in parking and changes to trees, creating detailed inventories. In some places, median trees were replaced by sidewalk trees, where proponents point out they can provide shade for pedestrians. Opponents countered that sidewalk trees would block customers’ view of businesses.

⁴⁷⁸ McKay 2016b.

⁴⁷⁹ One attendee’s feedback about those 2013 public meetings was that the City explained the corridor design and technical details well but could have done more to sell a new vision of Central Avenue (Majewski 2013).

Part-time Canvassing. Subsequently, ABQ RIDE revised their outreach approach to better reach the Central Avenue businesses.³⁸⁰ In early 2014, a few ABQ RIDE staff began canvassing Central Avenue on a part-time basis, in addition to their other project responsibilities. This led to unsatisfactory results. Part of the challenge was that information about the BRT project was not reaching the right people, since BRT staff would give project information to whoever was present in the business at the time of the visit, which was not necessarily the owner or manager.

Public meetings began 18 months before FTA approved the project for the Small Starts project development phase, nevertheless some people believed that by the time the outreach started, the project was already a “done deal.”³⁸¹ Members of the public felt the City was disingenuous in asking for people’s input, since the project scope, alignment, and other design details already seemed set in stone.

Intensive Door-to-Door Outreach. The final phase of the outreach strategy included full-time staff dedicated to daily canvassing of the BRT corridor. In spring 2015, ABQ RIDE hired several students to walk Central Avenue and meet with each of the 1,200 businesses with front doors along the BRT corridor. The general contractor hired a public relations firm, Griffin Associates, in January 2016 to coordinate communication with businesses during construction and added more staff to the corridor canvassing effort. This dedicated outreach team walked the corridor nearly every day from spring 2015 until the end of substantial construction in April 2018 and, through these door-to-door conversations, was able to make contact with the actual business owners and managers over 5,000 discrete times.

Other outreach approaches the BRT project team deployed included:

- **Regular construction coffee hours** for the general contractor to provide construction updates and answer questions.
- **A detailed corridor business database** with updated contact information and notes about how owners wanted to be kept informed. The project team communicated weekly with every business on the corridor.
- **A 24-hour telephone hotline** people could call with questions about access and disruptions during construction, the construction schedule, or the project in general.
- **Near daily media engagement** to put out positive stories about the project. By the end of the construction, there were more positive than negative stories about the project.
- **An online interactive map** on the branded project website that included detailed information about station locations and construction updates.

³⁸⁰ ABQ RIDE staff heard from businesses that they distrusted both City government and the neighborhood associations, who they viewed as anti-development. The BRT team realized that more direct communication with the businesses was needed to adequately inform and engage with them.

³⁸¹ McKay 2016a, 2016b.

BRANDING & MARKETING

Branding. Initially, the City underestimated the need for a branding, design, or marketing budget, but just before construction the City brought on Studio Hill Design, a local branding and design firm, to develop a BRT brand. Studio Hill Design developed an award-winning retro look for the ART brand, drawing inspiration from the cultural history of Route 66. The highway initially served a placemaking function, connecting different communities along a continuous route. So the new BRT would follow suit, connecting cool neighborhoods into one continuous cool Central Avenue. Shiny and new, ART's brand values try to offset the negative stigma of bus transit in Albuquerque.

The original electric ART buses reflected the new ART brand and promoted the city, rather than being wrapped in advertising. They were designed to look like a retro diner, with chrome and vinyl details inside (see Figure 43). Neon accent lights outside the buses mimicked vintage Route 66 signs and matched the stations. The station architect had already developed a concept for the ART logo with three circles, adapting the design of a vintage motel sign on Central Avenue (see Figure 44). Studio Hill Design further developed the red, black, and turquoise colors, and designed the station pylons. These locally manufactured signs include a star on top, neon lights rimming the ART letter circles, and a banner depicting something notable from each station neighborhood.



Figure 43:
The original electric buses
looked like a retro diner,
inside and out.

Source: Studio Hill Design

Figure 44:
Design of ART station pylons
inspired by Central Avenue's
vintage neon signs.



Sources: left Aileen Carrigan, right Tadson Bussey via Flickr

Promotion during Construction. The City deployed three main strategies to promote and support businesses during construction and to encourage people to continue visiting Central Avenue.

1. **Marketing and promoting corridor business.** Award-winning marketing efforts showcased the corridor and its businesses during construction. Studio Hill Design created the tagline “Route 66 Always Open” to remind the public that corridor businesses remained open. The design team also created a business survival kit—including corridor maps, parking information, and alternative routes—for businesses to share with their customers. A website promoting the corridor businesses was created in partnership with the Small Business Resource Collaborative program.³⁸²
2. **ARTBeat.** This was an event series developed by the ABQ RIDE marketing team to spotlight corridor businesses and draw people to Central Avenue even during construction. The City provided funding for hiring bands, providing food, and marketing the events (see Figure 45). The dozens of ARTBeat events at various corridor restaurants and shops each drew anywhere from 50 to 200 people.
3. **Business assistance program.** Albuquerque’s Economic Development Department had a very modest budget to assist Central Avenue businesses. They selected 30 mom-and-pop shops to support with core business skills training, such as accounting, social media, and marketing. Also, in exchange for offering a small discount to patrons, corridor businesses could be included in the City’s “66 Reasons to Love Central Avenue” promotional campaign, which highlighted shops along Central Avenue (see Figure 46).



Figure 45:
Live music at an ARTBeat
event along Central Avenue.

Source: Studio Hill Design

Help support your local businesses near ART stations during construction and be rewarded with money-saving incentives, contests, giveaways & special events.

For a full list of participating businesses visit www.abqbrt.com

66 REASONS... TO LOVE ROUTE 66

WHAT'S YOUR REASON?
SHOW THIS CARD... SHOW YOUR LOVE.

Figure 46: The “66 Reasons” campaign promoted Central Avenue businesses during ART construction.

Source: ABQ RIDE

66 REASONS... TO LOVE ROUTE 66.

#53 - THE DINING
From locally made beers and cocktails to quick bites and fine dining, the Central Avenue corridor is at the center of all things tasty in Albuquerque.

#27 - THE HISTORY
For more than 75 years the spirit of Route 66 has been at the center Albuquerque's history. Handed down from one generation to the next it has served as a strong and vibrant source of cultural pride and tradition for every Buqueño old and new.

#11- THE SHOPPING
From trendy boutiques offering local handmade goods to national retail gems located along the Albuquerque Central Avenue corridor, Route 66 is a favorite shopping destination for all.

#34 - THE FUTURE
The future meets the past on Route 66, connecting people, creating place and driving opportunity. With so many opportunities for celebration along the Central Avenue corridor the outlook for what lies around the corner could never be better for our community.

Feel the love.
❤️
Tell us your reason...

Help support your local businesses near ART stations during construction by showing this card and be rewarded with money-saving incentives, contests, giveaways & special events. For a full list of participating businesses visit www.abqbrt.com

Name: _____

I love Route 66 because... _____

“People whose sole objection to ART is that they can’t imagine anyone would want to ride a city bus are missing the point. ART is an infrastructure improvement project that is supposed to make these Mother Road neighborhoods more attractive, more walkable, more welcoming.”³⁸³

ECONOMIC DEVELOPMENT

There were high expectations of ART to leverage economic development.

ART proponents anticipate that public investment in the BRT will attract private investment to help transform Central Avenue into a more transit-oriented and walkable place.³⁸⁴ This would be a significant change from the existing development along the corridor, which is dominated by surface parking, vacant lots or buildings, and auto-oriented strip malls.³⁸⁵ Economic development along the BRT corridor may be hamstrung by the slow real estate market in Albuquerque and the fact that the ART buses are not yet running.

In conjunction with its BRT planning, the City of Albuquerque took a crucial step to encourage densification and infill development along the corridor, aligning the city’s planning and zoning regulations with the ART project. The comprehensive plan was updated in March 2017 to encourage development in certain activity centers and along key corridors that connect those centers.³⁸⁶ The new regulations grant bonuses for locating development projects along Central Avenue, and near BRT stations in particular, such as a height bonus and a 50% reduction in the required parking.³⁸⁷ Development projects along Central Avenue can earn additional height bonuses for including workforce housing.



Figure 47:
Branded signs identify future
ART station locations.

Source: ABQ RIDE

³⁸³ Quigley 2016.

³⁸⁴ The City intentionally did not make its own predictions about how much new development ART would attract, instead pointing to case studies from other cities and other organizations’ research about BRT and economic development.

³⁸⁵ Quigley 2016.

³⁸⁶ These centers include Downtown, designated “main street corridors,” and “premium transit” areas. Central Avenue, a “main street corridor” running through Downtown, was identified as a “premium transit” corridor. Premium transit areas lay within 650 feet of the ART stations. The City Council approved a long-overdue update and simplification of Albuquerque’s zoning code in the form of the Integrated Development Ordinance in November 2017, reflecting the comprehensive plan guidance through new development standards that further incentivize development in centers and along corridors like Central Avenue (Dovey 2017).

³⁸⁷ Parking requirements were abolished downtown in 2010.

With the underlying planning and zoning ordinances encouraging development along the BRT corridor, early trends suggest some developers are already responding to the transit investment, while others may be waiting for the BRT operations to begin. Through its zoning approval process, the City has had numerous developers inquiring about BRT station areas as sites for possible projects. Several projects along Central Avenue are underway in advance of the BRT service along Central Avenue, like a new mixed-use residential and hotel development across from Presbyterian Hospital and its ART station. A new apartment complex with small rental units near the Old Town ART station caters to young professionals and the creative class who want an urban, walkable lifestyle.³⁸⁸ More risk-averse developers may be waiting for the BRT service to launch before breaking ground on new projects.

NOTABLE CHALLENGES

Insufficient public meetings. The City-mandated public meetings to notify neighborhood associations about the public infrastructure project did not reach an important stakeholder group: the Central Avenue businesses. The ART project team had to modify their outreach approach to connect more directly with businesses and needed additional staff to do so. ABQ RIDE marketing resources were utilized to hire graduate students to canvass the corridor full-time. Daily contact with the 1,200 corridor businesses was necessary to counteract misinformation about the project and answer business owners' questions and concerns.

Vocal and organized opposition. Once the City announced in early 2014 that FTA had approved the Small Starts grant application, and ART seemed more certain, the opposition began to heat up. By 2015 through to the end of construction, opposition to the project increased, with some very heated public meetings and protests.³⁸⁹ Naturally, as residents and businesses near the corridor started to feel the impacts of construction, they became more vocal in their opposition. The ABQ RIDE team spent a lot of time in one-on-one conversations with constituents and speaking with the media to try to respond to the public's concerns and counteract misinformation about the project.

Lawsuits to halt ART. In June 2016, just before construction was slated to begin, opponents sued the City and FTA in an effort to stop the BRT project. The lawsuit claimed that the BRT should not have been granted a CE because it would in fact violate environmental and other laws, which the City and FTA disagreed with.³⁹⁰ For several weeks, this prevented the City from making any substantial progress on the corridor, as construction could not begin. In December 2016, the U.S. Court of Appeals affirmed the lower Court's decision in the City's favor, but the implementation schedule had suffered a setback.

388 The Country Club Plaza Development includes 23 one-bedroom rental apartments. They range in size from 573 to 767 square feet and ask monthly rents of \$875 to \$1300 (Guzman-Barrera 2016).

389 McKay 2016a, 2016b.

390 McKay 2016e.

Mayoral administration transition. In December 2017, just when ABQ RIDE was in the final implementation phase, preparing to launch operations and resolving critical issues with the electric buses, a new mayoral administration took office. The fate of ART was uncertain as Mayor Tim Keller had spoken against the dedicated lanes and left-turn restrictions during his campaign³⁹¹ and was inheriting a not-quite-complete project when he took office. Staff transitions disrupted the project continuity at an important juncture, and negative press about ART continued.³⁹² Managing the launch of a new BRT system is difficult within one administration; between two administrations, it is significantly more challenging.³⁹³

Operational issues after soft launch. There was a political deadline for completing the project: the end of Mayor Berry's second term. As the project implementation timeline got compressed, there was insufficient time to test the buses and launch operations before the end of the mayoral term. Instead, Albuquerque soft launched the BRT a few days before the end of Mayor Berry's second term, and at the ribbon-cutting ceremony he showed off the first electric ART bus that had been delivered. A BRT soft launch is common, but unfortunately ART's electric buses were not ready for revenue service.

Poorly performing electric buses. Two months after taking office, Mayor Keller revealed major performance problems with the electric buses that were manufactured by BYD in Los Angeles. The City had discovered during its inspections and testing that the buses were not meeting the contractual battery range of 275 miles per charge.³⁹⁴ A host of other mechanical, electrical, and safety problems were also identified.³⁹⁵ While BYD denied Albuquerque's allegations that the buses were not roadworthy or able to provide sufficient battery range, the City rejected all of the ill-performing electric buses, returned them to BYD, and canceled the procurement contract.^{396, 397} In May 2019, the City and BYD reached a settlement to resolve the case.³⁹⁸ Albuquerque claimed it could not find an alternative U.S. bus manufacturer who could produce a 60-foot articulated electric bus that met the City's battery range specification and also had both left- and right-hand doors, as needed for the ART corridor. Instead, the City ordered clean diesel replacement buses from New Flyer, which delayed the launch for at least a year.³⁹⁹

391 Carl 2017.

392 After Mayor Keller took office, there was continued negative press about the delayed federal funding and the electric bus performance. In addition, in mid-2018, Albuquerque's Inspector General reported some irregularities in the City's procurement process. For instance, political appointees were assigned to committees making procurement decisions. Furthermore, the Inspector General also examined how the City had paid ART project costs while waiting for the Small Starts grant reimbursement and concluded that the City's practice of using pooled cash accounts may have improperly mixed revenue from different sources (City of Albuquerque OIG 2018). While not specific to ART, these findings did add to the negative news about the BRT project.

393 Schmitt 2018a.

394 The 275-mile specification was based on the mileage each bus would be expected to drive each day before it could be recharged.

395 LA Metro and Indianapolis' IndyGo have also reported performance, electromechanical, and/or safety issues with BYD's electric articulated buses (St. John 2018). Indianapolis and BYD have since agreed on a workaround to the battery range challenges (IndyGo 2019).

396 Knight and Hayden 2018; While BYD claimed its 60-foot electric buses were built to Federal Motor Vehicle Safety Standards, at the time Albuquerque signed the bus procurement contract with BYD, the 60-foot, five-door battery electric buses were new to the market and had not yet completed the Altoona testing required before federal funding could be used to pay for them (Knight 2018a). As of mid-2019, only BYD's 40-foot electric bus had completed Altoona testing (LTI 2019).

397 Dyer 2018.

398 City of Albuquerque 2019.

399 Dyer 2018.

LESSONS OFFERED BY ART

- **Face-to-face conversations on the corridor are more effective than public meetings.** The public meetings held by the City early on in the project were not well attended, especially by local businesses. This approach to public outreach did not connect with the right people, those who could help cultivate support for the project.⁴⁰⁰ Door-to-door canvassing of Central Avenue, while labor intensive, was ultimately a more effective way to engage with people impacted by the BRT. Other public engagement formats and opportunities may have also helped reach a wider and more diverse audience.
- **Sell the BRT vision, early on.** With large public infrastructure investment projects like BRT, information vacuums are often filled with sensational and negative stories. Proactively telling the positive BRT story, and why BRT matters to the community, can help counteract the negative press.
- **Anticipate constituents' concerns.** Albuquerque was caught flat-footed with its outreach efforts and did not target communications directly to corridor businesses from the beginning. Opposition to changes in travel lanes and on-street parking is very common among BRT projects, and could be considered predictable at this point, based on the experiences of many cities. These are understandable and reasonable concerns by business owners, as is the fear that construction will deter customers from the corridor. Cities planning BRT should expect this response, have a business outreach strategy in place, and work closely with corridor businesses to find short- and long-term solutions. Highlighting the demonstrated economic benefits of multimodal streets may help.
- **Having up-to-date information about the corridor businesses is critical to successful outreach.** ABQ RIDE staff thought they knew the BRT corridor well, but as they started canvassing door to -door and trying to compile a database about the businesses, they realized they were misinformed. With dedicated staff canvassing the corridor, existing data about the businesses and their owners can be updated. Such a database enables targeted and personalized communication with business owners and managers on the BRT corridor.
- **Find and empower project supporters.** Finally, community advocates who supported better transit were not fully empowered by the City to promote the BRT project. For instance, the ART team could have provided the advocates with branded information and marketing materials to make communicating with their members quick and on-message. The community advocates could have amplified the City's limited staff efforts in cultivating support for the BRT and counteracting misinformation about ART. Building grassroots transit advocacy was an important step that was missed in Albuquerque.

⁴⁰⁰ A public relations expert familiar with the ART suggested that when trying to bring the right people together for public engagement, cities should identify the "mavens," "connectors," and "salesmen" in the community. Malcolm Gladwell described these archetypes of people who help spread ideas in his book *The Tipping Point*: "mavens" have information and provide the message, "connectors" are the social glue, and spread the message, while "salesmen" help persuade others about an idea.

WHAT'S NEXT FOR ART?

Awaiting clean diesel buses. The City of Albuquerque unveiled a demo of its 60-foot articulated, clean diesel ART bus on June 21, 2019.⁴⁰¹ New Flyer is expected to deliver the 20 replacement clean diesel articulated buses by the end of 2019.⁴⁰² The retro diner style of the electric buses will not be carried through to the clean diesel buses. “The demo vehicle currently has a turquoise colored base, which will eventually be painted with a design that city officials say will reflect the spirit of New Mexico”⁴⁰³ (see Figure 48). Some ART stakeholders are disappointed the BRT service will not launch with an electric fleet, but the City continues to pursue electrifying other routes in its network.⁴⁰⁴



Figure 48:
Rendering of possible
artwork for the clean diesel
ART buses.

Source: ABQ_RIDE

Launching ART service after BRT lanes have been idle. The new target for launching the service is May 2020.⁴⁰⁵ Building public trust and support for the new BRT service after the project’s challenges and delays may present a significant challenge for the City. New marketing and promotion efforts will need to focus on two things: (1) overcoming negative perceptions of the project and (2) re-educating people about how to move through the corridor. While the local and Rapid Ride routes have continued operating curbside along Central Avenue, the BRT lanes have sat empty since construction was completed in April 2018.⁴⁰⁶ Emboldened drivers have been making midblock left turns or U-turns, delivery trucks have been parking in the lanes, and people have taken advantage of the unused street space to walk, jog, skateboard, and bike. The City permitted creative uses of the lanes—like pop-up shops, running races, or art installations—while waiting for the replacement buses.⁴⁰⁷ With all these unplanned uses of the BRT lanes, it will take some effort to re-educate the public about how to use the reconfigured Central Avenue safely before BRT service launches.

401 Waneke-Libman 2019.

402 Dyer 2018, Waneke-Libman 2019.

403 Waneke-Libman 2019.

404 ABQ_RIDE 2019.

405 ABQ_RIDE 2019.

406 The Rapid Ride buses cannot make use of the dedicated BRT lanes since those require left-hand boarding at stations and the Rapid Ride buses only have right-hand doors.

407 City of Albuquerque 2018b.

Coordinating complex BRT operations. The Central Avenue BRT corridor includes two bidirectional flow segments, which necessitate precise signal timings. Since two buses cannot run on these segments simultaneously, one has to wait while the other has a green light. Getting the timing of this right will be critical to not introducing significant delay. After all, the City specified 7.5-minute headways in its Small Starts application, and FTA will hold the City to that. Another new aspect of the BRT operations, compared with the existing ABQ RIDE bus service, is the need for operators to dock the buses very close to the station platform to minimize the gap for passengers with disabilities.⁴⁰⁸ Like with all new BRT systems, there will be some wrinkles to iron out at first.

Determining ART ridership and its demographics. It remains to be seen whether the service is compelling for people moving along Central Avenue and whether the modeling assumptions hold. Who will ultimately benefit from the project remains uncertain, but early ridership data will give some hints. Route 66, the local bus service along Central Avenue, will be preserved, running parallel to the BRT route in mixed traffic and with curbside bus stops. If the speed of mixed traffic lanes decreases as a result of the BRT, the travel time for Route 66 passengers may increase and the reliability may decrease. It remains to be seen if, and how many, local route passengers shift to the BRT, which stops less frequently. Eighty-five percent of ABQ RIDE's passengers earn less than \$35,000 per year, and Central Avenue sees 40% of the city's total transit trips. Whether ART supports lower-income residents depends on how the demographics of BRT users compare with those of local route users and whether the local buses' travel times suffer in the curbside lanes along Central Avenue.

Considering more BRT in Albuquerque. *The Albuquerque / Bernalillo County Comprehensive Plan* identifies three "premium transit" corridors in Albuquerque, with Central Avenue as the southern east-west corridor. In September 2013, the Mid-Region Metropolitan Planning Organization conducted a feasibility study for BRT along University Boulevard, a north-south corridor, which would connect the Albuquerque Sunport Airport to the University of New Mexico (where riders could connect to the ART) and eventually further north to Journal Center, which is a major employment center for the city.⁴⁰⁹

CONCLUSION

Albuquerque's BRT has been nearly 20 years in the making, from the first suggestion of BRT on Central Avenue to the latest bus procurement hurdle. Like any BRT project, it has faced stiff opposition, as well as implementation challenges. There will certainly be more kinks to work out during the initial operations. Yet the City and its partners managed to design a high-quality BRT corridor with a substantial amount of dedicated lanes that should dramatically improve the transit and pedestrian experience along Central Avenue. With its revised comprehensive plan, the City has laid the foundation for attracting new infill and transit-oriented development along the corridor. If operations go as planned, ART could set an example for other cities about how to accommodate BRT elements, especially dedicated lanes, on an urban arterial. How ART will reshape Central Avenue, and the city's transit network more broadly, remains to be seen.

⁴⁰⁸ Along the entire length of each ART station is a thick rub-rail at the height of the tires. The bus operator slides the tires along the rub-rail, then the bus-station gap is at its minimum.

⁴⁰⁹ MRCOG 2019.

APPENDIX A: BASIC CHARACTERISTICS OF U.S. BRT CORRIDORS

CITY, SYSTEM, BRT CORRIDOR	BRT RATING	YEAR OPENED	BRT-RATED LENGTH*	CORRIDOR TYPE	AVERAGE PASSENGERS PER WEEKDAY (2018)	CAPITAL COST (CURRENT DOLLARS, MILLIONS)	CAPITAL COST PER MILE (2019 DOLLARS, MILLIONS)
Albuquerque, ART	Design characteristics only: Gold (Not operational as of mid-2019)	TBD	8.8 miles (14.2 km)	Arterial	TBD	\$133.7	\$15.2
Cleveland, HealthLine	Silver	2008	4.3 miles (6.9 km)	Arterial	11,300	\$199.4	\$33.4
Eugene-Springfield, EmX, Green Line	Bronze	2007	7.8 miles (12.5 km)	Arterial	10,000	\$24.6	\$3.9
Fort Collins, MAX	Projected: at least Basic BRT**	2014	5.0 miles (8.0 km)	Busway	4,022	\$86.8	\$18.8
Hartford, CTfastrak	Silver	2015	9.4 miles (15.1 km)	Busway	18,000	\$567.0	\$65.2
Las Vegas, Strip & Downtown Express (SDX)	Basic BRT	2010	1.2 miles (1.9 km)	Arterial	12,800	\$54.0	\$7.0
Los Angeles Metro, Orange Line	Bronze	2005	14.2 miles (22.9 km)	Busway	22,573	\$377.6	\$37.8
Pittsburgh, MLK Jr. East Busway (plus extension)	Bronze	1983 2003 (ext.)	9.3 miles (15.0 km)	Busway	23,600	\$181.5	\$41.5
Pittsburgh, South Busway	Basic BRT	1977	4.3 miles (6.9 km)	Busway	5,300	\$27.0	\$26.5
Pittsburgh, West Busway	Basic BRT	2000	5.0 miles (8.0 km)	Busway	7,600	\$275.0	\$81.8
Richmond, The Pulse	Bronze	2018	2.6 miles (4.2 km)	Arterial	7,075	\$64.9	\$8.7
San Bernardino, sbX	Bronze	2014	5.2 miles (8.4 km)	Regional Arterial	3,323	\$188.7	\$13.2
South Miami-Dade Busway	Projected: at least Basic BRT**	1997	6.5 miles (10.5 km)	Busway	16,000	\$66.2	\$12.9

* Corridor length includes only the portion of a corridor that meets the Basic BRT standard (ITDP 2019a).

** Fort Collins's MAX and the South Miami-Dade Busway have not been formally rated with the BRT Standard, but based on ITDP's preliminary assessment, they are referred to here as Basic BRT.

Ridership: Ridership is for whole corridor, not just the BRT-rated segment. Sources: Cleveland (Schmitt 2018b); Eugene 2013 data (BRT+ Centre of Excellence & WRI 2019); Fort Collins (Coltrain 2019); Hartford 2019 data (CTDOT 2019); Las Vegas (RTCSNV 2019); Los Angeles (LA Metro 2019a); Pittsburgh (Deto 2019); Richmond 2019 data (GRTC 2019d); San Bernardino 2017 data (Omnitrans 2018); South Miami-Dade 2016 data (Miami-Dade County DTPW 2018).

Capital Costs: Capital costs include fleet. Costs were converted to 2019 dollars assuming launch year as year of expenditure. Total length of the constructed corridor is used which may underestimate the cost per mile of the BRT-rated segment. Cleveland costs include extensive streetscape improvements to part of the corridor (FTA 2012; Greater Cleveland RTA 2018); Eugene (Thole et al. 2009); Fort Collins (Transfort 2014); Hartford (Frisman 2012); Las Vegas (BRT+ Centre of Excellence & WRI 2019); Los Angeles costs exclude 2012 extension, and include an estimated \$73 million (1991 USD) for prior right-of-way acquisition (Flynn et al. 2011, Perry 2017); Pittsburgh South Busway costs exclude right-of-way acquisition (Deto 2019, National Academies of Sciences, Engineering, and Medicine 2003c); Richmond (GRTC 2019f); San Bernardino (Omnitrans 2018); South Miami-Dade includes \$17 million (1997 USD) for right-of-way acquisition (National Academies of Sciences, Engineering, and Medicine 2003b).

APPENDIX B: CAPITAL FUNDING SOURCES FOR U.S. BRT CORRIDORS

CITY, SYSTEM, BRT CORRIDOR	TOTAL CAPITAL COST (CURRENT DOLLARS, MILLIONS)	FEDERAL SOURCES	FEDERAL SOURCES	REGIONAL & LOCAL SOURCES	OTHER SOURCES
Albuquerque, ART	\$133.70	80% federal <ul style="list-style-type: none"> • \$75.0m Small Starts • \$15.7m Urbanized Area Formula Program • \$12.1m FHWA flexible funds (CMAQ) • \$3.4m Bus and Bus Facilities Formula Funds (MAP-21) • \$0.8m Bus and Bus Facilities (SAFETEA-LU) 		20% regional & local <ul style="list-style-type: none"> • \$13m City Gross Receipts Tax Revenue Bonds • \$6.4m Department of Municipal Development Transportation Infrastructure Tax revenues • \$4.03m City General Obligation Bonds • \$3.1m City Capital Program • \$0.2m Bernalillo County General Funds 	
Cleveland, HealthLine	\$199.4	41.5% federal <ul style="list-style-type: none"> • \$82.2m New Starts • \$0.6m Fixed Guideway Modernization Funds 	37.6% state <ul style="list-style-type: none"> • \$50m Ohio DOT for Full Funding Grant Agreement (FFGA) • \$25m Ohio DOT for non-FFGA 	19.7% regional & local <ul style="list-style-type: none"> • \$10m NOACA MPO • \$8m City of Cleveland • \$17.6m RTA / local funds • \$3.8m RTA non-FFGA 	1.4% other <ul style="list-style-type: none"> • \$2.9m Cleveland Clinic for corridor improvements
Eugene-Springfield, EmX, Green Line	\$24.5m	80% federal <ul style="list-style-type: none"> • \$12.9m New Starts • \$6.7m Urbanized Area Formula Funds 		20% regional & local <ul style="list-style-type: none"> • \$4.9m Lane Transit District Capital Fund (local payroll tax) 	
Fort Collins, MAX	\$86.83m	80% federal <ul style="list-style-type: none"> • \$65.6m Small Starts • \$3.9m Grants for Buses and Bus Facilities 	11.4% state <ul style="list-style-type: none"> • \$9.9m Colorado DOT 	6.1% regional & local <ul style="list-style-type: none"> • \$2.2m City land value (maintenance facility & South Transit Center) • \$3.2m City of Fort Collins 	2.5% other <ul style="list-style-type: none"> • \$1.6m Colorado State University land value • \$0.6m Downtown Development Authority TIF revenue

CITY, SYSTEM, BRT CORRIDOR	TOTAL CAPITAL COST (CURRENT DOLLARS, MILLIONS)	FEDERAL SOURCES	FEDERAL SOURCES	REGIONAL & LOCAL SOURCES	OTHER SOURCES
Hartford, CTfastrak	\$567m	80.2% federal <ul style="list-style-type: none"> • \$275.3m New Starts • \$114m FHWA Flexible funds (CMAQ) • \$22.06m Grants for Buses and Bus Facilities • \$13.1m Fixed Guideway Modernization Funds • \$13m Urbanized Area Formula Funds • \$17.2m Other FTA funds 	19.8% state <ul style="list-style-type: none"> • \$112.2m CTDOT from various revenue sources, including gas tax, sales tax, and use tax 		
Las Vegas, Strip-Downtown Express (SDX)	\$54m	48% federal <ul style="list-style-type: none"> • \$25.9m New Starts 		52% regional & local <ul style="list-style-type: none"> • \$28.1m Sales tax-backed Commercial paper and/or 20-year bond 	
LA Metro Orange Line (busway and parallel multi-use trail)	\$304.6m	9.1% federal <ul style="list-style-type: none"> • \$17.5m Regional Surface Transportation Program (RSTP) • \$6m TEA-21 • \$1.4m TEA-21 High Priority • \$2.5m 5309 Bus Capital • \$0.4m Federal STIP 	47.9% state <ul style="list-style-type: none"> • \$145.5m Transportation Congestion Relief Program (TCRP) • \$0.3m State Regional Improvement Program 	43.1% regional & local <ul style="list-style-type: none"> • \$127.3m County Prop C Transit 25% sales tax • \$3.9m City of Los Angeles 	
Pittsburgh, MLK Jr. East Busway	\$113m	80% federal <ul style="list-style-type: none"> • \$90.4m Other FTA 	16.7% state <ul style="list-style-type: none"> • \$18.9m Commonwealth of Pennsylvania 	3.3% regional & local <ul style="list-style-type: none"> • \$3.8m County of Allegheny 	
Pittsburgh, MLK Jr. East Busway extension	\$68.5	80% federal <ul style="list-style-type: none"> • \$54.8m Other FTA 	10% state <ul style="list-style-type: none"> • \$6.9m Commonwealth of Pennsylvania 	10% regional & local <ul style="list-style-type: none"> • \$6.85m County of Allegheny 	
Pittsburgh, South Busway	\$27m	66.7% federal <ul style="list-style-type: none"> • \$18m Urban Mass Transportation Administration (UMTA) grant 	16.7% state <ul style="list-style-type: none"> • \$4.5m Commonwealth of Pennsylvania 	16.7% regional & local <ul style="list-style-type: none"> • \$4.5m County of Allegheny 	

CITY, SYSTEM, BRT CORRIDOR	TOTAL CAPITAL COST (CURRENT DOLLARS, MILLIONS)	FEDERAL SOURCES	FEDERAL SOURCES	REGIONAL & LOCAL SOURCES	OTHER SOURCES
Pittsburgh, West Busway	\$275m	80% federal <ul style="list-style-type: none"> · \$110m New Starts · \$110m FHWA funds 	16.7% state <ul style="list-style-type: none"> · \$45.8m Commonwealth of Pennsylvania 	3.3% regional & local <ul style="list-style-type: none"> · \$9.0m County of Allegheny 	
Richmond, The Pulse	\$64.9m	38.4% federal <ul style="list-style-type: none"> · \$24.9m TIGER 	49.3% state <ul style="list-style-type: none"> · \$32.0m VDOT and DRPT 	12.3% regional & local <ul style="list-style-type: none"> · \$7.6m City of Richmond · \$0.4m Henrico County 	
San Bernardino, sbX	\$188.7m	73.4% federal <ul style="list-style-type: none"> · \$75m Small Starts · \$42.6m Urbanized Area Formula Program · \$21m CMAQ 	16% state <ul style="list-style-type: none"> · \$14.3m Proposition 1B Bonds · \$15.9m other state funds 	10.6% regional & local <ul style="list-style-type: none"> · \$5.5m County half-cent sales tax · \$8m in-kind (permitting fees, facilities) from cities of San Bernardino and Loma Linda · \$6.5m other local funds 	

Note: Figures may not add to 100% due to rounding. Funding data for South-Miami Dade Busway unavailable.

Sources: Albuquerque (FTA 2019a); Cleveland (Callaghan 2007b, Greater Cleveland RTA 2018); Eugene-Springfield (Callaghan 2007b, Thole et al. 2009); Fort Collins (Pohl 2014); Hartford (Callaghan 2007b, FTA 2018e); Las Vegas (Callaghan 2007b); Los Angeles (Callaghan 2007b, Flynn et al. 2011); Pittsburgh (Callaghan 2007b, National Academies of Sciences, Engineering, and Medicine 2003c); Richmond (GRTC 2015); San Bernardino (Nisperos 2014, Omnitrans 2018, Perry 2017, Starcic 2015).

APPENDIX C: POTENTIAL FEDERAL FUNDING SOURCES FOR BRT

FUNDING SOURCE	FUNDING TYPE	DESCRIPTION	BRT-RELATED ELIGIBLE MODES OR PROJECTS	FUNDED BRT AND BUS CORRIDORS
BUILD (Better Utilizing Investments to Leverage Development) [previously TIGER] ^a	Discretionary grant	Investments in transportation infrastructure, including transit, that promise to achieve national objectives. Multijurisdictional and multi-modal projects eligible. Planning grants possible but scarce. Awards capped at \$25 million. Nearly any public entity is eligible.	Transit	<ul style="list-style-type: none"> Richmond, The Pulse (TIGER VI) Indianapolis, Red Line bus corridor (BUILD)
Buses and Bus Facilities Program [§ 5339, previously § 5309]	Formula and discretionary grants	Funding to states and transit agencies to replace, rehabilitate, and purchase buses and related equipment and to construct bus-related facilities.	Bus procurement and intermodal facilities	<ul style="list-style-type: none"> Albuquerque, ART Fort Collins, MAX Hartford CTfastrak LA Metro Orange Line Oakland, East Bay bus corridor
Capital Investment Grants (CIG) [§ 5309]	Discretionary grant	Funding for projects with a total estimated capital cost of \$300 million or more, or that are seeking \$100 million or more in Section 5309 CIG program funds.	<ul style="list-style-type: none"> New fixed-guideway projects Extensions to existing fixed-guideway systems 	<ul style="list-style-type: none"> Cleveland, HealthLine Eugene-Springfield, EmX Green Line Hartford, CTfastrak Las Vegas, SDX Pittsburgh, West Busway
CIG: Small Starts	Discretionary grant	Funding for projects with a total estimated capital cost of less than \$300 million and that are seeking less than \$100 million in Section 5309 CIG program funds.	<ul style="list-style-type: none"> New fixed-guideway projects Extensions to existing fixed-guideway systems Corridor-based BRT projects 	<ul style="list-style-type: none"> Albuquerque, ART Fort Collins, MAX San Bernardino, sbX Indianapolis, Red Line bus corridor Oakland, East Bay bus corridor San Francisco, Van Ness Improvement Project
CIG: Core Capacity	Discretionary grant	Substantial capital investments that increase capacity by not less than 10% in corridors that are at capacity today or will be in five years.	Corridor-based capital investments in existing fixed-guideway systems	
Community Development Block Grant Program	Formula grant	A flexible program that provides communities with resources to address a wide range of unique community development needs.		

FUNDING SOURCE	FUNDING TYPE	DESCRIPTION	BRT-RELATED ELIGIBLE MODES OR PROJECTS	FUNDED BRT AND BUS CORRIDORS
(CDBG) (as a local match for FTA grants)		Beginning in 1974, the CDBG program is one of the longest continuously run programs at the Department of Housing and Urban Development (HUD).		
Congestion Mitigation and Air Quality Improvement Program (CMAQ)	Formula grant	A flexible funding source to state and local governments for transportation projects and programs to help meet the requirements of the Clean Air Act. Funding is available to reduce congestion and improve air quality for areas that do not meet the National Ambient Air Quality Standards for ozone, carbon monoxide, or particulate matter (nonattainment areas) and for former nonattainment areas that are now in compliance (maintenance areas).	Any transit capital expenditures otherwise eligible for FTA funding that: (1) have an air-quality benefit and (2) are included in the MPO's current TIP	<ul style="list-style-type: none"> · Albuquerque, ART · Hartford, CT<i>fastrak</i> · San Bernardino, sbX · Oakland, East Bay bus corridor
Fixed Guideway Modernization Funds [§ 5309 (b)(2)]	Formula grant	A sub-program of the transit capital investment program providing formula funding to urbanized areas with rail systems in operation for at least seven years. Eligible entities include states, municipalities, transit agencies and others	Capital projects to modernize or improve existing fixed guideway systems not regulated by FRA	<ul style="list-style-type: none"> · Cleveland, HealthLine · Hartford, CT<i>fastrak</i>
Low or No Emission (Low-No) Vehicle Program [§ 5339(c)]	Discretionary grant	Sub-program of the Buses and Bus Facilities program. Provides funding to states and transit agencies to support the wider deployment of advanced propulsion technologies within the nation's transit fleet.	<ul style="list-style-type: none"> · Purchase or lease low- or no-emission transit buses and related equipment · Lease, construct or rehabilitate facilities to support low- or no-emission transit buses 	<ul style="list-style-type: none"> · Indianapolis, Red Line bus corridor
Pilot Program for Transit-Oriented Development Planning – Section 20005(b)	Discretionary grant	Funding to integrate land use and transportation with a transit capital investment that will seek CIG funding.	<ul style="list-style-type: none"> · Fixed guideway · Core capacity transit capital investment 	<ul style="list-style-type: none"> · Cleveland, HealthLine · Indianapolis, Blue Line bus corridor
Urbanized Area Formula Grants [§ 5307]	Formula grant	Funding for urbanized areas and governors for transit capital and operating assistance in urbanized areas and for transportation-related planning. An urbanized area is an incorporated area with a population of 50,000 or more that is designated as such by the U.S. Department of Commerce, Bureau of the Census.		<ul style="list-style-type: none"> · Albuquerque, ART · Eugene-Springfield, EmX, Green Line · Hartford, CT<i>fastrak</i> · San Bernardino, sbX

FUNDING SOURCE	FUNDING TYPE	DESCRIPTION	BRT-RELATED ELIGIBLE MODES OR PROJECTS	FUNDED BRT AND BUS CORRIDORS
(TIFIA (Transportation Infrastructure Finance and Innovation Act)	Secured (direct) loan, loan guarantee, and standby line of credit	The TIFIA program provides credit assistance for qualified projects of regional and national significance.	Highways and bridges, intelligent transportation systems, intermodal connectors, transit vehicles and facilities, intercity buses and facilities, transit-oriented development.	
Railroad Rehabilitation & Improvement Financing (RRIF)	Direct loans, loan guarantees	USDOT is authorized to provide direct loans and loan guarantees up to \$35.0 billion to finance development of railroad infrastructure.	Railroad, multimodal	
State of Good Repair (SGR) Grants [§ 5337]	Formula grant	Capital assistance for maintenance, replacement, and rehabilitation projects of high-intensity fixed-guideway and bus systems to help transit agencies maintain assets in a state of good repair. Additionally, SGR grants are eligible for developing and implementing Transit Asset Management plans.	High-intensity fixed-guideway and bus systems that have been in operation for at least 7 years	
Surface Transportation Block Grant Program (STBG)	Formula grant	Provides flexible funding that may be used by states and localities for projects to preserve and improve the conditions and performance of surface transportation.	Highway, bridge and tunnel projects on any public road, pedestrian and bicycle infrastructure, and transit capital projects, including intercity bus terminals.	

Note: An urbanized area is defined as an incorporated area with a population of 50,000 or more that is designated as such by the U.S. Department of Commerce, Bureau of the Census.

Sources: Callaghan 2007a and 2007b; Doyle 2019; FHWA 2017; FTA 2015c; FTA 2018a; FTA 2019c; FTA 2019d; USDOT 2014a; USDOT 2018; USDOT 2019

INTERVIEWS

ALBUQUERQUE

Anzures, Katherine. Marketing Specialist, ABQ RIDE. Phone interview with Aileen Carrigan. April 3, 2019.

Bernstein, Jean. President, Flying Star Cafe and member of Make Art Smart. Personal interview with Aileen Carrigan. Albuquerque, NM. March 20, 2019.

Brito, Russell. Planning Manager, Urban Design and Development, City of Albuquerque. Personal interview with Aileen Carrigan. Albuquerque, NM. March 21, 2019.

Cress, Diane. Treasurer, BikeABQ. Phone interview with Aileen Carrigan. March 20, 2019.

De Garmo, Andrew. Principal Planner, ABQ RIDE. Personal interview with Aileen Carrigan. Albuquerque, March 21, 2019.

De Reyes, Rick. Public Information Officer, ABQ RIDE. Phone interview with Aileen Carrigan. March 26, 2019.

Dekojova, Jitka. Landscape Architect, Dekker Perich Sabatini. Personal interview with Aileen Carrigan. Albuquerque, NM. March 20, 2019.

Gallegos, Yolanda. Attorney, Gallegos Legal Group. Personal interview with Aileen Carrigan. Albuquerque, NM. March 20, 2019.

Gleason, Will. Principal, Urban Designer, Dekker Perich Sabatini. Personal interview with Aileen Carrigan. Albuquerque, NM. March 20, 2019.

Griffin, Joanie. CEO, Sunny505. Phone interview with Aileen Carrigan. March 20, 2019.

Hill, Sandy. Owner, Studio Hill Design Ltd. Personal interview with Aileen Carrigan. Albuquerque, NM. March 21, 2019.

Kline, Lawrence. Principal Planner, ABQ RIDE. Personal interview with Aileen Carrigan. Albuquerque, NM. March 21, 2019.

Rael, Lawrence. Chief Operating Officer, City of Albuquerque. Personal interview with Aileen Carrigan. Albuquerque, NM. March 21, 2019.

Reed, Terra. Secretary, BikeABQ. Phone interview with Aileen Carrigan. April 1, 2019.

Toon, Bernie. Transit Director, City of Albuquerque. Personal interview with Aileen Carrigan. Albuquerque, NM. March 21, 2019.

HARTFORD

Carson, Charlie. Planning and Scheduling, *CTtransit*. Site visit and conversation with Aileen Carrigan and Julia Wallerce. Hartford, CT. March 28, 2019.

Cherolis, Tony. Coordinator, Transport Hartford Academy. Interview with Aileen Carrigan. Hartford, CT. March 28, 2019.

Davis, Randal. Special Assistant to Connecticut Transportation Commissioner. Site visit and conversation with Aileen Carrigan and Julia Wallerce. Hartford, CT. March 28, 2019.

Lawrence, Maureen. Transportation Supervising Planner, CTDOT. Site visit and conversation with Aileen Carrigan and Julia Wallerce. Hartford, CT. March 28, 2019.

Malone, Tim. Principal Planner, Capitol Region Council of Governments (CRCOG). Interview with Aileen Carrigan. Hartford, CT. March 29, 2019.

Radzins, Cara. Principal Transit Planner, CRCOG. Interview with Aileen Carrigan. Hartford, CT. March 29, 2019.

Rivers, Lisa. Transit Manager, CTDOT. Site visit and conversation with Aileen Carrigan and Julia Wallerce. Hartford, CT. March 28, 2019.

Wray, Lyle. Executive Director, CRCOG. Interview with Aileen Carrigan. Hartford, CT. March 29, 2019.

RICHMOND

Catrow, Ross. Executive Director, RVA Rapid Transit. Phone interview with Aileen Carrigan. March 21, 2019.

McDonough, Richard. Project Director, Lane Construction Corporation. Email with Aileen Carrigan. May 28, 2019.

McNally, Stephen. Director of Construction and Engineering, Greater Richmond Transit Company (GRTC). Phone interview with Aileen Carrigan. May 29, 2019.

Pace, Carrie Rose. Director of Communications, GRTC. Phone interview with Aileen Carrigan. March 14, 2019.

Williams, Garland. Director of Planning and Scheduling, GRTC. Phone interview with Aileen Carrigan. May 29, 2019.

SAN FRANCISCO BAY AREA

Calabrese, Christine. BRT Program Manager, Oakland DOT. Interview with Aileen Carrigan and Julia Wallerce. Oakland, CA. April 11, 2019.

Chang, Tilly. Executive Director, SFCTA. Interview with Aileen Carrigan and Julia Wallerce. San Francisco, CA. April 12, 2019.

David, Todd. Executive Director, San Francisco Housing Action Coalition. Interview with Aileen Carrigan and Julia Wallerce. San Francisco, CA. April 11, 2019.

Fleisher, Arielle. Transportation Policy Director, SPUR. Interview with Aileen Carrigan and Julia Wallerce. Oakland, CA. April 11, 2019.

Hiatt, Rachel. Principal Planner, SFCTA. Interview with Aileen Carrigan and Julia Wallerce. San Francisco, CA. April 12, 2019.

Medeiros, Jodie. Executive Director, WalkSF. Interview with Aileen Carrigan and Julia Wallerce. San Francisco, CA. April 12, 2019.

McGrath, James. Principal, Nelson\Nygaard. Phone interview with Aileen Carrigan and Julia Wallerce. April 12, 2019.

Sullivan, Cathleen. Principal Transportation Planner, Alameda County Transportation Commission. Interview with Aileen Carrigan and Julia Wallerce. Oakland, CA. April 11, 2019.

Tan, Mike. Capital Projects, SFCTA. Phone interview with Aileen Carrigan. March 13, 2019.

Tanois, Joseph. Construction Inspection Supervisor, City of Oakland. Interview with Aileen Carrigan and Julia Wallerce. Oakland, CA. April 11, 2019.

Villarreal, Susana. Housing and Community Development BRT Program Coordinator, City of Oakland. Interview with Aileen Carrigan and Julia Wallerce. Oakland, CA. April 11, 2019.

REFERENCES

- AASHTO Journal. 2015. "CTfastrak opens bus rapid transit on dedicated route between Connecticut cities." <https://news.transportation.org/Pages/040315ctfastrak.aspx>
- Aber, Judah. 2016. *Electric Bus Analysis for New York City Transit*. Columbia University. www.columbia.edu/~ja3041/Electric%20Bus%20Analysis%20for%20NYC%20Transit%20by%20J%20Aber%20Columbia%20University%20-%20May%202016.pdf
- ABQ RIDE. 2015. Categorical Exclusion Worksheet. FTA Region 6. https://abqbrt.blob.core.windows.net/resources/CatEx/Final_ART_CE%208-17-2015_web%20.pdf
- ABQ RIDE. 2019. Letter in Response to University Heights Association. March 4, 2019. www.uhanm.org/resources/Mayor%20Keller%20ART%20Response%20BT%20030419.pdf
- Albuquerque Journal. 2016. Albuquerque Rapid Transit (ART) in 3D and Virtual Reality. YouTube Video. Accessed August 7, 2019. www.youtube.com/watch?v=cbyvIRAW0y4
- Allard, Sam. 2017. "Transit Police Say RTA's Unofficial Fare-Enforcement Policies are Inequitable and Dangerous". *Cleveland Scene*. September 13, 2017. www.clevescene.com/cleveland/transit-police-say-rtas-unofficial-fare-enforcement-policies-are-inequitable-and-dangerous/Content?oid=10105428
- American Public Transportation Association (APTA). 2017. "Nearly 90% of Transit Ballot Initiatives Pass in 2017." November 8, 2017. www.apta.com/news-publications/press-releases/releases/nearly-90-of-transit-ballot-initiatives-pass-in-2017/
- American Public Transportation Association (APTA). 2018. "Public Transportation Wins Big at 85% Approval in the Midterm Elections." November 7, 2018. www.apta.com/news-publications/press-releases/releases/public-transportation-wins-big-at-85-approval-in-the-midterm-elections-2/
- Anzilotti, Eillie. 2017. "The MTA's New Payment System Could Promote Equity and Sustainability." *Fast Company*. November 6, 2017. www.fastcompany.com/40491062/the-mtas-new-payment-system-could-promote-equity-and-sustainability
- Ballotpedia. 2019. States with initiative or referendum. Accessed August 7, 2019. https://ballotpedia.org/States_with_initiative_or_referendum
- Bent, E. M., Hiatt, R., & Singa, K. 2008. Full-Featured Bus Rapid Transit in San Francisco, California: Toward a Comprehensive Planning Approach and Evaluation Framework. *Transportation Research Record*, 2072(1), 89–100. <https://doi.org/10.3141/2072-10>
- Bialick, Aaron. 2011. "What's the Hold Up for Van Ness BRT?" *StreetsblogSF*. December 2, 2011. <https://sf.streetsblog.org/2011/12/02/whats-the-hold-up-for-van-ness-brt/>

- Bialick, Aaron. 2013. "Van Ness BRT Delayed 2 More Years After Caltrans Pushes Wider Car Lanes." *StreetsblogSF*. July 11, 2013. <https://sf.streetsblog.org/2013/07/11/van-ness-brt-delayed-2-more-years-after-caltrans-pushes-wider-car-lanes/comment-page-1/>
- Bolton, Holly. 2018. "From Active Transportation to Assessed Value: Lessons from ULI's Small-Scale Development Forum." *UrbanLand*. Urban Land Institute. November 15, 2018. <https://urbanland.uli.org/sustainability/from-active-transportation-to-assessed-value-lessons-from-ulis-small-scale-development-forum/>
- Brakewood, Candice, Gregory S. Macfarlane, Kari Watkins. 2015. "The impact of real-time information on bus ridership in New York City." *Transportation Research Part C: Emerging Technologies*. Volume 53, 2015, Pages 59-75,
- Breckenridge, Tom. 2010. "RTA enforcement of fare evasion on HealthLine discriminates against blacks, ACLU and NAACP say". *The Plain Dealer*. December 15, 2010. http://blog.cleveland.com/metro/2010/12/rta_enforcement_of_fare_evasio.html
- Briggs, James. 2018. "Scooters showed why some people are afraid of spending big money on transit." *Indianapolis Star*. July 29, 2018. www.indystar.com/story/money/2018/07/29/when-scooters-arrived-indianapolis-pacers-bikeshare-lost-riders/837662002/
- BRT+ Centre of Excellence and WRI. 2019. Global BRTData. Version 3.43. Last modified: January 18, 2019. <https://brtdata.org>
- Cabanatuan, Michael. 2014. "Why bus rapid transit has stalled in Bay Area" *San Francisco Chronicle*. www.sfchronicle.com/bayarea/article/Why-bus-rapid-transit-has-stalled-in-Bay-Area-5461409.php
- California Governor's Office of Planning and Research. 2018. "Transportation Impacts (SB 743)." <http://opr.ca.gov/ceqa/updates/sb-743/>
- Callaghan, Lisa. 2007a. "Funding Bus Rapid Transit in the U.S." Submitted to Transportation Research Board November 15, 2007. www.reconnectingamerica.org/resource-center/browse-research/2007/funding-bus-rapid-transit-in-the-u-s/
- Callaghan, Lisa. 2007b. "Addendum to Funding Bus Rapid Transit in the U.S." www.reconnectingamerica.org/resource-center/browse-research/2007/addendum-to-funding-bus-rapid-transit-in-the-us/
- Campbell, Benjamin. 2017. "Boxed in." *Richmond Magazine*. <https://richmondmagazine.com/news/news/my-take-public-transportation-rev-benjamin-campbell/>
- Capitol Region Council of Governments (CRCOG). 2010. I-84 Viaduct Study, Hartford—Final Report. www.i84hartford.com/documents/misc/I84-Viaduct-Report110216.pdf
- Carl, David. 2017. "Mayoral candidates talk ART, panhandlers in debate." KOAT 7 News. October 30, 2017. www.koat.com/article/mayoral-candidates-talk-art-panhandlers-in-debate/13123506

Carrigan, Aileen et al. 2013. *Social, Environmental and Economic Impacts of Bus Rapid Transit*. Washington, D.C.: World Resources Institute. <http://wrirosscities.org/research/publication/social-environmental-and-economic-impacts-bus-rapid-transit>

Carter, V., M. Pastor, M. Wander. 2013. *An Agenda for Equity: A Framework for Building a Just Transportation System in Los Angeles County*. Executive Summary. USC Program for Environmental and Regional Equity. Commissioned by The California Endowment. https://dornsife.usc.edu/assets/sites/242/docs/Executive_Summary_Agenda_for_Equity_PERE_A.pdf

Cash, A. and P. Dow. 2017. "Beyond 'Build, Baby, Build': Towards A Nuanced Conversation About Affordable Housing Development." January 31, 2017. Urban Displacement Blog. www.urbandisplacement.org/blog/beyond-%E2%80%98build-baby-build%E2%80%99-towards-nuanced-conversation-about-affordable-housing-development

Center for Transportation and the Environment (CTE). 2019. Press Release: CTE to Conduct Zero Emission Bus (ZEB) Transition Plan for LA Metro. Atlanta, GA. February 2019. www.cte.tv/wp-content/uploads/2019/02/LA-Metro-Press-Release.pdf

Chicago Transit Authority (CTA). 2018. "CTA Expands Electric Bus Fleet." June 13, 2018. www.transitchicago.com/cta-expands-electric-bus-fleet/

City and County of Denver. 2019. Elevate Denver Bond Program. www.denvergov.org/content/denvergov/en/elevate-denver.html

City of Albuquerque. 2013. "Audit – Transportation Infrastructure Tax (Trans Tax) FY08 through FY10." Office of Internal Audit. www.cabq.gov/audit/news/audit-2013-transportation-infrastructure-tax-trans-tax-fy08-through-fy10

City of Albuquerque. 2018a. "Mayor Tim Keller: Our hard work to secure ART funding paid off." Press Release. August 21, 2019. www.cabq.gov/transit/news/mayor-tim-keller-our-hard-work-to-secure-art-funding-paid-off

City of Albuquerque. 2018b. "City ups bus order with New Flyer, plans to open ART lanes for special events." Press Release. December 12, 2018. www.cabq.gov/mayor/news/city-ups-bus-order-with-new-flyer-plans-to-open-art-lanes-for-special-events

City of Albuquerque. 2019. "City of Albuquerque and electric bus maker BYD reach settlement." Press Release. May 19, 2019. www.cabq.gov/transit/news/city-of-albuquerque-and-electric-bus-maker-byd-reach-settlement

City of Albuquerque, Office of Inspector General. 2018. Inspection of Albuquerque Rapid Transit Project Procurement. Report of Inspection: File Number OIG 18-0001-R. June 6, 2018. www.cabq.gov/inspectorgeneral/documents/rep-of-inspection-art.pdf/view

City of Richmond and Richmond Regional Transportation Planning Organization. 2017. The Pulse Corridor Plan. www.richmondregional.org/Publications/Reports_and_Documents/Planning/PulseCorridorPlan-July2017.pdf

Ciudad de México. 2011. "Metrobús Línea 4 - Buenavista - San Lazaro - Aeropuerto." https://web.archive.org/web/20110915131423/http://www.metrobus.df.gob.mx/docs/documentos_L4/MB-L4_ATNO_26082011.pdf

Coltrain, Nick. 2019. "Fort Collins' MAX bus might be a hit in its first five years, but expansion won't be easy." *Fort Collins Coloradoan*. May 16, 2019. <https://www.coloradoan.com/story/news/2019/05/17/fort-collins-transfort-max-bus-line-expansion-challenges-colorado/1189369001/>

Comé, Joseph. 2012. DOT Established Timely Controls for the TIGER Discretionary Grants Program, But Opportunities Exist To Strengthen Oversight Department of Transportation. Office of Inspector General Audit Report. September 20, 2012. www.oig.dot.gov/sites/default/files/TIGR%20Grants%20Final%20Report%2009202012.pdf

Congressional Research Service (CRS). 2011. "Accelerating Highway and Transit Project Delivery: Issues and Options for Congress." August 3, 2011. R41947. www.everycrsreport.com/reports/R41947.html

Congressional Research Service (CRS). 2016. "Public Transportation Capital Investment Grant (New Starts) Program: Background and Issues for Congress." June 20, 2016. R44534. www.everycrsreport.com/reports/R44534.html

Connecticut Department of Transportation (CTDOT). 2015. CTfastrak East Project Fact Sheet. November 2015. www.cttransit.com/sites/default/files/PDF_files/CTfastrak_Expansion_Fact_Sheet.pdf

Connecticut Department of Transportation (CTDOT). 2019a. I-84 Project website. Frequently Asked Questions. www.i84hartford.com/faq

Connecticut Department of Transportation (CTDOT). 2019b. CTfastrak. Bureau of Public Transportation. www.ct.gov/dot/cwp/view.asp?a=1386&Q=504888

Connecticut Main Street Center. 2015. CTfastrak Spurs Development While Connecting Communities. <https://ctmainstreet.org/ctfastrak-spurs-development-while-linking-communities/>

Cooper, Joe. 2018. "Newington PZC nixes affordable housing complex." *Hartford Business Journal*. October 25, 2018. www.hartfordbusiness.com/article/newington-pzc-nixes-affordable-housing-complex

Cowdrey, Bruce. 2012. "Innovative transit concept combines speed and convenience." *Right of Way*. November/December 2012. https://eweb.irwaonline.org/eweb/upload/web_novdec_12_CTfastrak.pdf

CPTDB Wiki. 2019. American Transit Agencies. Accessed August 12, 2019. https://cptdb.ca/wiki/index.php/American_Transit_Agencies

CTfastrak. 2016. CTfastrak Year One Report. Bureau of Public Transportation. https://portal.ct.gov/-/media/DOT/documents/dcommunications/Press_Release/CTfastrakYearOneReportpdf.pdf?la=en

CTtransit. 2018. The Simplest Way to Get the Lowest Fare System Wide. www.cttransit.com/news/simplest-way-get-lowest-fare

CTtransit. 2019. About CTfastrak. www.cttransit.com/about/about-ctfastrak

De la Rosa, Katie. 2015. "MAX gives right of way to moving trains for safety". *Coloradoan*. April 14, 2015. www.coloradoan.com/story/news/2015/04/14/max-gives-right-way-bnsf-trains-fort-collins/25752313/

Deto, Ryan. 2019. "How busways can lead Pittsburgh into an equitable public transit future." *Pittsburgh City Paper*. April 10, 2019. www.pghcitypaper.com/pittsburgh/how-busways-can-lead-pittsburgh-into-an-equitable-public-transit-future/Content?oid=14594516

Dovey, Rachel. 2017. "Albuquerque aims for simplicity in zoning overhaul." *NextCity*. November 22, 2017. <https://nextcity.org/daily/entry/albuquerque-zoning-overhaul>

Doyle, Sean. 2019. "BUILDing a better competitive grant program, in 5 steps". *T4America Blog*. Transportation For America. April 22, 2019. <http://t4america.org/2019/04/22/building-a-better-competitive-grant-program-in-5-steps/>

Drzewiecki, Erica. 2019. "Newington mulls moratorium on development of affordable housing." *New Britain Herald*. April 3, 2019. www.newbritainherald.com/NBH-Newington+News/348080/newington-mulls-moratorium-on-development-of-affordable-housing

Duduta, N. et al. 2015. *Traffic Safety on Bus Priority Systems*. Washington, D.C.: World Resources Institute. www.wri.org/publication/traffic-safety-bus-priority-systems

Dyer, Jessica. 2018. "City orders 10 diesel buses for ART routes." *Albuquerque Journal*. December 4, 2018. www.abqjournal.com/1253768/city-orders-new-art-buses.html

Eno Center for Transportation (Eno) & Transit Center. 2014. "Getting to the Route of It: The role of Governance in Regional Transit". October 2014. www.enotrans.org/etl-material/getting-to-the-route-of-it-the-role-of-governance-in-regional-transit/

Eucalitto, Garrett. 2016. "Fastrak to opportunity: Connecticut's first rapid transit corridor." Presented at 15th Annual New Partners for Smart Growth Conference. Portland. <https://newpartners.org/2016/wp-content/plugins/schedule-viewer/data/Friday/3.30-5.30pm/fastrak%20to%20opportunity/Eucalitto.PDF>

Fasano, Len. 2018. Fasano Statement on Governor Malloy's Celebration of CTfastrak and Inflated Ridership Numbers. March 28, 2018. <https://ctsenaterepublicans.com/2018/03/fasano-statement-on-governor-malloys-celebration-of-ctfastrak-and-inflated-ridership-numbers/>

Federal Highway Administration (FHWA). 2016. "Shared Mobility: Current Practices and Guiding Principles." U.S. Department of Transportation. <https://ops.fhwa.dot.gov/publications/fhwahop16022/fhwahop16022.pdf>

Federal Highway Administration (FHWA). 2017. Surface Transportation Block Grant Program (STBG). Special Federal-aid Funding. U.S. Department of Transportation. www.fhwa.dot.gov/specialfunding/stp/

Federal Transit Administration (FTA). 2004. "Transit at the Table: A Guide to Participation in Metropolitan Decision-making." U.S. Department of Transportation. www.planning.dot.gov/documents/TransitAtTable.pdf

Federal Transit Administration (FTA). 2009. "The EmX Franklin Corridor: BRT Project Evaluation." Final Report. U.S. Department of Transportation. April 2009. www.transit.dot.gov/sites/fta.dot.gov/files/EmX_FranklinCorridor_BRTProjectEvaluation.pdf

Federal Transit Administration (FTA). 2012. "Euclid Corridor Transportation Project Before-and-After Study. U.S. Department of Transportation. www.transit.dot.gov/funding/grant-programs/capital-investments/euclid-corridor-transportation-project-cleveland-ohio

Federal Transit Administration (FTA). 2015a. "FTA findings for Albuquerque Rapid Transit (ART) project - Route 66, Albuquerque, New Mexico." Letter dated August 26, 2015 from Donald Koski, Director of Planning and Program Development to Bruce Rizzieri, Director of ABQ RIDE. https://abqbrt.blob.core.windows.net/resources/CatEx/Approval_Letter_web.pdf

Federal Transit Administration (FTA). 2015b. Oversight Procedure 56 - Letter of No Prejudice Review. U.S. Department of Transportation. www.transit.dot.gov/sites/fta.dot.gov/files/docs/OP56%20Letter%20of%20No%20Prejudice%20Review%20-%20Sept%202015.pdf

Federal Transit Administration (FTA). 2015c. Grant Programs. U.S. Department of Transportation. www.transit.dot.gov/grants

Federal Transit Administration (FTA). 2016a. Bus Testing Requirements Frequently Asked Questions. U.S. Department of Transportation. www.transit.dot.gov/funding/procurement/third-party-procurement/bus-testing-requirements

Federal Transit Administration (FTA). 2016b. Categorical Exclusion. U.S. Department of Transportation. www.transit.dot.gov/regulations-and-guidance/environmental-programs/categorical-exclusion

Federal Transit Administration (FTA). 2016c. Final Interim Policy Guidance Federal Transit Administration Capital Investment Grant Program. U.S. Department of Transportation. www.transit.dot.gov/sites/fta.dot.gov/files/docs/FAST_Updated_Interim_Policy_Guidance_June%20_2016.pdf

Federal Transit Administration (FTA). 2017a. Bus Rapid Transit. U.S. Department of Transportation. January 6, 2017. www.transit.dot.gov/research-innovation/bus-rapid-transit

Federal Transit Administration (FTA). 2017b. *2016 National Transit Summary and Trends*. National Transit Database. Office of Budget and Policy. October 2017. www.transit.dot.gov/sites/fta.dot.gov/files/docs/ntd/66011/2016-ntst.pdf

Federal Transit Administration (FTA). 2018a. "About the Capital Investment Program." U.S. Department of Transportation. U.S. Department of Transportation. June 29, 2018 www.transit.dot.gov/funding/grant-programs/capital-investments/about-program

Federal Transit Administration (FTA). 2018b. Buy America Fact Sheet. U.S. Department of Transportation. www.transit.dot.gov/sites/fta.dot.gov/files/docs/Buy_America_Fact_Sheet.pdf

Federal Transit Administration (FTA). 2018c. Ensuring Equity in Service and Fare Changes. U.S. Department of Transportation. July 9, 2018. www.transit.dot.gov/regulations-and-guidance/civil-rights-ada/ensuring-equity-service-and-fare-changes

Federal Transit Administration (FTA). 2018c. “National Environmental Policy Act.” U.S. Department of Transportation. December 7, 2018. www.transit.dot.gov/regulations-and-guidance/environmental-programs/national-environmental-policy-act

Federal Transit Administration (FTA). 2018d. “U.S. Department of Transportation announces \$75 million grant agreement for bus rapid transit project in Albuquerque, New Mexico.” U.S. Department of Transportation. August 31, 2018. www.transit.dot.gov/about/news/us-department-transportation-announces-75-million-grant-agreement-bus-rapid-transit-0

Federal Transit Administration (FTA). 2018e. U.S. Department of Transportation Celebrates Opening of Connecticut’s First Bus Rapid Transit System. U.S. Department of Transportation. www.transit.dot.gov/about/news/us-department-transportation-celebrates-opening-connecticut%E2%80%99s-first-bus-rapid-transit

Federal Transit Administration (FTA). 2019a. “Albuquerque Rapid Transit project profile: FY 2019.” U.S. Department of Transportation. www.transit.dot.gov/funding/grant-programs/capital-investments/albuquerque-rapid-transit-project-profile-fy-2019

Federal Transit Administration (FTA). 2019b. Transportation Improvement Program (TIP). U.S. Department of Transportation. www.transit.dot.gov/regulations-and-guidance/transportation-planning/transportation-improvement-program-tip

Federal Transit Administration (FTA). 2019c. “Fiscal Year 2018 Transit-Oriented Development (TOD) Planning Projects”. U.S. Department of Transportation. www.transit.dot.gov/funding/grants/grant-programs/fiscal-year-2018-transit-oriented-development-tod-planning-projects

Federal Transit Administration (FTA). 2019d. Funding. U.S. Department of Transportation. Accessed August 13, 2019. www.transit.dot.gov/funding

Finn, Brendon. 2012. “BHLS - Bus with High Level of Service”. Presentation at Pontificia Universidad Catolica de Chile. April 20, 2012. <http://brt.cl/wp-content/uploads/2012/04/PUC-29th-March-Finn-BHLS.pdf>

Flynn, Jennifer et al. 2011. “Metro Orange Line BRT Project Evaluation”. Prepared for Federal Transit Administration. FTA Report No. 0004. October 2011. www.transit.dot.gov/sites/fta.dot.gov/files/FTA_Research_Report_0004_FINAL_2.pdf

Flynn, Jennifer and Menna Yassin. 2012. *Community-Oriented BRT: Urban Design, Amenities, and Placemaking*. Sponsored by FTA Office of Research, Demonstration and Innovation. FTA Report Number 0034. Washington, DC. www.transit.dot.gov/sites/fta.dot.gov/files/FTA_Report_No._0034.pdf

Foxx, Anthony. 2018. "Anthony Foxx: More Than Engineering: Infrastructure Shapes Places." *Using Dollars with Sense: Ideas for Better Infrastructure Choices*. Urban Institute. January 26, 2018. www.urban.org/infrastructure/more-engineering-infrastructure-shapes-places

Frisman, Paul. 2012. Hartford-New Britain Busway. Report 2012-R-0367. Connecticut Office of Legislative Research. www.cga.ct.gov/2012/rpt/2012-R-0367.htm

Gannett Fleming. 2015. "CTfastrak busway awarded 'Best Project.'" <http://gannettfleming.com/NewsRoom/NewsAndEvents/ctfastrak-busway-awarded-best-project>

Gladwell, Malcolm. 2000. *The Tipping Point: How Little Things Can Make a Difference*. Boston: Little, Brown, and Company.

Government Office of Accountability (GAO). 2010. Use of Contractors is Generally Enhancing Transit Project Oversight, and FTA is Taking Actions to Address Some Stakeholder Concerns. Report to Congressional Committees. September 2010. www.gao.gov/assets/310/309473.pdf

Government Office of Accountability (GAO). 2011. Requirements for Smaller Capital Projects Generally Seen as Less Burdensome. Report to Congressional Committees. August 2011. www.gao.gov/assets/330/322414.pdf

Greater Cleveland Regional Transit Authority (RTA). 2017. "Fare Collection Policy Changes." Service Alert. October 31, 2017. www.riderta.com/service-alerts/fare-collection-policy-changes

Greater Cleveland Regional Transit Authority (RTA). 2018. "RTA's HealthLine – the world-class standard for BRT service." October 2018. www.riderta.com/healthline/about

Greater Richmond Transit Company (GRTC) and Virginia Department of Rail and Public Transportation (DRPT). 2014a. *Broad Street Rapid Transit Study: Project Overview and History*. April 2014. <http://ridegrtc.com/media/main/brt/Broad%20Street%20Rapid%20Transit%20Study%20Overview%20and%20History.pdf>

Greater Richmond Transit Company (GRTC) and Virginia Department of Rail and Public Transportation (DRPT). 2014b. *Broad Street Rapid Transit Study: Economic Impact Analysis*. April 2014. http://ridegrtc.com/media/news/BRT_Econ_Impacts_FINAL_2014_May.pdf

Greater Richmond Transit Company (GRTC). 2015. Pulse Frequently Asked Questions. Revision 10/26/2015. www.ridegrtc.com/media/news/Final_BRT_FAQ_10-19-15.pdf

Greater Richmond Transit Company (GRTC). 2016. *The Pulse Public Outreach Plan*. http://ridegrtc.com/media/main/SUMMER_2016_Outreach_Plan_-_FINAL1.pdf

Greater Richmond Transit Company (GRTC). 2018a. *Momentum: Annual Report*. www.bluetoad.com/publication/?i=582025

Greater Richmond Transit Company (GRTC). 2018b. "Bon Secours and VCU Health secure sponsorship rights to GRTC Pulse." Press Release. April 5, 2018. <http://ridegrtc.com/news-initiatives/press-releases/bon-secours-and-vcu-health-secure-sponsorship-rights-to-grtc-pulse>

Greater Richmond Transit Company (GRTC). 2019a. GRTC Pulse (BRT) Milestones. Accessed August 7, 2019. <http://ridegrtc.com/brt/study-history/brt-milestones>

Greater Richmond Transit Company (GRTC). 2019b. Project History. Accessed August 7, 2019. <http://ridegrtc.com/brt/study-history/>

Greater Richmond Transit Company (GRTC). 2019c. Richmond Public Schools Ridership Program. Accessed August 7, 2019. <http://ridegrtc.com/fares/richmond-public-schools-ridership-program/>

Greater Richmond Transit Company (GRTC). 2019d. Trend Analysis. Board Presentation. May 21, 2019. http://ridegrtc.com/media/annual_reports/Ridership_Trends_5-21-19.pdf

Greater Richmond Transit Company (GRTC). 2019e. "GRTC reports 17% ridership increase during past year." Press Release. May 21, 2019. <http://ridegrtc.com/news-initiatives/press-releases/grtc-reports-17-ridership-increase-during-past-year/>

Greater Richmond Transit Company (GRTC). 2019f. GRTC Pulse Frequently Asked Questions. Accessed August 12, 2019. <http://ridegrtc.com/brt/frequently-asked-questions/>

Guzman-Barrera, Stephanie. 2016. "Country Club Plaza developer on offering new apartments under \$1,000 in rent." *Albuquerque Business First*. July 28, 2016. www.bizjournals.com/albuquerque/news/2016/07/28/country-club-plaza-developer-on-offering-new.html

Harrop, Chris. 2016. "BETTER LIFE ON THE 15: Denver, Aurora get different looks but headed in same direction on Colfax Avenue bus rapid transit". *Sentinel Colorado*. February 2, 2016 www.sentinelcolorado.com/news/denver-aurora-look-headed-in-same-direction-on-colfax-avenue-bus-rapid-transit/

Hartford Business Journal. 2015. "CTfastrak firm honored for shepherding project." *Hartford Business Journal*. October 23, 2015. www.hartfordbusiness.com/article/ct-fastrak-firm-honored-for-shepherding-project

Hidalgo, Dario. 2019. "Celebrating 18 years of TransMilenio: Growing pains and what lies ahead for Bogotá's BRT." *The City Fix*. February 28, 2019. <https://thecityfix.com/blog/celebrating-18-years-transmilenio-growing-pains-lies-ahead-bogotas-bus-rapid-transit-system-dario-hidalgo/>

Hinebaugh, Dennis. 2009. *Characteristics of Bus Rapid Transit for Decision-Making (CBRT)*. Roderick B. Diaz (editor). Washington, D.C.: Federal Transit Administration (FTA). www.transit.dot.gov/sites/fta.dot.gov/files/CBRT_2009_Update.pdf

Hook et al. 2013. "More Development for Your Transit Dollar: An Analysis of 21 North American Transit Corridors". New York: ITDP. www.itdp.org/2013/11/13/more-development-for-your-transit-dollar-an-analysis-of-21-north-american-transit-corridors/

IndyGo. 2019. "IndyGo finalizes new strategy to charge electric buses." Press Release. May 23, 2019. www.indygo.net/inside-indygo/indygo-finalizes-new-strategy-to-charge-electric-buses/

ITDP. 2016a. *The BRT Standard*. www.itdp.org/library/standards-and-guides/the-bus-rapid-transit-standard/

ITDP. 2016b. *The Online BRT Planning Guide* (4th ed.). <https://brtguide.itdp.org/branch/master/guide/>

ITDP. 2017. Going the Distance: The Path to Quality BRT in Connecticut. www.itdp.org/2017/10/23/highest-quality-brt-connecticut/

ITDP. 2019a. BRT Rankings. Accessed 7, 2019. www.itdp.org/library/standards-and-guides/the-bus-rapid-transit-standard/best-practices-2013/

ITDP. 2019b. What is TOD? Accessed August 9, 2019. www.itdp.org/library/standards-and-guides/tod3-0/what-is-tod/

Jaffe, Eric. 2014. "Transit Projects are About to Get Much, Much Easier in California." *CityLab*. July 8, 2014. www.citylab.com/transportation/2014/07/transit-projects-are-about-to-get-much-much-easier-in-california/374049/

Johnston, Caitlin. 2018. "Tampa Bay's new transit goal: Dedicated BRT lanes from St. Pete to USF Tampa." *Tampa Bay Times*. www.tampabay.com/blogs/baybuzz/2018/03/28/tampa-bays-new-transit-goal-dedicated-lanes-for-brt-from-st-pete-to-usf-tampa/

Kash, Gwen. 2018. "Vision Dissonance in Latin American Transit Reform." PhD diss. University of North Carolina at Chapel Hill. May 2018. <https://cdr.lib.unc.edu/concern/dissertations/9880vs47n>

Kimura, Donna. 2018. "Mixed-income development uplifts West Hartford, Conn." *Affordable Housing Finance*. July 1, 2018. www.housingfinance.com/developments/mixed-income-development-uplifts-west-hartford-conn_o

King, Ryan Caron. 2016. "In West Hartford, a look at the trials of transit-oriented development." WNPR.org. May 27, 2017. www.wnpr.org/post/west-hartford-look-trials-transit-oriented-development

King, S., and C. Belcher. 2018. "Navigating a new system." *Richmond Magazine*. <https://richmondmagazine.com/news/news/bus/>

King County Mobility Coalition. 2011. *Immigrant and Refugee Elders Transportation Project: Summary Report*. July 2011. http://metro.kingcounty.gov/tops/kccsnt/pdf/immigrant-and-refugee-elders-transportation-project_summary.pdf

Knight, Steve. 2018a. "Albuquerque's electric buses grounded after malfunctions." *Government Technology*. November 2, 2018. www.govtech.com/fs/transportation/Albuquerques-Electric-Buses-Grounded-After-Malfunctions.html

Knight, S., and M. Hayden. 2018. "Bus manufacturer taking 15 ART buses back to Calif. Plant." *Albuquerque Journal*. November 28, 2018. www.abqjournal.com/1251541/art-buses-head-back-to-california-plant.html

KRQE Media. 2018. "Mayor Keller announces federal funding for ART." August 21, 2018. www.krqe.com/news/albuquerque-metro/mayor-keller-announces-federal-funding-for-art/1386279717

Los Angeles County Metropolitan Transportation Authority (LA Metro). 2018. "We See a Better LA for Everyone: Metro Vision 2028 Strategic Plan." http://media.metro.net/about_us/vision-2028/report_metro_vision_2028_plan_2018.pdf

Los Angeles County Metropolitan Transportation Authority (LA Metro). 2019a. Interactive Estimated Ridership Stats. Accessed July 28, 2019. <http://isotp.metro.net/MetroRidership/IndexAllBus.aspx>

Los Angeles County Metropolitan Transportation Authority (LA Metro). 2019b. Joint Development Program. Accessed August 7, 2019. www.metro.net/projects/joint_dev_pgm/

Los Angeles County Metropolitan Transportation Authority (LA Metro). 2019c. Transportation Improvement Program. Accessed August 7, 2019. www.metro.net/projects/transport_improvement_pgm/

Lazarus, J.M. 2015. "Coalition to City Council: Slow your roll on rapid transit." *Richmond Free Press*. November 13, 2015. <http://richmondfreepress.com/news/2015/nov/13/coalition-city-council-slow-your-roll-rapid-transit/>

Lee, Mara. 2017. "While most cities add people Great Hartford population dips." *Hartford Courant*. March 25, 2017. www.courant.com/business/hc-census-population-hartford-20170324-story.html

Lee, Nadine. 2018. "Metro Vision 2028 - Leveraging BRT." Presentation at TRB's 6th Annual BRT Conference. Los Angeles, California. June 18, 2018.

Lindblom, Mike. 2018. "An uphill battle to get electric trolleybuses on Madison RapidRide route." *The Seattle Times*. August 27, 2018. www.seattletimes.com/seattle-news/transportation/metro-and-seattle-promised-electric-trolleybuses-on-a-new-madison-rapidride-turns-out-that-wont-work/

Linton, Joe. 2019. "Big wonky good news: L.A. City adopts people-centered transportation Metric: "VMT" in, "LOS" out." *Streetsblog LA*. August 6, 2019. <https://la.streetsblog.org/2019/08/06/big-wonky-good-news-l-a-city-adopts-people-centered-transportation-metric-vmt-in-los-out/>

- Lotshaw, Stephanie. 2011. "Profiles of American BRT: Pittsburgh's South Busway and East Busway." *Streetsblog USA*. usa.streetsblog.org/2011/06/20/profiles-in-american-brt-pittsburghs-south-busway-and-east-busway/
- Lyft. 2019. "Connecting your Clipper Card to your account." Accessed August 7, 2019. www.lyft.com/bikes/bay-wheels/clipper-card
- Majewski, Dan. 2013. "Central Avenue: The necessity of a strong vision, community champions and street trees." UrbanABQ. <https://urbanabq.com/2013/06/13/central-avenue-the-necessity-of-a-strong-vision-community-champions-and-street-trees/>
- Malouff, Dan. 2018. "Take a photo tour of Richmond's new bus rapid transit." *Greater Greater Washington*. September 18, 2018. <https://ggwash.org/view/69056/xx-photos-of-richmonds-new-brt>
- McKay, Dan. 2016a. "Meeting over bus rapid transit project turns chaotic." *Albuquerque Journal*. February 25, 2016. www.abqjournal.com/729738/shouts-interruptions-greet-abq-officials-at-rapid-transit-meeting.html
- McKay, Dan. 2016b. "Colorful language greets mayor at ART meeting." *Albuquerque Journal*. February 26, 2016. www.abqjournal.com/731874/colorful-language-greets-mayor-at-art-meeting.html
- McKay, Dan. 2016c. "Opponents say city misled FTA on ART project." *Albuquerque Journal*. April 21, 2016. www.abqjournal.com/761369/opponents-say-city-misled-fta-on-art-project.html
- McKay, Dan. 2016d. "City offers virtual tours of rapid transit stations." *Albuquerque Journal*. June 29, 2016. www.abqjournal.com/800178/abq-to-offer-virtual-tours-of-rapid-transit-project.html
- McKay, Dan. 2016e. "Albuquerque, N.M., Rapid Transit to deploy fleet of electric buses." *Albuquerque Journal*. July 13, 2016. www.govtech.com/fs/Albuquerque-NM-Rapid-Transit-to-Deploy-Fleet-of-Electric-Buses.html
- McKay, Dan. 2016f. "Councilor supports ART on conditions." *Albuquerque Journal*. March 17, 2016. <https://www.abqjournal.com/741815/councilor-supports-art-on-conditions.html>
- Metropolitan Transportation Commission (MTC). 2018. "A Guide to the San Francisco Bay Area's Transportation Improvement Program, or TIP." September 2018. [https://mtc.ca.gov/sites/default/files/Guide to the 2019 TIP.pdf](https://mtc.ca.gov/sites/default/files/Guide%20to%20the%202019%20TIP.pdf)
- Miami-Dade County Department of Transportation and Public Works (DTPW). 2018. South Corridor Rapid Transit Project: Project Update. Prepared for Miami-Dade Transportation Planning Organization Freight Transportation Advisory Committee. June 13, 2018. www.miamidadetpo.org/library/presentations/Freight-Transportation-Advisory-Committee/dtpw-south-corridor-rapid-transit-project-update-2018-06-13.pdf
- Mid-Region Council of Governments. 2019. UNM/CNM/Sun-Port Study. www.mrcog-nm.gov/339/UNM-CNM-Sunport-Study

Mid-Region Metropolitan Planning Organization. 2019. High Fatal and Injury Network. <http://mrmpo.maps.arcgis.com/apps/View/index.html?appid=71c867167fb74e0c8a48c44eee43cc28>

National Association of City Transportation Officials. 2017. "Better boarding, better buses: streamlining boarding & fares." https://nacto.org/wp-content/uploads/2017/02/NACTO_Better-Buses_Boarding.pdf

National Academies of Sciences, Engineering, and Medicine. 2003a. *Bus Rapid Transit, Volume 2: Implementation Guidelines*. Washington, DC: The National Academies Press. <https://doi.org/10.17226/21947>

National Academies of Sciences, Engineering, and Medicine. 2003b. "Miami, Florida South Miami-Dade Busway." *Bus Rapid Transit, Volume 1: Case Studies in Bus Rapid Transit*. Appendix B. Washington, DC: The National Academies Press. http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp90v1_cs/miami.pdf

National Academies of Sciences, Engineering, and Medicine. 2003c. "Pittsburgh, Pennsylvania South, East, and West Busways." *Bus Rapid Transit, Volume 1: Case Studies in Bus Rapid Transit*. Appendix B. Washington, DC: The National Academies Press. http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp90v1_cs/Pittsburgh.pdf

National Environmental Policy Act (NEPA). 2019. Categorical Exclusions. Accessed August 9, 2019. <https://ceq.doe.gov/nepa-practice/categorical-exclusions.html>

National Park Service. 2019. Route 66 Scenic Byways Programs. Accessed August 7, 2019. <https://ncptt.nps.gov/rt66/scenic-byway-programs/>

Nelson, Arthur and Joanna Ganning. 2015. "National Study of BRT Development Outcomes." Final Report NITC-UU-14-650. Prepared for National Institute for Transportation and Communities. https://pdxscholar.library.pdx.edu/trec_reports/32/

Nisperos, Neil. 2014. "sbX rapid transit line ready to roll out this month in San Bernardino." *The San Bernardino Sun*. April 19, 2014. <https://www.sbsun.com/2014/04/19/sbx-rapid-transit-line-ready-to-roll-out-this-month-in-san-bernardino/>

Oliver, Ned. 2015. "City to rethink GRTC routes, largely unchanged since trolley days." *Richmond Times-Dispatch*. December 26, 2015. www.richmond.com/news/local/city-of-richmond/city-to-rethink-grtc-routes-largely-unchanged-since-trolley-days/article_e31d93fa-8d3f-5ef2-af10-2f177c674e4e.html

Oliver, Ned. 2016. "McAuliffe gives ultimatum on city bus rapid transit project." *Richmond Times-Dispatch*. February 2, 2016. www.richmond.com/news/local/city-of-richmond/mcauliffe-gives-ultimatum-on-city-bus-rapid-transit-project/article_6104c962-d29e-5ebe-aa33-4dc0d13b429c.html

Omnitrans. 2018. *sbX Green Line Before and After Study*. May 2018. www.omnitrans.org/news-and-resources/plans-reports-and-guidelines/files/sbX%20Before%20&%20After%20Study.pdf

Orr, Susan. 2016. "Marion County votes for higher taxes to pay for expanded transit." *Indianapolis Business Journal*. November 8, 2016. www.ibj.com/articles/61174-marion-county-votes-for-higher-taxes-to-pay-for-expanded-transit

Orr, Susan. 2018. "Pacers Bikeshare rolling out major expansion in 2019." *Indianapolis Business Journal*. December 7, 2018. www.ibj.com/articles/71614-pacers-bikeshare-rolling-out-major-expansion-in-2019

Parsons Transportation Group and Michael Baker Jr, Inc. 2014. *Broad Street Rapid Transit Study: Draft Environmental Assessment*. http://ridegrtc.com/media/news/Broad_Street_Rapid_Transit_Study_EA_March_2014.pdf

Partnership for Smart Growth. 2019. "We want better transit, walking, and biking in Richmond." <https://www.psgrichmond.org/projects>

Penn State University. 2019a. Bus Database. Larson Transportation Institute's Bus Research and Testing Center. Accessed August 7, 2019. <http://apps.altoonabustest.psu.edu/>

Penn State University. 2019b. Test Reports. Larson Transportation Institute's Bus Research and Testing Center. Accessed August 7, 2019. www.altoonabustest.psu.edu/test-reports/index.aspx

Penn State University. 2019c. Time and Fee Schedule. Larson Transportation Institute's Bus Research and Testing Center. Accessed August 7, 2019. www.altoonabustest.psu.edu/assets/docs/bus%20docs/Fee-Schedule-10-2018.pdf

Perry, John. 2017. Measuring the Accuracy of Bus Rapid Transit Forecasts. *Journal of Public Transportation*. Vol. 20, No. 1. <https://scholarcommons.usf.edu/cgi/viewcontent.cgi?article=1592&context=jpt>

Pohl, Jason. 2014. "Hundreds line up Saturday to ride new MAX system." *The Coloradoan*. May 12, 2014. <https://amp.coloradoan.com/amp/8940973>

Poole, Heather. 2018. "Special Transportation Fund." Office of Legislative Research. 2018-R-0088. www.cga.ct.gov/2018/rpt/pdf/2018-R-0088.pdf

Porter, Mikaela. 2018. "As construction ends on West Hartford New Park Avenue apartments, tenants set to move in May 1." *Hartford Courant*. April 14, 2018. www.courant.com/community/west-hartford/hc-west-hartford-housing-authority-new-park-avenue-project-20180323-story.html

POWER, DataCenter, and Urban Habitat. 2012. "Next Stop: Justice. Race and the Environment at the Center of Transit Planning." www.datacenter.org/wp-content/uploads/POWER_NextStop_Eng_midrez.pdf

Prozzi, Joland, et al. 2014. "Public use of rail right-of-way in urban areas." Texas A&M Transportation Institute. <https://static.tti.tamu.edu/tti.tamu.edu/documents/PRC-14-12-F.pdf>

Quigley, Winthrop. 2016. "ART project could connect gems in string of Duke City neighborhoods." *Albuquerque Journal*. October 6, 2016. www.abqjournal.com/861381/art-could-link-diverse-neighborhoods.html
 Railvolution. 2018. "Transit and Displacement." January 28, 2018. <https://railvolution.org/transit-and-displacement/>

Regional Transportation Commission of Southern Nevada (RTC SNV). 2019. Transportation Access Advisory Committee. Monthly Operating Reports. July 24, 2019. www.rtcnv.com/wp-content/uploads/2019/07/TAAC-2019-07-24-AGENDA-FINAL.pdf

Riveron, Natasha. 2019. "A conversation with Tamika Butler." Smart Growth America blog. January 3, 2019. <https://smartgrowthamerica.org/a-conversation-with-tamika-butler/>

Robinson, Mark. 2016. "Full speed ahead: Richmond City Council approves Broad Street bus rapid transit project." *Richmond Mag*. February 9, 2016. <https://richmondmagazine.com/news/news/richmond-city-council-approves-brt/>

Robinson, Mark. 2017. "Richmond Planning Commission approves zoning changes for Scott's Addition, North Boulevard." *Richmond Times-Dispatch*. September 5, 2017. www.richmond.com/news/local/city-of-richmond/richmond-planning-commission-approves-zoning-changes-for-scott-s-addition/article_609a09ba-c50c-5062-9012-014a4277b892.html

Robinson, Mark. 2018a. "Local, state leaders celebrate launch of GRTC Pulse bus rapid transit line." *Richmond Times-Dispatch*. June 25, 2018. www.richmond.com/news/local/city-of-richmond/local-state-leaders-celebrate-launch-of-grtc-pulse-bus-rapid/article_069d6efd-efc9-5c80-8435-1dea7ace07fd.html

Robinson, Mark. 2018b. "Richmond City Council OKs special fund to aid businesses affected by GRTC Pulse construction." *Richmond Times-Dispatch*. June 25, 2018. www.richmond.com/news/local/city-of-richmond/richmond-city-council-oks-special-fund-to-aid-businesses-affected/article_b08546fb-b7f8-5b14-9e26-2cfbece3eb52.html

Rojas, C. Suarez. 2018. "Launch of expanded GRTC service in Henrico reflects shifting attitude toward mass transit." *Richmond Times-Dispatch*. September 22, 2018. www.richmond.com/news/local/henrico/launch-of-expanded-grtc-service-in-henrico-reflects-shifting-attitude/article_fc0397a2-bbcf-5f68-a110-b8f423f466bd.html

Rojas, C. Suarez. 2019a. "Despite outperforming ridership goals, GRTC is \$1 million below budgeted revenue." *Richmond Times-Dispatch*. January 17, 2019. www.richmond.com/news/local/city-of-richmond/despite-outperforming-ridership-goals-grtc-is-million-below-budgeted-revenue/article_16a49998-2dd3-5f1d-b3a4-7ae451e7a34a.html

Rojas, C. Suarez. 2019b. "Council slashes \$965,000 funding proposal for GRTC." *Richmond Times-Dispatch*. April 29, 2019. www.richmond.com/news/local/council-slashes-funding-proposal-for-grtc/article_ed64dcae-5444-5cdd-a1ec-e29381677042.html

Roldan, Roberto [@ByRobertoR]. 2019, May 21. "At the GRTC board meeting this morning they are looking at proposed signage for a new anti-fare evasion campaign. This comes after revelations during the #rvacouncil budget process that GRTC has still not started ticketing people caught riding without paying." <https://twitter.com/ByRobertoR/status/1130814642673131520>

Russo, Ed. 2016. "Cost rises for EmX's westward expansion." *The Register-Guard*. September 3, 2016. <http://projects.registerguard.com/rg/news/local/34758454-75/west-eugene-emx-route-to-cost-100-million.html.csp>

RVA Bike Share. 2019. System Map. Accessed August 8, 2019. www.rvabikes.com/#full-map

RVA Rapid Transit. 2019a. "GRTC's ridership up 23% year-over-year in March." April 16, 2019. www.rvarapidtransit.org/blog/grtcs-ridership-up-23-year-over-year-in-march

RVA Rapid Transit. 2019b. Richmond. www.rvarapidtransit.org/richmond-1

RVA Transit. 2019c. A transit system for the Richmond Region. www.rvarapidtransit.org/regional-vision-plan

St. John, Paige. 2018. "Stalls, stops and breakdowns: Problems plague push for electric buses." *Los Angeles Times*. May 20, 2018. www.latimes.com/local/lanow/la-me-electric-buses-20180520-story.html

Sachs, David. 2017a. "Denver Streets Partnership to Denverites: Convince Electeds to Restore Ped-Bike Funding." *Streetsblog Denver*. June 13, 2017. <https://denver.streetsblog.org/2017/06/13/denver-streets-partnership-to-denverites-convince-electeds-to-restore-ped-bike-funding/>

Sachs, David. 2017b. "Denver Public Works Unveils Plan for True Bus Rapid Transit on East Colfax Avenue." *Streetsblog Denver*. July 27, 2017. <https://denver.streetsblog.org/2017/07/27/denver-public-works-unveils-plan-for-true-bus-rapid-transit-on-east-colfax-avenue/>

Salazar, Martin. 2018. "ART contractors vow to resolve concerns as city chases \$75M." *Albuquerque Journal*. January 15, 2018. www.abqjournal.com/1119349/art-contractors-vow-to-resolve-concerns-as-city-chases-75m.html

Sanchez, Robert. 2016. "\$4.1 million for affordable housing." Connecticut House Democrats. www.housedems.ct.gov/article/4.1-million-for-affordable-housing

San Francisco County Transportation Authority (SFCTA). 2006. "Central Freeway Replacement Project Ancillary Project Study." www.sfcta.org/sites/default/files/content/legacy/documents/CentralFreewayReplacementProjectAncillaryProjectStudy021206.pdf

San Francisco County Transportation Authority (SFCTA). 2013. *Van Ness Avenue Bus Rapid Transit Project: Final Environmental Impact Statement / Environmental Impact Report*. Vols. II and II. www.sfcta.org/sites/default/files/2019-02/Van_Ness_BRT_Final_EIS_EIR_Volume_I.pdf and www.sfcta.org/sites/default/files/2019-02/Van_Ness_BRT_Final_EIS_EIR_Vol_II.pdf

San Francisco Municipal Transportation Authority (SFMTA). 2018. Press Release – Van Ness Left Turns. June 28, 2018. www.sfmta.com/press-releases/press-release-van-ness-left-turns

San Francisco Municipal Transportation Authority (SFMTA). 2019. Van Ness Business Advisory Committee. Accessed August 6, 2019. www.sfmta.com/committees/van-ness-business-advisory-committee

Sapin, Rachel. 2017. "Funding announced for ART project." May 1, 2017. *Albuquerque Business First*. www.bizjournals.com/albuquerque/news/2017/05/01/funding-announced-for-art-project.html

Schmitt, Angie. 2017a. "Why Cities Are Starting to Decriminalize Fare Evasion." *Streetsblog USA*. March 8, 2017. <https://usa.streetsblog.org/2017/03/08/why-cities-are-starting-to-decriminalize-fare-evasion/>

Schmitt, Angie. 2017b. "Cleveland Police Enforcement of Transit 'Proof-of-Payment' Ruled Unconstitutional." *Streetsblog USA*. November 2, 2017. <https://usa.streetsblog.org/2017/11/02/cleveland-police-enforcement-of-transit-proof-of-payment-ruled-unconstitutional/>

Schmitt, Angie. 2017c. "Hartford eliminates parking minimums citywide." *Streetsblog USA*. December 13, 2017. <https://usa.streetsblog.org/2017/12/13/hartford-eliminates-parking-minimums-citywide/>

Schmitt, Angie. 2018a. "Albuquerque's fledgling BRT has problems, but don't panic." *Streetsblog USA*. January 22, 2018. <https://usa.streetsblog.org/2018/01/22/albuquerques-fledgling-brt-has-problems-but-theyre-easy-to-solve/>

Schmitt, Angie. 2018b. "America's early bus rapid transit systems are working well." *Streetsblog USA*. November 5, 2018. <https://usa.streetsblog.org/2018/11/05/checking-in-on-americas-pioneering-bus-rapid-transit-systems/>

Schmitt, Angie. 2018c. "Why are We Still Waiting for Electric Buses?" *Streetsblog USA*. December 7, 2018. <https://usa.streetsblog.org/2018/12/07/why-are-we-still-waiting-for-electric-buses/>

Seattle DOT. 2019. "RapidRide G Line - Downtown Seattle to First Hill to Madison Valley (Madison Street Bus Rapid Transit) project update." www.seattle.gov/transportation/projects-and-programs/programs/transit-program/transit-plus-multimodal-corridor-program/madison-street-bus-rapid-transit

Segall, Grant. 2017. "New HealthLine fare enforcement method causes delays and confusion." *The Plain Dealer*. November 2, 2017. www.cleveland.com/metro/2017/11/new_healthline_fare_enforcemen.html

Shapiro, Ellen. 2006. "Metro Design Studio." *Communication Arts*. September/October 2006. www.commarts.com/features/metro-design-studio

Slipek, Edwin. 2018. "Incompatible heavy metal." *Style Weekly*. May 23, 2018. www.styleweekly.com/richmond/incompatible-heavy-metal/Content?oid=9079425

Spiers, Jonathan. 2016. "City weighs Scott's Addition rezoning." *Richmond Biz Sense.com*. December 1, 2016. <https://richmondbizsense.com/2016/12/01/city-weighs-scotts-addition-rezoning/>

Spiers, Jonathan. 2017. "New zoning in place for Scott's Addition, Boulevard." Richmond Biz Sense.com. September 28, 2017. <https://richmondbizsense.com/2017/09/28/new-zoning-place-scotts-addition-boulevard/>

Starcic, Janna. 2015. "Omnitrans sbX Green Line service." Metro Magazine. March 30, 2015. www.metro-magazine.com/bus/article/293730/omnitrans-sbx-green-line-service

Stuehrenberg, Justin. 2018. "Reconstructing the Network Around BRT." Presentation at TRB's 6th Annual BRT Conference. Los Angeles, California. June 18, 2019.

Tellis, Ray. 2018. "Federal Transit Administration BRT Guidelines." Presented at 6th National BRT Conference: No Longer an Emerging Mode. Transportation Review Board. Los Angeles. June 18-20, 2018. <http://onlinepubs.trb.org/onlinepubs/Conferences/2018/BRT/RTellis.pdf>

Thole, Cheryl, Alasdair Cain, and Jennifer Flynn. 2009. *The EmX Franklin Corridor – BRT Project Evaluation*. Funded by FTA. www.transit.dot.gov/sites/fta.dot.gov/files/EmX_FranklinCorridor_BRTProjectEvaluation.pdf

The Denver Post. 2016. "U.S. 36 Flatiron Flyer can drive on shoulders." April 29, 2016. www.denverpost.com/2016/04/29/u-s-36-flatiron-flyer-can-drive-on-shoulders/

The Greater Boston BRT Study Group. 2015. *Better Rapid Transit for Greater Boston*. BostonBRT. www.bostonbrt.org/the-brt-report

The Superlative Group. 2019. Joint naming rights partners announced for GRTC. www.superlativegroup.com/portfolio_page/joint-naming-rights-partners-announced-for-grtc/

Trail Link. 2019a. CTfastrak Multi-use Trail. www.traillink.com/trail/ctfastrak-multi-use-trail/

Trail Link. 2019b. Orange Line Bike Path. www.traillink.com/trail/orange-line-bike-path/

Transfort. 2014. MAX BRT Overview. Accessed August 12, 2019. http://www.ridetransfort.com/img/site_specific/uploads/MAX_BRT_Overview.pdf

Transfort. 2019. Bike-n-ride. <http://ridetransfort.com/abouttransfort/bike-n-ride>

Transit App. 2015. "The best bus in America?" <https://medium.com/transit-app/is-this-the-best-bus-in-america-b40b7bb4115d>

Transit Center. 2016. "In Richmond, new coalitions are building better transit." March 29, 2016. <http://transitcenter.org/2016/03/29/richmond-coalition-transit/>

Transit Center. 2019a. "Why Decriminalize Fare Evasion?" January 9, 2019. <http://transitcenter.org/2019/01/09/why-decriminalize-fare-evasion/>

Transit Center. 2019b. "Who's On Board 2019: How to Win Back America's Transit Riders." <http://transitcenter.org/publications/whos-on-board-2019/#findings>

Transportation for America. 2014. *The Innovative MPO: Smart Planning, Strong Communities*. December 2014. <http://t4america.org/maps-tools/the-innovative-mpo/>

Transportation for America. 2019. "Stuck in the Station." Infographic. Accessed August 7, 2019. <http://t4america.org/transitfundingdelays/>

Tsay, Shin-Pei, et al. 2015. *A People's History of Recent Urban Transportation Innovation*. Transit Center. New York. <http://transitcenter.org/publications/a-peoples-history-of-recent-urban-transportation-innovation/#foreword>

University of Minnesota. 2016. "Access across America." Accessibility Observatory. <http://access.umn.edu/>

University of New Mexico. 2019. Faculty & Staff. Office of Institutional Analytics. <https://oia.unm.edu/facts-and-figures/data-visualizations/faculty--staff.html>

UrbanABQ. 2016. "Take action: Email your city councilor and/or speak at City Council on Monday." March 17, 2016. <https://urbanabq.com/2016/03/17/takeactionforart/>

U.S. Department of Transportation (USDOT). 2014a. TIGER 2014 Project Fact Sheets. www.transportation.gov/sites/dot.gov/files/docs/TIGER14_Project_FactSheets.pdf#page=47

U.S. Department of Transportation (USDOT). 2014b. "U.S. Transportation Secretary Foxx announces \$24.9 million in TIGER funds for Richmond bus rapid transit." Press Release. September 13, 2014. www.transportation.gov/briefing-room/us-transportation-secretary-foxx-announces-249-million-tiger-funds-richmond-bus-rapid

U.S. Department of Transportation (USDOT). 2018. Transportation Infrastructure Finance and Innovation Act (TIFIA). Build America Bureau. June 27, 2018. www.transportation.gov/buildamerica/programs-services/tifa/overview

U.S. Department of Transportation (USDOT). 2019. About BUILD Grants. April 17, 2019. www.transportation.gov/BUILDgrants/about

Victoria Transport Policy Institute. 2018. TDM Encyclopedia. Accessed August 9, 2019. www.vtppi.org/tdm/tdm25.htm

Virginia Department of Historic Resources. 2018. 127-0375 Broad Street Commercial Historic District. www.dhr.virginia.gov/historic-registers/127-0375/

Virginia Department of Rail and Public Transportation (DRPT). 2018. Broad Street Rapid Transit Study. www.drpt.virginia.gov/planning/projects/broad-street-rapid-transit-study/

Vock, Daniel. 2017. "Bus Network Redesigns Are the 'Hottest Trend in Transit'." *Governing*. September 18, 2017. www.govtech.com/fs/Bus-Network-Redesigns-are-the-Hottest-Trend-in-Transit.html

Wanek-Libman, Mischa. 2019. "Albuquerque debuts new ART bus." *Mass Transit*. www.masstransitmag.com/bus/vehicles/gas-diesel-cng-lng/article/21084659/albuquerque-debuts-new-art-bus

Washington County Regional Rail Authority et al. 2015. *Gateway Corridor Goldline BRT Draft Environmental Impact Statement: Managed Lane Bus Rapid Transit Alternative Technical Memo*. http://thegatewaycorridor.com/wp-content/uploads/2016/03/Managed-Lane-Tech-Memo_for-website.pdf

Wattenhofer, Jeff. 2016. "Ballot Measure M." *Curbed Los Angeles*. <https://la.curbed.com/2016/10/11/13239050/explain-ballot-measure-m-los-angeles>

Weber, Erik, Ethan Arpi, and Aileen Carrigan. 2011. *From Here to There: A Creative Guide to Making Public Transport the Way to Go*. Washington, D.C.: World Resources Institute. www.wrirosscities.org/sites/default/files/From-Here-to-There-EMBARQ.pdf

Wirtschaftler, Eli. 2017. "Bus-Only Lanes Drive Fears of Displacement in East Oakland." *KALW 91.7 San Francisco*. November 1, 2017. www.kalw.org/post/bus-only-lanes-drive-fears-displacement-east-oakland#stream/0

WSP. 2016. *Transit-Oriented Development Analysis & Implementation Strategies Report*. Prepared for CTDOT. In association with HR&A Advisors. www.ct.gov/dot/lib/dot/tod/ctfastrak_final_report_book_2016.pdf

WTVR. 2015. "GRTC answers 17 questions about the \$54 million bus rapid transit plan." July 26, 2016. <https://wtvr.com/2015/07/26/grtc-answers-17-questions-about-the-bus-rapid-transit-plan/>

Zuk, M., and Chapple, K. 2015a. Urban Displacement Project. UC Berkeley Case Studies. www.urbandisplacement.org/research#section-177

Zuk, M., Chapple, K. 2015b. "Case Studies on Gentrification and Displacement in the San Francisco Bay Area." University of California, Berkeley Center for Community Innovation. www.urbandisplacement.org/sites/default/files/images/case_studies_on_gentrification_and_displacement_full_report.pdf#page=4

Zullo, Robert. 2016a. "State board endorses contract to build Richmond's bus rapid transit" *Richmond Times-Dispatch*. April 20, 2016. www.richmond.com/news/local/state-board-endorses-contract-to-build-richmond-s-bus-rapid/article_09dddedc-8677-5aaa-a22e-c4c23960d395.html

Zullo, Robert. 2016b. "Transit vision plan is an 'immense opportunity' for Richmond region, advocate says." *Richmond Times-Dispatch*. December 16, 2016. www.richmond.com/news/transit-vision-plan-is-an-immense-opportunity-for-richmond-region/article_b7566fcd-e6cb-502a-8417-fad19e6633b5.html

Zullo, R., and N. Oliver. 2017. "When will Pulse construction end? VDOT, city and GRTC can't say for sure." *Richmond Times-Dispatch*. October 1, 2017. www.richmond.com/business/when-will-pulse-construction-end-vdot-city-and-grtc-can/article_c6280833-1f7b-5cc4-89c6-eb0bf8f71527.html

