Executive Summary

PART I: Moving a Nation

Part I includes six chapters, each of which describes the current system from a different perspective:

- Chapter 1, **System Assets**, describes the existing extent of the highways, bridges, and transit systems.
- Chapter 2, **Funding**, provides data on the revenue collected and expended by different levels of governments and transit operators to fund transportation construction and operations.
- Chapter 3, **Travel Behavior**, explores the 2017 National Household Travel Survey (NHTS), including data on internet-based and phone-based mobility solutions.
- Chapter 4, **Mobility and Access,** covers highway congestion and reliability in the Nation's urban areas. The transit section explores ridership, average speed, vehicle utilization, and maintenance reliability.
- Chapter 5, **Safety**, presents statistics on highway safety performance, focusing on the most common roadway factors that contribute to fatalities and injuries. The transit section summarizes safety and security data by mode and type of transit service.
- Chapter 6, **Infrastructure Conditions**, presents data on the current physical conditions of the Nation's highways, bridges, and transit assets.

Transportation Performance Management

The Federal Highway Administration (FHWA) defines Transportation Performance Management (TPM) as a strategic approach that uses system information to make investment and policy decisions that contribute to national performance goals. FHWA has finalized six related rulemakings to implement the TPM framework established by the Moving Ahead for Progress in the 21st Century (MAP-21) Act and the Fixing America's Surface Transportation (FAST) Act:

- Statewide and Metropolitan / Nonmetropolitan Planning Rule (implements a performance-based planning process at the State and metropolitan levels; defines coordination in the selection of targets, linking planning and programming to performance targets).
- Safety Performance Measures Rule (PM-1) (establishes five safety performance measures to assess fatalities and serious injuries on all public roads, a process to assess progress toward meeting safety targets, and a national definition for reporting serious injuries).
- Highway Safety Improvement Program (HSIP) Rule (integrates performance measures, targets, and reporting requirements into the HSIP).
- Pavement and Bridge Performance Measures Rule (PM-2) (defines pavement and bridge condition performance measures, along with target establishment, progress assessment, and reporting requirements).
- Asset Management Plan Rule (defines the contents and development process for an asset management plan; also defines minimum standards for pavement and bridge management systems).
- System Performance Measures Rule (PM-3) (defines performance measures to assess performance of the Interstate System, non-Interstate National Highway System, freight movement on the Interstate System, Congestion Mitigation and Air Quality Improvement Program traffic congestion, and on-road mobile emissions).

All 50 State DOTs, the District of Columbia, and Puerto Rico reported performance data and targets for each of 17 performance measures. These data are available at https://www.fhwa.dot.gov/tpm/reporting/state/index.cfm

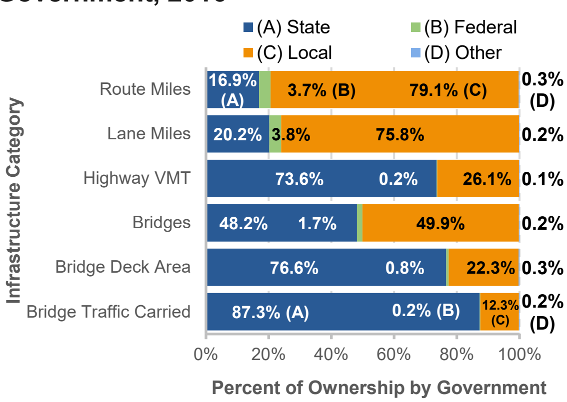
CHAPTER 1: System Assets – Highways

Based on data collected from States through the Highway Performance Monitoring System (HPMS), in 2016 local governments owned 79.1 percent of the Nation's 4,157,292 public road route miles and 75.8 percent of its lane miles (computed as roadway length times number of lanes). However, State-owned roads carried a disproportionate share of the Nation's travel in motorized vehicles, accounting for 73.6 percent of the 3.189 trillion vehicle miles traveled (VMT) in 2016.

Based on 2016 data collected from States through the National Bridge Inventory (NBI), ownership of bridges is more evenly split, as local governments owned slightly more (49.9 percent) of the Nation's 614,387 bridges in 2016 than did State governments (48.2 percent). State-owned bridges made up 76.6 percent of the Nation's bridge deck area, and carried 87.3 percent of total bridge traffic.

Although the Federal government provides significant financial support for the Nation's highways and bridges, it owns only 3.7 percent of public road route miles and 1.7 percent of bridges.

Highway and Bridge Ownership by Level of Government, 2016



Sources: HPMS and NBI.

Roadways are categorized by functional classifications, based on the degree to which they provide access relative to the degree to which they provide mobility. Arterials serve the longest distances with the fewest access points. Roads classified as local (which are not all owned by local governments) are greatest in number and provide the most access to adjacent land. Collectors funnel traffic from local roads to arterials.

Nearly half the Nation's route mileage was classified as rural local in 2016, part of the 70.7 percent of route mileage located in rural areas. Almost one-third of the Nation's bridges were classified as rural local.

Highway Mileage and Bridges, by Functional System, 2016

Functional System	Route Miles	Bridges
Rural Areas (less than 5,000 in population)		
Interstate	0.7%	4.1%
Other Principal Arterial	2.3%	6.1%
Minor Arterial	3.2%	6.2%
Collector	16.1%	22.8%
Local	48.4%	33.1%
Subtotal Rural Areas	**70.7%**	**72.2%**
Urban Areas (5,000 or more in population)		
Interstate	0.5%	5.2%
Other Principal Arterial	1.9%	8.2%
Minor Arterial	2.7%	5.1%
Collector	3.5%	3.7%
Local	20.7%	5.5%
Subtotal Urban Areas	**29.3%**	**27.8%**
Total	**100.0%**	**100.0%**

Note: Other Freeway and Expressway is shown within Other Principal Arterial. Collector includes Major Collector and Minor Collector.

Source: HPMS and NBI.

In general, the 1,026,319 route miles of public roads that were functionally classified as arterials, urban collectors, or rural major collectors in 2016 are eligible for Federal-aid highway funding (and are described as "Federal-aid highways").

MAP-21 expanded the National Highway System (NHS) to include almost all principal arterials; the NHS also includes collector and local mileage that connects principal arterials to other transportation modes and defense installations. The total length of the NHS was 222,331 miles in 2016, including 48,474 miles on the Interstate Highway System. State highway agencies own 89.2 percent of the NHS and 94.4 percent of Interstate highways. A combination of local governments and other State agencies own most of the remaining NHS mileage.

CHAPTER 1: System Assets – Transit

Most transit systems in the United States report to the National Transit Database (NTD). In 2016, 949 systems served 486 urbanized areas that have populations greater than 50,000. In rural areas, about 1,301 systems were operating, of which 718 were located in urban clusters (urban areas with population of less than 50,000 and over 2,500), 395 were located in Census-designated rural areas, and the remaining 188 were tribes and agencies that could not be geocoded.

Modes. Transit is provided through 18 distinct modes in two major categories: rail and nonrail. Rail modes include heavy rail, light rail, streetcar, commuter rail, and other less common modes that run on fixed tracks, such as hybrid rail, inclined plane, monorail, and cable car. Nonrail modes include bus, trolleybus, commuter bus, bus rapid transit, demand response, vanpools, other less common rubber-tire modes such as jitney and público, ferryboats, and aerial tramways.

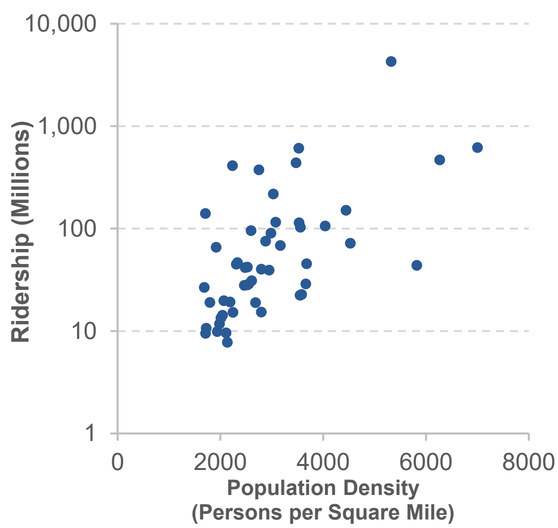
Urbanized Areas, Population Density, and Demand. Based on the 2010 census, the average population density of the United States is 82.4 people per square mile. The average population density of all 497 urbanized areas combined is 2,548 people per square mile. The exhibit shows the relationship between ridership and urbanized area density for the top 50 areas in 2016. Areas with higher population density are able to attract more discretionary transit riders.

Organizational Structure of Urban and Rural Agencies. Approximately 50 percent of transit agencies in the United States are transportation units or departments of cities, counties, and local government units. Independent public authorities or agencies account for 21 percent; 19 percent are private operators and the remaining 9 percent are other organizational structures such as State governments, area agencies on aging, municipal planning organizations, planning agencies, Tribes, and universities.

National Transit Assets

- Of the 212,668 vehicles in urban and rural areas, 191,064 are nonrail vehicles (buses, demand response, and vanpool), whereas 21,604 rail vehicles are rail passenger cars.
- Demand response is the most common mode in rural areas, with over 79 percent of the 21,331 vehicles in the rural fleet.
- Rail systems operate on 13,094 miles of track and bus systems operate over 233,000 directional route miles.
- Urban and rural areas have 3,449 stations and 2,424 maintenance facilities, of which 70 are heavy facilities.

Urbanized Area Density vs. Ridership, 2016 (Top 50 Areas in Population)



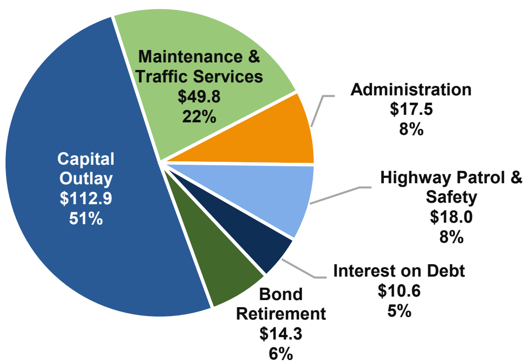
Source: U.S. Census and National Transit Database.

ADA Compliance. The Americans with Disabilities Act of 1990 (ADA) ensures equal opportunity and access for persons with disabilities. The ADA requires transit agencies to provide accessible vehicles (e.g., with lifts) and accessibility enhancements to key rail stations, such as barriers on platforms, ramps, elevators, and other elements. Nearly 95 percent of vehicles are ADA-compliant. Most key rail stations are compliant, but many non-key rail stations are not fully accessible.

CHAPTER 2: Funding – Highways

Total expenditures for highways and bridges by all levels of government combined reached $223.2 billion in 2016. Slightly more than half of that amount (50.6 percent or $112.9 billion) was for capital outlays. Noncapital expenditures such as maintenance and traffic services, administration, and highway patrol and safety totaled $95.9 billion (43.0 percent) and another $14.3 billion (6.4 percent) was used for bond retirement.

Highway Expenditures by Type, 2016



Source: FHWA Bulletin: Highway Funding 2013–2016.

Of the $112.9 billion in capital outlays, $70.0 billion was used for system rehabilitation, $27.6 billion for system expansion, and $15.3 billion for system enhancement.

All levels of government raised a combined $272.1 billion for highways and bridges in 2016, of which $49.0 billion was put in reserves for future use.

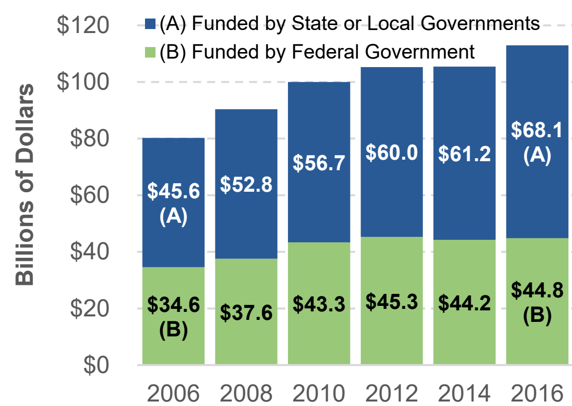
State governments raised $122.4 billion for highways in 2016, and directly spent $144.6 billion on highways. Local governments raised $60.1 billion for highways and directly spent $75.6 billion.

The Federal government raised $89.6 billion for highways in 2016, including a one-time transfer of $51.9 billion from the general fund to the Highway Trust Fund required under the FAST Act. These revenues supported a large $42.4 billion increase in the cash balance of the Federal Highway Trust Fund to support highway spending over the duration of the FAST Act; the Federal government funded $47.2 billion of highway expenditures in 2016.

Most of this ($44.2 billion) took the form of transfers to State and local governments; direct spending by Federal agencies on roads and bridges totaled $3.0 billion in 2016.

Although federally funded highway capital outlay grew nominally from 2006 to 2016, the federally funded share of highway capital decreased from 43.1 percent to 39.7 percent, as capital outlay funded by non-Federal sources grew even faster.

Highway Capital Outlay Funded by Level of Government, 2006–2016



Sources: FHWA Bulletin: Highway Funding 2013–2016, Table HF-10B; Highway Statistics, various years, Table HF-10A.

User charges (tolls, vehicle and fuel taxes) accounted for 43.2 percent ($117.7 billion of the $272.1 billion raised). General fund appropriations accounted for another 30.4 percent ($82.8 billion), bolstered by the large one-time Federal general fund transfer. The rest came from property taxes, other taxes and fees, investment income and other receipts, and bond issue proceeds.

Alternative Funding Mechanisms

Many jurisdictions are using alternative methods to raise additional transportation funds, including public-private partnerships (P3), value capture techniques, Federal credit assistance, and other debt-financing tools. Of the 74 loans issued through FY 2017 under the Transportation Infrastructure Finance and Innovation Act (TIFIA) program, 16 were for Design-Build-Finance-Operate-Maintain highway projects where the financing responsibility was given to private partners.

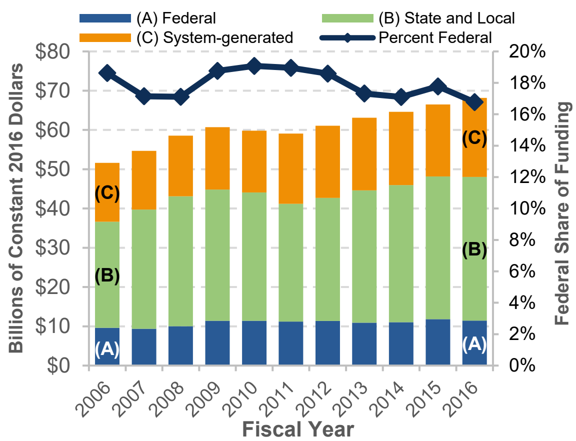
CHAPTER 2: Funding – Transit

Funding Sources

In 2016, $68.4 billion was generated from all sources to fund urban and rural transit. Transit funding comes from public funds that Federal, State, and local governments allocate and from system-generated revenues that transit agencies earn from the provision of transit services. Of the funds generated in 2016, 70 percent came from public sources and 30 percent came from system-generated funds (passenger fares and other system-generated revenue sources). The Federal share was $12.0 billion (25 percent of total public funding and 17.5 percent of all funding).

Between 2006 and 2016, all sources of public funding for transit increased by 3.6 percent per year. The Federal share remained relatively stable, varying in the range of 17 to 20 percent.

Funding for Urban Transit by Government Jurisdiction, 2006–2016



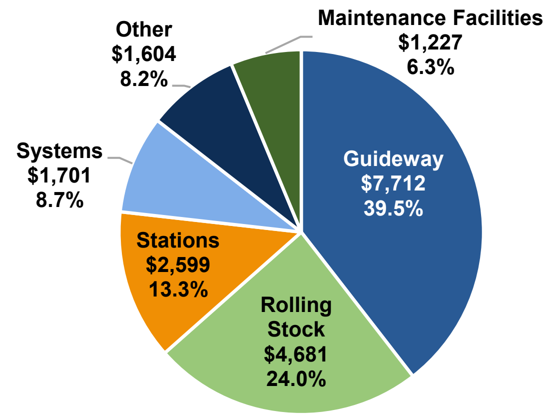
Source: NTD.

Expenditures

In 2016, operating expenses consumed $48.7 billion of all funding while capital expenditures consumed $18.2 billion of all funding devoted to transit ($68.4 billion).

Capital investment consumed $18.1 billion. The largest share of capital expenditures—39.5 percent ($7.7 billion)—was used for expansion or rehabilitation of guideway assets.

Urban Capital Expenditures by Asset Type, 2016

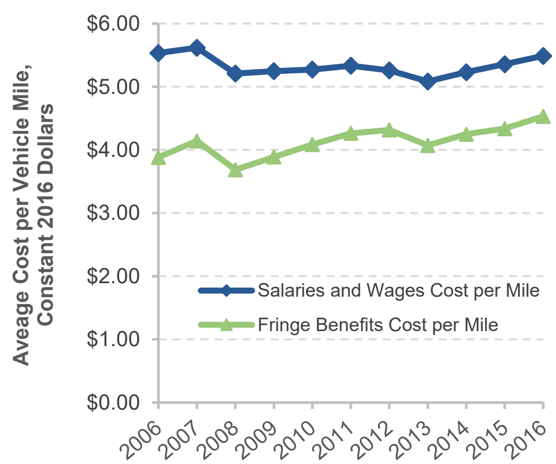


Source: NTD.

Salaries and Fringe Benefits

From 2006 to 2016, for the top 10 transit agencies, fringe benefits increased at the highest rate of any operating cost category on a per-mile basis. Over this period, the cost of fringe benefits increased at an annual compound average rate of 1.6 percent with a total accumulated increase of 16.8 percent. Fringe benefits can include many components, but the cost of medical insurance is usually a key element. Meanwhile, salaries and wages decreased by nearly 1 percent over the 10-year period.

Salaries/Wages and Fringe Benefits, Average Cost per Mile, Top 10 Transit Agencies, 2006–2016



Sources: NTD and Bureau of Labor Statistics Consumer Price Index.

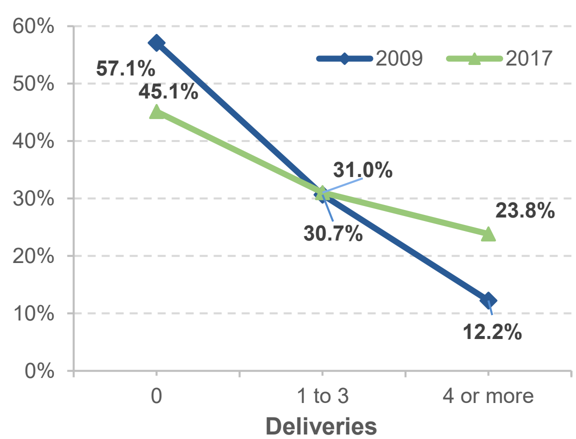
CHAPTER 3: Travel Behavior

Household travel behavior depends heavily on demographic distribution and geographic location. Many of these characteristics can be found in the National Household Travel Survey (NHTS) data.

The 2017 NHTS also captures information on household technology use. New technologies and internet access have opened the door to a growing number of mobility options for many Americans. The most recent NHTS has revealed the ubiquity of internet use—more than 80 percent of households use the internet on a daily basis and more than 90 percent use it at least a few times a month. Wireless connectivity is more prevalent in urban households with 81 percent of urban and 73 percent of rural households using the internet via smartphone at least a few times a week. Despite these high levels of connectivity, only 9 percent of Americans at or above 16 years old indicated that they hailed a ride with a ridehail smartphone app in the last 30 days.

The share of households reporting having received a delivery from an online purchase in the last 30 days grew from 42.9 percent in 2009 to 54.9 percent in 2017. The share of households with frequent deliveries has increased considerably; households receiving four or more monthly deliveries almost doubled from 12.2 percent in 2009 to 23.8 percent nationally in 2017.

Online Monthly Purchase Deliveries, 2009–2017



Source: NHTS.

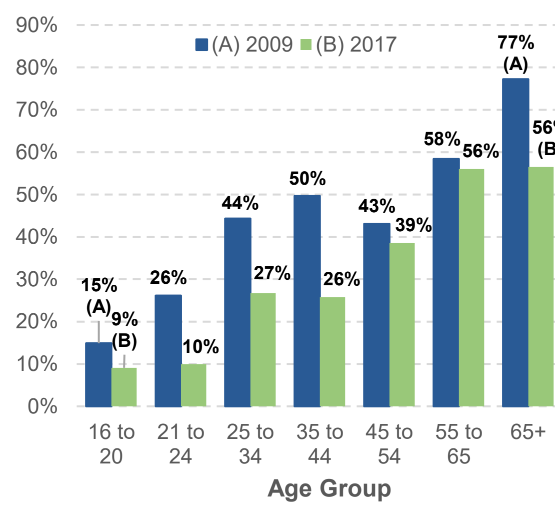
Telework has also seen growth with eligibility increasing from 11 percent in 2001 to 14 percent in 2017. Ineligibility to telework is more pronounced in rural areas where 90 percent of workers are not eligible to work from home compared with their urban counterparts at 85 percent.

Travel Patterns Associated with Household Characteristics

Vehicle miles traveled (VMT) has consistently shown a strong relationship with labor force participation over time. The most recent NHTS data show that an average worker drove 13,733 miles annually, almost double the miles driven by nonworkers at 7,600 miles. Workers travel more regardless of whether it is in a vehicle with almost 60 percent more passenger miles traveled than those of nonworkers in 2017.

Baby boomers are working longer, and they are driving more miles than their cohorts of the past with women moving closer to parity and closing the VMT gap. Although men 65+ drove 56 percent more annual average miles than did their female counterparts in 2017, women have lessened the gap by 21 percentage points from 2009 when men 65+ drove 77 percent more annual average miles than did women 65+.

Percent Difference in Average Annual VMT Between Male and Female Drivers, by Age



Source: NHTS.

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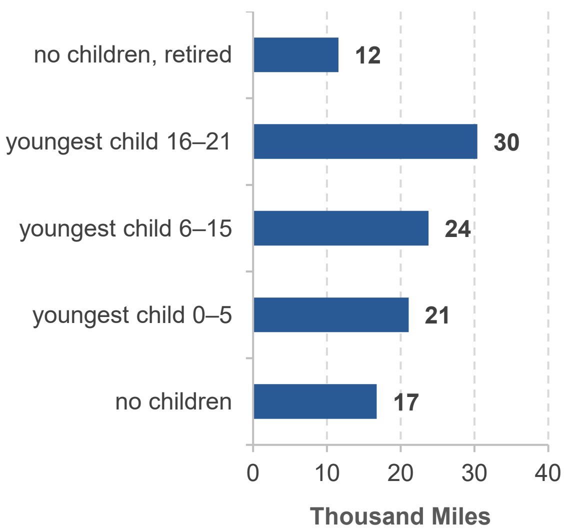
Households with children have higher than average annual household VMT whereas retirees and households with no children have lower than average household VMT. More than 80 percent of households without a car have no children present.

Household minors create many additional drop-off and pick-up trips with school and extracurricular activities, adding more miles to the household log that likely already contains regular work trips.

2017 Average Household Annual VMT



Source: NHTS.

According to the Centers for Disease Control and Prevention, U.S. women are waiting longer to have their first child. In 1970, the mean age of a first-time mother was 24.6 years compared with 28 years in 2016. This growing delay in parenthood may also result in pushing back the need for vehicle purchases and higher VMT levels for older age groups.

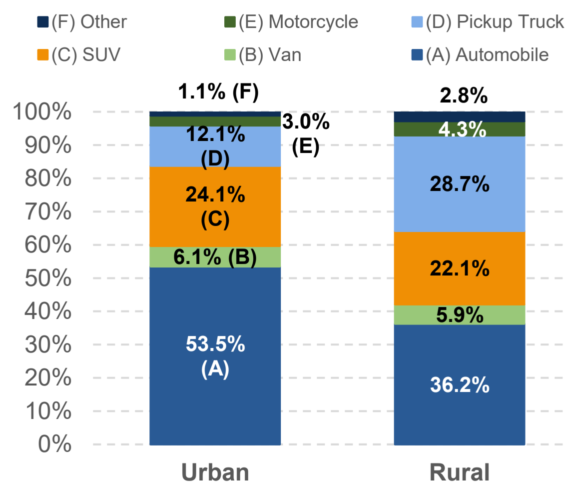
Travel Behavior Characteristics

Since 2009, the United States has seen an uptick in both vehicle and nonmotorized trips. Households living in areas with a population density greater than 10,000 people per square mile consistently have higher household person trips across all vehicle ownership levels, likely due to higher average income levels and the larger variety of mobility options.

When NHTS respondents were asked how many walking or bicycling trips taken in the past seven days, the data showed a 7.7 percentage point increase (from 65.4 percent in 2001 to 73.1 percent in 2017) in individuals who took at least one walking trip, and a 5.1 percentage point increase in individuals who took at least one bicycling trip in the 2017 survey compared with the 2001 survey.

The number and type of vehicles in U.S. households vary by region. Pickup trucks and motorcycles are more prevalent in rural areas (28.7 percent vs. 12.1 percent and 4.3 percent vs. 3.0 percent, respectively) whereas automobiles and sport utility vehicles (SUV) are more common in urban areas (53.5 percent vs. 36.2 percent and 24.1 percent vs. 22.1 percent, respectively).

2017 Vehicle Types, Rural vs. Urban



Source: NHTS.

The total mileage-weighted average vehicle occupancy is 1.67. This varies by mode with vans at the top at 2.44 and motorcycles and pickup trucks at the bottom with 1.20 and 1.49, respectively.

The median age of the household vehicle fleet has been growing over the last 40 years. The average U.S. vehicle is almost 4 years older than in 1977 with rural households holding their vehicles longer than urban households. This pattern of vehicle ownership leads to a slower turnover of the U.S. vehicle fleet and delays in the penetration of safety and fuel-efficient technologies.

CHAPTER 4: Mobility and Access – Highways

The Texas Transportation Institute's 2019 Urban Mobility Study indicates that congestion grew worse from 2006 to 2016. The average delay experienced by an individual commuter rose from 42 hours in 2006 to 53 hours in 2016. Total delay rose from 6.7 billion hours to 8.6 billion hours during this 10-year period, while fuel wasted rose from 3.1 billion gallons to 3.3 billion gallons. Expressed in constant 2017 dollars, the estimated total cost of congestion rose from $115 billion in 2006 to $171 billion in 2016.

NPMRDS

The National Performance Management Research Data Set (NPMRDS) is a compilation of vehicle probe-based data in both rural and urban areas on the National Highway System, as well as over 25 key Canadian and Mexican border crossings. It includes observed travel times, date/time, direction, and location for freight, passenger, and other traffic.

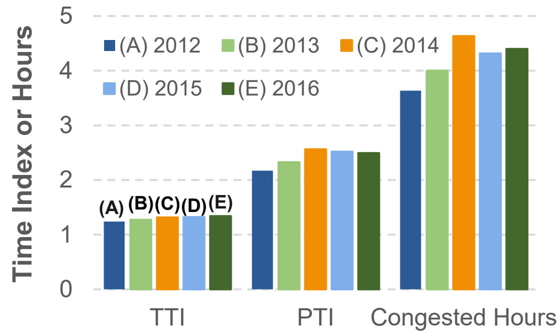
Based on the NPMRDS, the Travel Time Index (TTI) was 1.34 in 2016 for Interstate highways in the 52 largest metropolitan areas, meaning that the average peak-period trip took 34 percent longer than the same trip under free-flow traffic conditions.

The Planning Time Index (PTI) is a measure of travel time reliability. In 2016, the PTI of Interstate highways in the NPMRDS was 2.49 in the 52 largest metropolitan areas, meaning that drivers making a trip would need to leave early enough each day to account for it taking 2.49 times longer than it would under free-flow traffic conditions, if they wanted to get to their destination on time 19 days out of 20.

On average, Interstate highways were congested 4.4 hours per weekday in 2016.

Average travel time delays represented by the TTI increased from 2012 (the first year that data are available) to 2016. However, travel reliability and the length of road congestion have improved since 2014 when the values of PTI (2.56) and congested hours (4.6) peaked and then tapered off. A similar congestion trend is also observed on the limited-access non-Interstate highways.

Mobility on Interstate Highways in 52 Urban Areas, 2012–2016



Source: FHWA staff calculation from the NPMRDS.

Congestion occurs in urban areas of all sizes. Residents in large metropolitan areas tend to experience more severe congestion. Average values of TTI, PTI, and congested hours were consistently higher in larger urban areas than in medium and small ones.

In 2016, the average TTI was 1.47, 1.27, and 1.19 on Interstate Highways in metropolitan areas with populations over 5 million, between 2 and 5 million, and between 1 and 2 million, respectively. For the same sized areas, the average PTI was 2.89, 2.28, and 2.02 respectively in 2016.

Interstate Mobility

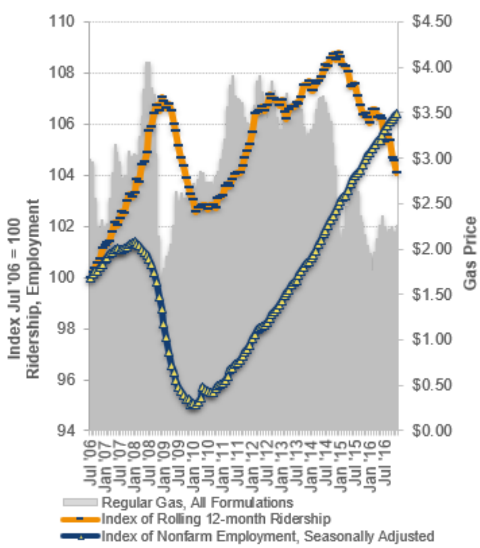
Combined with a detailed geospatial network, FHWA uses NPMRDS to examine speeds on Interstate highways for the entire Nation. The average observed vehicle speed on the entire Interstate Highway System in 2016 was 56.8 mph including peak and off-peak travel, compared to an average speed limit of 67.0 mph. The average observed speed was 60.3 mph on rural Interstates, and 53.8 mph on urban Interstates.

On rural Interstates, average speeds were relatively uniform and constant during the weekday morning and afternoon peak hours, varying within a small range between 59 and 62 mph. Average urban Interstate speed dropped substantially during weekday morning and afternoon peak hours, with the most noticeable reductions during the p.m. peak hours. Average speed fell to 47 mph between 5:00 and 6:00 p.m.

Transit Ridership and Employment

Transit ridership increased significantly from July 2006 to January 2009, then plummeted following the economic crisis in 2009. Between 2010 and 2015, growth in ridership tracked employment levels. Ridership declined roughly 5 percent between January 2015 and the end of 2016. This decline coincided with a drop in gas prices, despite ongoing growth in employment.

Transit Ridership vs. Employment, 2006–2016

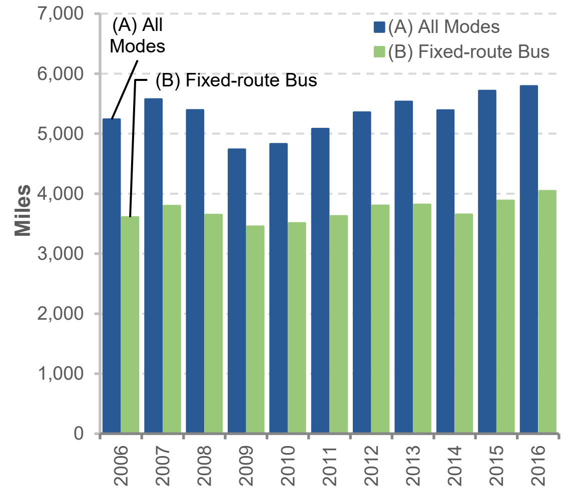


Source: NTD, EIA Gas Pump Data History, and BLS Employment Data.

Maintenance Reliability

The mean distance between failures is an important performance measure for analysis of replacement and rehabilitation needs of the national transit fleet. Between 2006 and 2016, the number of miles between failures increased by an average of 1.0 percent annually. Miles between failures for all modes combined increased in 2007, decreased until 2009, then increased steadily until 2016. The overall increase between 2006 and 2016 was 10.5 percent. The trend for fixed-route bus is nearly identical to that of all modes combined, with miles between failures increasing by 12 percent between 2006 and 2016. Bus replacement was an important factor for the increase.

Mean Distance Between Urban Vehicle Failures, 2006–2016



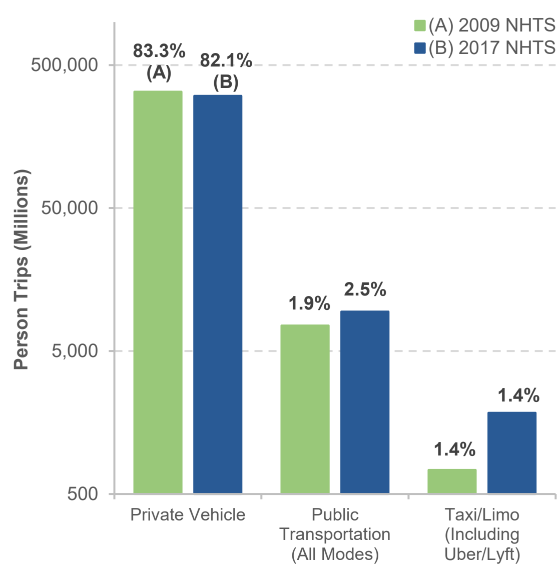
Notes: Only directly operated vehicle data were used to calculate mean distance between failures. Data from 2014 to 2016 do not include agencies that qualified for and opted to use the small systems waiver of the National Transit Database.

Source: NTD.

Market Share of Public Transportation

The share of public transportation users increased from 1.9 percent of person trips in 2009 to 2.5 percent in 2017.

Market Share Change of Public Transportation, Private Vehicles, and Taxi Trips, 2009 and 2017



Note: NHTS is National Household Travel Survey. Vertical axis is portrayed using a logarithmic scale.

Source: NHTS, FHWA, 2017.

CHAPTER 5: Safety – Highways

DOT's top priority is to make the U.S. transportation system the safest in the world. Three operating administrations within DOT—FHWA, the National Highway Traffic Safety Administration (NHTSA), and the Federal Motor Carrier Safety Administration (FMCSA)—have specific responsibilities for addressing highway safety. This balance of coordinated efforts, coupled with a comprehensive focus on shared, reliable safety data, enables these DOT administrations to concentrate on their areas of expertise and responsibility while working toward the Nation's safety goal.

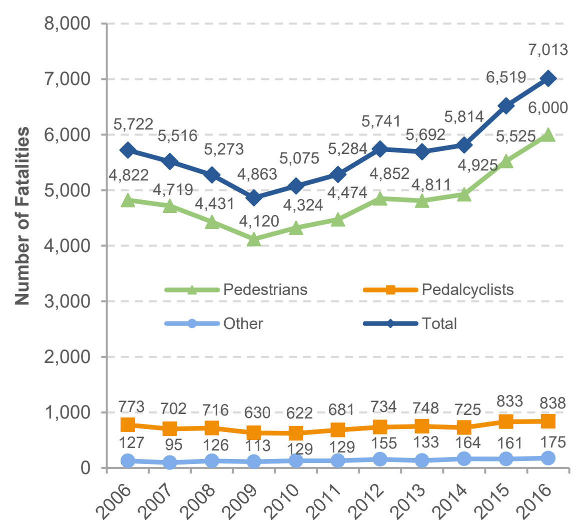
Great progress has been made in reducing overall roadway-related fatalities and injuries over time despite increases in population, travel, and some types of crashes. The figures below come from NHTSA's Fatality Analysis Reporting System (FARS).

- From 2006 to 2016, highway fatalities decreased by nearly 12 percent.
- In 2006, 42,708 motor vehicle fatalities occurred. By 2011, that count declined by 24 percent, to 32,479. Fatalities changed little from 2011 through 2014, but increased in 2015 and 2016. The 2016 fatality count of 37,461 was more than 14 percent higher than the 32,744 fatalities in 2014.
- From 2006 to 2016, fatality rates per 100 million vehicle miles traveled decreased by 17 percent.
- From 2006 to 2010, the fatality rate per 100 million VMT dropped significantly from 1.42 down to 1.11 and varied little from 2010 through 2014. The rate rose in 2015 and 2016, from 1.08 in 2014 up to 1.15 in 2015 and 1.18 in 2016.

FHWA has established three focus areas based on the most common crash types relating to roadway characteristics. In 2016, roadway departure, intersection, and pedestrian/pedalcyclist fatalities accounted for 48 percent, 27 percent, and 19 percent, respectively, of the 37,461 fatalities. Note that these three categories overlap, and 11 percent of fatalities involve more than one of these three focus areas; 13 percent do not involve a focus area.

- From 2006 to 2016, roadway departure fatalities decreased by 20.2 percent.
- From 2006 to 2016, intersection-related fatalities increased by 0.5 percent. Estimates indicate that the United States has more than 3 million intersections, most of which are nonsignalized (controlled by stop signs or yield signs, or without any traffic control devices), and a small portion of which are signalized (controlled by traffic signals). In 2016, 34.8 percent of fatalities related to intersections occurred in rural areas and 65.2 percent occurred in urban areas.
- From 2006 to 2016, pedestrian/bicyclist fatalities increased by 22.6 percent.
- From 2006 to 2009, nonmotorist fatalities showed a steady decline of 15.0 percent, but beginning in 2009 that trend began to shift and resulted in a 44.2-percent increase by 2016. Pedestrian fatalities rose from 4,120 in 2009 to 6,000 in 2016, an increase of 45.6 percent. Pedalcyclist (primarily bicyclist) fatalities rose from 630 in 2009 to 838 in 2016, an increase of 33 percent.

Pedestrian, Pedalcyclist, and Other Nonmotorist Traffic Fatalities, 2006–2016



Source: FARS Final File for 2006 to 2015; FARS Annual Report File (ARF) for 2016.

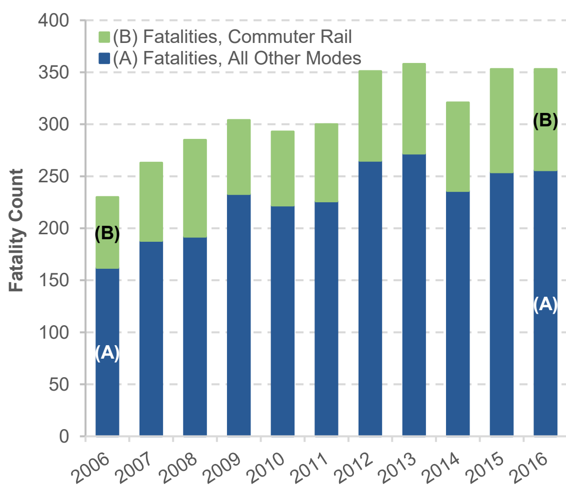
CHAPTER 5: Safety – Transit

Rates of injuries and fatalities on public transportation generally are lower than for other types of transportation. Nonetheless, serious incidents do occur and the potential for catastrophic events remains.

Most victims of injuries and fatalities in rail transit are not passengers or patrons but are members of the general public such as pedestrians, automobile drivers, bicyclists, or trespassers. Patrons are individuals in stations who are waiting to board or just got off transit vehicles. Passengers are individuals boarding, traveling, or alighting a transit vehicle.

Fatality measures exhibited a general increasing trend between 2006 and 2016 (rising from 230 in 2006 to 353 in 2016), but were essentially flat between 2012 and 2016. One significant contributor to the 10-year increase was growth in the number of suicides in transit, from 12 in 2006 to 81 in 2016.

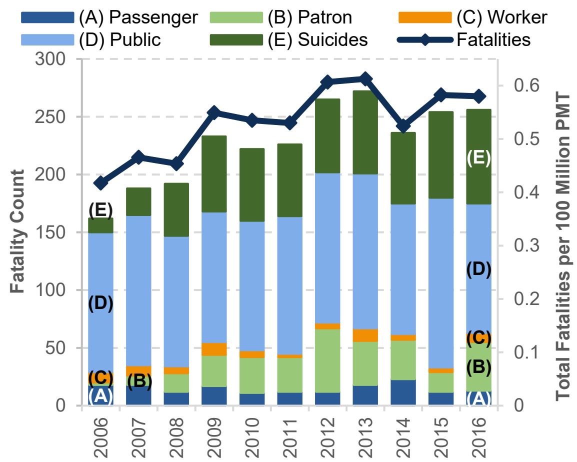
Annual Fatalities, for All Modes, 2006–2016 (Including Commuter Rail)



Source: NTD, Transit Safety and Security Statistics and Analysis Reporting.

Of the 256 transit-related fatalities in 2016 (excluding commuter rail), 13 were passengers, 42 were patrons, 8 were workers, and 112 (44 percent) were members of the public. The remaining 81 were suicides. The number of fatalities per 100 million passenger miles travelled increased from 0.4 in 2006 to 0.6 in 2016.

Annual Transit Fatalities, by Victim Type, 2006–2016 (Excluding Commuter Rail)

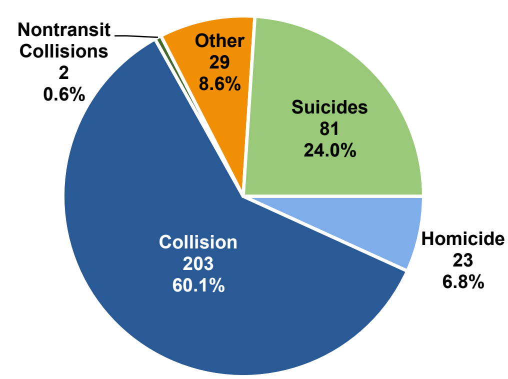


Notes: The right Y-axis displays total fatalities per 100 million passenger miles traveled (PMT), including suicides. Fatality totals include both directly operated (DO) and purchased transportation (PT) service types.

Source: NTD, Transit Safety and Security Statistics and Analysis Reporting.

Collisions are the most common type of fatal incident in rail transit. In 2016, 203 people, or 60 percent of all fatalities (excluding commuter rail), died in collision incidents. Most victims were not passengers or patrons but individuals in the general public. Suicides were the second most common type with 81 fatalities in 2016, down from 74 in 2015.

Transit Fatality Event Types, 2016 (Excluding Commuter Rail)



Notes: Exhibit includes data for both rail and nonrail transit modes, excluding commuter rail. Two NTD event type categories were updated in 2016.

Source: NTD.

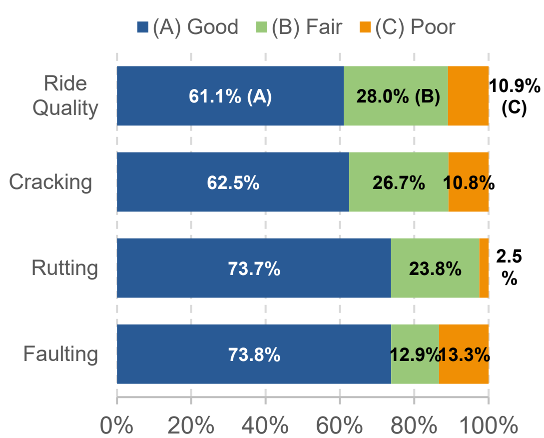
Commuter rail fatalities have risen by 42 percent since 2006, from 68 fatalities to 97 in 2016.

CHAPTER 6: Infrastructure Conditions – Highways

FHWA is transitioning to a new set of condition measures based on categorical ratings of good, fair, and poor for pavements and bridges. HPMS contains data on multiple types of pavement distresses, including pavement roughness (used to assess the quality of the ride that highway users experience), pavement cracking, pavement rutting (surface depressions in the vehicle wheel path, generally relevant only to asphalt surface pavements), and pavement faulting (the vertical displacement between adjacent jointed sections on concrete surface pavements).

Weighted by lane miles, 10.9 percent of pavements on Federal-aid highways for which data were available had poor ride quality in 2016; the comparable shares for cracking, rutting, and faulting were 10.8 percent, 2.5 percent, and 13.3 percent, respectively.

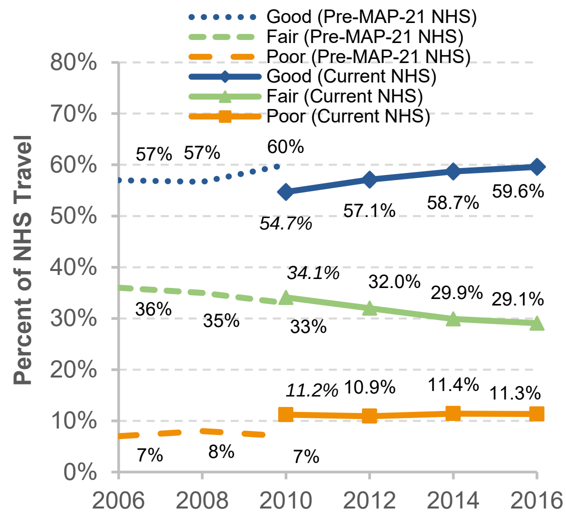
Federal-aid Highway Pavement Condition, Weighted by Lane Miles, 2016



Source: HPMS.

FHWA currently uses the share of VMT on NHS pavements with good ride quality as a metric for performance planning purposes; this metric was affected by the expansion of the NHS under MAP-21, as pavement conditions on the additions to the NHS were not as good as those on the pre-expansion NHS. The share of pavements with good ride quality rose from 57 percent in 2006 to 60 percent in 2010 on the pre-expansion NHS, and from an estimated (italicized in chart) 54.7 percent in 2010 to 59.6 percent in 2016 on the expanded NHS.

NHS Pavement Ride Quality, Weighted by VMT, 2006–2016



Notes: Data for odd-numbered years are omitted.

Source: HPMS.

The NBI contains data on bridge decks, superstructures, substructures, and culverts that can be combined to form an overall bridge condition rating. The share of bridges rated poor was reduced from 10.4 percent in 2006 to 7.9 percent in 2016. Larger bridges carrying more traffic fared even better, with the deck-area weighted share rated poor reduced from 9.0 percent to 5.9 percent and the traffic-weighted share reduced from 7.1 percent to 3.9 percent over this period. It should be noted that a poor condition rating does not mean that a bridge is unsafe.

Systemwide Bridge Conditions, 2006–2016

Category	2006	2016
Percent Good		
By Bridge Count	48.2%	47.4%
Weighted by Deck Area	46.1%	46.5%
Weighted by Traffic	45.6%	48.1%
Percent Fair		
By Bridge Count	41.2%	44.6%
Weighted by Deck Area	44.7%	47.6%
Weighted by Traffic	47.1%	47.9%
Percent Poor		
By Bridge Count	10.4%	7.9%
Weighted by Deck Area	9.0%	5.9%
Weighted by Traffic	7.1%	3.9%
Percent Structurally Deficient		

Source: NBI.

CHAPTER 6: Infrastructure Conditions – Transit

Transit asset infrastructure in the C&P Report includes five major asset groups: guideway elements, maintenance facilities, stations, systems, and vehicles.

Major Asset Categories

Asset Category	Components
Guideway Elements	Tracks, ties, switches, ballasts, tunnels, elevated structures, bus guideways
Maintenance Facilities	Bus and rail maintenance buildings, bus and rail maintenance equipment, storage yards
Stations	Rail and bus stations, platforms, walkaways, shelters
Systems	Train control, electrification, communications, revenue collection, utilities, signals and train stops, centralized vehicle/train control, substations
Vehicles	Large buses, heavy rail, light rail, commuter rail passenger cars, nonrevenue vehicles, vehicle replacement parts

Source: TERM.

Assets belong to two other categories: replaceable and non-replaceable assets. Non-replaceable assets are assets such as tunnels, bridges, and certain stations and facilities.

Condition Rating

FTA uses a capital investment needs tool, the Transit Economic Requirements Model (TERM), to measure the condition of transit assets. The model uses a numeric scale that ranges from 1 to 5.

Definition of Transit Asset Conditions

Rating	Condition	Description
Excellent	4.8–5.0	No visible defects, near-new condition
Good	4.0–4.7	Some slightly defective or deteriorated components
Adequate	3.0–3.9	Moderately defective or deteriorated components
Marginal	2.0–2.9	Defective or deteriorated components in need of replacement
Poor	1.0–1.9	Seriously damaged components in need of immediate repair

Source: TERM.

The replacement value of the Nation's transit assets was $850 billion in 2016. Nonreplaceable assets accounted for 39 percent of this total.

The relatively substantial proportion of facilities elements and systems assets that are rated below 2.5, or a state of good repair (SGR), and the magnitude of the $174-billion investment required to replace them, represent major challenges to the rail transit industry.

Asset Categories Rated Below SGR, 2016

Asset Category	Percentage Below SGR
Guideway Elements	43.2
Systems	23.8
Facilities	14.7
Stations	53.7
Vehicles	19.7

Source: TERM.

SGR. An asset is deemed in SGR if its condition rating is 2.5 or higher. An agency mode is in SGR if all its assets are rated 2.5 or higher.

Average Age and Trends in Urban Bus and Rail Transit

The average condition rating for bus and rail fleets did not change much between 2006 and 2016, ranging between 3.3 and 3.5 for buses and remaining relatively constant for rail, ranging between 3.5 and 3.7. The percentage of the bus fleet not in SGR rose from a value of 13.2 percent in 2006 to 21.4 percent in 2016. For rail, the percentage not in SGR increased from 3.6 percent to 9.9 percent. Heavy rail contributed the most, with an increase from 5.5 percent in 2006 to 16 percent in 2016. However, for modes such as light rail, the share decreased from 6.4 percent in 2006 to 2 percent in 2016.

The average age of rail assets varies by category. For instance, for rail facilities the average age is 39 years, for stations it is 61, and for guideway elements it is 73.

PART II: Investing for the Future

Within this report, the term "investment" refers to capital spending, which includes the construction or acquisition of new assets and the rehabilitation of existing pavement, bridge, and transit assets, but does not include routine maintenance expenditures. Chapters 7 through 10 present and analyze general scenarios for future capital investment in highways, bridges, and transit. In each of these 20-year scenarios, the investment level is an estimate of the spending that would be required to achieve a certain level of infrastructure performance. **These scenarios are illustrative, and DOT does not endorse any of them as a target level of investment.** Where practical, supplemental information is included to describe the impacts of other possible investment levels.

The system conditions and performance projections in this report's capital investment scenarios represent what **could** be achievable assuming a particular level of investment, rather than what **would** be achieved. The analytical models used to develop the projections assume that, when funding is constrained, the benefit-cost ratio (BCR) establishes the order of precedence among potential capital projects, with projects having higher BCRs selected first. In actual practice, the BCR generally omits some types of benefits and costs because of difficulties in quantifying them and valuing them monetarily, and these other benefits and costs can and do affect project selection. In addition, actual project selection can be guided by other considerations outside benefit-cost analysis (BCA).

The capital investment scenarios shown in this report reflect complex technical analyses that attempt to predict the potential impacts of capital investment on the future conditions and performance of the transportation system. The combination of engineering and economic analysis in this part of the C&P Report is consistent with the movement of transportation agencies toward asset and performance management, value engineering, and greater consideration of cost-effectiveness in decision-making.

Sustain Recent Spending Scenario

Although some earlier C&P editions included analyses showing the impacts of sustaining spending at base-year levels, the 2008 C&P Report was the first to include a full-fledged scenario projecting the impact of sustaining investment at base-year levels in constant-dollar terms over 20 years. This approach was retained in subsequent editions; most recently, the 23rd C&P Report included a Sustain 2014 Spending scenario. Although this scenario has proven useful in providing a frame of reference to readers, one issue with this approach was that spending levels in a single base year could be influenced by one-time events, and might not be representative of typical annual spending. This edition replaces this scenario with a Sustain Recent Spending scenario based on average annual spending over 5 years (2012–2016) converted to base-year (2016) constant dollars. This approach is expected to smooth out annual variations and make the scenarios more consistent between editions of this report.

Constant-dollar conversions for the Highway Sustain Recent Spending scenario were performed using the National Highway Construction Cost Index (NHCCI), resulting in an average annual capital spending level from 2012 to 2016 of $106.9 billion.

Derivation of Highway Sustain Recent Spending Scenario

Year	National Highway Construction Cost Index	Total Highway Capital Spending (Billions of Dollars)	
		Current Dollars	Constant 2016 Dollars
2012	1.6016	$105.3	$109.2
2013	1.6130	$98.7	$101.6
2014	1.6816	$105.4	$104.1
2015	1.6984	$109.3	$106.9
2016	1.6606	$112.9	$112.9
5-Year Average		$106.3	$106.9

Sources: FHWA Bulletin: Highway Funding 2013–2016, Table HF-10B; Highway Statistics, Various Years, Tables HF-10A and PT-1.

Constant-dollar conversions for the Transit Sustain Recent Spending scenario were performed using the RS Means Construction Index, resulting in an average annual capital spending level from 2012 to 2016 of $18.9 billion.

Derivation of Transit Sustain Recent Spending Scenario

Year	RS Means Construction Index (2016 = 100)	Total Transit Capital Spending (Billions of Dollars)	
		Current Dollars	Constant 2016 Dollars
2012	92.73	$16.8	$18.4
2013	94.37	$17.1	$18.4
2014	97.58	$17.4	$18.1
2015	99.37	$19.3	$19.7
2016	100.00	$19.4	$19.4
5-Year Average		$18.0	$18.9

Sources: National Transit Database; Bureau of Labor Statistics.

Part II Chapters

The four investment-related chapters in Part II measure investment levels in constant 2016 dollars, except where noted otherwise. The chapters consider scenarios for investment from 2017 through 2036 that are geared toward maintaining some indicator of physical condition or operational performance at its 2016 level, sustaining investment at recent levels, or achieving some objective linked to benefits vs. costs. The average annual investment level over the 20 years from 2017 through 2036 is presented for each scenario.

This report does not attempt to address issues of cost responsibility. The scenarios do not address how much different levels of government might contribute to funding the investment, nor do they address the potential contributions of different public or private revenue sources.

Chapter 7, Capital Investment Scenarios, defines the core scenarios and examines the associated projections for condition and performance. It also explains how the projections are derived by supplementing the modeling results with assumptions about nonmodeled investment.

Chapter 8, Supplemental Analysis, explores some implications of the scenarios presented in Chapter 7 and discusses potential alternative methodologies. It includes a comparison of highway projections from previous editions of the C&P Report with current findings. This edition includes a special section that looks back at the 1968 Highway Needs report, in recognition of the 50th anniversary of the report series.

Chapter 9, Sensitivity Analysis, explores the impacts on scenario projections of changes to several key assumptions that are relatively arguable, such as the discount rate and the future rate of growth in travel demand.

Lastly, Chapter 10, Impacts of Investment, explores the impacts of alternative levels of possible future investment on various indicators of conditions and performance.

Analytical Tools

Applying an economic approach to transportation investment modeling entails analysis and comparison of benefits and costs. Investments that yield benefits for which the values exceed their costs increase societal welfare and are thus considered "economically efficient," or "cost-beneficial." The Highway Economic Requirements System (HERS) was first used in the production of the 1995 C&P Report. The Transit Economic Requirements Model (TERM) was introduced in the 1997 C&P Report, and the National Bridge Investment Analysis System (NBIAS) was first used in the 2002 C&P Report. Each of these tools has subsequently undergone several rounds of updates and refinements to expand its accuracy and coverage.

As in any modeling process, simplifying assumptions have been used to make analysis practical and to report within the limitations of available data. Each of the models used in this report—HERS, NBIAS, and TERM—omits various types of investment impacts from its BCAs. To some extent, these omissions reflect the national coverage of the models' primary databases. Although consistent with this report's national focus, such broad geographic coverage requires some sacrifice of detail to stay within feasible budgets for data collection.

CHAPTER 7: Capital Investment Scenarios – Highways

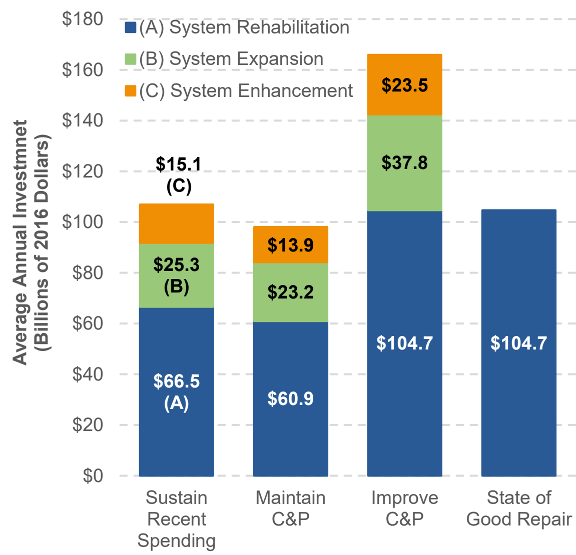
This report presents a set of illustrative 20-year highway capital investment scenarios based on simulations developed using HERS and NBIAS, with scaling factors applied to account for types of capital spending that are not currently modeled. All scenario investment levels are stated in constant 2016 dollars.

The Sustain Recent Spending scenario assumes that annual capital spending is sustained over the next 20 years at the average level from 2012–2016 ($106.9 billion), in constant-dollar terms. In other words, spending would rise by exactly the rate of inflation during that period. The model results suggest that it would be economically advantageous to slightly increase the share of total capital spending directed to system rehabilitation (improvements to the physical condition of existing infrastructure assets) from the recent (2012–2016) 60.8 percent average to 62.2 percent ($66.5 billion per year) under this scenario.

The Maintain Conditions and Performance scenario seeks to identify the level of investment needed to keep selected measures of overall system conditions and performance unchanged after 20 years. The average annual investment level associated with this scenario is $98.0 billion; this suggests that sustaining spending at the 2012–2016 average level of $106.9 billion should result in improved overall conditions and performance in 2036 relative to 2016.

The Improve Conditions and Performance scenario seeks to identify the level of investment needed to implement all potential investments estimated to be cost-beneficial. The investment estimate includes projects off the Federal-aid highway system and enhancement projects regardless of whether they are cost-beneficial, due to data limitations. This scenario can be viewed as an "investment ceiling," above which it would not be cost-beneficial to invest. Of the $165.9 billion average annual investment level under the Improve Conditions and Performance scenario, $104.7 billion would be directed toward system rehabilitation; this portion is identified as the State of Good Repair benchmark. This scenario also includes $37.8 billion directed toward system expansion and $23.5 billion for system enhancement.

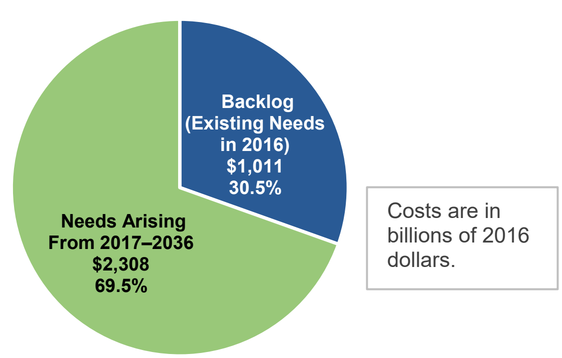
Highway Capital Investment Scenarios



Sources: HERS and NBIAS.

Cumulative 20-year investment under the Improve Conditions and Performance scenario would total more than $3.3 trillion. This includes an estimated $1.0 trillion (30.5 percent), as of 2016, needed to address an existing backlog of cost-beneficial highway and bridge investments. The remainder would address future highway and bridge needs as they arise over the next 20 years.

Composition of 20-year Spending under the Improve Conditions and Performance Scenario, Backlog vs. Emerging Needs



Source: HERS and NBIAS.

CHAPTER 7: Capital Investment Scenarios – Transit

Chapter 7 presents a reference benchmark focused solely on preservation spending and three transit investment scenarios covering both preservation and expansion capital spending, along with the impact of these expenditures on asset conditions and future ridership capacity.

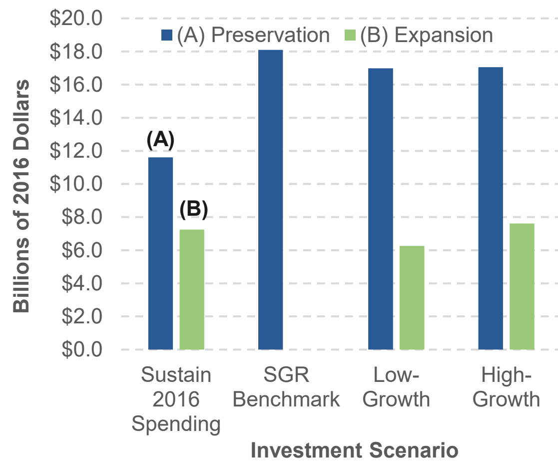
SGR Benchmark: This benchmark depicts the level of preservation expenditures required to eliminate the SGR backlog over 20 years (by 2036). The benchmark does not include investment in expansion assets. Unlike the three scenarios, the benchmark is not subject to a benefit-cost screen.

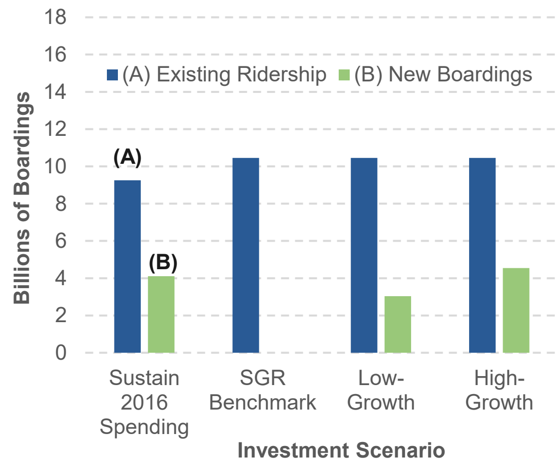
- Expenditures: An estimated $18.1 billion in annual reinvestment is required to fully eliminate the SGR backlog by 2036. This is 42 percent higher than the actual 2016 reinvestment of $11.6 billion.
- Asset Conditions: Despite elimination of the backlog, average asset conditions are projected to decrease slightly from a 2016 rating of 3.0 to 2.9 in 2036.

Sustain 2016 Spending Scenario: Under this scenario, 2016 spending on transit asset preservation and expansion ($11.6 billion and $7.2 billion, respectively) is sustained for the next 20 years.

- Backlog: Given that the current rate of capital reinvestment is insufficient to fully address the replacement needs of the existing stock of transit assets, the size of that backlog is projected to decrease only marginally from the current estimated level of $105.1 billion to roughly $102.3 billion by 2036.
- Asset Conditions: Under this scenario, the average condition rating of physical assets is expected to decline from 3.0 in 2016 to 2.7 in 2036 due in part to the ongoing aging of rail systems built since 1980.
- Ridership: The $7.2 billion annual rate of investment in expansion assets is estimated to support a 1.7-percent annual increase in ridership, or 0.2 percent above the annual 1.5-percent rate of growth experienced since 2001—potentially resulting in decreased vehicle crowding.

Scenario Investment Summary





Source: TERM.

Low-Growth and High-Growth Scenarios: These scenarios model the level of investment required both to eliminate the backlog by 2036 and to support ridership growth within ±0.3 percent of the 1.5-percent average annual rate experienced since 2001.

- Preservation Expenditures: The reinvestment need of the Low-Growth scenario is $17.0 billion; the reinvestment need of the High-Growth scenario is not significantly higher, at $17.1 billion
- Ridership: The estimated annual rate of expansion investment ranges from $6.3 billion to $7.6 billion under the Low-Growth and High-Growth scenarios respectively. This range encompasses the $6.7 billion expended on expansion in 2016. These investments support an additional 2.9 to 4.5 billion annual boardings by 2036.

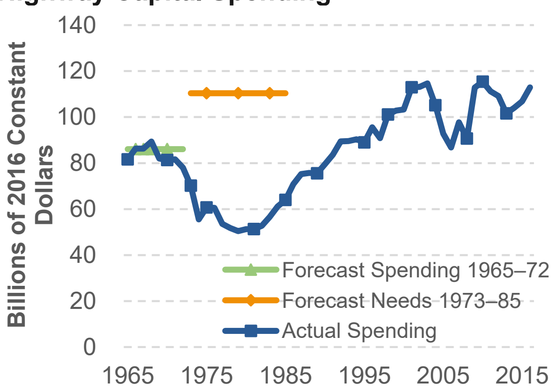
1968 C&P Report

The C&P Report series dates back to the 1968 *National Highway Needs Report*. Looking back to that report on the occasion of the 50th anniversary of the series sheds light on what has changed over time and what perennial challenges remain.

The 1968 edition was written during a period of high travel growth and it underestimated future growth for the 1965 to 1985 period. It forecast that highway travel would grow by 2.7 percent annually to reach 1.5 trillion VMT in 1985. The actual average annual growth rate over this period was 3.5 percent, resulting in 1.7 trillion VMT in 1985. The 1968 edition similarly underestimated the wide adoption of motor vehicle ownership. National motor vehicle registrations reached 172 million in 1985, higher than the forecast 144 million.

The 1968 edition projected capital spending by all levels of government for the 1965 to 1972 period and estimated annual capital investment needs for 1973 to 1985.

1968 C&P Forecasts Compared to Actual Highway Capital Spending



Sources: 1968 C&P Report; FHWA Construction Bid Price Index and National Highway Construction Cost Index 2.0; FHWA Bulletin: Highway Funding 2013–2016; Highway Statistics, various years, Table HF-10A.

Converted to constant 2016 dollars, actual spending averaged $83.3 billion per year from 1965 to 1972, aligning well with the forecast ($86.1 billion). During the 1973 to 1985 period, highway spending did not keep pace with inflation, averaging only $56.9 billion in constant 2016 dollars, well short of the estimated investment needs for this period ($110.4 billion).

Although the investment needs presented in the 1968 edition were determined by engineering criteria alone, the report referenced the importance of a broader assessment of costs and benefits (foreshadowing the benefit-cost modeling approach used in more recent reports). Needs in the 1968 edition were based on an aggregation of State estimates of capital investment needed to raise the highway system to predetermined design standards (such as lane width and number, maximum grades, minimum curvature, and a capacity adequate to accommodate the level of traffic forecast for 20 years ahead). The 1968 Report notes that States were given only a few months to prepare their needs estimates, and they did not provide any measure of monetized benefits derived from reduction in accidents, gains in travel time and pavement quality, or vehicle operation savings; these factors are all considered in current C&P reports.

24th Edition vs. Recent Editions

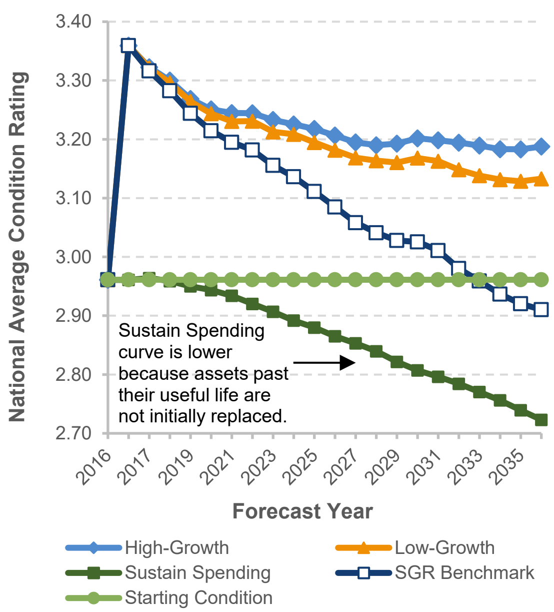
The 23rd C&P report estimated scenario investment levels in 2014 dollars. Converting these amounts to 2016 dollars facilitates more direct comparisons to results from this 24th C&P report. The annual investment level for the Maintain Conditions and Performance scenario and the Improve Conditions and Performance scenario were 3.0 percent lower and 23.8 percent higher, respectively, in this 24th C&P Report relative to inflation-adjusted values based on the 23rd C&P Report. Among the last 11 C&P reports, the gap between base-year spending and the average annual investment level for the primary "Improve" and "Maintain" scenarios has varied, reaching the highest level in the 2008 C&P Report (121.9 percent and 34.2 percent, respectively). The gap between the Improve Conditions and Performance scenario and base-year spending was 55.2 percent in this 24th edition. Base-year spending has been higher than the Maintain Conditions and Performance scenario since the 2013 edition.

CHAPTER 8: Supplemental Analysis – Transit

Chapter 8 analyzes assumptions underlying the scenarios presented in Chapter 7, along with implications of their outcomes.

Impact of scenario assumptions on asset conditions. The Chapter 7 scenarios use differing assumptions regarding the rate at which assets are replaced, and tha t result in different impacts on asset conditions. Specifically, the Sustain Spending scenario assumes a constant annual reinvestment rate resulting in a steady change in asset conditions from the current 2.96 average. In contrast, the State of Good Repair (SGR) benchmark and the Low-Growth and High-Growth scenarios are fully unconstrained. Here, all backlog needs are fully addressed in the first year of the model run, resulting in a spike in asset conditions. For the growth scenarios, investment in expansion assets ultimately results in average conditions above the current level.

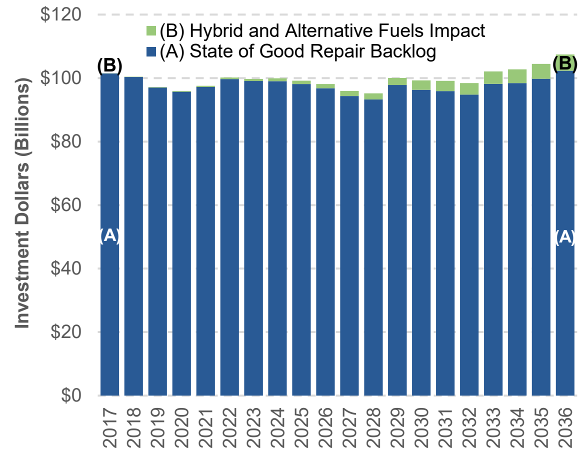
Scenario Impacts on Conditions



Source: TERM.

Effect of new technologies on transit investment needs. TERM does not consider the impact of technological improvements on reinvestment needs. These improvements typically come at a higher cost, driving up the cost of replacement and, in the absence of additional funding, the size of the SGR backlog. As an example, alternative fuel propulsion buses add an additional cost, as depicted in the following figure. This is just one of many technological trends that could affect transit reinvestment needs through 2036.

Impact of Technological Change on Backlog

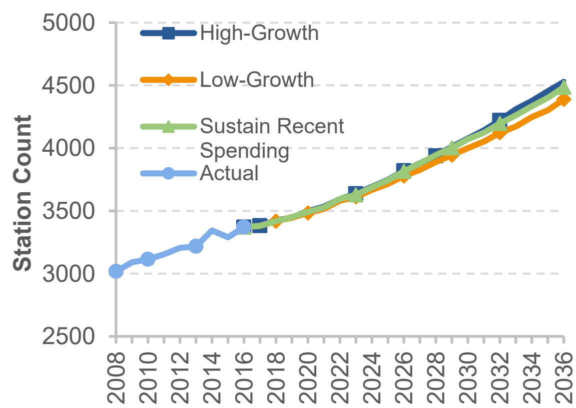


Source: TERM.

Investment in expansion assets. Chapter 8 assesses the increase in transit assets required to support the additional 2.8 to 4.0 billion annual boardings by 2036 projected by the Low-Growth and High-Growth scenarios. This increase includes:

- Fleet: 51,800 to 72,900 additional vehicles (29- to 40-percent increase from 2016)
- Rail Guideway: 1,700 to 1,900 additional route miles (12- to 14-percent increase)
- Stations: 2,600 to 4,000 additional stations (76- to 120-percent increase)

Growth Scenario Investment in Stations



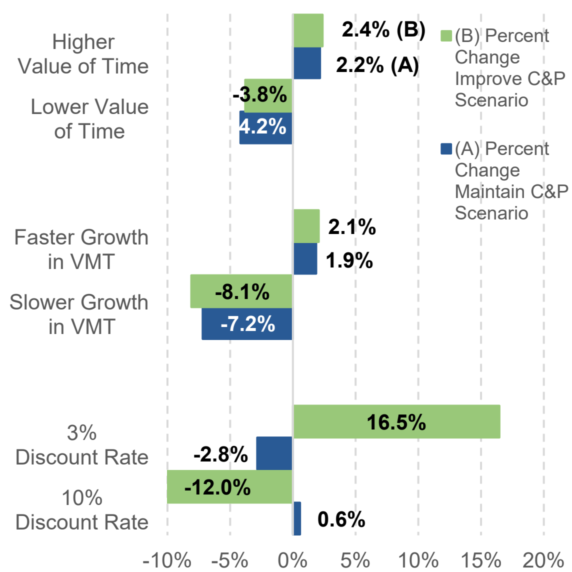
Note: Data through 2016 are actual; data after 2016 are estimated based on trends.

Source: TERM.

Sound practice in modeling includes analyzing the sensitivity of key results to changes in assumptions. This section analyzes how changing key assumptions regarding the value of travel time savings, the discount rate, and traffic growth projections would affect the investment levels for two of the future capital investment scenarios presented in Chapter 7.

The Improve Conditions and Performance scenario is highly sensitive to the real discount rate, a value used in benefit-cost analyses to scale down benefits and costs arising later in the future relative to those arising sooner. Substituting a 3-percent discount rate for the 7-percent discount rate assumed in the baseline would increase its average annual investment requirements by 16.5 percent (from $165.9 billion to $193.2 billion). The Maintain Conditions and Performance scenario would be reduced by 2.8 percent assuming a 3-percent discount rate. Substituting in a 10-percent discount rate would reduce the Improve scenario by 12.0 percent and increase the Maintain scenario by 0.6 percent.

Sensitivity of Highway Scenarios to Alternative Assumptions, Percent Change in Investment Levels from Baseline

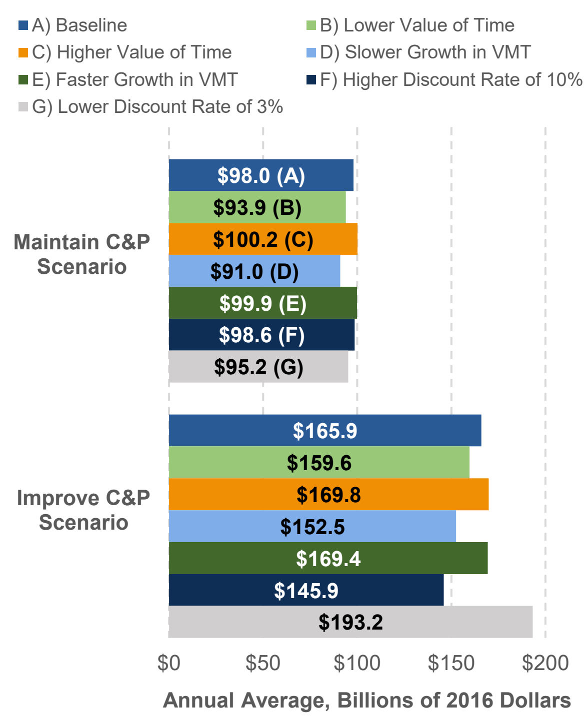


Sources: Highway Economic Requirements System; National Bridge Investment Analysis System.

The overall impact of different estimates of growth in VMT was similar for both scenarios. Applying a forecast of 1.3-percent growth per year (linked to an optimistic economic growth forecast), instead of 1.2 percent, increases the Improve Conditions and Performance scenario funding level by 2.1 percent and the Maintain Conditions and Performance scenario by 1.9 percent. Applying a forecast of 0.9-percent growth in VMT per year (linked to a pessimistic economic growth forecast) reduces the Improve scenario by 8.1 percent and the Maintain scenario by 7.2 percent.

Different assumptions about the value of time have similar effects on both the Improve Conditions and Performance scenario and the Maintain Conditions and Performance scenario. Assuming lower values of time for personal travel (35 percent of median hourly household income instead of 50 percent) reduces the average annual investment level for the Improve scenario by 3.8 percent and for the Maintain scenario by 4.2 percent. Conversely, assuming higher values of time for personal travel (60 percent of median hourly household income) increases the average annual investment level for the Improve scenario by 2.4 percent and for the Maintain scenario by 2.2 percent.

Impact of Alternative Assumptions on Highway Scenario Investment Levels



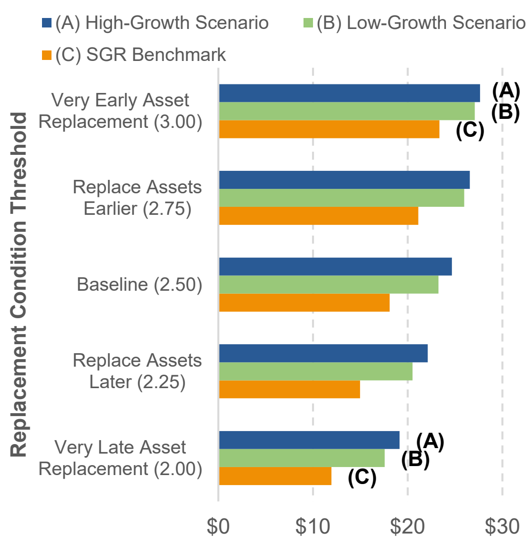
Sources: Highway Economic Requirements System; National Bridge Investment Analysis System.

TERM relies on several key input parameters, variations of which can significantly influence the model's projected investment needs and backlog estimates.

Alternative Replacement Thresholds

TERM uses a "replacement threshold" to specify the condition at which aging assets are replaced. The benchmark threshold value is 2.5 on a scale of 1 to 5. A 0.5-point change in the threshold yields a roughly ±30-percent change in replacement investment needs for the SGR benchmark. The same change in threshold results in approximately ±18-percent change in replacement investment needs for the Low-Growth and High-Growth scenarios.

Sensitivity to Replacement Threshold



Source: TERM.

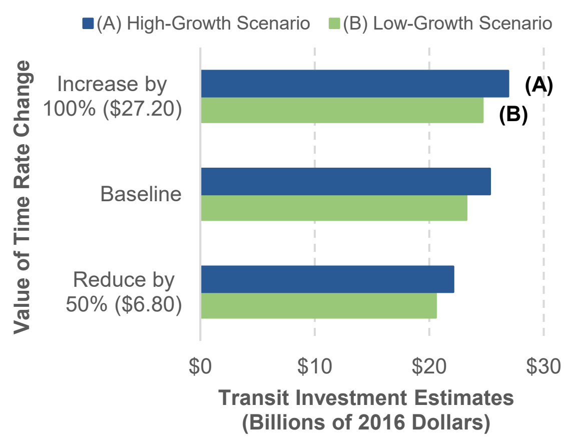
Increase in Capital Costs Impact

The sensitivity of estimated scenario investment needs to changes in capital costs is dependent on whether TERM's benefit-cost test is applied for that scenario. Under the Low-Growth and High-Growth scenarios, both of which apply the test, a 25-percent increase in asset costs yields 20.3-percent to 18.5-percent increases in needs, as the cost increase forces some reinvestment actions to fail the benefit-cost test.

Value of Time

The per-hour value of travel time for transit riders is a key model input, and a key driver of total investment benefits. The current hourly rate based on U.S. Department of Transportation guidance is $13.60.[1] Increasing this rate results in greater benefits, allowing more projects to pass the benefit-cost test, leading to higher needs estimates. Decreasing the rate has the opposite effect. Doubling the rate (to $27.20) results in increases of 6.0 percent in needs for both the Low-Growth and High-Growth scenarios. Reducing the rate by half (to $6.80) results in decreases of 12 percent and 13 percent, respectively.

Sensitivity to Value of Time



Source: TERM.

Impact of Discount Rate

TERM's benefit-cost test is sensitive to the discount rate used to calculate the present value of investment costs and benefits. TERM's analysis uses a rate of 7.0 percent in accordance with Office of Management and Budget guidance. The analysis using a rate of 3 percent (57 percent smaller) leads to an increase of 1.2 percent in investment needs in the High-Growth scenario, and a 0.9-percent increase in the Low-Growth scenario.

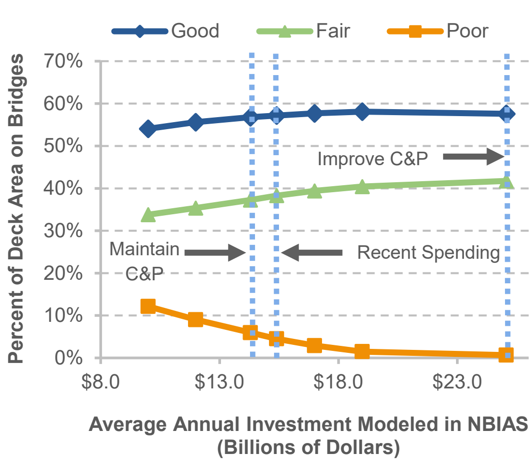
[1] Although the analyses performed elsewhere in this report used a value of time of $12.80, the most recent value of time as stated by DOT is $13.60. This discrepancy in time valuation translates to a less than 1-percent difference in TERM's estimates of 20-year transit reinvestment needs for those scenarios that employ TERM's benefit-cost analysis.
Source: DOT, Revised Departmental Guidance on Valuation of Travel Time in Economic Analysis.

CHAPTER 10: Impacts of Investment – Highways

Of the $165.9 billion average annual investment level for all public roads under the Improve Conditions and Performance scenario presented in Chapter 7, 15.1 percent ($25.1 billion) was derived from NBIAS estimates of rehabilitation and replacement needs for all bridges. HERS evaluates needs on Federal-aid highways associated with pavement resurfacing or reconstruction and widening, including those associated with bridges; 55.2 percent ($91.7 billion) of this scenario was derived from HERS. The remaining 29.7 percent was nonmodeled; this includes estimates for system enhancements on all public roads plus pavement resurfacing or reconstruction and widening not on Federal-aid highways. Nonmodeled spending was scaled so that its share of the total scenario investment level would match its share of recent (2012 to 2016) spending.

Sustaining NBIAS-modeled investment at $15.4 billion (the portion of recent spending directed toward implementation types modeled in NBIAS) in constant-dollar terms over 20 years is projected to result in deck area-weighted bridge conditions of 57.2 percent good, 38.3 percent fair, and 4.5 percent poor. Increasing annual investment to $25.1 billion would increase the deck area-weighted share rated as good to 57.6 percent and reduce the share rated as poor to 0.7 percent.

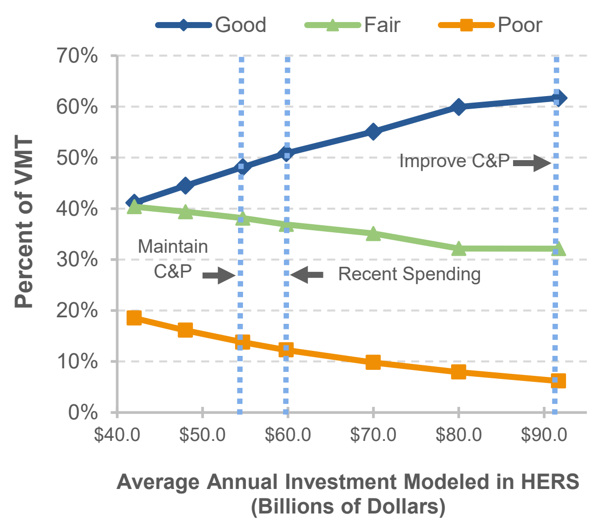
Projected Impact of Future Investment Levels on 2036 Bridge Condition Indicators for All Bridges



Source: NBIAS.

Sustaining HERS-modeled investment at $59.8 billion (the portion of recent spending directed toward improvement types modeled in HERS) in constant-dollar terms over 20 years is projected to result in 50.9 percent of VMT in 2036 occurring on Federal-aid highway pavements with good ride quality, 36.9 percent on pavements with fair ride quality, and 12.3 percent on pavements with poor ride quality. Increasing annual investment to $91.7 billion would increase the VMT-weighted share rated as good to 61.7 percent and reduce the share rated as poor to 6.2 percent.

Projected Impact of Alternative Investment Levels on 2036 Pavement Ride Quality Indicators for Federal-aid Highways



Source: HERS.

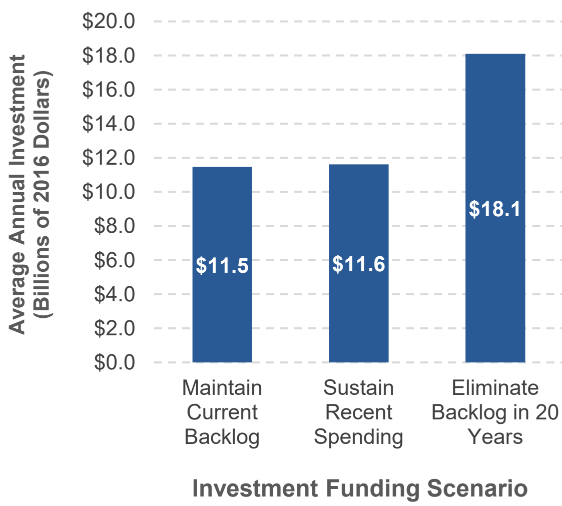
Other projected impacts of investing at the Improve scenario level include reducing VMT-weighted average pavement roughness on Federal-aid highways by 15.4 percent in 2036 relative to 2016 and reducing average delay per VMT by 28.8 percent. Average total user costs (including travel time costs, vehicle operating costs, and crash costs) are projected to decrease by 4.8 percent, from $1.355 per VMT in 2016 to $1.289 per VMT in 2036.

HERS computes the average benefit-cost ratio over 20 years for the HERS-modeled portion of the Improve scenario to be 2.15, suggesting that total benefits would be more than double the total capital costs associated with this scenario.

CHAPTER 10: Impacts of Investment – Transit

The current level of investment in transit asset preservation is insufficient to materially reduce the size of the SGR backlog. Assuming preservation expenditures are sustained at the 2016 level ($11.6 billion annually), the State of Good Repair (SGR) backlog is projected to decline marginally from $105.1 billion to $102.3 billion by 2036. Based on current estimates, $18.9 billion in annual investment is required to fully eliminate the SGR backlog in 20 years (by 2036).

Investment Funding Scenarios



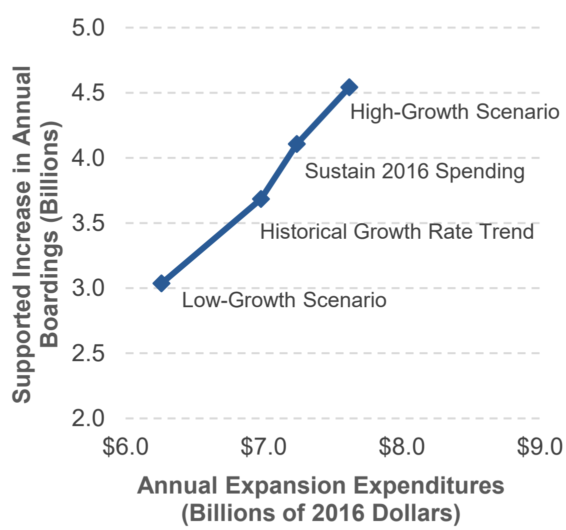
Source: TERM.

A much higher rate of reinvestment is required to maintain the current average condition rating of all transit assets nationwide than is required to maintain the size of the current SGR backlog. If the current rate of reinvestment is sustained at the recent 5-year average ($11.6 billion), overall average asset conditions are projected to decline from a condition rating of 3.0 in 2016 to 2.7 by 2036 (near the upper bound of the "marginal" range). Much of this decline is due to the ongoing aging of newer rail systems developed within the last 20- to 30-year period. In contrast, annual preservation expenditures of $18.9 billion are required to sustain an overall average condition rating of 2.9, with higher rates of annual investment required to attain significant improvements in overall asset conditions.

The 2016 level of expansion investment supports ridership growth that is marginally above the historical rate. Investment in transit expansion investments was $7.2 billion in 2016. If maintained into the future, this annual investment amount is estimated to support roughly 1.7 percent in annual ridership growth, which is above the 1.5 percent average rate experienced since 2001.

Assuming this trend continues, the limited overinvestment could result in a decrease in vehicle occupancy rates through 2036, with reduced vehicle crowding and dwell times. Expenditures in 2016 are within the $6.2 billion to $7.6 billion range covered by the Low-Growth and High-Growth scenarios (supporting ridership growth rates of 1.3 to 1.8 percent).

Growth Scenarios: Expansion Expenditures vs. Increase in Annual Boardings



Source: TERM.

Introducing a cost-effectiveness prioritization criterion reduces the projected size of the backlog in model run year 20. Introduction of the cost-effectiveness criterion, defined as an asset's reinvestment cost divided by the number of riders benefiting from the investment, results in a more cost-efficient selection of investments that reduces the rate of backlog growth.

PART III: Freight

Pursuant to the Fixing America's Surface Transportation (FAST) Act of 2015, the Federal Highway Administration (FHWA) prepared this section to serve as the second edition of the biennial report on the conditions and performance of the National Highway Freight Network (NHFN), referred to hereafter as the *Highway Freight C&P* Report to Congress.

The FAST Act required FHWA to establish an NHFN to strategically direct Federal resources and policies toward improved performance of that network. The NHFN is composed of four component subsystems: the Primary Highway Freight System (PHFS), other Interstate portions not on the PHFS, Critical Rural Freight Corridors (CRFCs), and Critical Urban Freight Corridors (CUFCs).

The Nation's freight transportation system—a complex network of millions of miles of public roads, railways, navigable waterways, pipelines, and airways—is an extraordinary asset to our wellbeing and our country's economic health. Significant investments, however, are required to sustain the conditions and performance of that system and accommodate expected growing demand. In analyzing the NHFN conditions and performance, this section supports improved freight decision-making.

This edition includes many of the same NHFN conditions and performance indicators reported in the previous edition. It also updates the analysis to 2016 (primary data sources are the Highway Performance Monitoring System and the National Bridge Inventory, although additional sources with dates other than 2016 are used).

This edition includes several new conditions and performance indicators and analyses:

- NHFN pavement condition: overall ride quality, individual pavement distresses, and overall ride quality by roadway functional class; and
- NHFN bridges: overall condition rating and condition rating by roadway functional class.

Notably, this edition includes CRFCs/CUFCs (submitted as of May 1, 2018) as part of the NHFN conditions and performance analysis. The CRFCs/CUFCs had not yet been designated when the first edition was developed.

As of May 1, 2018, the NHFN consists of an estimated 54,310 miles, including 41,308 miles of Interstate and 9,541 miles of non-Interstate roads. The CRFCs and CUFCs represent a total of 3,461 miles (about six percent) of this total NHFN mileage. More recent data show that, as of April 2021, the NHFN had grown to 57,943 miles, of which CRFCs/CUFCs represented 6,720 miles (about 12 percent of the total).

This edition provides:

- An overview of the freight transportation network;
- An examination of trends that characterize freight movement on the NHFN;
- An analysis for NHFN conditions and performance indicators; and
- A series of "spotlight topics," which are initiatives or issues that affect freight transportation management and provide context for understanding NHFN conditions and performance analysis.

Between 2014 and 2016, NHFN pavement and bridge condition largely stayed the same. Many portions of the NHFN experience congestion. Between 2011 and 2016, travel reliability decreased for the majority (72 percent) of the Nation's top 25 domestic freight corridors. Average travel speeds slightly increased or remained the same for just over half (52 percent) of these corridors.

The first edition of the *Highway Freight C&P* Report to Congress (included as Part III of the 23rd C&P Report) provided a baseline understanding of NHFN conditions and performance. This edition improves this baseline by including additional indicators and examining new data not previously available. Furthermore, this edition benefitted from the implementation of data improvements identified in the previous edition.

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CHAPTER 11: Rural America – Highways

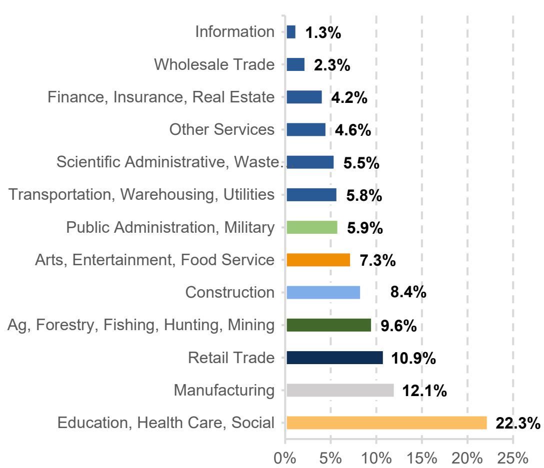
Rural communities provide most of the Nation's food and energy and encompass more than 70 percent of the Nation's roadways. Although the rural population has declined overall during the last quarter century, rural areas have experienced rising net population growth since 2011.

Rural America is diverse: some areas are commuting sheds for large metropolitan areas, others are remote communities with limited access to major cities; some thrive on agriculture or mining, others rely on tourism or manufacturing. Rural area transportation must provide the means to access employment, education, and goods and services while also providing connections to other communities and commerce.

Rural Economics

The economy in rural counties is not entirely dependent on agriculture or manufacturing: in fact, the largest segment of the workforce is employed in professional, managerial, or technical occupations.

Rural Employment by Type of Industry



Source: U.S. Census Bureau, American Community Survey, 2011–2015, 5-year estimates (http://www.census.gov/programs-surveys/acs/).

Due to the longer distances traveled in rural areas, rural households on average spend more on transportation than their urban counterparts.

Transportation is the second largest household expenditure category after housing, and in 2017 rural households devoted almost 20 percent of their total budget to transport, four percentage points more than urban households.

Modal Availability and Travel Behavior

Travel patterns for urban and rural households are distinctly different, with options varying by geography, population size, and density. Households in high-density areas typically have fewer vehicles and are more likely to use public transit, rideshare, bikeshare, and pedestrian facilities, which are costly to operate in less-dense areas such as suburbs, small towns, and rural communities, resulting in a dependency on personal vehicles.

According to the 2017 National Household Travel Survey, rural households account for 24 percent of all passenger vehicle miles traveled (VMT), with an average annual household VMT of 24,465—about 50 percent higher than that of urban households.

The proportion of Americans with access to broadband internet continues to increase, creating an alternative to travel for employment, education, entertainment, and the purchase of goods and services.

Freight Movement in Rural Areas

Although rural transportation is an important resource for people living in rural areas, it is also an important asset for the movement of goods. Trucks continue to move the bulk of freight in the United States, and over half of all truck VMT occurs on rural roads. In 2018, combination trucks on rural roads logged 95.13 billion VMT for goods movement, significantly more than the 89.04 billion VMT by combination trucks in urban areas. Maintaining the condition of rural roadways and bridges is critical to the safe, secure, and efficient transport of freight by trucks.

CHAPTER 11: Rural America – Transit

In 2018, rural transit in the United States accounted for 55 percent of transit agencies, 14 percent of the National fleet, 10 percent of revenue vehicle miles, and 1.3 percent of unlinked trips.

Bus and demand response are the most common modes of rural transit and account for more than 95 percent of total service supply and consumed.

There were 1,301 rural transit systems that reported to the NTD in 2018, of which 1,167 were rural agencies and 134 were Tribes. In addition, X systems in urbanized areas also served rural areas.

Of the 1,167 rural agencies reporting to NTD, 718 were located in urban clusters and 395 were in Census-designated rural areas; the remaining 54 could not be geocoded.

The State with the largest number of systems in 2018 was Georgia, with 79 systems, followed by Kansas with 77. The number of systems by State is not necessarily driven only by demand, but also by local decisions.

Number of Systems by State

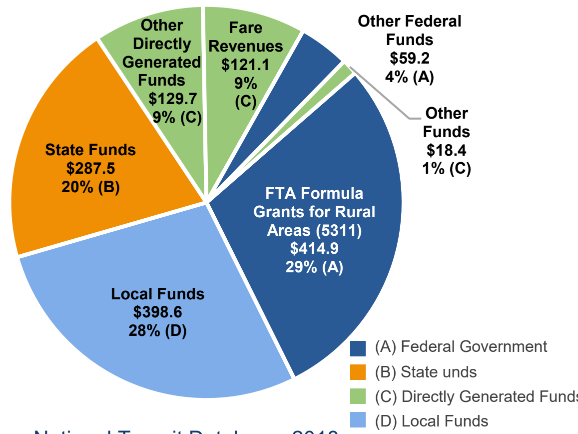
Bus and demand response systems serve distinct markets. Bus ridership is driven by the demand for recreational destinations during winter and summer months, such as ski resorts, National and state parks, beaches, and others. Service is seasonal and concentrated around destinations.

Demand response systems, which provide service to persons with disabilities and other conditions, are offered in all urban and rural areas of the country.

Operating Funding

In 2018, public funds of $1.4 billion were spent in rural transit operations. Of this amount, Federal funding provided $474.0 million or 33 percent of total funding.

Operating Funding Sources, 2018

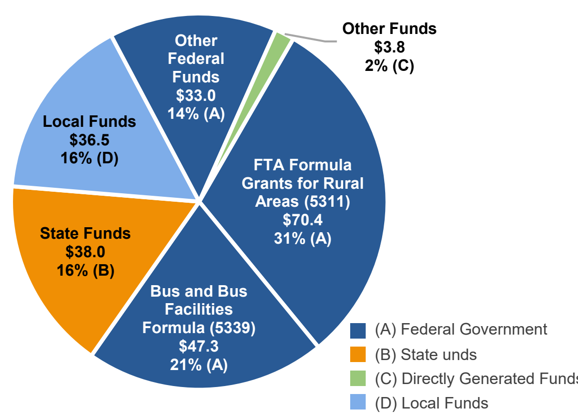


Source: National Transit Database, 2018.

Capital Funding

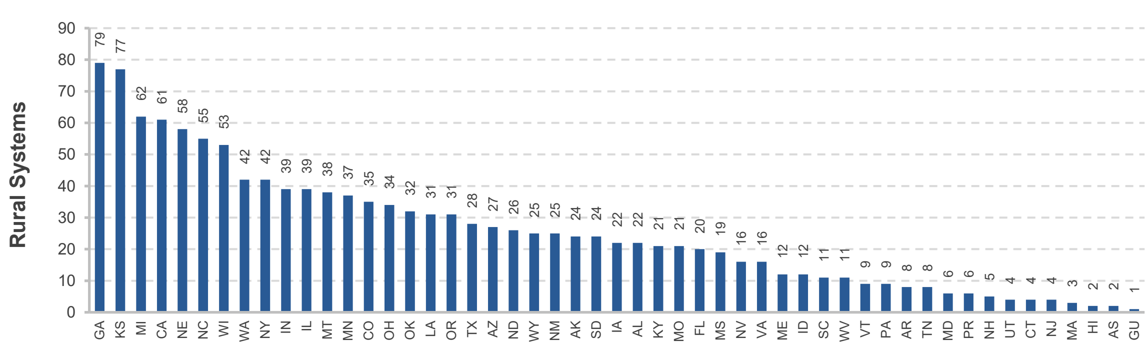
Capital funding in 2018 was $229.0 million, of which Federal sources accounted for 66 percent.

Capital Funding Sources, 2018



Source: National Transit Database, 2018.

Rural Systems by State/Territory, 2018



Source: National Transit Database.

CHAPTER 12: Transformative Technologies – Highways

Trends of the past decade in technology and innovation are reshaping our options in surface transportation.

Information Technology

Smartphone technology has spurred the creation of countless "on-the-go" traveler mobile apps that offer travelers and service providers key information such as work zone, traffic incident, and inclement road weather locations, as well as predicted travel times, cost of travel, alternative routes, and parking availability.

Traveler information has evolved at a rapid rate over the past decade and is expected to continue evolving as the public becomes increasingly dependent on real-time, easily accessible information.

Innovation in Transportation Services

Recent technology innovations have expanded beyond traditional transportation and ownership models of personal vehicles, transit, walking, biking, and taxis. Through innovations in transportation, service travelers can request a ride (ride hailing); access a shared car, bicycle, or scooter for a short trip (micromobility); ride a private shuttle on demand; and have groceries, packages, or take-out food delivered, all using internet-enabled smartphones and tablets.

Since 2010, the proportion of Americans with access to broadband internet has increased from about 74.5 percent to 93.5 percent, and one-third of workers now say they can work from home, making broadband an emerging trend as a travel alternative.

Emerging Trends

In addition to the deployment of micromobility and the widespread use of broadband, testing of vehicle automation and the use of drones have become commonplace in the transportation sector, providing new opportunities and challenges for improved transportation safety, accessibility, and mobility.

Supported by advances in artificial intelligence, rapid progress is being made in automated vehicle development and deployment. Automation is categorized in six levels: from Level 0, which has no automation, to Level 5, which is fully automated. Levels 1 and 2 control some aspects of steering, braking, or acceleration (e.g., adaptive cruise control or parallel parking assist), and currently operate on public roadways. Level 3, 4, and 5 technologies are still in development and are being tested on public roads.

Infrastructure and Technology

Infrastructure and technology, often via intelligent transportation systems, improve transportation safety and mobility through the integration of advanced communications technologies for payment systems (user fees and tolls), connected vehicles, construction work zones, and traffic incident response.

Modern communication technology is becoming more embedded within vehicles or roadway infrastructure, allowing for continuous communication and data exchange between individual vehicles or between vehicles and infrastructure. Connected vehicle applications include safety, navigation, and diagnostics, which could reduce crash rates, increase transportation options, and reduce travel times.

Work zones play a key role in maintaining and upgrading the Nation's roadways, but often create a combination of factors resulting in crashes, injuries, and fatalities. Transportation agencies across the country are using technology to keep transportation workers safe and make travel through and around work zones safer and more efficient. This includes efforts toward creating universal access to data on work zone activity.

CHAPTER 12: Transformative Technologies – Transit

FTA's research mission is to advance public transportation by accelerating innovation that improves peoples' mobility, enhances public transportation operations, and ensures everyone's safety.

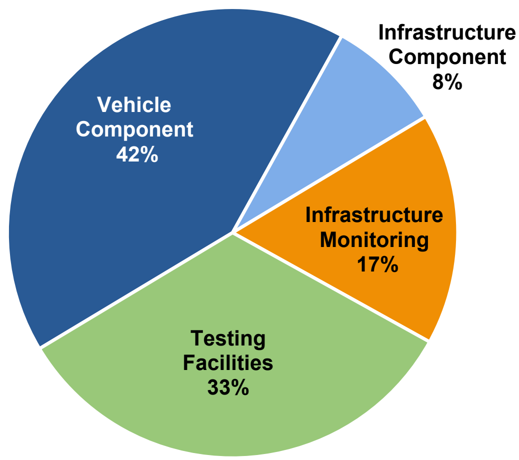
In recent years, FTA has invested more than $40 million in grants for programs such as Mobility on Demand, Integrated Mobility Innovation, and Accelerating Innovative Mobility. Through these grants, transit agencies across the United States are experimenting and demonstrating new technologies and approaches that integrate public and private mobility services to increase service hours, geographic coverage, and accessibility.

Public transportation is one of the safest modes of travel. However, certain types of safety events continue to pose challenges, such as bus collisions at intersections with vehicles and pedestrians, track worker injuries and fatalities, and suicides at rail stations. FTA is addressing these issues by investing in new technologies to enhance vehicle components, collision avoidance, and worker communication and alerts.

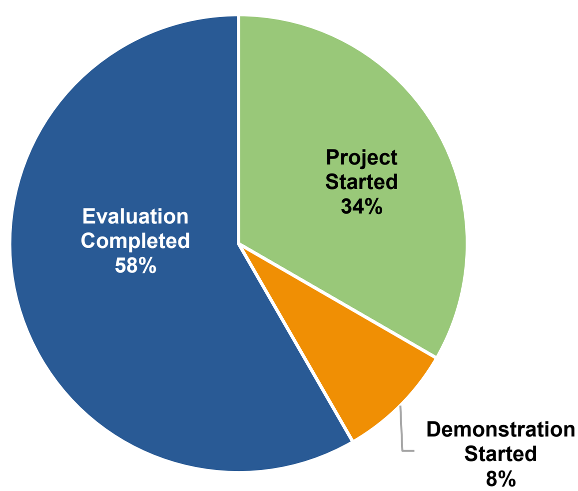
FTA's research and demonstration projects use technology to enhance public transportation operations across all aspects of system services, from the design of buses to the maintenance and management of important transit assets and ensuring a state of good repair. Key areas of focus include enhancing public transit operational effectiveness and efficiency through new technologies such as unmanned aerial systems, artificial intelligence, and robotics. FTA is also exploring new energy technologies and innovative bus designs in partnership with the Department of Energy.

Over the next decade, emergent technologies such as artificial intelligence, machine learning, and autonomous vehicles will continue to provide transit agencies with opportunities to improve their infrastructure and operations. As more data become available and accessible through applications, travelers can make informed decisions about ride sources and agencies can optimize travel through transit routing and scheduling. Strategies to improve data governance, standardization, and interoperability are increasingly important as the transit industry operates in a more data-driven environment.

Infrastructure Technology Categories



Infrastructure Technology Deployment Status, March 2020



Tomorrow's public transportation may look very different from today's, as transit agencies transform themselves and their operations to meet the changing needs and expectations of their customers. Emerging technologies provide the fuel for this transformation. Whether disruptive or complementary, technology is the yin to new transportation modes' yang.