Highlights

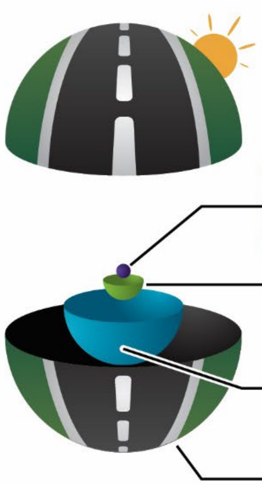
This edition of the C&P Report is based primarily on data through 2016. In assessing recent trends, it generally focuses on the 10-year period from 2006 to 2016. The prospective analyses generally cover the 20-year period from 2016 to 2036; the investment levels associated with these scenarios are stated in constant 2016 dollars. This section presents key findings for the overall report. Key findings for individual chapters are presented in the Executive Summary.

Highlights: Highways and Bridges

Extent of the System

- The Nation's road network included 4,157,292 miles of public roadways and 614,387 bridges in 2016. This network carried 3.189 trillion vehicle miles traveled (VMT) and 5.458 trillion person miles traveled, up from 3.034 trillion VMT and up from 4.961 trillion person miles traveled in 2006.
- The 1,026,319 miles of Federal-aid highways (25 percent of total mileage) carried 2.710 trillion VMT (85 percent of total travel) in 2016.
- Although the 222,331 miles on the National Highway System (NHS) comprise only 5 percent of total mileage, the NHS carried 1.749 trillion VMT in 2016, approximately 55 percent of total travel.
- The 48,474 miles on the Interstate System carried 0.811 trillion VMT in 2016, slightly more than 1 percent of total mileage and close to 25 percent of total VMT. The Interstate System has grown since 2006, when it consisted of 46,836 miles that carried 0.727 trillion VMT.

2016 Highway System Statistics



United States Road System	EXTENT (Miles per System)	VMT (Vehicle Miles Traveled)	CAPITAL SPENDING ($ Billions)
Interstate System	1% 48,474 miles	25% 0.811 trillion VMT	23% $26.4 billion
National Highway System	5% 222,331 miles	55% 1.749 trillion VMT	52% $59.2 billion
Federal-aid Highways	25% 1,026,319 miles	85% 2.710 trillion VMT	74% $84.1 billion
Systemwide (All Roads)	100% 4,157,292 miles	100% 3.189 trillion VMT	100% $112.9 billion

The Interstate System accounts for 1% of road mileage, but carries 25% of highway travel.

Highway Funding – 2016

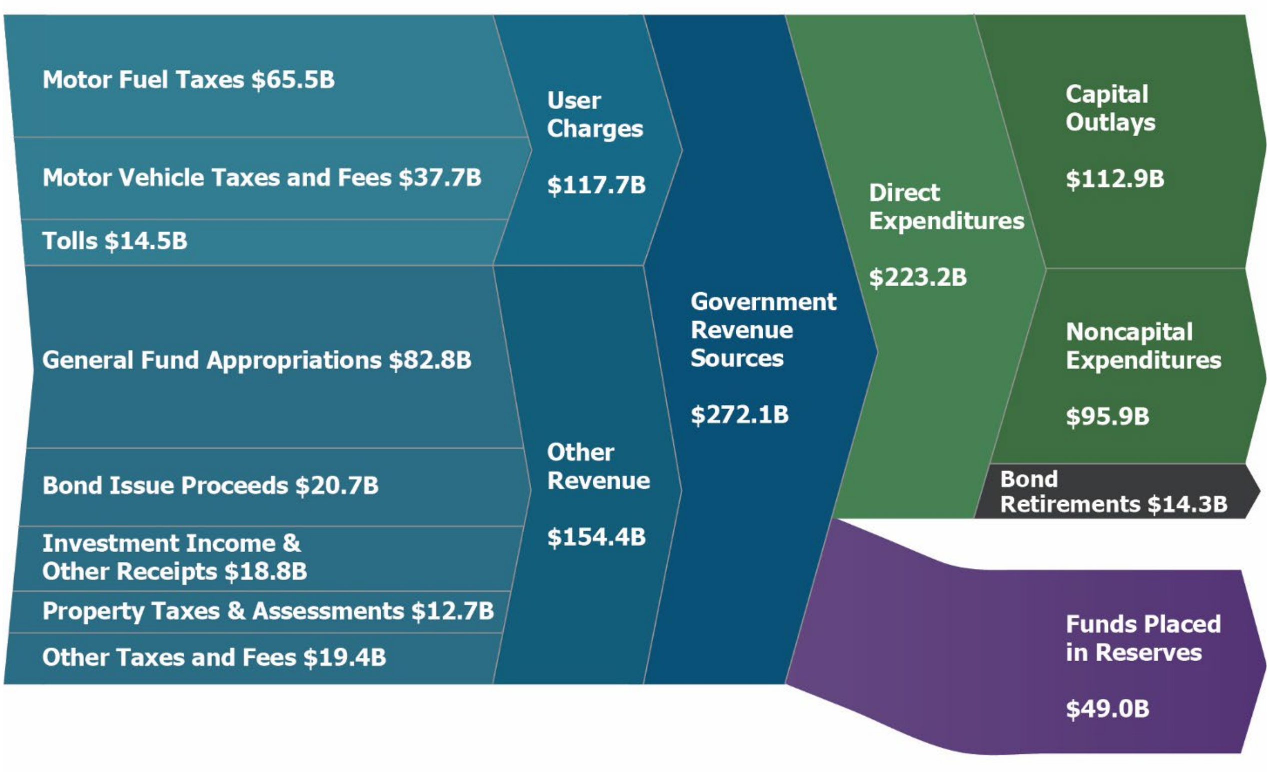
- All levels of government spent a combined $223.2 billion for highway-related purposes in 2016. More than half (50.6 percent) of total highway spending ($112.9 billion) was for capital improvements to highways and bridges; the remainder included expenditures for physical maintenance, highway and traffic services, administration, highway safety, bond interest, and bond retirement.
- Of the $112.9 billion spent on highway capital improvements in 2016, $26.4 billion (23 percent) was spent on the Interstate System, $59.2 billion (52 percent) was spent on the NHS, and $84.1 billion (74 percent) was spent on Federal-aid highways (including the NHS).

Highway System Terminology

"Federal-aid highways" are roads that generally are eligible for Federal funding assistance under current law. (Note that certain Federal programs do allow the use of Federal funds on other roadways.)

The NHS includes those roads that are most important to Interstate travel, economic expansion, and national defense. It includes the entire Interstate System. The NHS was expanded under the Moving Ahead for

2016 Highway Revenues and Expenditures



- Revenues raised for use on highways, by all levels of government combined, totaled $272.1 billion in 2016. The $49.0 billion difference between highway revenues and highway expenditures ($223.2 billion) identified as "funds placed in reserves" represents the net increase during 2016 of the cash balances of the Federal Highway Trust Fund and comparable dedicated accounts at the State and local level. This single-year increase in cash balances is by far the largest ever recorded, and is due entirely to a $51.9 billion one-time transfer of general funds to the Federal Highway Trust Fund required under the Fixing America's Surface Transportation Act (FAST Act).

- Of the total $272.1 billion of revenues raised in 2016 for use on highways, $117.7 billion (43 percent) was collected from various forms of user charges, including fuel taxes ($65.5 billion), tolls ($14.5 billion), and vehicle taxes and fees ($37.7 billion).
- During 2016, $154.5 billion was raised from nonuser sources for use on highways, including general fund appropriations ($82.8 billion), bond issue proceeds ($20.7 billion), investment income and other receipts ($18.8 billion), property taxes ($12.7 billion), and other taxes and fees ($19.4 billion). The amount of general funds directed toward highway purposes in 2016 was nearly double the highest amount recorded in any previous year due to a $51.9-billion transfer of general funds to the Federal Highway Trust Fund in 2016.

Highway Spending Trends

- In nominal dollar terms, highway spending increased by 36.5 percent (3.2 percent per year) from 2006 to 2016; after adjusting for inflation this equates to a 20.0-percent increase (1.8 percent per year).
- Highway capital expenditures rose from $80.2 billion in 2006 to $112.9 billion in 2016, a 40.7-percent increase (3.5 percent per year) in nominal dollar terms; after adjusting for inflation this equates to a 30.1-percent (2.7 percent per year) increase.

Constant-dollar Conversions for Highway Expenditures

This report uses the Federal Highway Administration's National Highway Construction Cost Index (NHCCI) 2.0 for inflation adjustments to highway capital expenditures, and the Consumer Price Index (CPI) for adjustments to other types of highway expenditures.

- The portion of total highway capital spending funded by the Federal government decreased from 43.1 percent in 2006 to 39.7 percent in 2016. Federally funded highway capital outlay grew by 2.6 percent per year over this period, compared with a 4.1-percent annual increase in capital spending funded by State and local governments.
- The composition of highway capital spending shifted during the 2006–2016 period. The percentage of highway capital spending directed toward system rehabilitation rose from 51.5 percent in 2006 to 62.0 percent in 2016. Over the same period, the percentage of spending directed toward system enhancement rose from 10.6 percent to 13.6 percent, whereas the percentage of spending directed toward system expansion fell from 37.9 percent to 24.4 percent.

Highway Capital Spending Terminology

This report splits highway capital spending into three broad categories. "System rehabilitation" includes resurfacing, rehabilitation, or reconstruction of existing highway lanes and bridges. "System expansion" includes the construction of new highways and bridges and the addition of lanes to existing highways. "System enhancement" includes safety enhancements, traffic operation improvements such as the installation of intelligent transportation systems, environmental enhancements, and other enhancements such as construction of bicycle and pedestrian facilities.

Conditions and Performance of the System

Bridge Conditions Have Improved

- Based directly on bridge counts the share of bridges classified as poor has improved, dropping from 10.4 percent in 2006 to 7.9 percent in 2016. The share of NHS bridges classified as poor also improved over this period, dropping from 5.4 percent to 3.5 percent. (More recent data show that from 2017 to 2020, the number of bridges in poor condition decreased by 5 percent, from 47,619 to 45,031.)
- Weighted by deck area the share of bridges classified as poor also improved, declining from 9.0 percent in 2006 to 5.9 percent in 2016. The deck area-weighted share of poor NHS bridges dropped from 8.3 percent to 5.2 percent over this period.
- The decline over the past decade in the percentage of bridges classified as poor was accompanied by an increase in the share of bridges classified as good. Weighted by deck area, the share of bridges classified as good improved slightly, increasing from 46.1 percent in 2006 to 46.5 percent in 2016. The deck area-weighted share of good NHS bridges improved from 43.9 percent to 44.5 percent over this period.

Bridge Condition Terminology

Bridges are given an overall rating of "good" if the deck, substructure, and superstructure are all found to be in good condition. Bridges receive a rating of "poor" if any of these three bridge components is found to be in poor condition. All other bridges are classified as "fair."

These classifications are often weighted by bridge deck area, recognizing that bridges are not all the same size and, in general, larger bridges are costlier to rehabilitate or replace to address deficiencies. The classifications are also sometimes weighted by annual daily traffic because more heavily traveled bridges have a greater effect on total highway user costs.

The classification of a bridge as poor does not mean it is unsafe; bridges that are considered to be unsafe are closed to traffic.

Highway Safety Improved Overall, but Pedestrian and Bicyclist Fatalities Rose

- The annual number of highway fatalities decreased by 12.3 percent from 2006 to 2016, dropping from 42,708 to 37,461. However, fatalities increased after 2014, by 8.4 percent from 2014 to 2015, and by 5.6 percent from 2015 to 2016. (More recent data show a 3.3-percent decrease in fatalities between 2016 and 2018).
- From 2006 to 2016 the number of nonmotorists (pedestrians, bicyclists, etc.) killed by motor vehicles increased by 22.6 percent, from 5,722 to 7,013 (18.7 percent of all fatalities). 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 up to 2016. (More recent data show that from 2017 to 2018, fatalities involving pedestrians increased by 3.4 percent and bicyclist fatalities increased by 6.3 percent.)
- Fatalities related to roadway departure decreased by 20.2 percent from 2006 to 2016, but roadway departure remains a factor in close to half (48.3 percent) of all highway fatalities. Intersection-related fatalities remained virtually flat from 2006 to 2016, but more than one-fourth (27.4 percent) of highway fatalities in 2016 occurred at intersections. (More recent data show that roadway departure and intersection fatalities accounted for 51 percent and 27 percent, respectively, of total fatalities.)
- The fatality rate per 100 million VMT declined from 1.42 in 2006 to 1.18 in 2016, but has increased since reaching a low of 1.08 in 2014. (More recent data show that the fatality rate per 100 million VMT declined to 1.13 in 2018.)

2006–2016 Highway System Trends

Poor ride quality data are affected by changes in reporting instructions beginning in 2010.

Pavement Condition Trends Have Been Mixed

- In general, pavement condition trends over the past decade have been better on the NHS (the 5 percent of total system mileage that carries 55 percent of total system VMT) than on Federal-aid highways (the 25 percent of system mileage that carries 85 percent of total system VMT, including the NHS).
- The share of Federal-aid highway VMT on pavements with "good" ride quality rose from 47.0 percent in 2006 to 48.9 percent in 2016. Over this same period, the trend based on highway mileage was different, with the share of mileage that had good ride quality declining from 41.5 percent to 40.2 percent and the lane mile-weighted share declining from 41.1 percent to 38.2 percent. This divergence may be due to States focusing improvements on those roads that are most heavily traveled.

Pavement Condition Terminology

This report uses the International Roughness Index (IRI) as a proxy for overall pavement condition. Pavements with an IRI value of less than 95 inches per mile are considered to have "good" ride quality. Pavements with an IRI value greater than 170 inches per mile are considered to have "poor" ride quality. Pavements that fall between these two ranges are considered "fair."

- The share of Federal-aid highway pavements with "poor" ride quality rose during the 2006–2016 period, as measured on both a VMT-weighted basis (rising from 14.0 percent to 17.1 percent) and a mileage basis (rising from 15.8 percent to 22.0 percent). However, weighted by lane miles, the share of pavements with poor ride quality decreased from 19.9 to 17.4 over this period.
- The share of VMT on NHS pavements with good ride quality rose from 57.0 percent in 2006 to 59.6 percent in 2016. This gain is especially impressive considering MAP-21 expanded the NHS by 60,292 miles (37 percent), as pavement conditions on the additions to the NHS were not as good as those on the pre-expansion NHS. The share rose from 57.0 percent in 2006 to 60 percent in 2010 based on the pre-expansion NHS, and from an estimated 54.7 percent in 2010 to 59.6 percent in 2016 based on the post-expansion NHS.
- The share of VMT on NHS pavements with poor ride quality stayed the same at 7 percent from 2006 to 2010; since the expansion of the NHS under MAP-21 this share has remained relatively constant at approximately 11 percent.

Pavement Data Reporting Change

A change in data reporting instructions beginning in 2010 led States to split roadways into shorter segments for purposes of evaluating pavement conditions. This more refined approach captured more of the variation in pavement conditions, which tended to increase the share of sections considered "good" or "poor" and to reduce the share considered "fair." For example, the share of mileage rated "poor" rose from 15.8 percent in 2008 to 20.0 percent in 2010.

Operational Performance Has Worsened

- Based on the National Performance Management Research Data Set (NPMRDS), the Travel Time Index (TTI) for Interstate highways averaged 1.34 in 2016 in the Nation's 52 largest metropolitan areas. This means that the average peak-period trip took 34 percent longer than did the same trip under free-flow traffic conditions. The comparable TTI value for 2012 was 1.24.
- For the same 52 metropolitan areas, the Planning Time Index (PTI) averaged 2.49 for Interstate highways in 2016, meaning that ensuring on-time arrival 95 percent of the time required planning for 2.49 times the travel time under free-flow traffic conditions. The comparable PTI value for 2012 was 2.17. On average, urban Interstate highways in these areas were congested for 4.4 hours per day in 2016, up from 3.6 hours in 2012.
- The Texas Transportation Institute 2019 Urban Mobility Report estimates that the average commuter in 494 urbanized areas experienced a total of 53 hours of delay resulting from congestion in 2016, up from 43 hours in 2006. Total delay reached 8.6 billion hours and fuel waste reached 3.3 billion gallons in 2016, leading to a total cost of $171

Operational Performance Terminology

The TTI measures the average intensity of congestion, calculated as the ratio of the peak-period travel time to the free-flow travel time for the peak period on weekdays. The value of the TTI is always greater than or equal to 1, with a higher value indicating more severe congestion. For example, a value of 1.30 indicates that a 60-minute trip on a road that is not congested would typically take 78 minutes (30 percent longer) during the period of peak congestion.

The PTI measures travel time reliability and the severity of delay, defined as the ratio of the 95th percentile of travel time during the peak periods to the free-flow travel time. For example, a PTI of 1.60 means that, for a trip that takes 60 minutes in light traffic, a traveler should budget a total of 96 (60 × 1.60) minutes to ensure on-time arrival for 19 out of 20 trips (95 percent of the trips).

billion. (More recent data show that in 2017, these commuters experienced an estimated average of 54 hours of congestion delay.)

Future Capital Investment Scenarios

The scenarios that follow pertain to spending by all levels of government combined for the 20-year period from 2016 to 2036 (reflecting the impacts of spending from 2017 through 2036); the funding levels associated with these analyses are stated in constant 2016 dollars. The results discussed in this section apply to the overall road system; separate analyses for the Interstate System, the NHS, and Federal-aid highways are presented in the body of this report.

Improve Conditions and Performance Scenario

- The Improve Conditions and Performance scenario seeks to identify the level of capital investment needed to address all potential investments estimated to be cost-beneficial. The average annual level of systemwide capital investment associated with this scenario is $165.9 billion, 55.2 percent higher than the level of the Sustain Recent Spending scenario.
- Approximately 30.5 percent of the capital investment under the Improve Conditions and Performance scenario would go toward addressing an existing backlog of cost-beneficial investments of $1.01 trillion. The rest would address new needs arising from 2017 through 2036. The backlog includes $556 billion related to the pavement component of system rehabilitation investments, $132 billion related to the bridge component of system rehabilitation investments, $181 billion related to system expansion, and $143 billion related to system enhancement.
- The State of Good Repair benchmark represents the subset of the Improve Conditions and Performance scenario spending level that is directed toward addressing deficiencies in the physical condition of existing highway and bridge assets. The average annual investment level associated with this benchmark is $104.7 billion, 63.1 percent of the $165.9 billion cost of the overall scenario.
- The Improve Conditions and Performance scenario also includes average annual spending of $37.8 billion (22.8 percent) directed toward system expansion, and $23.5 billion (14.1 percent) directed toward system enhancement.

Highway Investment/ Performance Analyses

To provide an estimate of the costs that might be required to maintain or improve system performance, this report includes a series of investment/performance analyses that examine the potential impacts of alternative levels of future combined investment by all levels of government on highways and bridges for different subsets of the overall system.

Drawing on these investment/performance analyses, a series of illustrative scenarios was selected for more detailed exploration and presentation.

The Sustain Recent Spending scenario and the Maintain Conditions and Performance scenario each assume a fixed level of highway capital spending in each year in constant-dollar terms (i.e., spending keeps pace with inflation each year). These scenarios also assume that spending would be directed toward projects with the largest benefit-cost ratios.

Spending under the Improve Conditions and Performance scenario varies by year, depending on the set of potential cost-beneficial investments available at that time. Because an existing backlog of cost-beneficial investments has not previously been addressed, investment under this scenario is frontloaded, with higher levels of investment in the early years of the analysis and lower levels in the latter years.

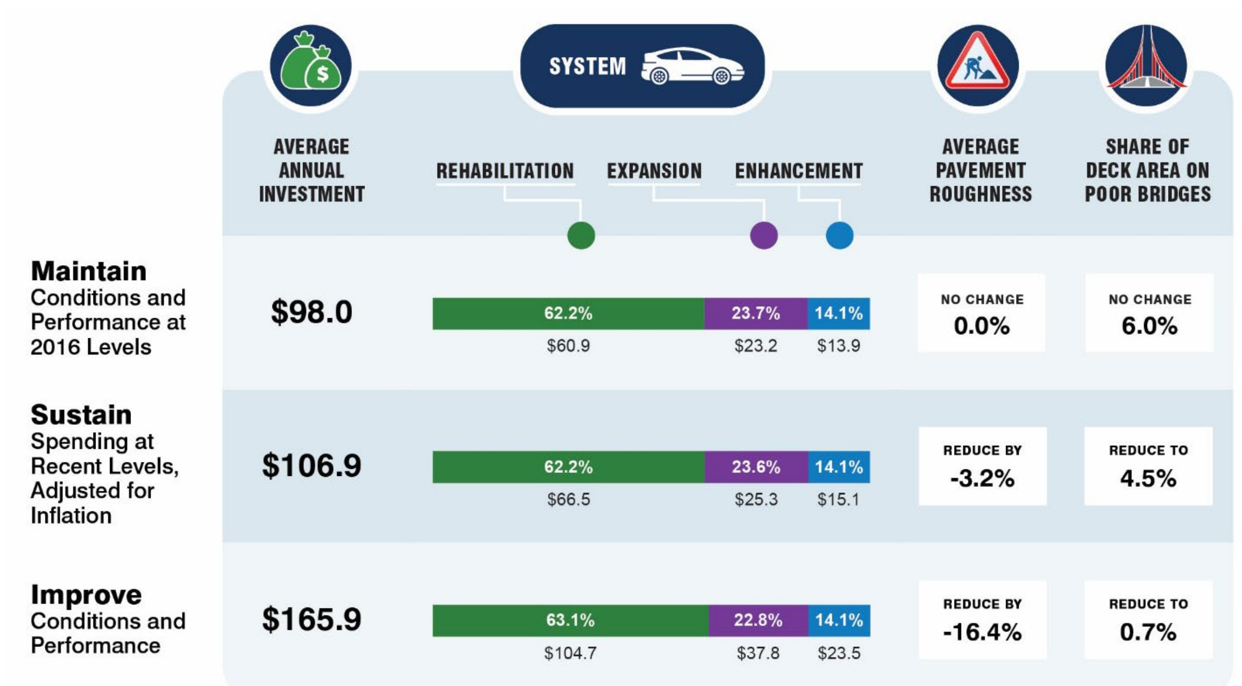
- Under the Improve Conditions and Performance scenario, average pavement roughness on Federal-aid highways is projected to improve by 16.4 percent. The share of bridges classified as poor is also projected to improve, declining from 6.0 percent in 2016 to 0.7 percent in 2036. This scenario would not eliminate all poor pavements and bridges because in some cases it only becomes cost-beneficial to improve assets after they have declined into poor condition, and in others it is cost-beneficial to proactively improve assets before they become poor. Therefore, at the end of any given year, some portion of the pavement and bridge population would remain in poor condition.

Scenario Impacts on Delay

Congestion-related delay is projected to decrease sharply under all three of the highway scenarios presented in this report. For example, average delay per VMT is projected to improve by 24.8 percent over 20 years under the Maintain Conditions and Performance scenario.

These results can be explained in part by assumptions regarding a slowdown in future travel growth and the future adoption rate for various highway management and operational strategies. However, it also appears that there are issues with the State-supplied data for some highway sections that are skewing upward the national-level estimates of base-year delay. This issue will be addressed in future editions of this report.

2016–2036 Future Highway Capital Investment Scenarios



Billions of 2016 dollars. Includes all public and private investment.

Modeled vs. Nonmodeled Investment

Each highway investment scenario includes projections for system conditions and performance based on simulations using the Highway Economic Requirements System (HERS) and the National Bridge Investment Analysis System (NBIAS). Each scenario scales up the total amount of simulated investment to account for capital improvements that are outside the scopes of the models, or for which no data are available to analyze. Of recent (2012 to 2016) average annual capital spending on all U.S. roads, 14.1 percent was used for system enhancements (safety enhancements, traffic control facilities, and environmental enhancements) that neither model analyzes directly. An additional 15.5 percent was used for pavement and capacity improvements on non-Federal-aid highways; FHWA does not collect the detailed information for such roadways that would be necessary to support analysis using HERS. (FHWA does collect sufficient data for all of the Nation's bridges to support analysis using NBIAS.)

Combining these two percentages yields a total of approximately 29.6 percent; each scenario for the overall road system was scaled up so that nonmodeled investment would comprise this share of its total investment level. For example, of the $165.9 billion average annual investment level under the Improve Conditions and Performance scenario, $49.2 billion represents nonmodeled investment.

Sustain Recent Spending Scenario

- The Sustain Recent Spending scenario assumes that capital spending by all levels of government is sustained through 2036 at the average annual level from 2012 to 2016 ($106.9 billion), and that all spending supports only cost-beneficial projects. Under these assumptions, average pavement roughness on Federal-aid highways would be projected to improve (i.e., be reduced) by 3.2 percent, and the share of bridges classified as poor would also be projected to improve, declining from 6.0 percent in 2016 to 4.5 percent in 2036.

Maintain Conditions and Performance Scenario

- The Maintain Conditions and Performance scenario seeks to identify a level of capital investment at which, if only cost-beneficial projects are chosen, selected measures of future conditions and performance in 2036 are maintained at 2016 levels. The average annual level of investment associated with this scenario is $98.0 billion, 8.3 percent lower than the level of the Sustain Recent Spending scenario.

Changes in Improve Scenario and Backlog Estimates

The average annual investment level for the Improve Conditions and Performance scenario increased from $135.7 billion (in 2014 dollars) in the 23rd C&P to $165.9 billion (in 2016 dollars) between the 23rd and 24th C&P reports. (The subset of this scenario that represents the existing investment backlog similarly increased from $786.4 billion to $1.01 trillion.)

As explained in the "Comparison with the 23rd C&P Report" section in Chapter 8, the estimates in the 23rd C&P were likely an underestimate, mostly because the data available data for processing in HERS were less comprehensive, causing some existing deficiencies to go undetected, but also because of other factors such as improved HERS analysis procedures.

- Under this scenario, $60.9 billion per year would be directed to system rehabilitation, $23.2 billion to system expansion, and $13.9 billion to system enhancement. Average pavement roughness on Federal-aid highways and the share of bridges classified as poor in 2036 would match their 2016 levels.

Highlights: Transit

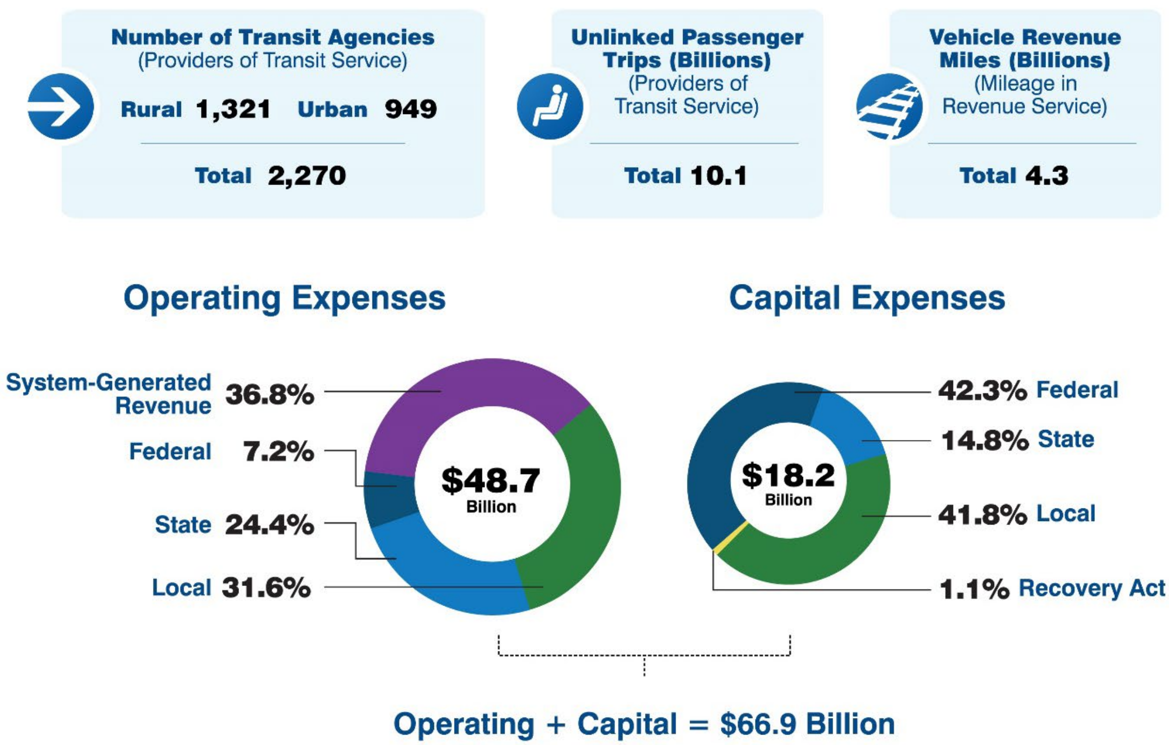
Operating and Capital Funds

- All levels of government spent a combined $66.9 billion to provide public transportation and to maintain and expand transit infrastructure in 2016.
- Operating funding totaled $48.7 billion in 2016, a 36.8-percent increase from 2006. Of this total, 36.8 percent was system-generated revenue, of which most came from passenger fares. Federal funding comprised 7.2 percent of revenues for operations; the remaining funds (54.0 percent) came from State and local sources.
- Capital funding totaled $18.2 billion in 2016, a 29.7-percent increase from 2006. Federal funding made up 42.3 percent of revenues for capital spending. Remaining funds from the Federal American Recovery and Reinvestment Act provided another 1.1 percent, and the rest (56.6 percent) came from State and local sources.
- In 2016, $14.4 billion, or 72.4 percent of total transit capital expenditures, was invested in rail modes and $5.3 billion, or 27.1 percent, was invested in non-rail modes. Guideway investments, including at-grade rail, elevated structures, tunnels, bridges, track, and power systems, totaled $7.7 billion or 53.7 percent of the total capital expenditure in 2016. Investments in vehicles, stations, and maintenance facilities totaled $8.5 billion.
- Between 2006 and 2016, public funding for transit increased at an average annual rate of 2.7 percent, Federal funding increased at an average annual rate of 1.7 percent, and State and local funding increased at an average annual rate of 3.1 percent after adjusting for inflation (constant dollars).
- Farebox recovery ratios, representing the share of operating expenses that come from passenger fares, were about 31.7 percent for the top 10 transit agencies. The 2016 average recovery ratio reflects a total 5.8-percent decrease and an average annual 0.6-percent decrease since 2006.

Transit Agencies, Service Supply, and Ridership

- Of the 2,270 transit systems in the United States that report to FTA's National Transit Database (NTD), 949 provided service primarily to urbanized areas and 1,321 provided service primarily to rural areas in 2016.
- Transit ridership was 10.1 billion unlinked passenger trips on 4.3 billion vehicle revenue miles (VRM) supplied in 2016.

2016 Transit System Extent and Spending



Service Supply and Consumption by Mode

- Urban and rural agencies operated 1,138 bus systems (including regular local bus service, commuter service, trolleybus, bus rapid transit, and the Puerto Rico público) and 1,894 demand-response systems. There were also 15 heavy rail systems, 23 light rail systems, 18 streetcar systems, 27 commuter rail systems, and six hybrid rail systems that mixed the characteristics of light rail and commuter rail. Also, there were 13 smaller rail systems including monorail, automated guideway, inclined planes, aerial tramways, and the San Francisco Cable Car, along with 104 transit vanpool systems and 30 ferryboat systems.
- Fixed-route bus is the most common mode of public transportation in the United States. It accounts for nearly 50 percent of all vehicle revenue miles and unlinked passenger trips, and is provided by transit agencies of all sizes in virtually all urbanized areas and in many rural areas of the country.
- Heavy rail, by contrast, is provided solely in the largest, most densely populated areas of the country by 15 agencies in cities such as New York City, Chicago, Philadelphia, Boston, Miami, and others. Heavy rail accounts for 38 percent of all public transportation trips, but only 16 percent of all miles and hours of service.
- Light rail (including streetcars), like heavy rail, exhibits a relatively higher share of passenger trips than vehicle revenue miles but accounts for a smaller share of the overall transit market. Of all modes, light rail has increased the most in the last 10 years; the number of agencies operating light rail grew from 28 in 2006 to 39 in 2016 (39 percent).

- Commuter rail, like light rail, has also expanded significantly as suburban areas have continued to grow in population. Commuter rail trips have a small share of total transit passenger trips but have long average passenger trip lengths (APTL) of approximately 30 miles.
- The demand-response mode specifically targets the needs of persons with disabilities and persons in special conditions; its provision is required by the Americans with Disabilities Act (ADA) of 1990. A large share of the demand-response market consists of people living below the poverty level and who lack other options for transportation. Demand-response service usually generates large operating deficits and requires higher public subsidies due to both the nature of the service (on-demand, limited capacity, and commonly serving areas of low population density) and to its generally serving a market with transportation needs that often cannot be met by fixed-route transit service.

Federal Transit Funding Urban and Rural

Federal Transit Administration (FTA) Urbanized Area Formula Funds are apportioned to urbanized areas (UZAs) as defined by the Census Bureau. Each UZA has a designated recipient—a metropolitan planning organization or large transit agency—that sub-allocates FTA funds according to local policy. In small urban and rural areas, FTA apportions funds to the State, which allocates them according to State policy. Indian tribes are apportioned their formula funds directly. Once obligated (i.e., awarded in a grant), all funds then become available on a reimbursement basis and cash payments are disbursed.

Transit Service Supplied and Consumed

	No. of Transit Systems	% of Vehicle Revenue Miles (Supply)	% of Unlinked Passenger Trips (Consumption)
Fixed-route Bus Systems	1,659	47.0%	48.5%
Heavy Rail Systems	15	15.7%	37.6%
Light Rail Systems (includes street cars)	45	2.7%	5.4%
Commuter Rail Systems	29	8.0%	4.9%
Demand-response Systems (includes taxi cabs)	2,240	20.1%	1.1%
Other Systems (Rail)	19	0.2%	0.4%
Other Systems (Nonrail)	167	6.3%	2.2%

- Fixed-route Bus Systems includes local service bus, commuter bus, and Bus Rapid Transit (BRT)
- Other Systems (Rail) includes inclined plane, cable car, hybrid rail, automated guideway/monorail
- Other Systems (Nonrail) includes vanpools, tramway, jitney, públicos, trolleybus, ferryboat

Fatalities, VRM, Cost, and Average Fleet Age

- Transit fatalities rose from 220 in 2006 to 354 in 2016, an increase of 61 percent. This sharp increase was driven mainly by an increased rate of suicides. In 2006, suicides accounted for 7 percent of all fatalities; in 2016, the share was 31 percent.
- Two measures of service supplied by transit agencies are vehicle revenue miles (VRM) and fleet (vehicles available for maximum service). Light rail and commuter rail had the largest number of new systems installed between 2006 and 2016 relative to all modes. From a fleet perspective, commuter rail and light rail increased at an average rate lower than that of VRM. This is explained by the fact that a marginal increase of one passenger car results in a higher marginal increase in VRM.

Some Aspects of System Performance Have Improved

- Between 2006 and 2016, the service offered by transit agencies grew substantially. The annual rate of growth in VRM ranged from 0.2 percent per year for heavy rail to 7.9 percent per year for light rail. This has resulted in 42 percent more route miles available to the public.
- In 2016, agencies reported 212,668 transit vehicles serving urban and rural areas, 3,449 rail passenger stations, and 2,424 maintenance facilities. Rail systems operated on 13,094 miles of track and fixed-route buses operated on over 233,000 mixed traffic route miles.
- Rail systems are more cost-efficient in providing service than are nonrail systems, once investment in rail infrastructure has been completed. (Indeed, this is one of the explicit tradeoffs that agencies consider when deciding whether to construct or expand an urban rail system.) Based on operating costs alone, heavy rail is the most efficient at providing transit service and demand-response systems are the least efficient.

- The average age and condition of the Nation's bus fleet remained unchanged between 2006 and 2016; however, the percentage of vehicles below the replacement threshold increased from 13.2 percent in 2006 to 21.4 percent in 2016.
- Between 2006 and 2016, the number of annual service miles per vehicle (vehicle productivity) remained unchanged and the average number of miles between breakdowns (mean distance between failures) increased by 11 percent.
- Growth in service offered was nearly equal to growth in service consumed. Despite steady growth in route miles and revenue miles, average vehicle occupancy levels did not decrease. Passenger Miles Traveled (PMT) grew at a 2.0-percent annual pace, whereas the number of trips grew by 1.6 percent annually. This is significantly faster than the annual growth rate in the U.S. population during this period (0.93 percent), suggesting that transit has been able to attract riders who previously used other modes of travel. Increased availability of transit service has likely been a factor in this outcome.

Transit Modes

Public transportation is provided by several different types of vehicles that are used in different operational *modes*.

Fixed-route bus service uses rubber-tired buses that run on scheduled routes.

Commuter bus service is similar, but runs longer distances between stops.

Bus rapid transit is high-frequency bus service similar to light rail service.

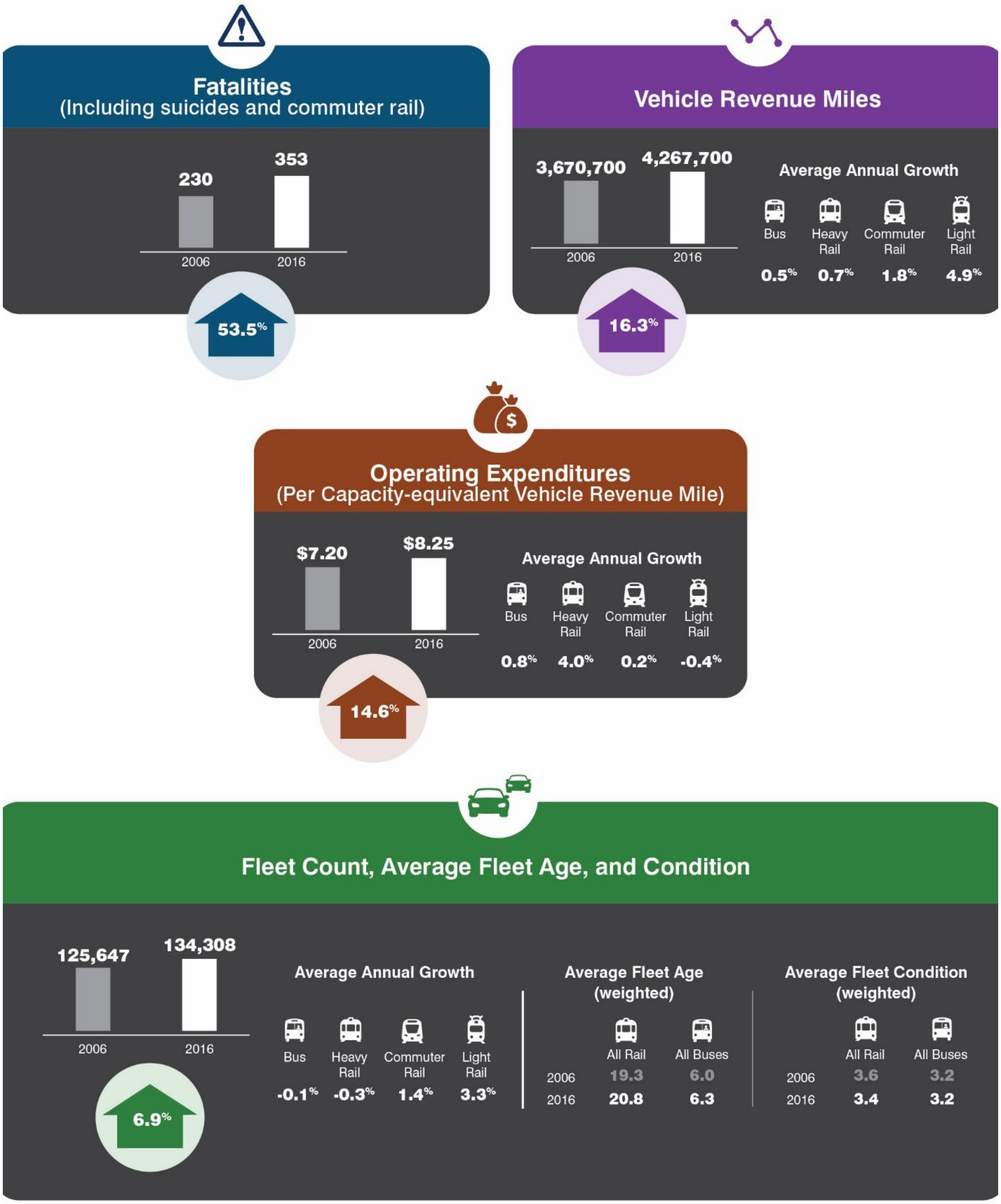
Públicos and jitneys are small owner-operated buses or vans that operate on less-formal schedules along regular routes.

Larger urban areas are often served by one or more varieties of *fixed-guideway* (rail) service. These include:

- *Heavy rail* (often running in subway tunnels), characterized primarily by third-rail electric power and exclusive dedicated guideway.
- *Commuter rail*, which often shares track with freight trains and usually uses overhead electric power (but may also use diesel power or third rail); typically found in extended urban areas.
- *Light rail* systems, which are common in large- and medium-sized urban areas, feature overhead electric power and run on track that is generally or in part on city streets with pedestrian and automobile traffic.
- *Streetcars* are small light rail systems, usually with only one or two cars per train that often run in mixed traffic.
- *Hybrid rail,* previously reported as light rail and commuter rail, is a mode with shared characteristics of these two modes. It has higher average station density (stations per track mileage) than commuter rail and lower station density than light rail; it has a smaller peak-to-base ratio than that of commuter rail.
- Cable cars, trolley buses, monorail, and automated guideway systems are less common fixed-guideway systems.

Demand-response transit service is usually provided by vans, taxicabs, or small buses that are dispatched to pick up passengers on request. This mode is mostly used to provide *paratransit* service as required by the ADA, but in some cases is used to provide service to the general public in low ridership areas or at off-peak service times. These vehicles do not follow a fixed schedule or route.

2006–2016 Transit Trends in Urban Area



Future Transit Capital Investment Scenarios and the State of Good Repair Benchmark

As in the highway discussion, the transit investment scenarios discussed in this section pertain to spending by all levels of government combined for the 20-year period from 2016 to 2036; the funding levels associated with all of these analyses are stated in constant 2016 dollars. Unlike the highway scenarios, these transit scenarios assume an immediate jump to a higher (or lower) investment level that is maintained in constant-dollar terms throughout the analysis period.

Included in this section for comparison purposes is an assessment of the investment level needed to replace all assets that are currently past their useful life or that will reach that state over the forecast period. This level of investment would be necessary to achieve and maintain a state of good repair (SGR), but would not address any increases in demand during that period. Although not a realistic scenario, it provides a benchmark for infrastructure preservation. All other capital investment scenarios are subjected to cost-benefit constraints.

State of Good Repair – Expansion vs. Preservation

State of Good Repair (SGR) is defined in this report as all transit capital assets being within their average service life. This is a general construct that allows FTA to estimate *system preservation* needs. The analysis looks at the age of all transit assets and adds the value of those that are past the age at which that type of asset is usually replaced to a total reinvestment needs estimate. Some assets may continue to provide reliable service well past the average replacement age and others will not; over the large number of assets nationally, the differences average out. Some assets will need to be replaced, some will just get refurbished. Both types of cost are included in the reinvestment total. SGR is a measure of system preservation needs, and failure to meet these needs results in increased operating costs and poor service.

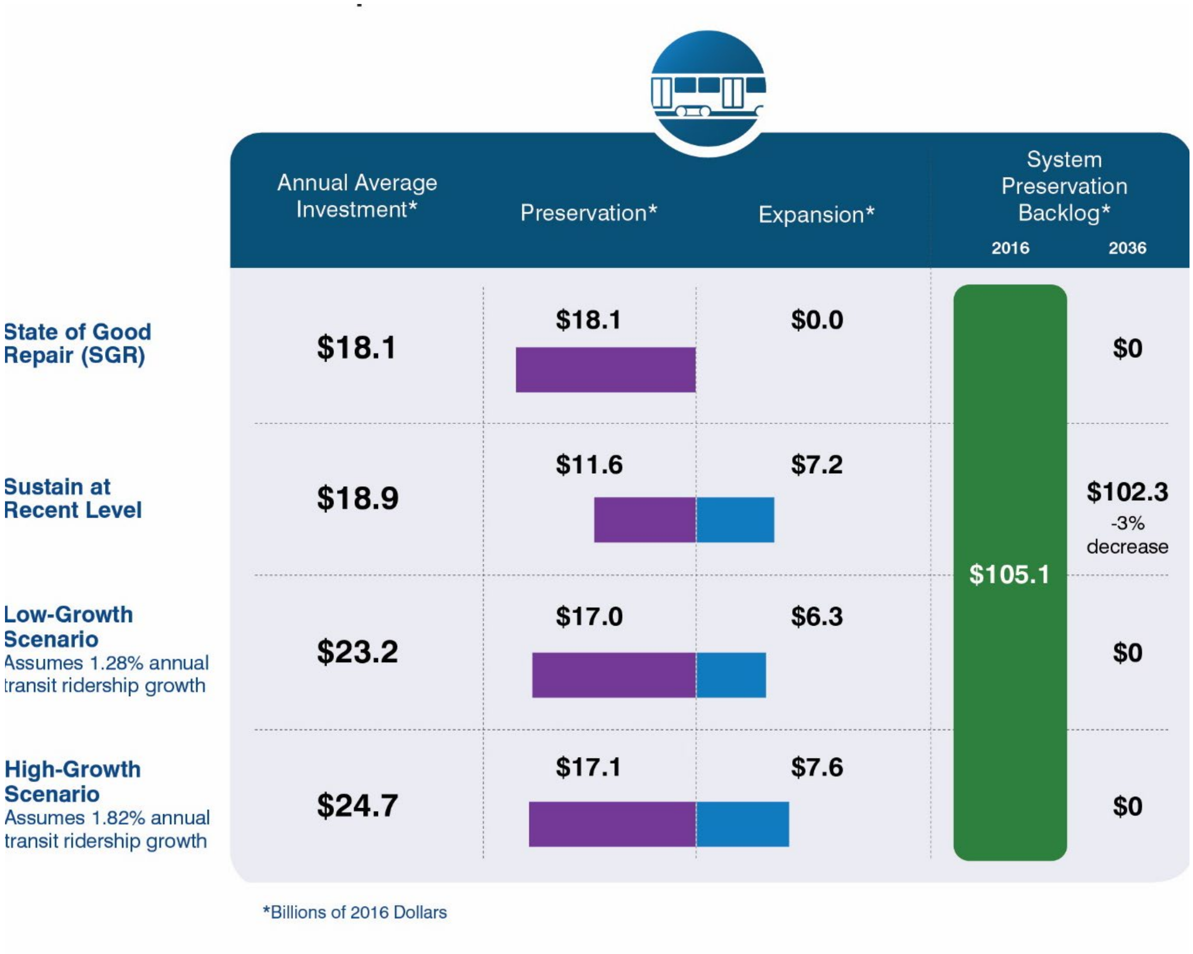
Expansion needs are treated separately in this analysis. They result from the need to add vehicles and route miles to accommodate more riders. Estimates of future demand are, by their nature, speculative. Failure to meet this type of need results in crowded vehicles and represents a lost opportunity to provide the benefits of transit to a wider customer base.

Sustain Recent Spending Scenario

- The **Sustain Recent Spending** scenario assumes that capital spending by all levels of government is sustained in constant-dollar terms at recent levels (average from 2012–2016) through 2036. Unlike the growth scenarios, which estimate the levels of investment required to meet ridership growth and eliminate the backlog at year 20, the Sustain Recent Spending scenario assumes continued spending at the actual average investment levels for rehabilitation/replacement and expansion during 2012–2016. It then estimates the size of the backlog at year 20 and the ridership level supported by the average recent expansion investment.
- The average recent (2012–2016) capital invested stood at $18.9 billion, of which $11.6 billion was devoted to rehabilitation/replacement and $7.2 billion to expansion. At this level, this scenario results in a backlog of $102.3 billion in 2036, 3 percent less than the $105.1 billion in 2016. It is the first time in the last three editions of the C&P Report that the backlog did not grow over the 20-year timeframe.
- The Sustain Recent Spending scenario addresses 61 percent of the required level to eliminate the backlog in 2036.

- It supports a ridership level increase of 4.1 million trips on average per year, which is higher than that of the Low-Growth scenario (3 million per year), but lower than that of the High-Growth (4.5 million per year).

2016–2036 Future Transit Capital Investment Scenarios



Growth Scenarios

The growth scenarios estimate capital investment levels required to meet two primary objectives: (1) eliminate the backlog at year 20 (2036) by investing in preservation and replacement of legacy and new assets past their useful lives subjected to a cost-benefit test, and (2) invest in the acquisition of new assets to meet a forecasted ridership growth based on 15-year historical trends analysis at the UZA and mode levels.

- The **Low-Growth scenario** assumes that transit ridership will grow at an average rate of 3 billion trips per year, corresponding to an average annual rate of 1.28 percent. It also eliminates the backlog of legacy assets, estimated at $105.1 billion, plus the backlog of new assets past their useful lives. Only new assets with relatively short useful lives, such as buses (12-year average) and smaller vehicles, affect the size of the backlog. The average annualized cost of this scenario is $23.2 billion, of which $17.0 billion is to eliminate the backlog in 2036 and $6.3 billion is for service expansion.
- The Low-Growth scenario requires a level of investment in system expansion of $6.3 billion, which is less than the recent spending on expansion at $7.2 billion.

- The **High-Growth scenario** is similar to the Low-Growth scenario but assumes that transit ridership will grow at an average rate of 4.5 billion trips per year, corresponding to an annual rate of 1.82 percent between 2016 and 2036. The annualized cost of this scenario is $24.7 billion, of which $17.1 billion is to eliminate the backlog in 2036 and $7.6 billion is for service expansion.

The small difference in average annual preservation investment between the High-Growth and Low-Growth scenarios ($100 million per year) is proportional to the actual difference in ridership growth forecasted for the two scenarios. A higher rate requires more assets, which require more rehabilitation and replacement investment.

State of Good Repair Benchmark

- The State of Good Repair (SGR) benchmark estimates, on an unconstrained basis, the annual investment in preservation of existing assets at year 1 (2016) that are required to eliminate the backlog in year 20 (2036). FTA estimates that $18.1 billion annually will reduce the backlog of $105.1 billion to zero in 2036.