NTD

National Transit Database

2017 National Transit Summary and Trends

Office of Budget and Policy

October 2018

Federal Transit Administration
U.S. Department of Transportation

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Introduction

General Information

Welcome to the National Transit Summaries and Trends (NTST), one of the Federal Transit Administration's (FTA) National Transit Database (NTD) Annual Data Products. The goal of the NTST is to present and summarize transit data in an easy-to-read format and to provide an overview of public transit in the United States. This 2017 NTST discusses data from 2008 to 2017. **Except for the Rural transit exhibits presented and where explicitly noted, all data included in the NTST are from agencies operating within an Urbanized Area (UZA).**

What is the National Transit Database (NTD)?

The National Transit Database (NTD) is the primary source for information and statistics on transit systems in the United States. Congress requires the NTD to collect financial and service information annually from public transportation agencies that benefit from FTA grants. The NTD also requires larger urban transit providers (Full Reporters) to submit monthly operating and safety data. Each year, the FTA uses NTD data to apportion over $8 billion to urbanized areas (UZAs) and States under funding programs such as §5307 (Urbanized Area Formula grants), §5311 (Formula Grants for Rural Areas), §5329 (Transit Safety & Oversight grants), and §5337 (State of Good Repair grants).

Who reports data to the NTD?

§5307 Program Recipients

Recipients or beneficiaries of the FTA's Urbanized Area Formula Program (§5307) must file annual reports, monthly ridership, and safety and security reports with the NTD. These reporters are also called **Urban Reporters**. Beginning in FY 2011, transit agencies with 30 or fewer vehicles became eligible for reduced reporting requirements, including reporting exemptions for passenger miles, mode-specific capital and operations costs, employee counts, maintenance performance, energy consumption, monthly ridership, and safety data.

§5311 Program Recipients

Recipients or beneficiaries of the FTA's Other Than Urbanized Area Formula Program (§5311) must file annual reports to the rural module of the NTD, also called **Rural Reporters**. States and Indian Tribes report directly to the NTD. States file reports on behalf of their sub-recipient rural transit agencies, who do not report directly to the NTD.

Voluntary NTD Reporters

The FTA accepts voluntary NTD reports from other transit systems, both public and private, that serve both urbanized and non-urbanized areas. Voluntary reporters must provide public transportation services and meet the same reporting obligations as mandatory reporters.

Some agencies that do not operate transit service report to the NTD. **Build Reporters** are agencies that benefit from federal funding and are in the process of building transit infrastructure but do not yet operate service. **Planning Reporters** do not operate transit service but instead receive federal funding and distribute the funds among transit operators in their area.

Because of the difference in reporting requirements for agencies that report as Small Systems, or **Reduced Reporters**, certain exhibits within this document exclude their data for the entire ten-year period presented. In these cases, exhibits are labeled with a footnote. Unless otherwise noted, all exhibits in the NTST include data from all urban reporters.

What are the modes of transit?

Public transit includes buses, trains, ferryboats, paratransit, and much more. Certain transportation services are specifically excluded, such as intercity bus service, intercity rail service, intra-facility transport (airport people movers), and sightseeing rides.

Different types of vehicles, technologies, and operational characteristics distinguish the modes of transit. FTA identifies the following modes of public transit:

- **Aerial Tramway (TR)** is an electric system of aerial cables powered by centralized motors with suspended powerless passenger vehicles.
- **Alaska Railroad (AR)** is a public transportation system that shares vehicles and facilities with freight rail operations.
- **Bus (MB)** includes a variety of rubber-tired passenger vehicles operating on fixed routes and schedules over roadways.
- **Bus Rapid Transit (RB)** is a fixed-route bus mode that operates frequent service (short headways), has at least 50 percent of its route on exclusive guideways, and includes features that emulate rail transit modes.
- **Cable Car (CC)** is a street-running railway with individually controlled rail cars propelled by underground cables powered by centralized motors not on board the cars.

- **Commuter Bus (CB)** is a fixed-route bus mode that primarily connects outlying areas with a central city through bus service that goes at least five miles of closed-door service.
- **Commuter Rail (CR)** is an electric- or diesel-propelled railway for urban passenger travel on the general railroad system between a central city and adjacent suburbs.
- **Demand Response (DR)** includes automobiles, vans, or small buses dispatched by request to pick up passengers and transport them to their destinations.
- **Demand Response-Taxi (DT)** is a Demand Response function operated through contracted taxicab providers.
- **Ferryboat (FB)** is a seafaring mode carrying passengers over a body of water using steam- or diesel-powered boats.
- **Heavy Rail (HR)** is an electric railway that operates on exclusive track with the ability to carry a heavy volume of passengers and is typically powered by an electrified third rail.
- **Hybrid Rail (YR)** systems primarily operate light rail-type diesel multiple-unit vehicles on the national system of railroads.
- **Inclined Plane (IP)** is a railway on steep slopes with powerless vehicles propelled by centrally powered moving cables.
- **Jitney (JT)** includes passenger cars or vans on fixed routes (sometimes with minor deviations according to passenger demand) without fixed schedules or fixed stops.
- **Light Rail (LR)** is an electric railway that intersects vehicular traffic at grade crossings and is typically powered by overhead wires.
- **Monorail/Automated Guideway (MG)** is a group of rail services that operate over exclusive guideway and include monorails and driverless people movers.
- **Público (PB)** includes passenger vans or small buses operating with fixed routes but no fixed schedules.
- **Streetcar Rail (SR)** is a rail transit system powered by overhead catenaries that operates mostly on streets in mixed traffic.
- **Trolleybus (TB)** is an electric rubber-tire bus system powered by overhead catenaries that operates on streets in mixed traffic.

- **Vanpool (VP)** includes vans, small buses, and other vehicles operating as a ride-sharing arrangement, transporting at least seven people directly between their home area and a regular destination.

What is an Urbanized Area (UZA)?

The U.S. Census Bureau defines urbanized areas based on incorporated places (e.g., cities, towns, villages) and their adjacent areas. The U.S. Census Bureau considers a densely populated area of 50,000 people or more to be a UZA. There are 498 UZAs according to the 2010 U.S. census, and while UZAs make up 2.5 percent of United States land area, the populations of UZAs make up 71.5 percent of United States population.

The FTA bases UZA designations on the most recent census (currently the 2010 census). The NTD reporting system uses a unique number for each UZA that represents its numerical ranking by population. For the purpose of transit grants, the FTA also designates the Virgin Islands, Lake Tahoe, and certain areas in Puerto Rico as urbanized areas.

In the NTD, transit providers indicate the primary UZA of service operations as their "primary UZA" along with any secondary UZAs they serve. For analysis purposes, the NTST groups UZAs into the following categories:

- **UZAs over 1 million**: population of more than 1 million (42 urbanized areas, 500 agencies, or 46.4 percent of all agencies reporting Primary UZA).
- **UZAs under 1 million**: population of more than 50,000 and less than 1 million (456 urbanized areas, 577 agencies, or 53.6bpercent of all agencies reporting Primary UZA).

What is a Rural Area?

Rural areas are all areas not included in a UZA. The FTA includes Urban Clusters (2,500 – 50,000 population) in rural areas, while the U.S. Census Bureau considers Urban Clusters a part of urban areas. For this reason, the FTA provides "Other Than Urbanized Area Formula Program" funds to reporters to the rural module of the NTD. In comparison to UZAs, rural areas tend to have large distances between transit destinations and smaller populations.

What data does the NTD collect?

Transit operators report information regarding service provided, service consumed, and service resources, including financial data. Service provided includes information such as Vehicle Revenue Hours (VRH) and Vehicle Revenue Miles (VRM). Service consumed is

described in terms of Unlinked Passenger Trips (UPT) — the total count of individual vehicle boardings — and Passenger Miles Traveled (PMT) — the total number of miles traveled by passengers. The NTD collects financial data such as Operating Expenses (OE) for each mode operated, as well as the sources of funds used to support transit service. The NTD also collects resource data related to transit staffing levels and asset data for fleets and facilities.

What is Safety and Security reporting?

NTD safety and security (S&S) reporting requires all reporters to provide the number of safety and security events that involve the transit system's property, along with the number of fatalities and injuries that result from those safety and security events. While the exact reporting timelines and level of detail differ slightly based on agencies' NTD reporting type, a safety or security event is one that meets any of the following criteria:

- A fatality resulting from the event occurs within 30 days;
- Injuries to one or more persons resulting from the event that require immediate transport for medical attention;
- The estimated property damage from the event is at least $25,000;
- Collisions involving transit vehicles that require towing away from the scene;
- An evacuation that is made due to potentially life-threatening conditions or to the rail right-of-way;
- Derailments including both mainline and yard derailments, as well as non-revenue vehicle derailments;
- Rail transit vehicle collisions at rail grade crossing;
- Rail transit vehicle collision with an individual on the right-of-way; and
- Collision between a rail transit vehicle and a second rail transit vehicle or rail transit non-revenue vehicle.

Generally, the NTD requires Full Reporters to provide summary data for all events on a monthly basis. However, these agencies report additional details for more serious safety events. In contrast, Rural Reporters and urban Reduced Reporters provide only annual summary totals of safety and security events, fatalities, and injuries.

Rounding and Inflation

Rounding may lead to minor variations in total values from one exhibit to another within this analysis or may lead to instances where percentages may not add to 100. Due to rounding, percent changes may not exactly match the values calculated using the formatted figures shown in the exhibits.

The NTD has adjusted all exhibits involving dollar amounts to 2017 constant-dollar values, or dollar amounts adjusted in terms of constant purchasing power using the Consumer Price Index (CPI).

Web Information

For information about National Transit Database publications and training, visit the FTA website at transit.dot.gov or the National Transit Database website at transit.dot.gov/ntd.

Transit Trends in Service Operated, Service Consumed, and Costs

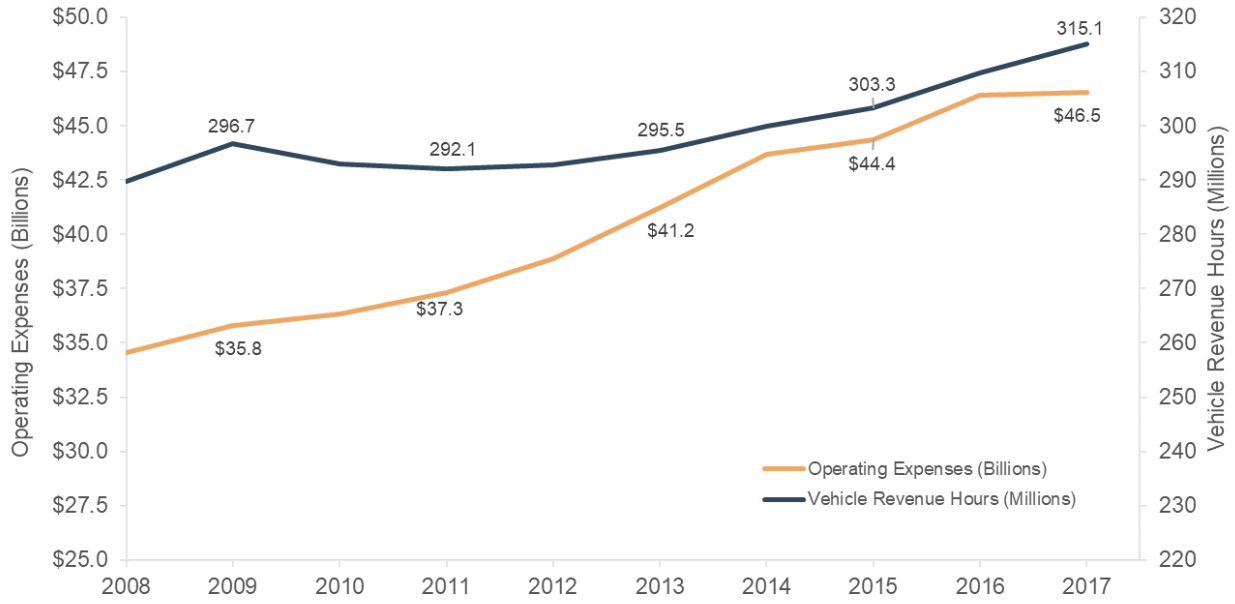


Exhibit 1 *Operating Expenses and Vehicle Revenue Hours: Time Series (includes rural and tribe data)*

Since 2006, use of public transit has increased overall. We see this increase in terms of service operated, service consumed, and service costs. In 2007, FTA introduced rural service data reporting into the NTD, increasing total transit service data collected. Rural service makes up approximately 8.6 percent of all vehicle revenue hours (VRH) in 2017.

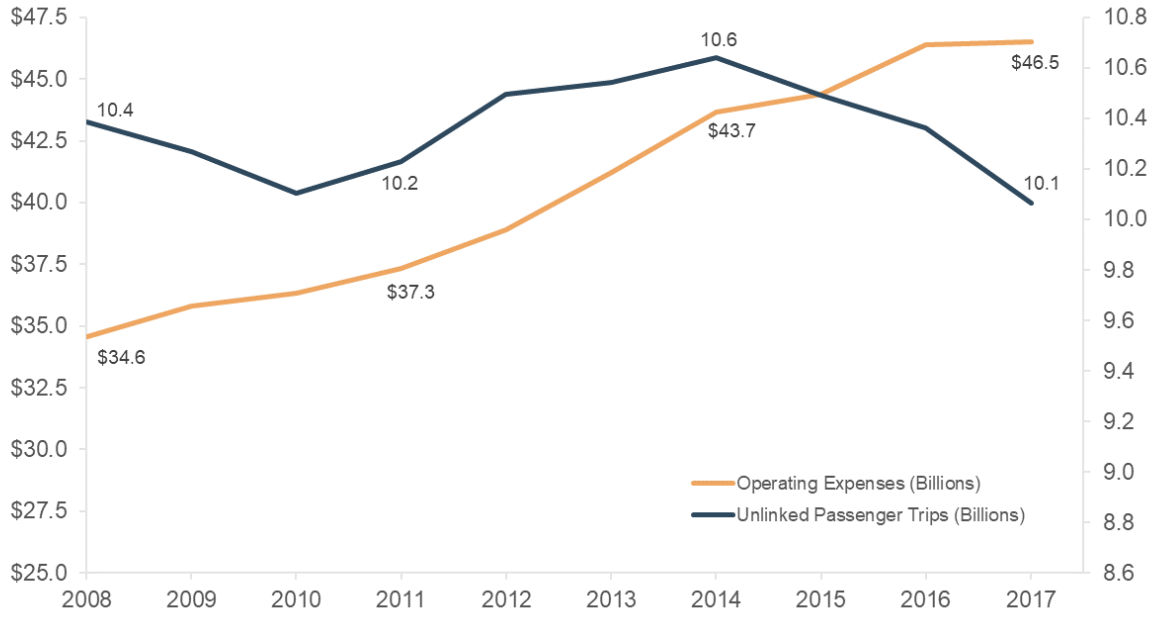


Exhibit 2 *Operating Expenses and Unlinked Passenger Trips: Time Series (includes rural and tribe data)*

Following the U.S. recession from 2007–2009, public transit passenger trips dropped 2.7 percent from 2008 to 2010 (10.4 billion trips to 10.1 billion trips). In response to reduced trip demand, transit operating expenses plateaued briefly, while transit service hours dropped 1.4 percent from 296.2 million revenue hours in 2009 to 292 million revenue hours in 2011. Since 2014, ridership has declined from 10.6 to 10.1 billion trips.

Report Year 2017 Service and Cost Ratios

Service is provided, consumed, and financed differently for every transit mode. Service factors and expenses depend on the limitations and opportunities of different vehicles and the operating environment of different areas. For example, the average operating cost per vehicle revenue hour is highest for ferries (FB, $1,413.75). However, the mode provides an average of 167 trips per hour on large boats, thus the final cost per boarding is relatively low ($8.46).

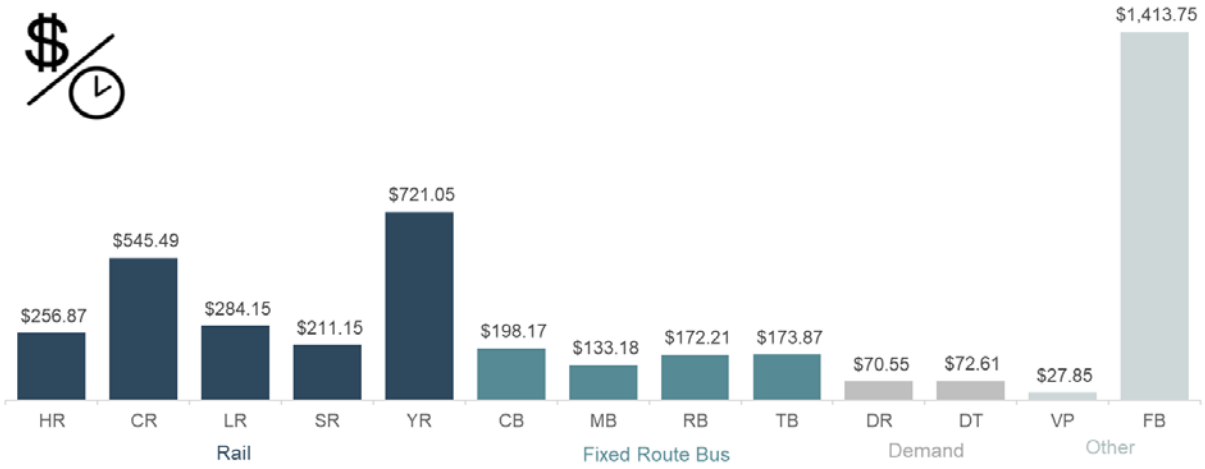


Exhibit 3 *2017 Cost per Vehicle Revenue Hour*

By contrast, demand-based modes (demand response (DR) and demand response taxi (DT)) — which frequently provide single-passenger trips for individuals who meet the requirements of the Americans with Disabilities Act (ADA) — are relatively inexpensive per vehicle hour. However, because less service is consumed, the ultimate cost per passenger trip on these modes is higher than other transit modes.

Exhibit 4 *2017 Cost per Unlinked Passenger Trip*

Rail modes split into transit rail (heavy rail (HR), light rail (LR), and streetcar (SR)) and commuter rail (commuter rail (CR) and hybrid rail (YR)). Typically, transit rail passengers use these services for shorter trips; commuter rail services carry passengers for longer trips on the Federal Railroad Administration-regulated (FRA) general railroad system. Transit rail has among the highest number of trips per hour among all modal categories. Therefore, even though cost per hour is higher than fixed route services, the ultimate operating cost per trip is comparable.

Unlinked Passenger Trips (UPT) are only one way to measure service consumed by the riding public. The goal of transit service is to transport passengers from one place to another, and a measure of that distance is Passenger Miles Traveled (PMT). With this more complete picture of service consumed, the operating cost per passenger unit is slightly different. Vanpool (VP) service, for example, may carry fewer people, but it carries them a consistently longer distance per trip. The opposite is true of trolleybuses (TB) and streetcars (SR), which carry many people — but not very far — in dense urban settings.

Exhibit 5 *2017 Cost per Passenger Mile*

Transit Service Providers: Organization Type

Transit providers indicate their organization type on the NTD Annual Report. The totals in Exhibit 7 do not include systems such as the Roosevelt Island Tramway in New York City and other systems that do not benefit from FTA funds and do not report to the NTD.

City and county organizations are departments of local government, while Transit Authorities are independent public agencies led by boards focused on providing public transit. Together, the two make up 81.7 percent of all public transit. The remaining portion of public transit is operated by private for-profit companies, non-profit companies, contractors, and semi-public corporations (9.1 percent); state governments (departments of transportation) (2.1 percent); universities (1.5 percent); and other transit operators (5.6 percent).

Organization Type	Count
City/County	507
Transit Authority	268
Non-Profit	37
For-Profit	26
Planning	32
Subsidiary	8
Contractor	9
Tribe	2
University	14
Semi-Public Corp	9
Other	33
Other Types	170
Total Transit Providers	**945**

Exhibit 6 *Urban Transit Providers by Type*

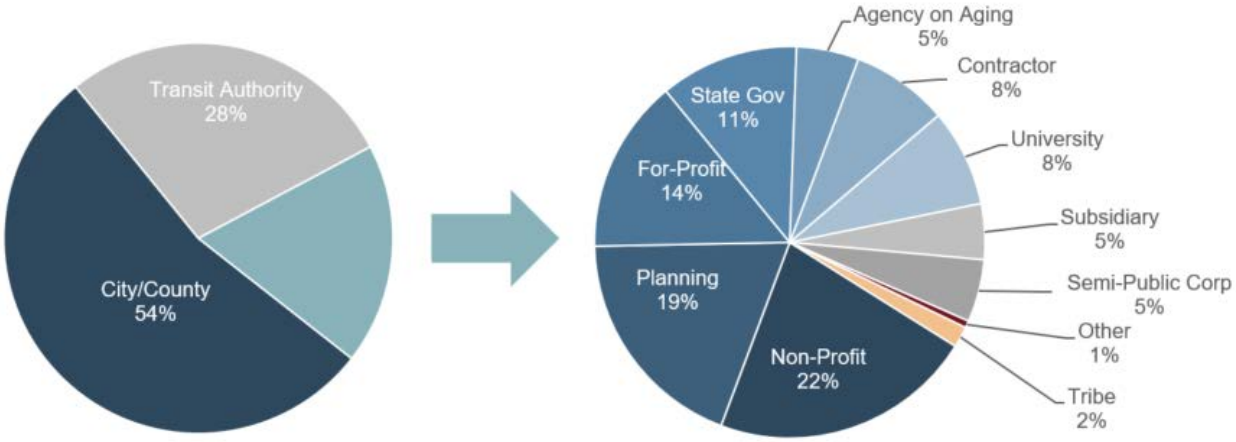


Exhibit 7 *2017 Transit Provider Organization Types*

Transit Funding

The Federal Transit Administration's Annual Budget

The FTA budget is a portion of the U.S. Federal Government's total annual budget. During 2017, Congress appropriated 1.9 percent ($77 billion) of the total federal budget ($3.85 trillion) for transportation needs for the entire country. Over $12.4 billion is allocated to the FTA, making up 0.31 percent of the total federal budget.

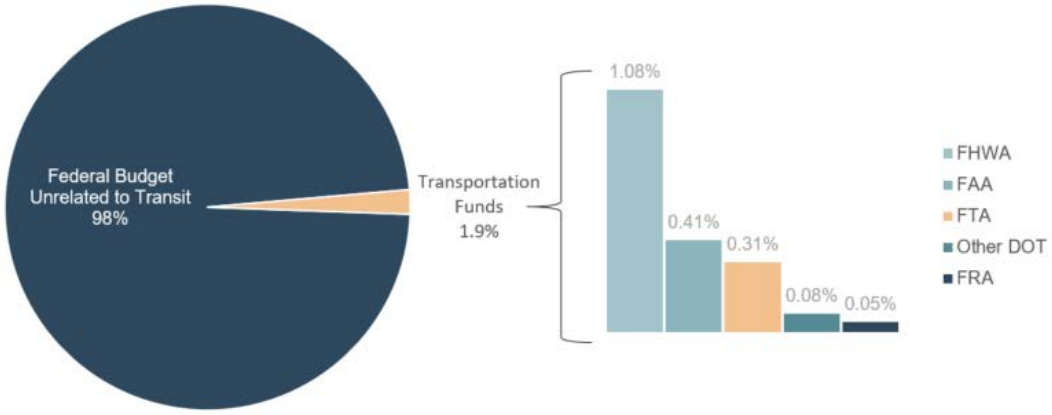


Exhibit 8 *2017 Transportation as a Percentage of the Total Federal Budget*

Operating Expense Funding Sources

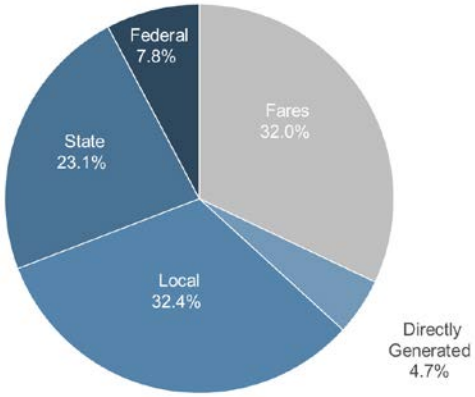


Exhibit 9 *2017 Funding Sources for Transit Operations*

On average, passenger fares fund 32 percent of public transit operations in the United States, with another 4.7 percent generated directly by the transit operator. Local and State

sources fund 32.4 percent and 23.1 percent, respectively; Federal Government sources fund the remaining 7.8 percent.

Capital Expenditure Funding Sources

Transit operators spend resources not only on operations but also on constructing, acquiring, and improving the systems and equipment used to operate transit service. These improvements are called Capital Expenses.

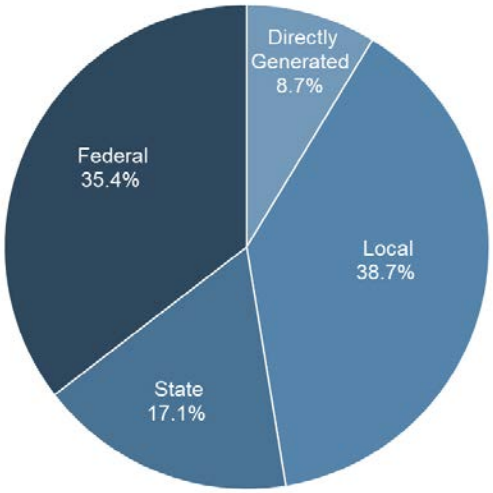


Exhibit 10 *2017 Funding Sources for Capital Expenses*

The funding support for capital expenses differs from operational expenditures. In 2017, 35.4 percent of all capital funds came from federal sources. Recently, transit agencies and local and state governments have increased their funding to replace and rehabilitate aging infrastructure. Fares and directly generated funds from transit agencies now account for about 8.7 percent of all capital purchases. Local and state governments make up the remaining 55.8 percent of capital funding.

Fare Box Recovery

Transit agencies do not establish passenger fares simply based on the cost of each trip. For each dollar spent in operating costs per trip across all modes and all transit systems, 35 cents are recovered through fares. The fare box recovery ratio is the percent of a trip's operating costs recovered through passenger fares. This ratio varies by mode and each transit operator. It is typical, for example, to see low recovery ratios on demand response services (DR and DT) that often serve the needs of customers who cannot use conventional modes of transportation and frequently have no alternate means of transportation. Vanpool transit, however, operates by scheduling passengers ahead of time, with one passenger driving the van to and from a specified destination. The combination of efficient scheduling, unpaid drivers, and simplicity of technology results in a high fare box recovery ratio (78.2 percent in 2017).

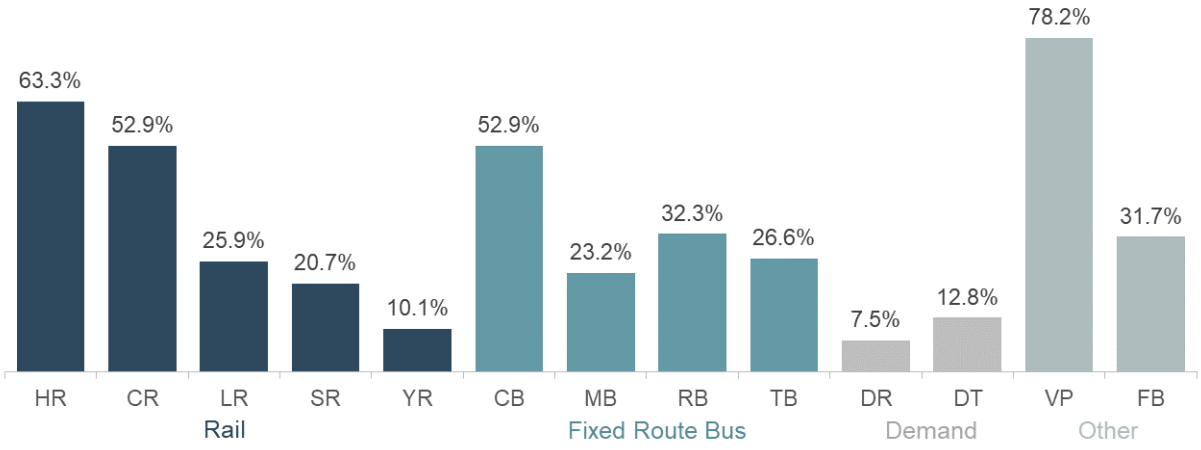


Exhibit 11 *2017 Fares as a Proportion of Operating Costs*

Modal Differences

Service Size

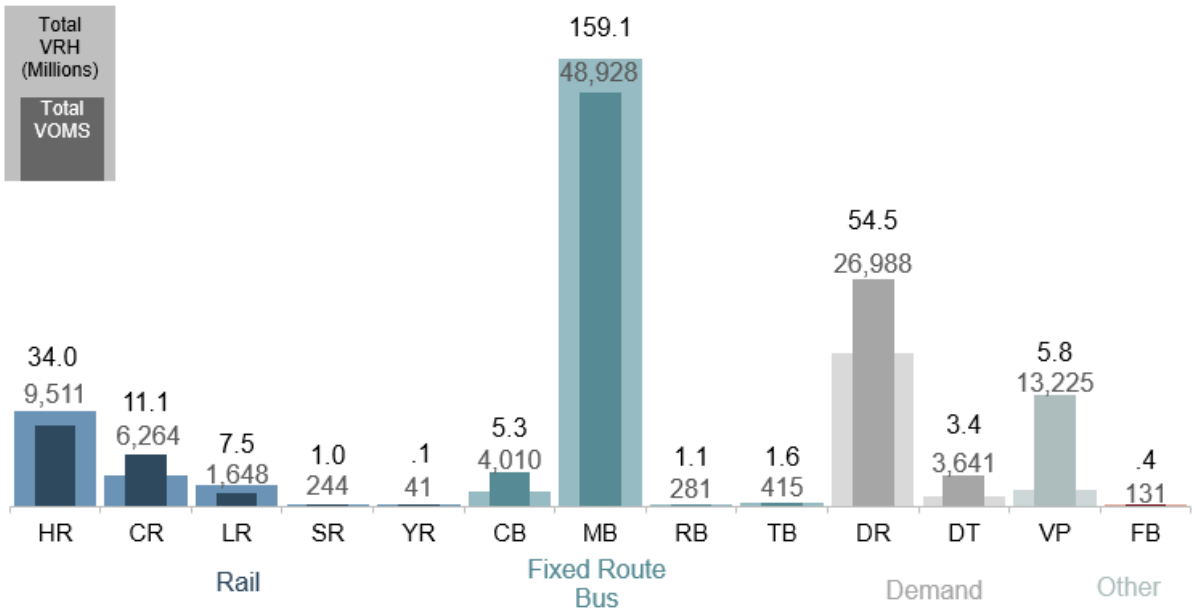


Exhibit 12 *2017 Service Provided Size*

Of the modes defined in the introduction, Exhibit 12 above demonstrates that fixed route bus (MB) systems are the most common form of public transit service provided in the United States, with nearly 49 thousand vehicles operating during peak service (VOMS) and operating 159 million revenue hours (VRH) of service. MB is typically a more cost-effective method of providing public transit in an urbanized area where building the necessary infrastructure for a rail network is impractical or infeasible. Demand response (DR) is the second largest transit service type (27 thousand VOMS and 55 million VRH) and is the main provider of service in rural and sparsely populated areas. Among rail modes, heavy rail (HR) systems are the most used (over 9 thousand VOMS and 34 billion VRH), with commuter (CR) and light rail (LR) close behind in terms of service provided.

Exhibit 13 *2017 Service Consumed Size*

Service Data by Factor

Exhibits 14, 15, and 16 compare transit operation statistics across transit modes. **Average Trip Length** (passenger miles per trip) estimates the average distance a passenger travels on public transit, and **Trips per Vehicle Revenue Hour** indicates the average volume of passengers carried in an equivalent period on a vehicle. **Passenger Miles Traveled per Vehicle Revenue Miles** estimates the average number of passengers per vehicle at any given time.

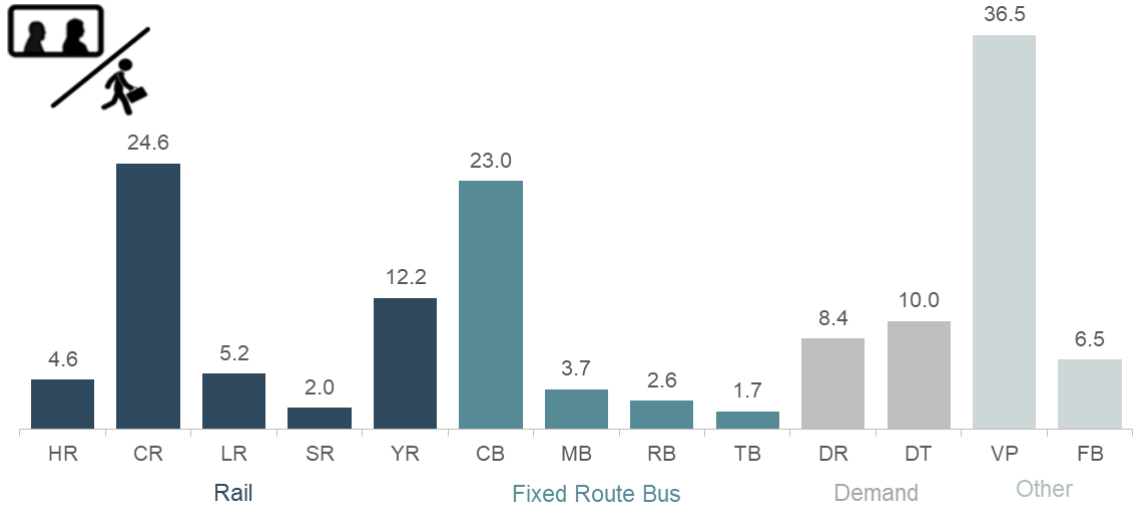


Exhibit 14 *2017 Passenger Miles per Unlinked Passenger Trip (Avg. Trip Length)*

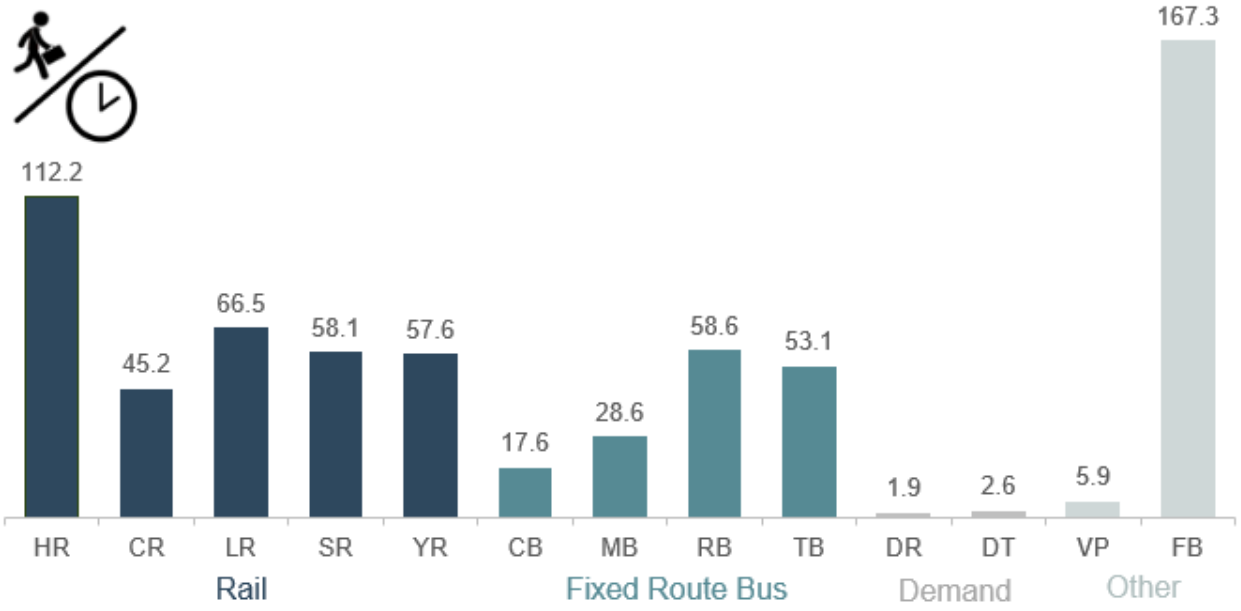


Exhibit 15 *2017 Unlinked Passenger Trips per Vehicle Revenue Hour*

Comparing average trips per hour and average trip length demonstrates how many passengers are on a transit vehicle and how far they travel, respectively. Demand modes take small passenger loads a relatively long distance to meet the requirements of the ADA. Ferry boats move the largest number of passengers often a very short distance across a waterway. Commuter rail (CR), hybrid rail (YR), commuter bus (CB), and vanpool (VP) all transport a comparatively smaller load of commuters (typically) a longer distance per trip.

Intensive city transit modes such as heavy rail (HR), light rail (LR), streetcar rail (SR), bus rapid transit (RB), trolleybus (TB), and bus (MB) all tend to provide a larger number of trips for a much shorter distance compared to long distance commuter-related modes. These intensive city transit modes also often include multiple transfers on a passenger's journey between vehicles of the same mode and among multiple modes. To get to work, for example, a passenger might take a bus trip to get to the underground train, ride the train for three stops, and walk from the train station to their workplace. In this example, the single commuter represents two unlinked passenger trips, one on bus and one on rail.

Ferryboats can carry more passengers at a single time than any other mode, an average of 127 passengers. Demand modes often assist disabled passengers (as a part of the ADA compliance) and respond to single passenger trip requests, dropping their load factor to nearly one passenger at a time. For most of the other modes that run on schedules instead of requests, load factor does not consider peak travel, such as rush hour, which can be more than twice the number of passengers in off-peak times.

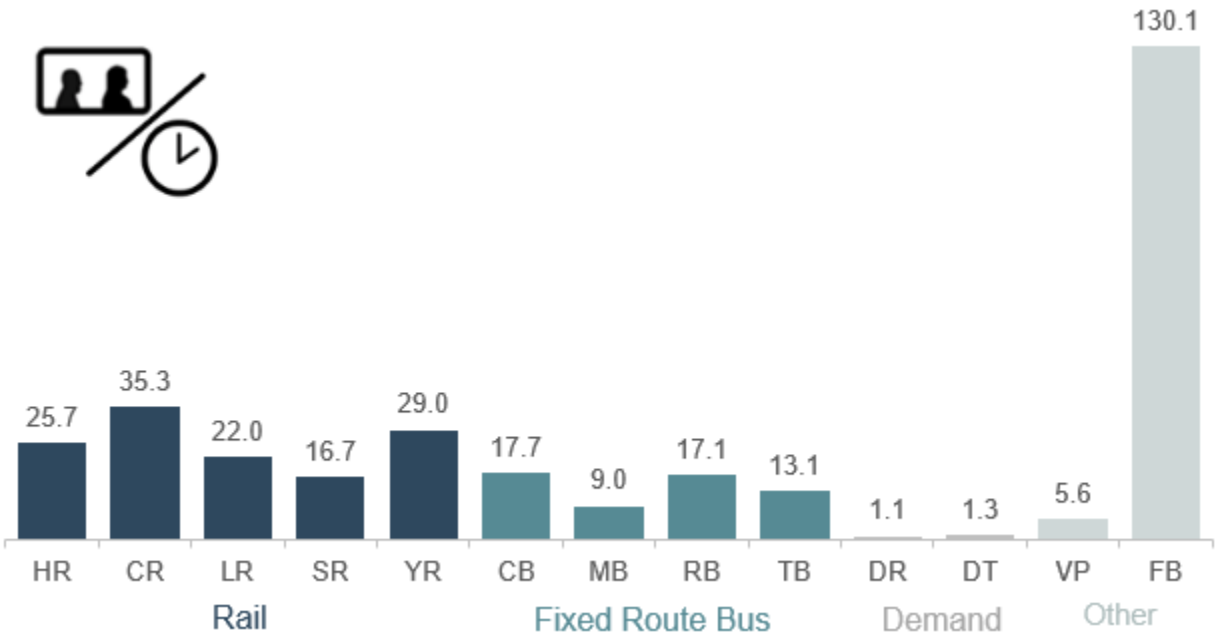


Exhibit 16 *2017 Passenger Miles per Vehicle Mile (Average Passengers per Vehicle)*

Fixed Guideway and High Intensity Busway

Fixed Guideway Route Miles from 2008 to 2017

Public transit often operates on fixed guideway. The NTD separates fixed guideway into two categories: exclusive fixed guideway (FG) and high intensity busway (HIB). FG is a facility that uses separate right-of-way (ROW) or rail exclusively for public transportation. FG may be a fixed catenary system useable by multiple forms of public transit (e.g., trolleybus, light rail, etc.). HIB is roadway that is either:

- Exclusive at all times (24 hours, 7 days per week) as a High Occupancy Vehicle (HOV) lane or transit-way; or
- Controlled access, which is exclusive for part of the time but is otherwise available to general traffic.

All rail, catenary, and ferryboat (FB) systems operate over FG. Bus systems may operate over FG, HIB, or publicly available roadway (mixed traffic ROW).

The NTD collects directional route miles for FG, HIB, and mixed traffic. The total mileage in each direction that public transportation vehicles travel in revenue service is calculated in directional route miles. For example, if a transit provider operates one mile of revenue service in two directions, the NTD counts this as two directional route miles.

Congress introduced HIB lanes during 2012 in the "Moving Ahead for Progress in the 21st Century Act" (MAP-21) legislation. In 2008, over 2,000 bus directional route miles qualified for funding as bus fixed guideway. After MAP-21, only 320 bus directional route miles qualify as bus fixed guideway, with the remainder being reclassified as either HIB lanes or bus rapid transit (BRT or RB) mixed traffic.

Since 2008, public transit agencies have added 1,360.7 new miles of rail FG routes. In 2017, rail transit modes accounted for 78.9 percent of all directional route miles of fixed guideway, up 2.3 percent from 2008. This high proportion of rail is due in part to the increase of light rail (LR) and streetcar rail (SR) modes in growing urban areas.

Fixed Guideway Concentration

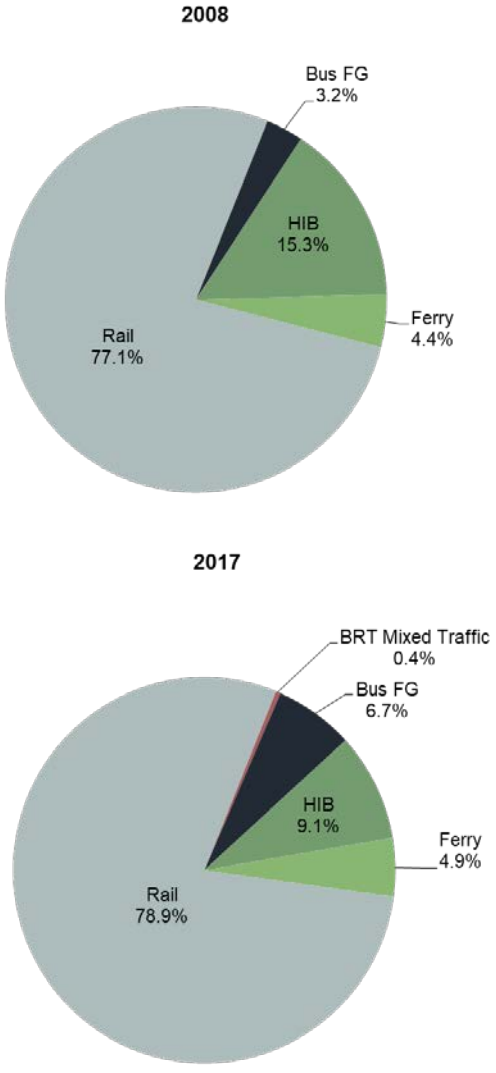


Exhibit 17 *FG Route Miles, 2008-2017*

Building separate infrastructure for public transit is costly, and dedicated rail transit only makes sense in high density areas with congested transportation and high demand for travel alternatives. As a result, the most populous cities in the United States have built and maintained fixed guideway transit. According to the U.S. Census Bureau, the densest metropolitan areas in the 2010 census were New York, San Francisco, Los Angeles, Honolulu, Chicago, San Jose/Santa Clara, Boston, and Philadelphia.

In 2017, the 5 urbanized areas with the most directional route miles of fixed guideway account for nearly 44 percent (6,301 miles) of all fixed guideway route miles, an average of 1,260 fixed guideway miles per UZA.

The UZAs in the exhibit below reached a higher populous sooner, and with time to develop, have gradually invested resources towards rail and fixed guideway infrastructure. The remaining 86 urbanized areas (and rural Alaska)

account for 7,915 fixed guideway miles, an average of 92 fixed guideway miles per UZA.

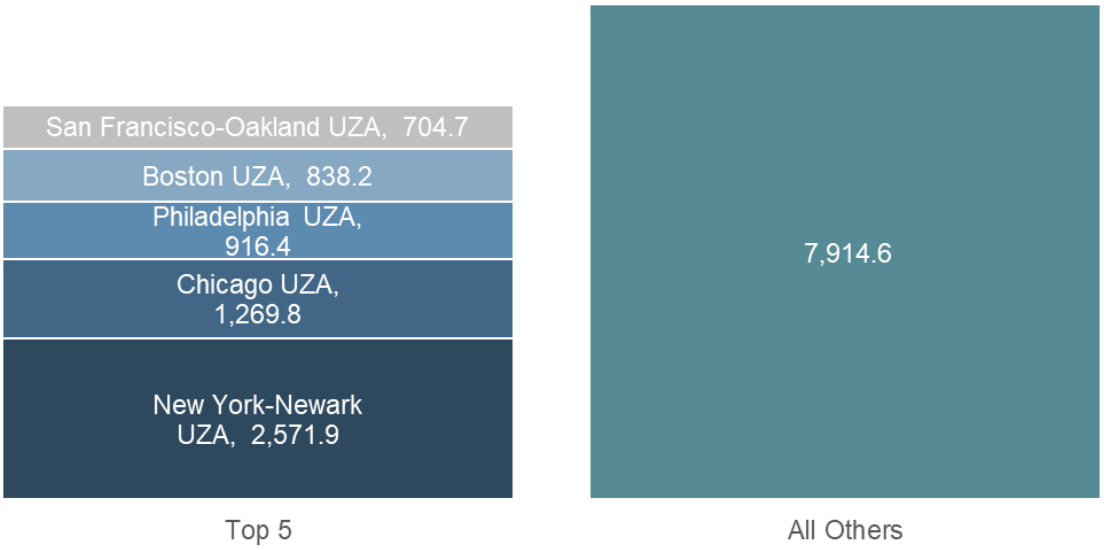


Exhibit 18 *UZAs with Most Directional Route Miles*

The serviced consumed on fixed guideway systems varies significantly across the country. For example, Philadelphia had 916.4 fixed guideway route miles in 2017, which provided 1.0 billion passenger miles, an average of 1.1 million passenger miles per fixed guideway route mile. In comparison, Antioch, CA, has 8.3 fixed guideway route miles and provided 71.5 million passenger miles, an average of 8.6 million passenger miles per fixed guideway route mile.

Safety and Security

Safety and Security (S&S) events include vehicle collisions on the roadway, assaults on transit property, train derailments, slips and falls, damage from fallen trees, and more. The NTD requires large transit agencies to report any safety or security events that meet any of the following criteria:

- A fatality resulting from the event occurs within 30 days;
- Injuries to one or more persons resulting from the event that require immediate transport for medical attention;
- The estimated property damage from the event is at least $25,000;
- Collisions involving transit vehicles that require towing away from the scene;

- An evacuation that is made due to potentially life-threatening conditions or damage to the rail right-of-way;
- Derailments, including both mainline and yard derailments, as well as non-revenue vehicle derailments;
- Rail transit vehicle collisions at rail grade crossing;
- Rail transit vehicle collision with an individual on the right-of-way; and
- Collision between a rail transit vehicle and a second rail transit vehicle or rail transit non-revenue vehicle.

Any of these events qualify as a Major Event that the agency must report within 30 days to help FTA more rapidly address safety and security issues in public transit.

Important Considerations for NTD Safety Data:

- All safety data presented on the following pages are sourced from Calendar Year 2017 NTD major event reports. At the time of this document's publication, NTD reporters can still add, modify, and delete major event data for Calendar Year 2017. As such, these data are considered "preliminary" and numbers may change based on ongoing validation activity.
- The analyses on the following pages use Calendar Year service data sourced from the NTD's Monthly Ridership data collection to calculate Calendar Year safety rates.
- The Federal Railroad Administration oversees safety for commuter rail (CR) systems and a select set of Hybrid Rail (YR) and Heavy Rail (HR) systems. These agencies do not report safety data to the NTD and are therefore excluded from any safety analyses in this document.

2017 NTD Safety Statistics by Mode

Mode	S&S Events per 100M VRM	Fatalities per 100M VRM	Injuries per 100M VRM	Fatalities per 100 Events	Injuries per 100 Events
SR	4,843.0	15.8	2,421.5	0.3	50.0
CC	5,416.9	386.9	1,934.6	7.1	35.7
MG	278.1	34.8	104.3	12.5	37.5
CB	81.3	4.1	104.8	5.0	129.0
MB	307.2	4.7	426.4	1.5	138.8
RB	815.9	-	1,282.1	-	157.1
TB	309.5	8.8	477.5	2.9	154.3
DR	136.2	1.0	137.2	0.7	100.7
DT	93.9	-	93.9	-	100.0
FB	136.3	-	409.0	-	300.0
VP	22.1	-	9.7	-	44.0
PB	36.3	5.2	31.1	14.3	85.7
Total Avg.	**241.4**	**6.5**	**282.1**	**2.7**	**116.9**

Exhibit 19 *2017 NTD Safety and Security Major Event Rates by Mode*

Streetcar (SR) and Cable Car (CC) modes operate across short distances and within motor vehicle traffic and experience higher event rates than other modes. However, CC and SR modes also operate at lower speeds and report fewer injuries and fatalities per event. Ferryboat (FB), Motor Bus (MB), Bus Rapid Transit (RB), and Trolleybus (TB) modes operate over longer distances at higher speeds with more people aboard. These modes report fewer events per VRM, but more injuries and fatalities per event.

Non-Rail Safety Events

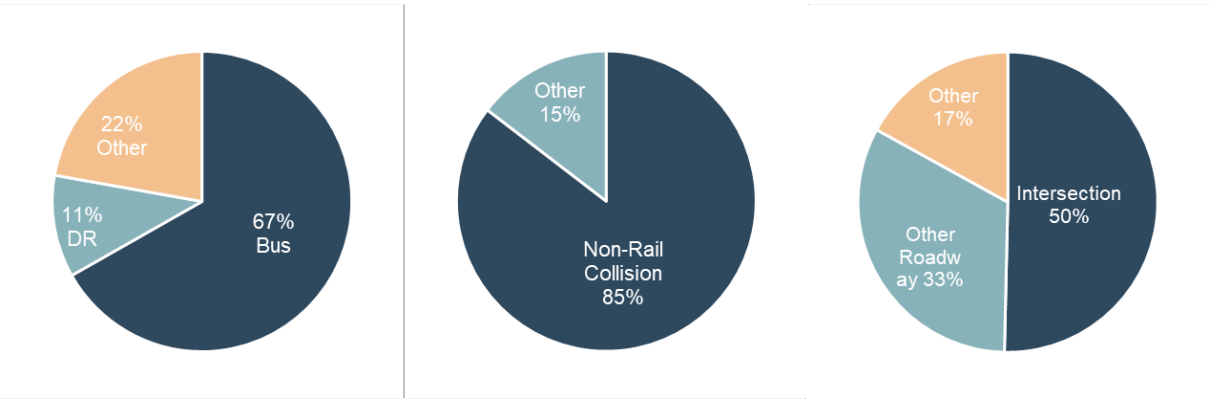


Exhibit 20 *Non-Rail Event Categories*

Between 2008 and 2017, transit agencies reported 64,544 major events, 80 percent of which involved non-rail transit modes. Of these non-rail events, 67 percent involved Motor Bus (MB) modes. Of the Motor Bus events, 85 percent were collisions, and of those MB collisions, 83 percent occurred in the roadway.

Rail Safety Events

Between 2008 and 2017, urban transit agencies reported 12,651 rail safety and security events to the NTD, 49percent of which were on heavy rail (HR) modes.

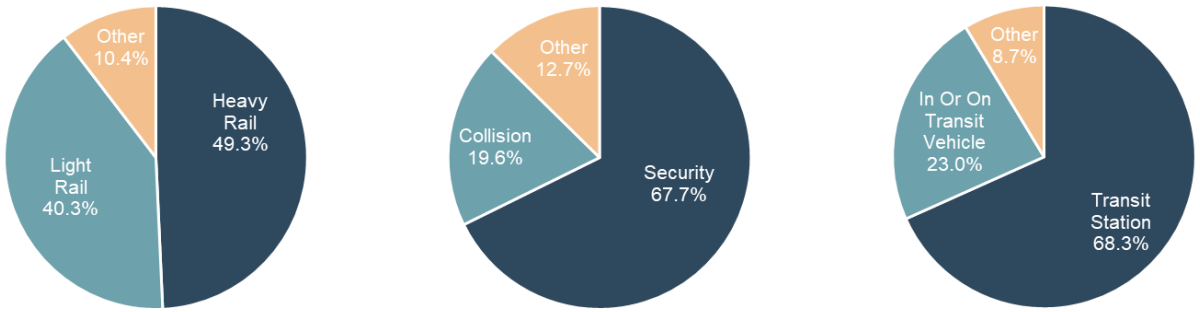


Exhibit 21 *Rail Events by Mode*

Of those HR events, 68 percent were security-related events, 68 percent of which occurred within a transit station. HR service interacts far less often with general vehicular traffic and pedestrians than bus modes and experiences fewer collisions. Almost half of all HR events were security incidents occurring in the station.

Fatalities

In 2017, transit agencies reported 241fatalities. Most of these fatalities were members of the public, such as non-customer pedestrians, cyclists, and occupants of other vehicles. Rail security events (such as suicides and homicides) and non-rail collisions accounted for 68.9% of all fatalities in 2017.

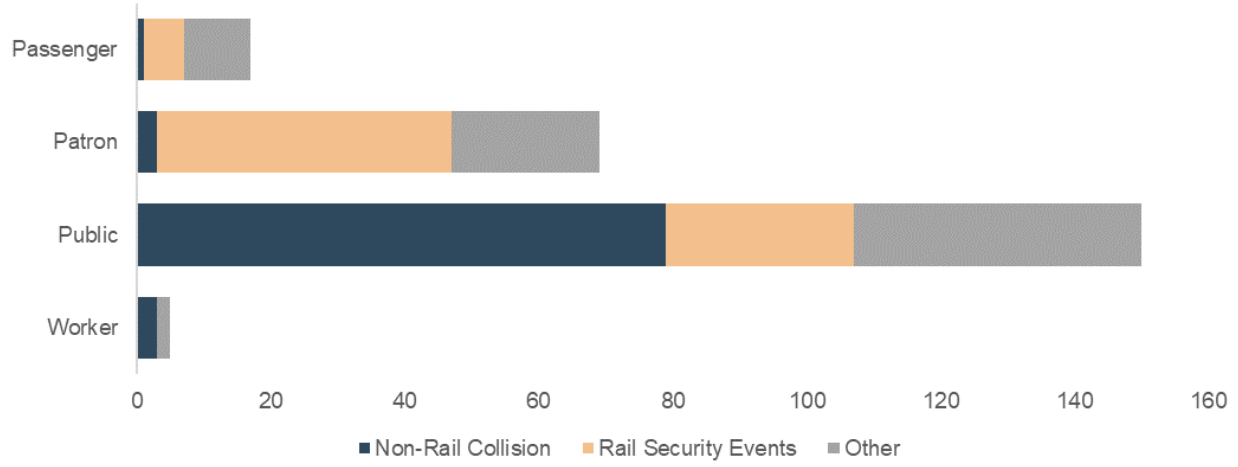


Exhibit 22 *Fatalities by Person Type*

- Worker – Transit agency employee or contractor
- Public – Individual who is not a transit customer
- Patron – Transit customers that are not on board a vehicle
- Passenger – Transit customers that are on board a vehicle

Urbanized Areas Over and Under 1 Million People

Population and Transit Agencies

Public Transit Service is dependent on population density to function efficiently. In the United States, most UZAs have populations of less than 1 million people, but most people live in those UZAs, and they consume most of the public transit service; Residents of the largest 42 UZAs consume 88.6% of the public transit service captured in the NTD as measured by Passenger Miles Traveled.

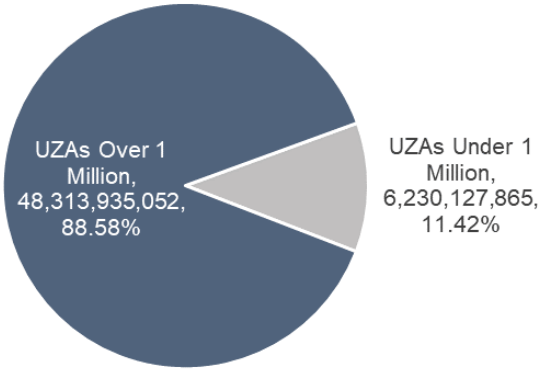


Exhibit 23 *Total Passenger Miles Traveled per UZA Size*

Trips per Capita

UZAs over 1 million have more trips on public transit per capita. The median ridership density for UZAs under 1 million in 2017 is 5.16 trips per capita, whereas the median for UZAs over 1 million is 22.29. Owning and driving your own vehicle in a dense urbanized area can be both expensive and inconvenient. Choosing public transit over private cars, bicycles, motorcycles, or walking is called a “discretionary trip” and indicates a personal choice that is not out of necessity, medical or otherwise.

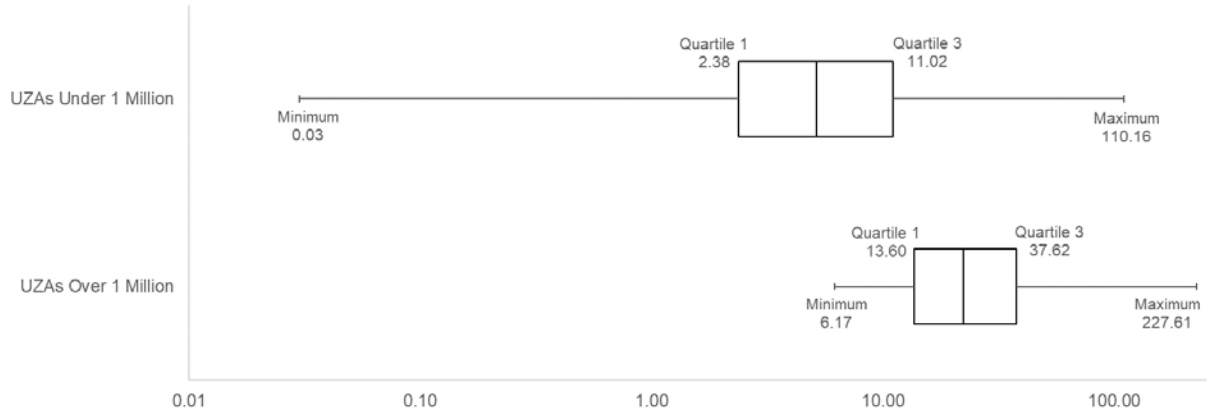


Exhibit 24 *2017 Ridership Density (Passenger Trips per Capita)*

Operating Cost per Passenger Trip

Cost per trip varies widely in UZAs under 1 million, from $1.07 to over $41.25. In UZAs over 1 million, the range is narrower, between $3.27 and just over $9.31 per trip. There is less difference between the median cost per trip between UZA size categories (a difference of $1.48), suggesting that there are more rural demand response services (comparatively expensive) in UZAs under 1 million. These rural demand response services on average carry the fewest number of passengers per trip. UZAs over 1 million more often have extensive fixed-route and fixed-guideway systems that carry more passengers per trip, dramatically dropping the average cost per trip.

Exhibit 25 *Operating Cost per Passenger Trip*

Operating Cost per Revenue Hour

UZAs over 1 million have a slightly lower cost per trip than UZAs under 1 million, but a higher average cost per hour. The lowest average cost per hour in UZAs over 1 million is $84.82, the median for UZAs under 1 million is $75.83. Intensive urban transit carries

significantly more passengers at a time, requiring more workers, equipment, and space. Additionally, prices are higher in dense cities as reflected in wages, property costs, and supply prices.

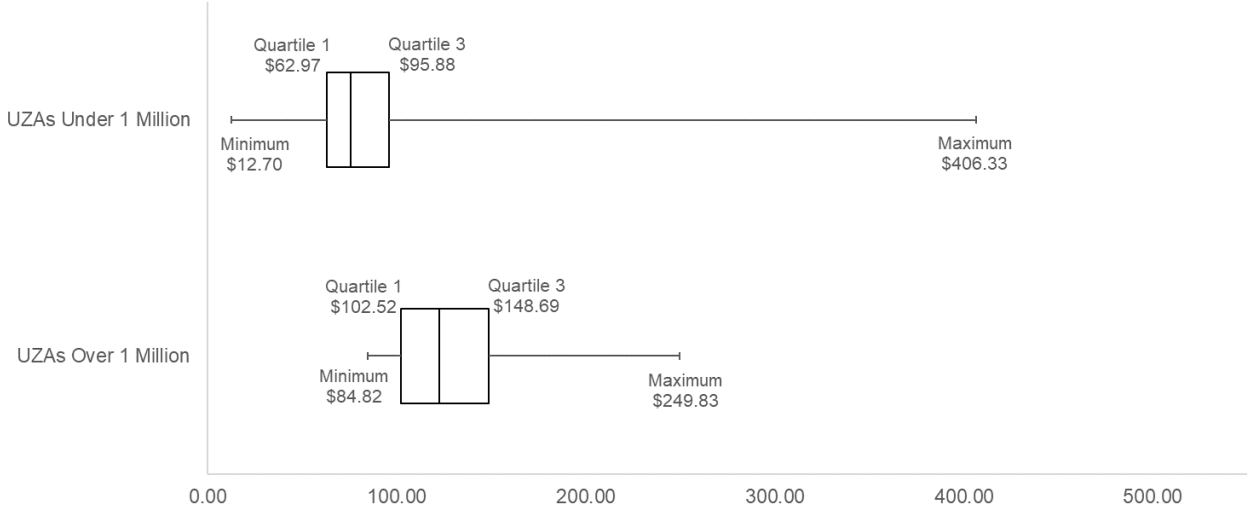


Exhibit 26 *2017 Operating Cost per Vehicle Revenue Hour*

Event Rate Comparison

In 2017, UZAs with populations over 1 million experienced 257.64 reportable Safety and Security events per 100 million Vehicle Revenue Miles (VRM). UZAs with populations less than 1 million people experienced S&S events at a lower rate: 178.23 events per 100 million VRM.

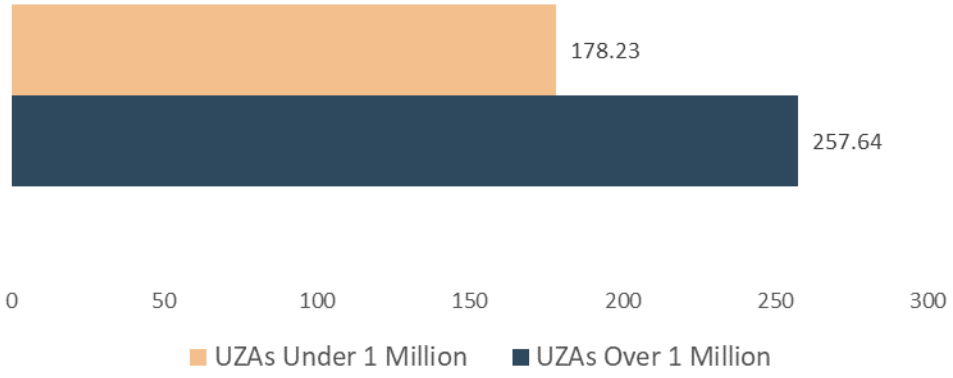


Exhibit 27 *Total Reportable S&S Events per 100 Million VRM, by UZA Size*

Fixed Guideway Comparison

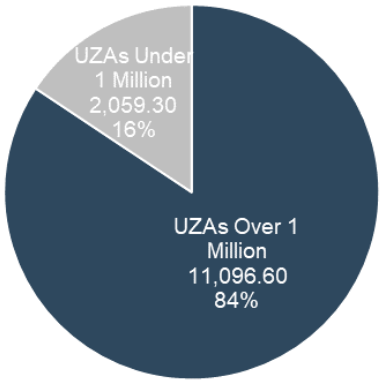


Exhibit 28 *Rail, Bus, and Other Fixed Guideway Directional Route Miles Comparison*

UZAs with populations over 1 million operate over 84 percent of all fixed guideway directional route miles. Each directional route mile is a mile of transit operation space where private transportation cannot operate. For example, the New York City Subway operates on rail track unavailable to Amtrak, CSX, and any other private trains. The Boston Silver Line is bus rapid transit with dedicated right-of-way, meaning that it operates similarly to rail transit: car traffic cannot trespass on the roadway reserved exclusively for the Silver Line.

Modal Spotlight: Monorail/ Automated Guideway

There is an increasing interest surrounding autonomous travel, mostly in the consumer car market. Interestingly, examples of autonomous public transportation systems that have long been used in the United States transit industry in Monorail and Automated Guideway (MG).

Ridership by Region

Over the last few years, talk about autonomous travel has captured the public imagination, particularly in the consumer car market. However, autonomous public transportation modes have existed in the United States since 1975 with Morgantown Personal Rapid Transit. American monorails are automated, transporting passengers without drivers; with exception to Seattle Center Monorail.

Exhibit 29 *2017 Monorail and Automated Guideway Locations*

Automated guideway generally operates service in its own exclusive right-of-way and is typically built on elevated structures. The design may be considered by cities planning public transit above ground, through the city, along with modes like Light Rail (LR) and Streetcar (SR). The main difference in operating characteristics is that LR and SR modes both have drivers, generally operate service at grade (ground level), can operate in mixed traffic, or intersect streets at grade crossing. To compare the performance of MG relative to these two modes, we can examine data for ridership, recovery ratio, operating costs, and capital costs.

Exhibit 30 shows the current passenger use of these three modes in the United States. Monorail systems typically have the smallest number of Directional Route Miles (DRM) but provided the greatest number of UPT per mile (582,252) in 2017. Light rail systems have higher service volumes, carrying 321,601 UPT per mile DRM of fixed guideway. Streetcar generates the lowest ridership, 260,855 UPT per mile of fixed guideway.

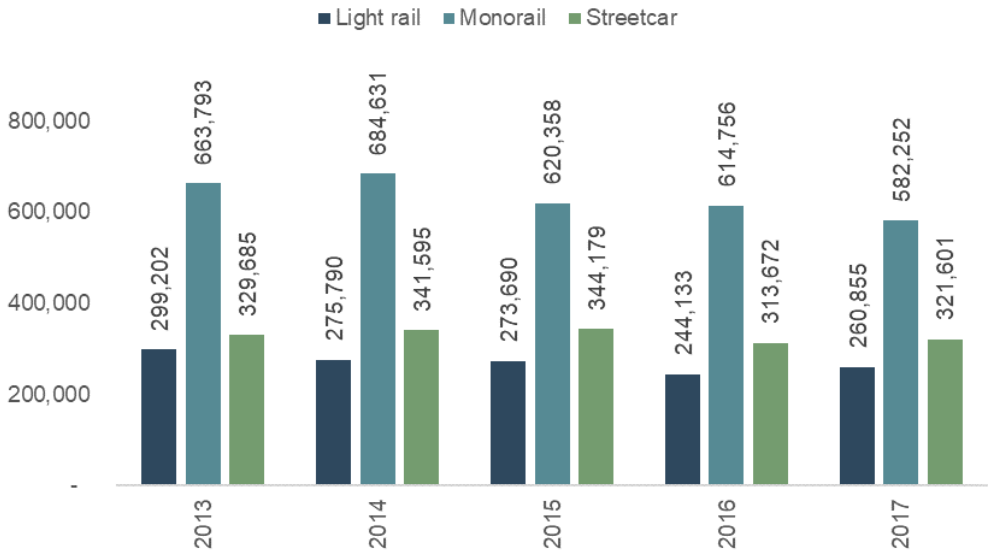


Exhibit 30 *Unlinked Passenger Trips per Directional Route Mile*

Modal Expenses and Fare Recovery

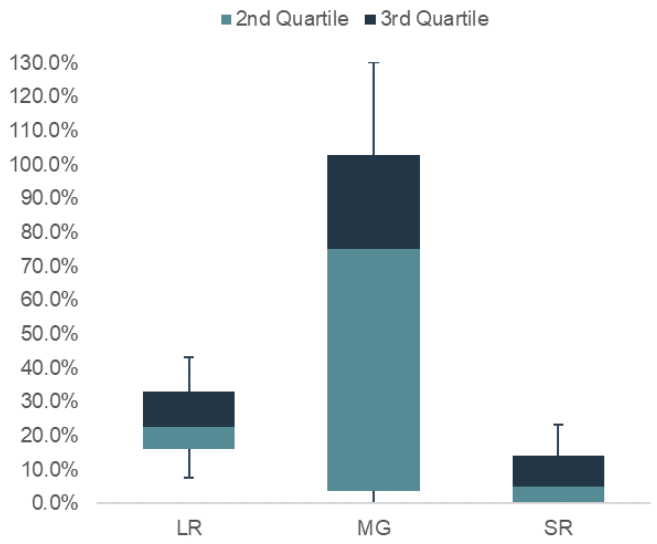


Exhibit 31 *Fare Recovery Ratio (agencies operating at least one year)*

One benefit of the automated guideway modes is they generate more revenue as a percentage of their overall costs. Fare Recovery ratio is the metric by which we can measure how much money a mode or system makes back from passenger fares to cover the costs of its operations. A fare recovery ratio of zero percent would indicate the service does not charge a fare. Of the nineteen streetcar agencies reporting to the NTD six do not charge a fare to riders. For Automated Guideway, that number is two out of seven. All Light Rail agencies charge a fare. For the automated guideway mode, the average fare recovery ratio is 75.3 percent, more than the maximum recovery ratio for both Light Rail (47.2 percent) and Streetcar (35.5 percent).

One might assume that the automated guideway systems would have lower overall costs. However, as shown in Exhibit 34, the average cost per hour for Light Rail, Monorail, and Streetcar are all very close, at $272.55, $260.55, and $203.42 respectively.

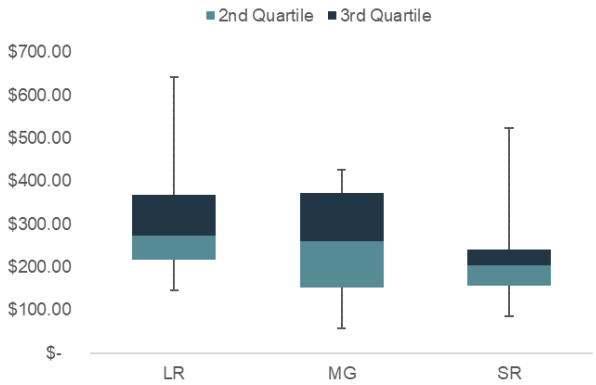


Exhibit 32 *Cost per Hour (agencies operating at least one year)*

A closer examination of the operating expenses per vehicle hour shows that while operating expenses for general administration and maintenance rival and slightly exceed Light Rail, operating costs are much lower. We can assume this is due to lower labor

costs, as the mode does not employ drivers. Across all rail modes, driver salaries on average account for 8.1% of a transit agency's total operating budget.

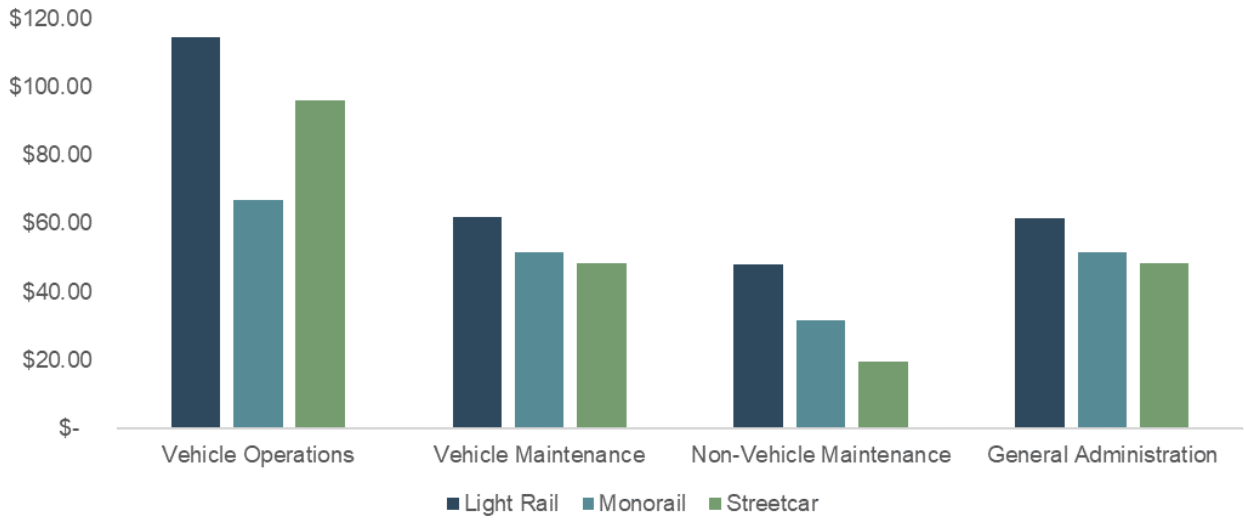


Exhibit 33 *Operating Expense Function per VRH by Mode (2017)*

One might expect that rail systems with more directional route miles have fewer capital expenses per mile, due to economies of scale. However, in 2017, light rail was the most expensive mode at $588,939 per DRM. Monorail is close behind at $537,078, but streetcar is nearly half as expensive per DRM at $275,292.

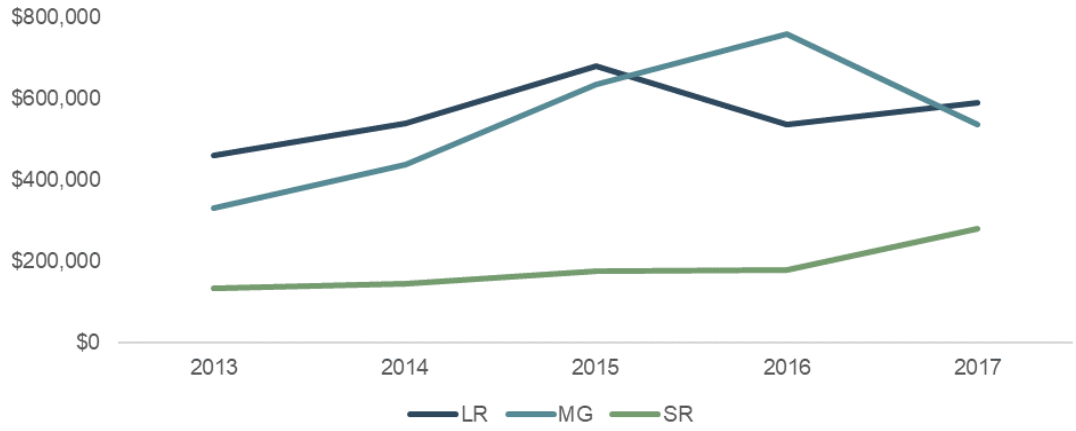


Exhibit 34 *Capital Cost per DRM*

This cursory comparison of operation and capital costs and recovery ratio suggests that cities planning new rail infrastructure may want to further examine whether Monorail fits their current and future needs.

Agency Spotlight: Massachusetts Bay Transportation Authority

Rail Direction Route Miles

Boston was the second city in the United States to construct a rail system in 1897 — Chicago's L line was first in 1892 — and the first to build a subway tunnel in 1898. Since then, the Massachusetts Bay Transportation Authority (MBTA) has expanded the rail system to include 903.4 miles of fixed guideway operated across three rail modes (Commuter Rail, Heavy Rail, Light Rail). The Commuter Rail mode accounts for 776.08 of these miles.

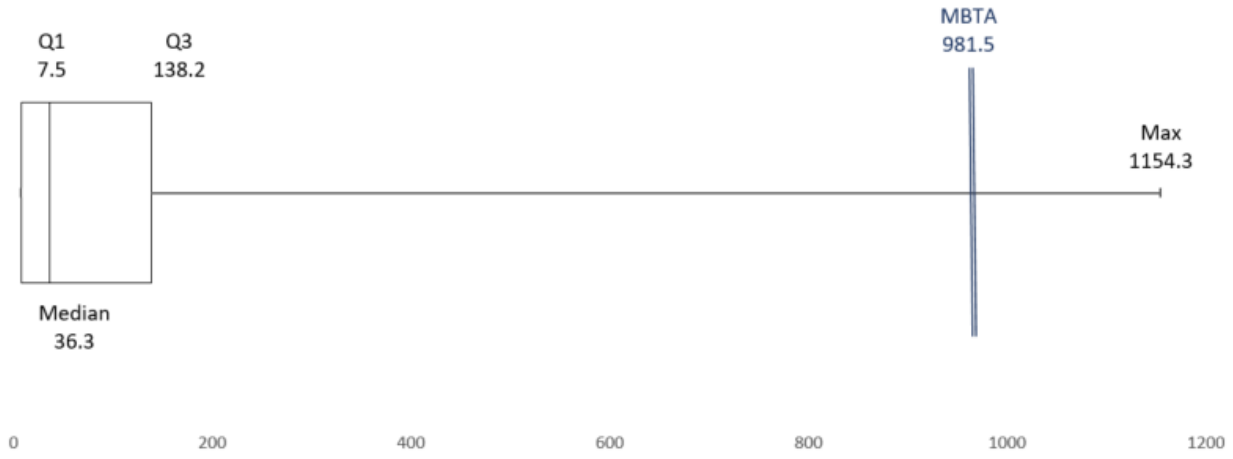


Exhibit 35 *Fixed Guideway DRM for MBTA*

MBTA operates four additional modes (Bus, Ferryboat, Bus Rapid Transit, and Trolleybus). Across all modes they have ownership of 981.47 Directional Route Miles. In total, MBTA accounts for 1 in every 16 miles (6.2 percent) of the nation's fixed guideway Directional Route Miles, the second only to New York City's Metropolitan Transit Authority (MTA).

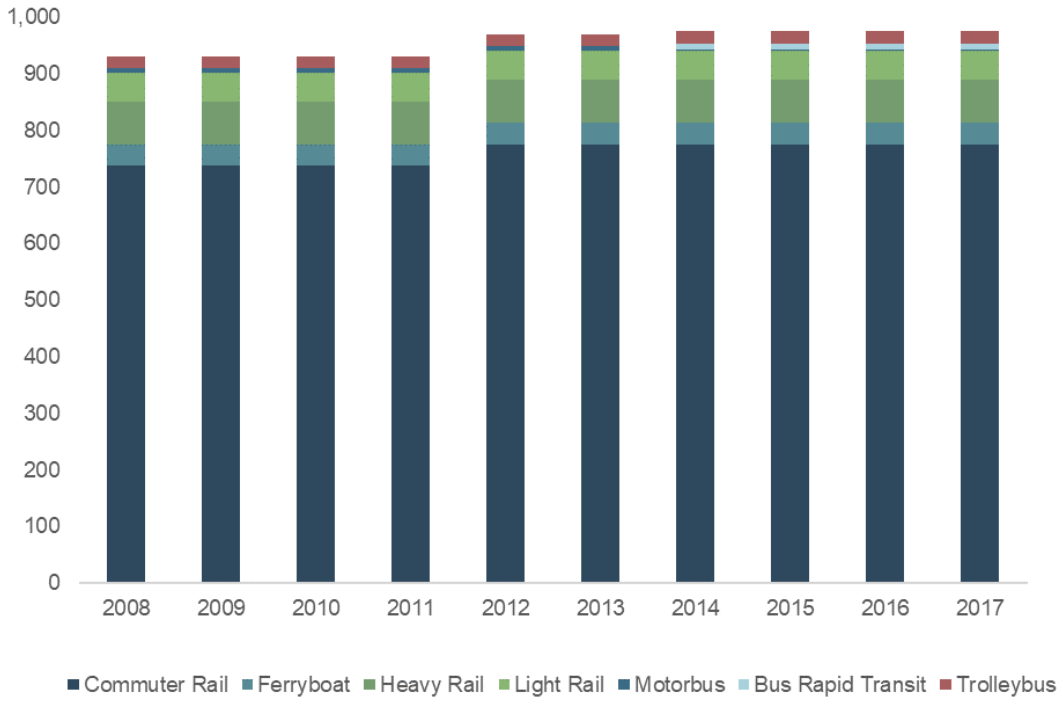


Exhibit 36 *MBTA Directional Route Miles by Mode*

Since 2008, MBTA has added 56.7 miles of new track and exclusive roadways, an increase of 5 percent.

Mode	DRM	National DRM	MBTA % of Total	PMT
CR	776.08	7,911.9	9.8%	697,665,040
FB	38.42	831.2	4.6%	16,570,127
HR	76.3	1,659.8	4.6%	557,734,891
LR	51	1,572.1	3.2%	158,992,398
MB	2.52	3,082.7	0.3%	276,815,538
RB	10.38	252.9	4.1%	19,893,655
TB	21.58	458.0	4.7%	4,559,747
Total	**976.28**	**15,768.7**	**6.2%**	**17,077,017**

Exhibit 37 *MBTA Directional Route Miles by Mode*

The agency now operates transit service across seven fixed guideway modes — more than any other agency in the United States. The largest portion of miles comes from their Commuter Rail (CR) system, accounting for 9.8 percent of the nation's CR Directional Route Miles. It is the fifth most utilized CR system in the country.

Boston – A Transit Intensive City

Boston's vast system of fixed guideway segments supports a large ridership base. Of the six agencies with the most cumulative passenger miles traveled, MBTA is second after New York City's MTA.

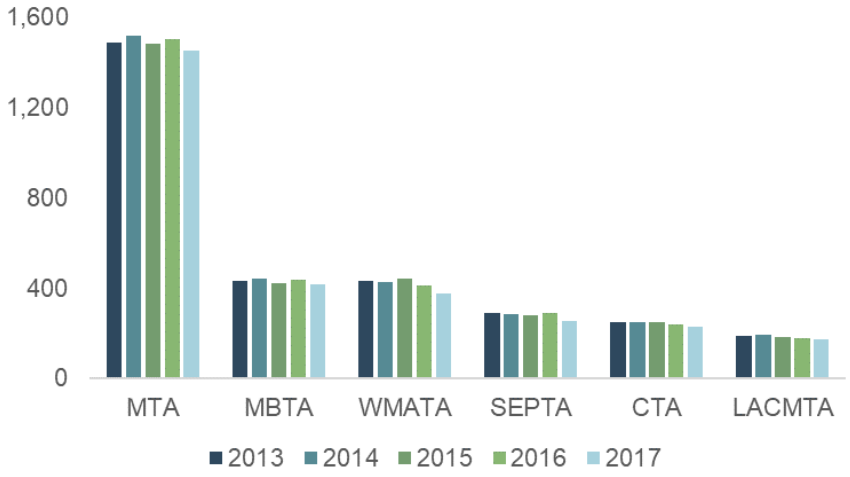


Exhibit 38 *PMT per Capita by Top 5 Agencies (Primary UZA)*

Like many other agencies across the country, MBTA has not been immune to declining ridership. However, it has maintained a high level of system usage in relation to the amount of system load factor. The NTD calculates Load Factor as passenger miles traveled over vehicle revenue mile. Load factor is the measure of average passengers on board the vehicle at any one time. Within the same group of agencies, MBTA provides the second-most trips per mile of service: in 2017, it had 18.2 trips per mile (MTA provided 25.2).

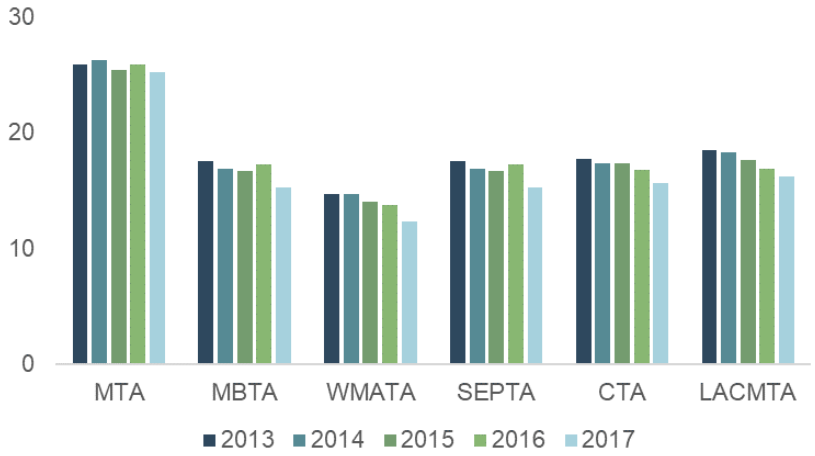


Exhibit 39 *Load Factor of Top 5 Agencies*

Unique Transit Modes

More modes were described in the Introduction than were included in most exhibits. This is because some modes are so rare and unique in their service characteristics that they appear as outliers in comparison to all other modes.

Passenger Miles Traveled (PMT) provides insight into the use of public transit services. Most passenger miles are traveled on three transit modes: Bus (MB), Heavy Rail (HR), and Commuter Rail (CR) (see Exhibit 40). About 86 percent of the PMT are accounted for by these three modes. The remaining modes account for about 14 percent of passenger miles traveled, of which the unique modes subset accounts for less than 1 percent. The NTD includes the following under unique modes of service:

- Aerial Tramways (TR)
- Alaska Railroad (AR)
- Cable Car (CC)
- Inclined Plane (IP)
- Monorail/Automated Guideway (MG)
- Públicos (PB)

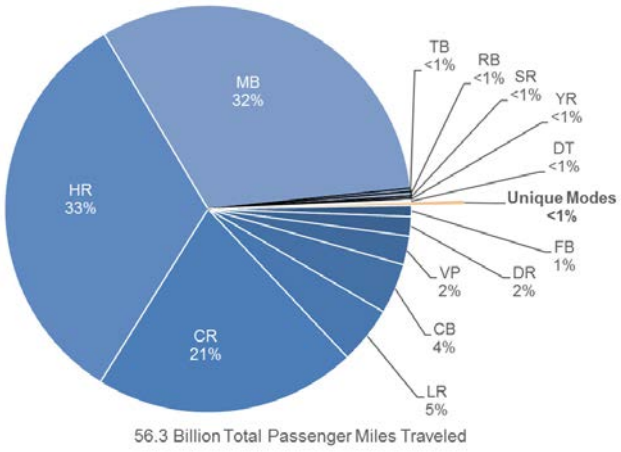


Exhibit 40 *Full Reporters' Passenger Miles Traveled, 2017*

Aerial tramways, cable cars, inclined planes, and automated guideway systems are unique because of the technology required to run these systems. The Alaska Railroad, for example, services the widest area of any rail system in the country, using more than 500 miles of track across Alaska. The Público system is the largest transit system in Puerto Rico, and each driver operates as a separate business unit.

Aerial Tramway

Aerial tramway (TR) is a transit mode where vehicles shuttle along suspended cables between two tram terminals at differing heights. In most cases, one or two fixed cables support the vehicle while the vehicle's electrically powered wheels roll up and down a third cable, or haulage rope. This propulsion method and cable setup enables aerial trams to move forward or backwards as needed.

Source: http://commons.wikimedia.org/wiki/User:Another_Believer

Exhibit 41 *Portland Aerial Tram*

Different variations of tramways have been in use for hundreds of years, especially for industrial cargo and in mountainous regions to carry ore in mining operations. As time passed, aerial trams began to carry passengers instead of exclusively cargo.

However, as electric power became more widely used in transit services in the 1930s and 1940s, aerial tramways became obsolete. Since then, tramways have been largely used for recreational purposes such as ski lifts. However, there has been a recent interest in operating tramways in the urban market. There now are two aerial tramways that provide mass transit service in the country. The Roosevelt Island Tramway connects Roosevelt Island to the upper east side of Manhattan in New York City, which does not benefit from federal funding.

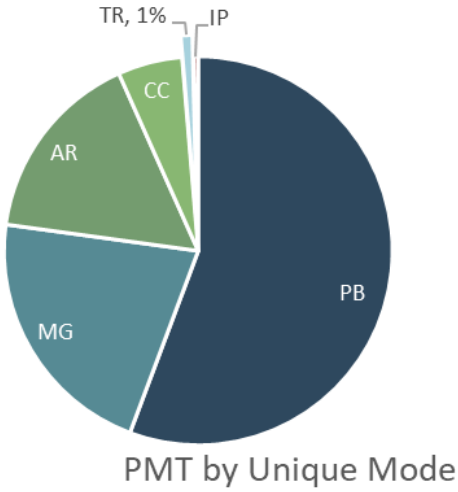


Exhibit 42 *Aerial Tramway PMT*

The City of Portland is the only NTD reporter that reports aerial tramway service. The Portland Aerial Tram opened in 2006 and operates a two-vehicle line service that can carry 78 passengers per cabin. The tramway connects the Oregon Health & Science University (OHSU) campus with the South Waterfront district of Portland.

While an aerial tramway does not operate on rails or roadway, it operates in exclusive air space. For the purposes of NTD reporting, the NTD considers aerial tramway a non-rail, fixed route mode operating exclusively on fixed guideway.

Alaska Railroad

Alaska railroad (AR) is a transit mode designated solely for the Alaska Railroad Corporation. This railroad provides both freight and passenger service and uses more than 500 miles of track across the state of Alaska.

Source: Alaska Railroad Corporation http://www.alaskarailroad.com

Exhibit 43 *Alaska Railroad Corporation*

This railroad has been in operation since the early 1900s. The Alaska Central Railway constructed the railroad to provide an all-weather route to take advantage of the natural resources in the interior of the Alaska Territory. Alaska Central Railway began laying the first railroad in Seward, Alaska, in 1903, which eventually extended 50 miles north. In 1914, Congress approved the construction of 470 miles of track to Fairbanks that was completed in 1923.

During World War ll, the railroad played an important role in the war effort by hauling military and civilian supplies and materials to and from Whittier, a military port and fuel depot. Due to the heavy use of the railway, Congress approved a $100 million rehabilitation program after the war.

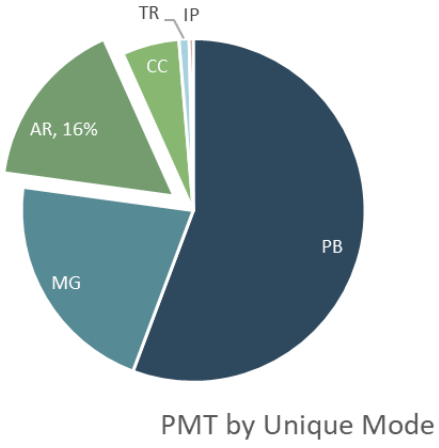


Exhibit 44 *Alaska Railroad PMT*

The Alaska Railroad experienced another challenge in the mid-1960s when an earthquake caused $30 million in damage. The 9.2 magnitude earthquake, known as the Great Alaskan Earthquake, is the strongest recorded in North America and the second strongest in recorded history.

In 1984, Governor Sheffield signed legislation creating the Alaska Railroad Corporation. Shortly thereafter, the State of Alaska purchased the railroad from the

Federal government. The Alaska Railroad continues to provide freight and passenger services today.

The Alaska Railroad Corporation provided 23.4 million passenger miles of service in Report Year 2017. This service accounted for approximately 16 percent of the total unique mode PMT.

Cable Car

The cable car (CC) mode operates on a railway propelled by underground cables. While several cities operated cable cars in the past, the San Francisco cable car system is the last system in operation in the country today and has received recognition as a National Historic Landmark. This system is one of two National Historic Landmarks that move — the other is New Orleans' St. Charles Streetcar line. Andrew Smith Hallidie created the first cable railway in San Francisco known as the Clay Street Hill Railroad. Clay Street provided the template for San Francisco's cable car system that exists today.

Exhibit 45 *San Francisco Cable Car*

Prior to cable cars, people used horses to move passengers and supplies up and down San Francisco's steep streets. Throughout the late 1800s, San Francisco converted from horse operations to cable cars, reaching 23 operating lines by 1890. There are three cable car lines still in operation today: Powell-Mason, Powell-Hyde, and California.

San Francisco's cable cars move using centralized, powerful electric motors that replaced the original steam powered engines. These engines move large wheels that pull the underground cables through the streets. Each car requires two operators on board for the cable car to move safely and efficiently — a grip operator and a conductor.

The cable car system employs “grips” that extend through the vehicle and directly clench and release the cable underground. This gripping action is performed by grip operators, or gripmen, through a ratchet lever. This procedure allows the cars to coast over crossing cables and brake whenever necessary. Conductors are responsible for fare collection, boarding management, and control over the rear wheel brakes. The San Francisco Municipal Railway operates the cable cars and reports the data to the NTD. In Report Year 2017, cable cars provided 7.8 million passenger miles of service, making up 5.4 percent of total unique modes PMT.

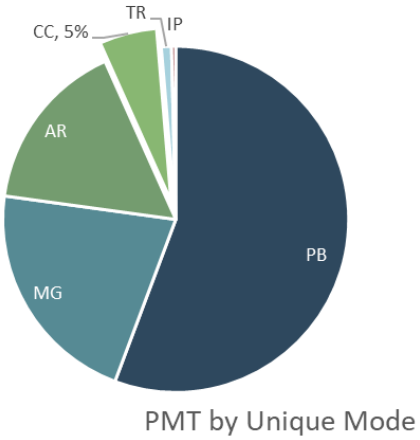


Exhibit 46 *Cable Car PMT*

Inclined Plane

An incline plane (IP), commonly referred to as a funicular railway, is a mode of transit that operates on a railway over steep slopes and grades. Moving cables power the vehicles, which can move both up and down the grade. An incline plane differs from a cable car in that the cable is permanently attached to the inclined plane vehicle.

There are three NTD reporters that provide information for inclined planes: Cambria County Transit Authority (CCTA), Port Authority of Allegheny County (PAAC), and Chattanooga Area Regional Transportation Authority (CARTA).

PAAC owns and operates the Monongahela Incline, also known as the Mon Incline, which is the oldest continuously operating incline plane in the country. John Endres built the incline plane in 1870 in response to the rapid expansion of Pittsburgh. As the factories and mills grew on flats near the river, people built houses nearby on top of Mount Washington. The construction of the incline facilitated further development and accessibility to the area.

Source: http://en.wikipedia.org/wiki/Monongahela_Incline

Exhibit 47 *Monongahela Incline*

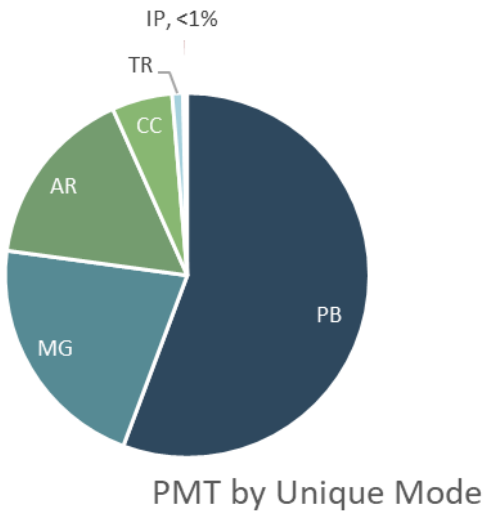


Exhibit 48 *Inclined Plane PMT*

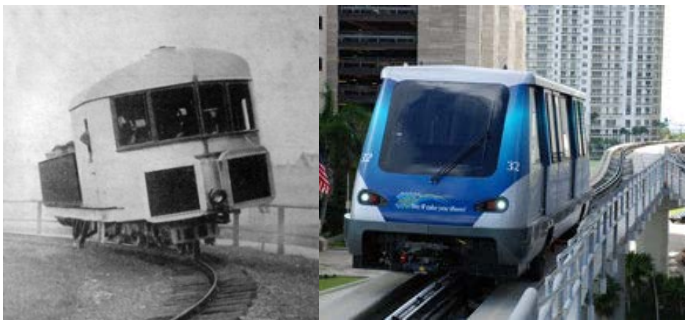
CCTA owns and operates the Johnstown Inclined Plane, another transit service rich in history. This incline is 118-years-old and carries nearly 100,000 riders each year.

Lookout Mountain Incline Railway is the inclined plane operated by CARTA. Located in Chattanooga, Tennessee, this incline began operation in 1895 and today is one of the word's steepest passenger railways.

Inclined planes operate using two cars that attach to a cable. This cable runs through a pulley at the top of the grade. The two cars run simultaneously; one car moves up the incline while the other moves down. This procedure allows the cars to counterbalance, therefore minimizing the energy required to propel the car going up the incline.

The inclined plane mode generates the smallest amount of passenger miles traveled of all NTD transit modes. During Report Year 2017, the IP passengers traveled just over 562,000 miles.

Monorail/Automated Guideway



Sources: http://en.wikipedia.org/wiki/Monorail / www.miamidade.gov/transit/metromover.asp

Exhibit 49 *Louis Brennan's Gyrocar & Miami-Dade Metromover*

Automated Guideway (MG) is a type of public transit system where trains operate over a single electric rail. Automated guideway systems are typically above grade, or elevated, and may either operate over or suspend from the central beam. Many airports utilize automated guideway systems for transferring passengers to and from terminals.

Henry Palmer invented and patented one of the earliest monorail designs in 1821. Since that time, many engineers experimented with a single rail system as a cheaper alternative to existing rail transport.

In 1903, Louis Brennan patented a gyroscopically balanced monorail, or gyrocar, as shown on the left-hand side of Exhibit 55. While he intended to use this system for military purposes, it did not move past the prototype stage.

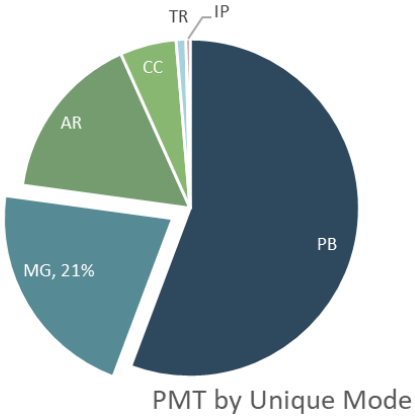


Exhibit 50 *Monorail PMT*

Since then, automated guideway systems have become significantly more modern. Today's automated guideway systems straddle center beams that support and guide the train, and use pneumatic, or air-filled, rubber tires. The electric motors use third rails or contact wires that power the straddle beam to propel the trains forward.

Automated guideway systems benefit from being elevated above normal traffic, allowing them to operate free of congestion and pedestrians. Additionally, monorail systems are typically quiet and environmentally friendly due to their electrical propulsion, and costs tend to be lower than tunneling options.

There are six agencies that reported data for MG services to the NTD: Seattle Center Monorail Transit, Morgantown Personal Rapid Transit, Miami-Dade Transit, Detroit Transportation Corporation, Jacksonville Transit Authority, and Las Vegas Monorail Company.

Públicos

Exhibit 51 *Público*

The Público system (PB) is a transit mode unique to Puerto Rico and provides fixed route services predominantly in Puerto Rico's urbanized areas. The Público system is the largest public transportation system in Puerto Rico.

Públicos are similar to informal transport systems operated in developing countries. The biggest distinction between the Público service and other transit modes is the way in which Públicos operate. Drivers own their vehicle and are given exclusive rights to the route where they provide service. The drivers, or route owners, are responsible for their service and operate as independent business units. Besides maintaining the vehicles and routes, drivers must determine their schedule and supply the funds to run the service.

Puerto Rico Highway and Transportation Authority (PRHTA) manages the Público service and grants permission to potential drivers. PRHTA surveys the area and determines if there is a need for transit. If approved, PRHTA franchises the rights for that particular route to the prospective operator. There are currently over 2,800 operators providing Público service. In some cases, drivers may have rights to multiple routes and employ others to operate the service on their behalf.

The drivers operate entirely from revenues earned from passenger fares. PRHTA does not provide drivers with operating or capital assistance. Drivers collect and report their financial and service data to PRHTA, who subsequently reports it to the NTD under the Público mode.

Públicos account for 56 percent of the passenger miles traveled by unique transit modes in the U.S. This translates to 81 million out of the 145 million unique modes' PMT.

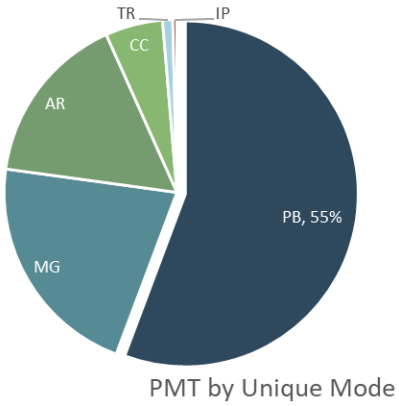


Exhibit 52 *Público PMT*