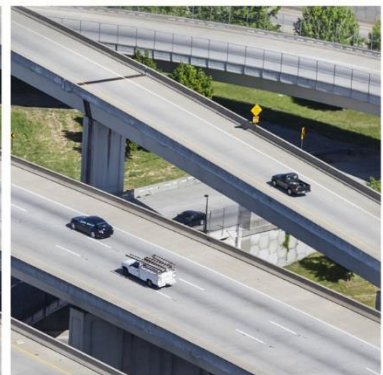
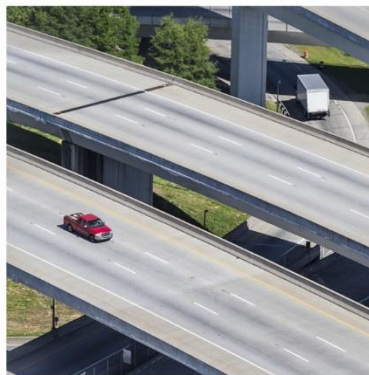
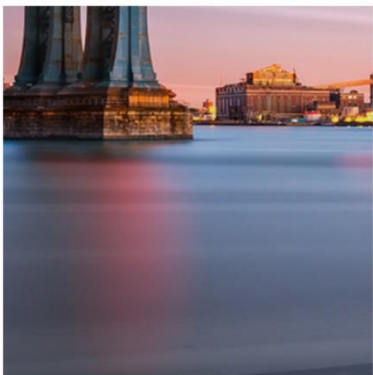
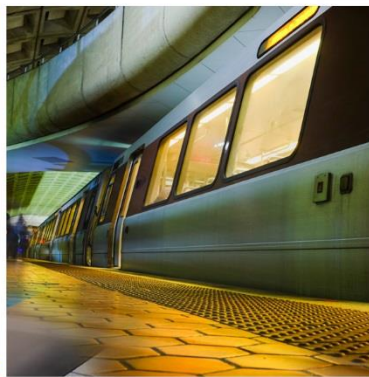


# Status of the Nation's Highways, Bridges, and Transit

## Conditions and Performance

23<sup>rd</sup> Edition

### Executive Summary



U.S. Department  
of Transportation  
**Federal Highway  
Administration**  
**Federal Transit  
Administration**

REPORT TO CONGRESS





U.S. Department  
of Transportation

**Federal Highway  
Administration**

**Federal Transit  
Administration**

# Status of the Nation's Highways, Bridges, and Transit

## Conditions and Performance

23<sup>rd</sup> Edition

### EXECUTIVE SUMMARY

REPORT TO CONGRESS



# Introduction

This document is a summary of the 23<sup>rd</sup> edition of the *Status of the Nation's Highway, Bridges, and Transit: Conditions and Performance Report to Congress* (C&P Report). The C&P Report is intended to provide decision makers with an objective appraisal of the physical conditions, operational performance, and financing mechanisms of highways, bridges, and transit systems based on both their current state and their projected future state under a set of alternative future investment scenarios. The report offers a comprehensive, data-driven background context to support the development and evaluation of legislative, program, and budget options at all levels of government. It also serves as a primary source of information for national and international news media, transportation associations, and industry.

The main body of the report is organized into four major sections and draws primarily on 2014 data. Part I, *Moving a Nation*, contains the core retrospective analyses of the report and includes chapters on infrastructure assets, revenue sources and expenditure patterns, personal travel, mobility and access, safety, and physical conditions.

Part II, *Investing in the Future*, contains the core prospective analyses of the report, including 20-year future capital investment scenarios. Chapters in this section relate a set of select capital investment scenarios to current levels of capital investments; provide supplemental analysis relating to primary investment scenarios and compare the findings of the future investment scenarios to findings in previous reports; discuss scenario implications; explain how changing some underlying technical assumptions would affect future highway and transit investment scenarios; and project the potential impacts of additional alternative technical levels of future capital investment on the future performance of various components of the system.

The highway investment scenarios are developed in part from the Highway Economic Requirements System (HERS), which models highway investment using benefit-cost analysis. The HERS model quantifies user, agency, and societal costs for various types and combinations of capital improvements. HERS considers costs associated with travel time, vehicle operation, safety, routine maintenance, and emissions, including greenhouse gases. Bridge investment scenario estimates are developed from the National Bridge Investment Analysis System (NBIAS) model. Unlike earlier bridge models (and similar to HERS), NBIAS incorporates benefit-cost analysis into the bridge investment/performance evaluation. The transit investment analysis is based on the Transit Economic Requirements Model (TERM). TERM consolidates older engineering-based evaluation tools and uses a benefit-cost analysis to ensure that investment benefits exceed investment costs. TERM identifies the investments needed to replace and rehabilitate existing assets, improve operating performance, and expand transit systems to address the growth in travel demand.

Part III, *Highway Freight Transportation Conditions and Performance*, explores issues pertaining specifically to freight movement, including those focused on the National Highway System (NHS) and the conditions and performance of the National Highway Freight Network. Part IV, *Recommendations for HPMS Changes*, provides information on the status and planned direction of the Highway Performance Monitoring System (HPMS). The C&P Report also contains three technical appendices that describe the investment/performance methodologies used in the report for highways, bridges, and transit. A fourth appendix describes an ongoing research effort for *Reimagining the C&P Report in a Performance Management-Based World*.

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# Highlights

This edition of the C&P Report is based primarily on data through 2014. In assessing recent trends, this report generally focuses on the 10-year period from 2004 to 2014. The prospective analyses generally cover the 20-year period ending in 2034; the investment levels associated with these scenarios are stated in constant 2014 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 4,177,074 miles of public roadways and 610,749 bridges in 2014. This network carried more than 3.040 trillion vehicle miles traveled (VMT) and almost 5.205 trillion person miles traveled, up from 2.982 trillion VMT and up from 4.876 trillion person miles traveled in 2004.
- The 1,016,963 miles of Federal-aid highways (24 percent of total mileage) carried 2.572 trillion VMT (85 percent of total travel) in 2014.
- Although the 226,767 miles on the National Highway System (NHS) comprise only 5 percent of total mileage, the NHS carried 1.661 trillion VMT in 2014, approximately 55 percent of total travel.
- The 47,944 miles on the Interstate System carried 0.751 trillion VMT in 2014, slightly over 1 percent of total mileage and just under 25 percent of total VMT. The Interstate System has grown since 2004, when it consisted of 46,836 miles carrying 0.727 trillion VMT.

#### 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.)

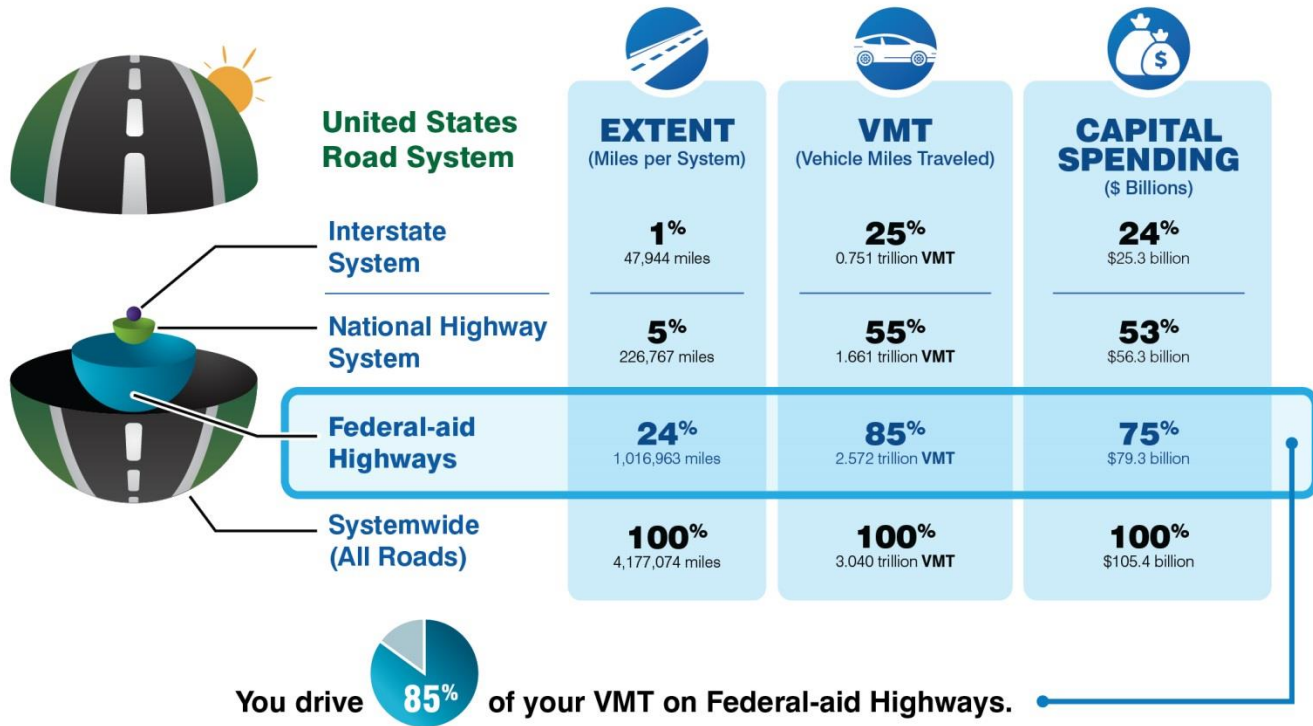
The "National Highway System" (NHS) includes those roads that are most important to interstate travel, economic expansion, and national defense. It includes the entire Interstate System. The NHS was expanded under MAP-21.

### Spending on the System

- All levels of government spent a combined \$222.6 billion for highway-related purposes in 2014. About 47.4 percent of total highway spending (\$105.4 billion) was for capital improvements to highways and bridges; the remainder included expenditures for physical maintenance, highway and traffic services, administration, highway safety, and debt service.
- Of the \$105.4 billion spent on highway capital improvements in 2014, \$25.3 billion (24 percent) was spent on the Interstate System, \$56.3 billion (53 percent) was spent on the NHS, and \$79.3 billion (75 percent) was spent on Federal-aid highways (including the NHS).
- In nominal dollar terms, highway spending increased by 50.9 percent (4.2 percent per year) from 2004 to 2014; after adjusting for inflation, this equates to a 9.5-percent increase (0.9 percent per year).
- Highway capital expenditures rose from \$70.3 billion in 2004 to \$105.4 billion in 2014, a 50.0-percent (4.1 percent per year) increase in nominal dollar terms; after adjusting for inflation, this equates to a

1.0-percent (0.1 percent per year) decrease, meaning that capital spending did not keep pace with increases in construction costs.

## 2014 Extent of the Highway System



- The portion of total highway capital spending funded by the Federal government decreased from 43.8 percent in 2004 to 42.5 percent in 2014. Federally funded highway capital outlay grew by 3.8 percent per year over this period, compared with a 4.4-percent annual increase in capital spending funded by State and local governments.
- The composition of highway capital spending shifted from 2004 to 2014. The percentage of highway capital spending directed toward system rehabilitation rose from 51.7 percent in 2004 to 62.0 percent in 2014. Over the same period, the percentage of spending directed toward system enhancement rose from 11.2 percent to 13.5 percent, while the percentage of spending directed toward system expansion fell from 37.1 percent to 24.5 percent.

### 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. From 2004 to 2014 the NHCCI 2.0 increased by 51.5 percent (4.2 percent per year), while the CPI increased by only 25.3 percent (2.3 percent per year). Previous editions of the C&P Report reflected an earlier version of the NHCCI, which showed smaller increases than the CPI in recent years.



### 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 control facilities, and environmental enhancements.

## Conditions and Performance of the System

Highway vehicle miles traveled increased by 2.0 percent (0.2 percent per year) from 2004 to 2014, while highway capital spending declined by 1.0 percent in constant-dollar terms (and overall highway spending increased). These trends were present while indicators of the performance and condition of the overall system had mixed results.

### 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 24 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 44.2 percent in 2004 to 47.0 percent in 2014. The share of mileage with good ride quality declined from 43.1 percent to 38.4 percent over this same period, however, indicating that conditions have worsened on roads with lower travel volumes.
- The share of Federal-aid highway pavements with “poor” ride quality rose from 2004 to 2014, as measured on both a VMT-weighted basis (rising from 15.1 percent to 17.3 percent) and a mileage basis (rising from 13.4 percent to 22.2 percent). Although this trend is exaggerated due to changes in data reporting instructions beginning in 2010, the data clearly show that more of the Nation’s pavements have deteriorated to the point that they are adding to vehicle operating costs and reducing driver comfort.
- The share of VMT on NHS pavements with good ride quality rose from 52 percent in 2004 to 59 percent in 2014. This gain is especially impressive considering MAP-21 expanded the NHS by 62,292 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 52 percent in 2004 to 60 percent in 2010 based on the pre-expansion NHS and from an estimated 54.7 percent in 2010 to 58.7 percent in 2014 based on the post-expansion NHS, which translates into an average increase of more than 1 percentage point per year.
- The share of VMT on NHS pavements with poor ride quality declined from 9 percent to 7 percent from 2004 to 2010; since the expansion of the NHS under MAP-21, this share has remained relatively constant at approximately 11 percent.

### 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.”

## Bridge Condition Trends Have Been Mixed

- Based directly on bridge counts, the share of bridges classified as poor has improved, dropping from 11.0 percent in 2004 to 8.7 percent in 2014 (and to 8.3 percent in 2015). The share of NHS bridges classified as poor also improved over this period, dropping from 5.6 percent to 4.1 percent (and to 3.7 percent in 2015).
- Weighted by deck area, the share of bridges classified as poor improved, declining from 9.4 percent in 2004 to 6.7 percent in 2014 (and to 6.4 percent in 2015). The deck area-weighted share of poor NHS bridges dropped from 8.7 percent to 5.8 percent over this period (and to 5.5 percent in 2015).
- Weighted by deck area, the share of bridges classified as structurally deficient improved, declining from 10.1 percent in 2004 to 7.1 percent in 2014. The deck area-weighted share of structurally deficient NHS bridges dropped from 8.9 percent to 6.0 percent over this period.
- While the percentage of poor bridges has declined over the last decade, the share of bridges classified as good has also gone down. Weighted by deck area, the share of bridges classified as good worsened, declining from 46.1 percent in 2004 to 44.7 percent in 2014 (before rebounding to 45.5 percent in 2015). The deck area-weighted share of good NHS bridges dropped from 43.8 percent to 42.2 percent over this period (rising to 43.0 percent in 2015).

## Operational Performance in Urbanized Areas Has Slowly Worsened

- The Texas Transportation Institute 2015 Urban Mobility Scorecard estimates that the average commuter in 471 urbanized areas experienced a total of 42 hours of delay resulting from congestion in 2014, up from 41 hours in 2004. Congestion delay was worse in the largest metro areas, for example averaging 82 hours in Washington D.C., 80 hours in Los Angeles/Long Beach, 78 hours in San Francisco/Oakland, and 74 hours in New York/Newark. Total delay experienced by all urbanized area travelers combined rose by 11.5 percent from 6.1 billion hours in 2004 to 6.8 billion hours in 2014, an all-time high.

### FHWA Bridge Classifications

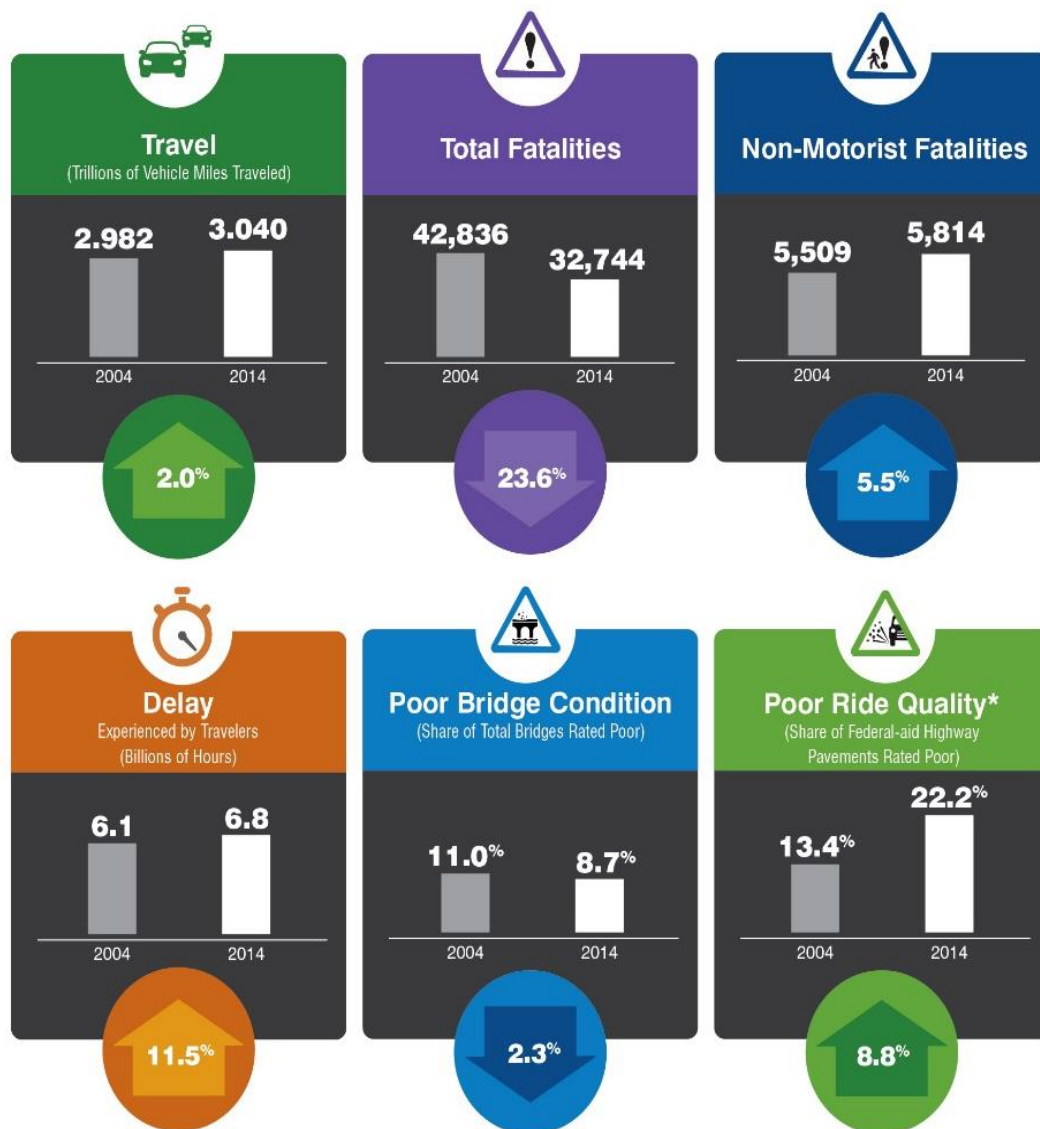
FHWA is currently transitioning to a new set of bridge condition descriptors. Bridges are given an overall rating of “poor” if the deck, substructure, or superstructure is found to be in poor condition due to deterioration or damage. The legacy term “structurally deficient” includes “poor” bridges as well as those failing other criteria, such as adequacy of the waterway opening under the bridge. The classification of a bridge as poor or structurally deficient does not mean it is unsafe.

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

Another legacy term is “functionally obsolete,” which relates to the geometric characteristics of a bridge (e.g., bridge width, load-carrying capacity, clearances, approach roadway alignment) in relation to current design standards. The magnitude of such deficiencies determines whether a bridge is classified as “functionally obsolete.” This metric is a legacy classification that was used to implement the Highway Bridge Program, which was discontinued as a separate program with the enactment of MAP-21. In the absence of a programmatic reason to collect the data necessary to support this classification, some of the data necessary to compute it are being removed from the National Bridge Inventory. Future editions of the C&P Report will not contain this information. This edition presents “functionally obsolete” as a measure of operational performance, rather than a measure of physical conditions.

- The combined cost of wasted time and wasted fuel caused by congestion in urbanized areas rose from an estimated \$136 billion in 2004 to \$160 billion in 2014. Although these costs had declined during the most recent recession, they now exceed their pre-recession peak.
- One indicator with more positive trends relates to bridge geometrics, which can influence operational performance. Based directly on bridge counts, the share of bridges classified as functionally obsolete declined from 15.2 percent in 2004 to 13.8 percent in 2014 (unchanged at 13.8 percent in 2015). Weighted by deck area, the share of bridges classified as functionally obsolete improved slightly, dropping from 20.5 percent in 2004 to 20.3 percent in 2014 (before rebounding to 20.5 percent in 2015). Functional obsolescence tends to be a more significant problem on larger bridges carrying more traffic.

## 2004–2014 Highway System Trends



\*Poor ride quality data are affected by changes in reporting instructions beginning in 2010. The share rated poor rose from 15.8 percent in 2008 to 20.0 percent in 2010.

## Highway Safety Improved Overall, but Nonmotorist Fatalities Rose

- The annual number of highway fatalities was reduced by 23.6 percent from 2004 to 2014, dropping from 42,836 to 32,744 (before rising to 35,485 in 2015 and 37,806 in 2016, then declining to 37,133 in 2017).
- From 2004 to 2014, the number of nonmotorists (pedestrians, bicyclists, etc.) killed by motor vehicles increased by 5.5 percent, from 5,509 to 5,814 (17.8 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 19.6-percent increase through 2014. (Nonmotorist fatalities rose to 6,556 in 2015 and 7,193 in 2016 before declining to 6,988 in 2017).
- Fatalities related to roadway departure decreased by 24.8 percent from 2004 to 2014, but roadway departure remains a factor in over half (54.4 percent) of all highway fatalities. Intersection-related fatalities decreased by 17.0 percent from 2004 to 2014, but over one-fourth (26.5 percent) of highway fatalities in 2014 occurred at intersections.
- The fatality rate per 100 million VMT declined from 1.45 in 2004 to an all-time low of 1.08 in 2014 (before rising to 1.15 in 2015 and 1.19 in 2016, then declining to 1.16 in 2017).
- The number of traffic-related injuries decreased by 18.8 percent, from 2.7 million in 2004 to 2.2 million in 2014. The injury rate per 100 million VMT declined from 90 in 2004 to 71 in 2014.

## Future Capital Investment Scenarios

The scenarios that follow pertain to spending by all levels of government combined for the 20-year period from 2014 to 2034 (reflecting the impacts of spending from 2015 through 2034); the funding levels associated with all of these analyses are stated in constant 2014 dollars. The results below 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.

### 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 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. In 2014, 13.5 percent of highway capital spending was used for system enhancements (safety enhancements, traffic control facilities, and environmental enhancements) that neither model analyzes directly. An additional 15.8 percent was used in 2014 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 29.3 percent; each scenario for the overall road system was scaled up so that nonmodeled investment would comprise this share of its total investment level.

## 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 2014 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).

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 there is an existing backlog of cost-beneficial investments that have 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.





### Sustain 2014 Spending Scenario

- The Sustain 2014 Spending scenario assumes that capital spending by all levels of government is sustained in constant-dollar terms at the 2014 level (\$105.4 billion systemwide) through 2034. It also assumes that spending would be directed toward projects with the largest benefit-cost ratios. At this level of capital investment, average pavement roughness on Federal-aid highways would be projected to improve by 0.3 percent, while the share of bridges classified as poor would be projected to improve, declining from 6.8 percent in 2014 to 4.7 percent in 2034. Average delay per VMT would be projected to improve by 18.5 percent, as travel growth gradually slows over time and various highway management and operational strategies are adopted more broadly.

### Maintain Conditions and Performance Scenario

- The Maintain Conditions and Performance scenario seeks to identify a level of capital investment at which selected measures of future conditions and performance in 2034 are maintained at 2014 levels. It also assumes that spending would be directed toward projects with the largest benefit-cost ratios. The average annual level of investment associated with this scenario is \$102.4 billion, 2.9 percent less than actual highway capital spending by all levels of government in 2014.
- Under this scenario, \$66.5 billion per year would be directed to system rehabilitation, \$22.1 billion to system expansion, and 13.8 billion to system enhancement. Average pavement roughness on Federal-aid highways and the share of bridges classified as poor in 2034 would match their 2014 levels. Average delay per VMT would be projected to improve by 18.4 percent, as travel growth gradually slows over time and various highway management and operational strategies are adopted more broadly.

# 2014–2034 Future Highway Capital Investment Scenarios

	 <b>AVERAGE ANNUAL INVESTMENT*</b>	 <b>AVERAGE DELAY PER VMT</b>	 <b>AVERAGE PAVEMENT ROUGHNESS</b>	 <b>SHARE OF DECK AREA ON POOR BRIDGES</b>
<b>Maintain</b> Conditions and Performance at 2014 Levels	<b>\$102.4</b>	REDUCE BY <b>18.4%</b>	NO CHANGE <b>0.0%</b>	NO CHANGE <b>6.8%</b>
<b>Sustain</b> Spending at 2014 Level, Adjusted for Inflation	<b>\$105.4</b>	REDUCE BY <b>18.5%</b>	REDUCE BY <b>0.3%</b>	REDUCE TO <b>4.7%</b>
<b>Improve</b> Conditions and Performance (BCR 1.0 or Higher)	<b>\$135.7</b>	REDUCE BY <b>19.3%</b>	REDUCE BY <b>5.6%</b>	REDUCE TO <b>0.6%</b>

\*Billions of 2014 dollars. Includes all public and private investment.

29.3 percent of each scenario (including \$39.8 percent of the Improve scenario) is derived from non-modelled estimates for which the BCR is not known.

## 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 \$135.7 billion, 28.8 percent higher than actual 2014 capital spending.
- Approximately 29 percent of the investment under the Improve Conditions and Performance scenario would go toward addressing an existing backlog of cost-beneficial investments of \$786.4 billion. The rest would address new needs arising from 2015 through 2034.
- 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 \$88.4 billion, 65.1 percent of the \$135.7 billion cost of the overall scenario. The scenario also includes average annual spending of \$29.1 billion (21.4 percent) directed toward system expansion, and \$18.3 billion (13.5 percent) directed toward system enhancement.
- An estimated \$39.8 billion of the spending in this scenario is not constrained by benefit-cost analysis because it is outside the scope of the models. The amount of such “nonmodeled” spending included in this scenario’s estimate is equal to the share of capital spending in 2014 that was outside the scope of the

models. Such spending is for system enhancement projects on all public roads, and pavement rehabilitation and capacity expansion projects on non-Federal aid highways.

- Under the Improve Conditions and Performance scenario, average pavement roughness on Federal-aid highways would be projected to improve by 5.6 percent, while the share of bridges classified as poor would be projected to improve, declining from 6.8 percent in 2014 to 0.6 percent in 2034. This scenario would not eliminate all poor pavements and bridges because, while in some cases it is cost-beneficial to proactively improve assets before they become poor, in other cases it only becomes cost-beneficial to improve assets after they have declined into poor condition. Therefore, at the end of any given year, some portion of the pavement and bridge population would remain deficient.

## Highlights: Transit

### Extent of the System

- Of the transit agencies that submitted data to the National Transit Database (NTD) in 2014, 849 provided service primarily to urbanized areas and 1,684 provided service to rural areas. Urban and rural agencies operated 1,267 bus systems, 1,858 demand-response systems, 15 heavy rail systems, 29 commuter rail systems, 33 light rail and streetcar systems, 25 streetcar systems, and 5 hybrid rail systems. There were also 98 transit vanpool systems, 29 ferryboat systems, 5 trolleybus systems, 6 monorail and automated guideway systems, 3 inclined plane systems, 1 cable car system, 2 tramway systems, and 1 público. (Público is a mode that exists only in Puerto Rico but has the same operating characteristics as Jitney. These modes operate on fixed routes but with no fixed schedules.)
- Transit operators reported 10.6 billion unlinked passenger trips on 4.6 billion vehicle revenue miles in 2014.

### Bus, Rail, and Demand Response: Transit Modes

Public transportation is provided by several different types of vehicles that are used in different operational *modes*. The most common is *fixed-route bus* service, which uses different sizes of rubber-tired buses that run on scheduled routes. *Commuter bus* service is similar, but uses over-the-road buses and runs longer distances between stops. *Bus rapid transit* is high-frequency bus service that emulates 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), which is primarily characterized by third-rail electric power and exclusive dedicated guideway. Extended urban areas may have *commuter rail*, which often shares track with freight trains and often uses overhead electric power (but may also use diesel power or third rail). *Light rail* systems are common in large-and medium-sized urban areas; they feature overhead electric power and run on track that is entirely or in part on city streets that are shared 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 or 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 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.

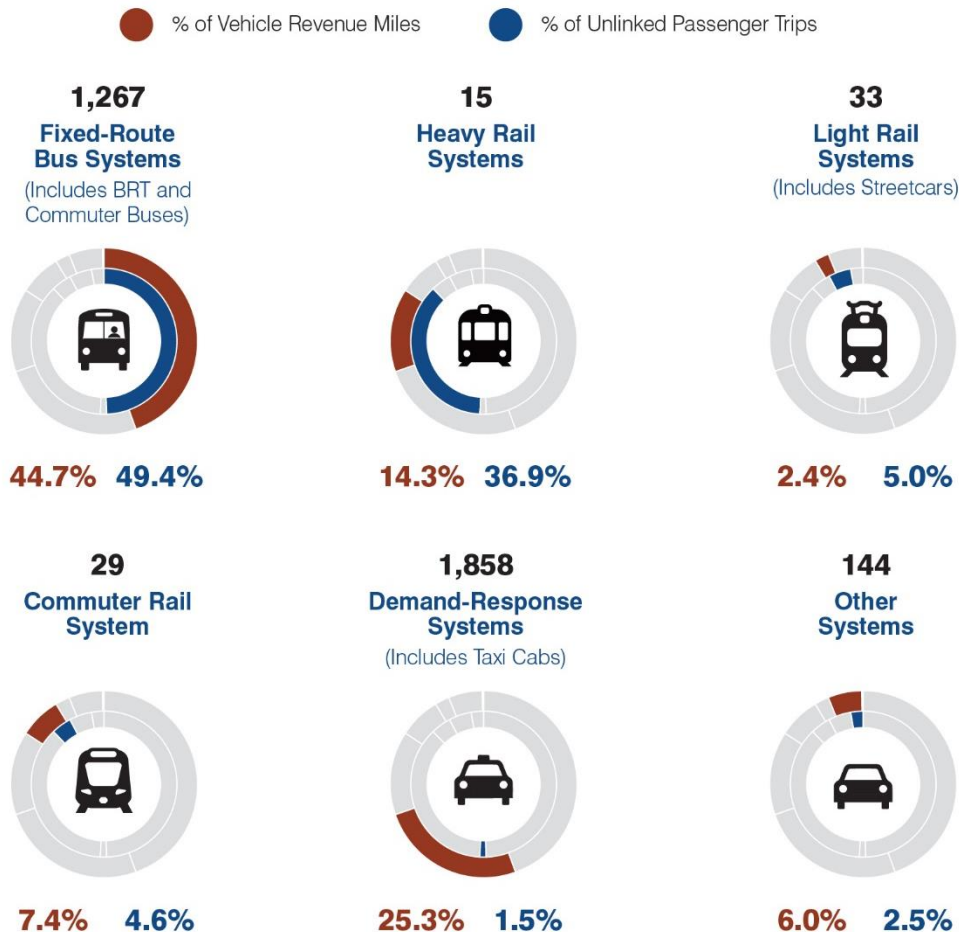
*Demand-response* transit service is usually provided by vans, taxicabs, or small buses that are dispatched to pick up passengers upon request. This mode is mostly used to provide paratransit service as required by the Americans with Disabilities Act. These vehicles do not follow a fixed schedule or route.

- Bus and heavy rail modes continue to be the largest segments of the industry, serving 48 percent and 37 percent of all transit trips, respectively. Commuter rail supports a relatively high share of passenger miles (20.5 percent). Light rail is the fastest-growing rail mode (with passenger miles growing at 4.7 percent per year between 2004 and 2014), but it still provides only 4.4 percent of transit passenger miles. Vanpool growth during that period was 11.1 percent per year, but with vanpools still accounting for only 2.3 percent of all transit passenger miles.

## 2014 Extent of the Transit System



### Transit Systems Operated in the United States





## Spending on the System

- All levels of government spent a combined \$65.2 billion to provide public transportation and maintain transit infrastructure. Of this total, 29 percent was system-generated revenue, of which most came from passenger fares. Eighteen percent of revenues came from the Federal government while the remaining funds came from State and local sources.
- Of the combined \$65.2 billion spent on public transportation, public transit agencies spent \$17.7 billion on capital investments in 2014. Regularly authorized and appropriated Federal funding made up 39.5 percent of these capital expenditures. Funds from the Federal American Recovery and Reinvestment Act provided another 2.5 percent.
- Federal funding is targeted primarily for capital assistance, although Federal funding for operating expenses at public transportation agencies increased from 30 percent of all Federal funding in 2004 to 36 percent in 2014. Virtually all of the increase is due to increased use of “preventive maintenance” eligible for reimbursement from 5307 grant funds.
- From 2004 to 2014, the urban systems’ total fares per revenue mile increased by 1.6 percent and operating costs per mile increased by 32 percent over the same period in 2014 constant dollars. The average fare box recovery ratio decreased from 36.2 percent to 35 percent. For the Nation’s 10 largest transit agencies, which account for majority of the transit ridership, average fares per mile increased by 18 percent in constant-dollar terms from 2004 to 2014, while average constant-dollar operating costs per mile increased by 23.3 percent. This resulted in a decline in the average fare recovery ratio (the percentage of operating costs covered by passenger fares) from 45 percent in 2004 to 43 percent in 2014.

### 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. UZAs in this report were defined by the 2010 census. Each UZA has a designated recipient, usually a metropolitan planning organization (MPO) or large transit agency, which then sub-allocates FTA funds in its area according to local policy. The designated recipient may then allow these organizations to apply directly for a grant with FTA as a designated recipient. 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 in a grant, all funds then become available, on a reimbursement basis.

## Conditions and Performance of the System

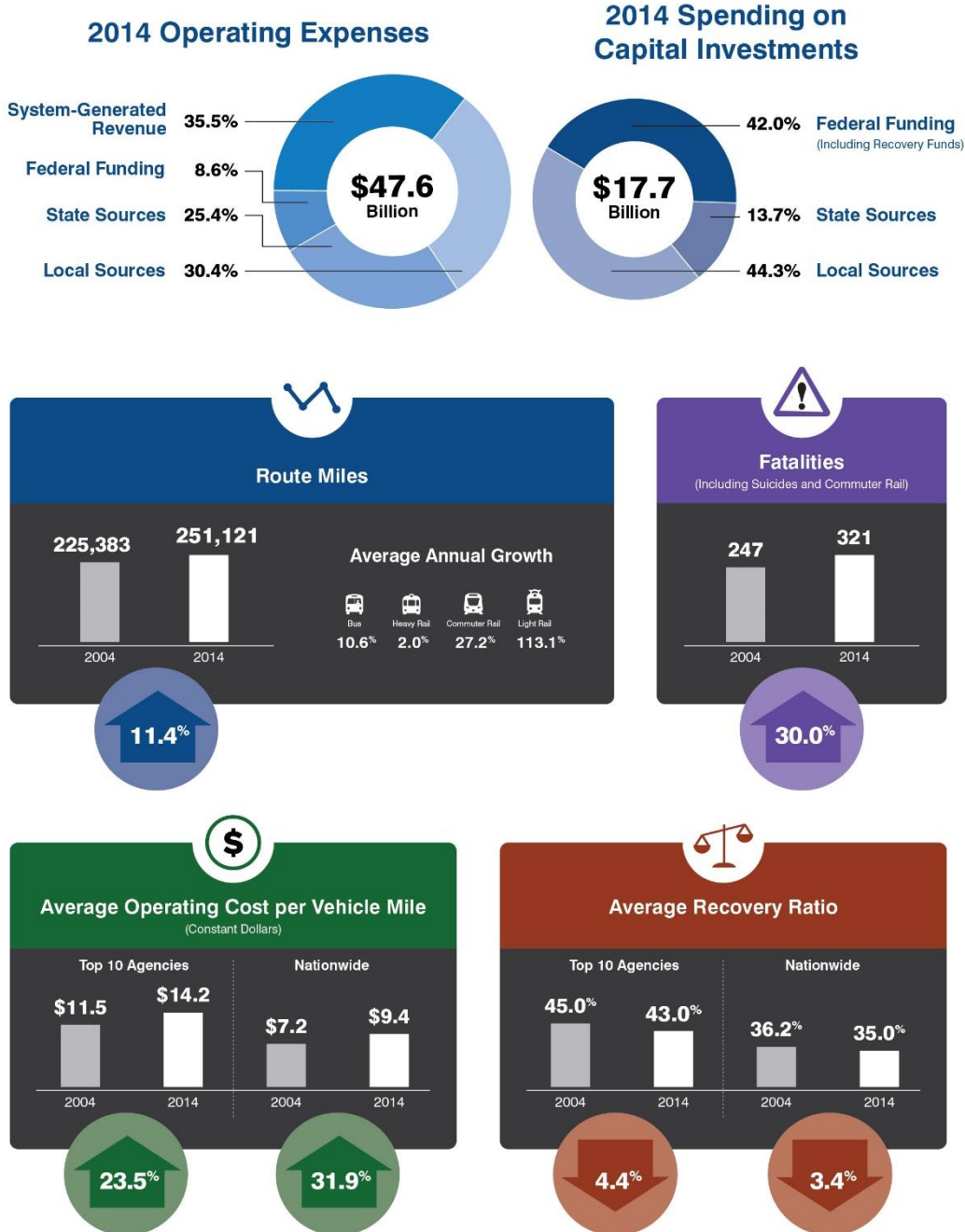
### Some Aspects of System Performance Have Improved

- Between 2004 and 2014, the service offered by transit agencies grew substantially. The annual rate of growth in route miles 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.
- Between 2004 and 2014, the number of annual service miles per vehicle (vehicle productivity) remained unchanged and the average number of miles between breakdowns (mean distance between failures) decreased by 9 percent.
- Growth in service offered was nearly in accordance with growth in service consumed. Despite steady growth in route miles and revenue miles, average vehicle occupancy levels did not decrease. Passenger miles traveled grew at a 2.0 percent annual pace while 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 success.

Fatalities Increased Due to an Increase in Suicides

- The number of fatalities on transit systems in the United States increased steadily between 2004 and 2011, from 250 fatalities in 2004 to 300 fatalities in 2011. This number increased to around 350 per year in 2012 and 2013, declining to 321 in 2014. In 2014, one in four transit-related fatalities was classified as a suicide (excluding commuter rail). In 2004, the rate was just one in 10. The rate of suicides in transit facilities has gone up every year since 2005.

## 2004–2014 Transit Trends



### Unlinked Passenger Trips, Passenger Miles, Route Miles, and Revenue Miles

*Unlinked passenger trips* (UPT), also called boardings, count every time a person gets on an in-service transit vehicle. Each transfer to a new vehicle or route is considered another unlinked trip, so a person's commute to work may count as more than one trip if that person transferred between routes.

*Passenger miles traveled* (PMT) simply count how many miles people travel on transit. UPT and PMT are both commonly used measures of transit *service consumed*.

*Directional route miles* (DRM) measure the number of miles of transit route available to customers. They are directional because each direction counts separately; thus, a one-mile-out and one-mile-back bus route would be two DRM. *Vehicle Revenue Miles* (VRM) count the miles of revenue service provided by transit operators over their networks.

## Future Capital Investment Scenarios – Systemwide

As in the highway discussion, the transit investment scenarios that follow pertain to spending by all levels of government combined for the 20-year period from 2014 to 2034 (reflecting the impacts of spending from 2015 through 2035); the funding levels associated with all of these analyses are stated in constant 2014 dollars. These transit scenarios also assume an immediate jump to a higher (or lower) investment level that is maintained in constant-dollar terms throughout the analysis period.

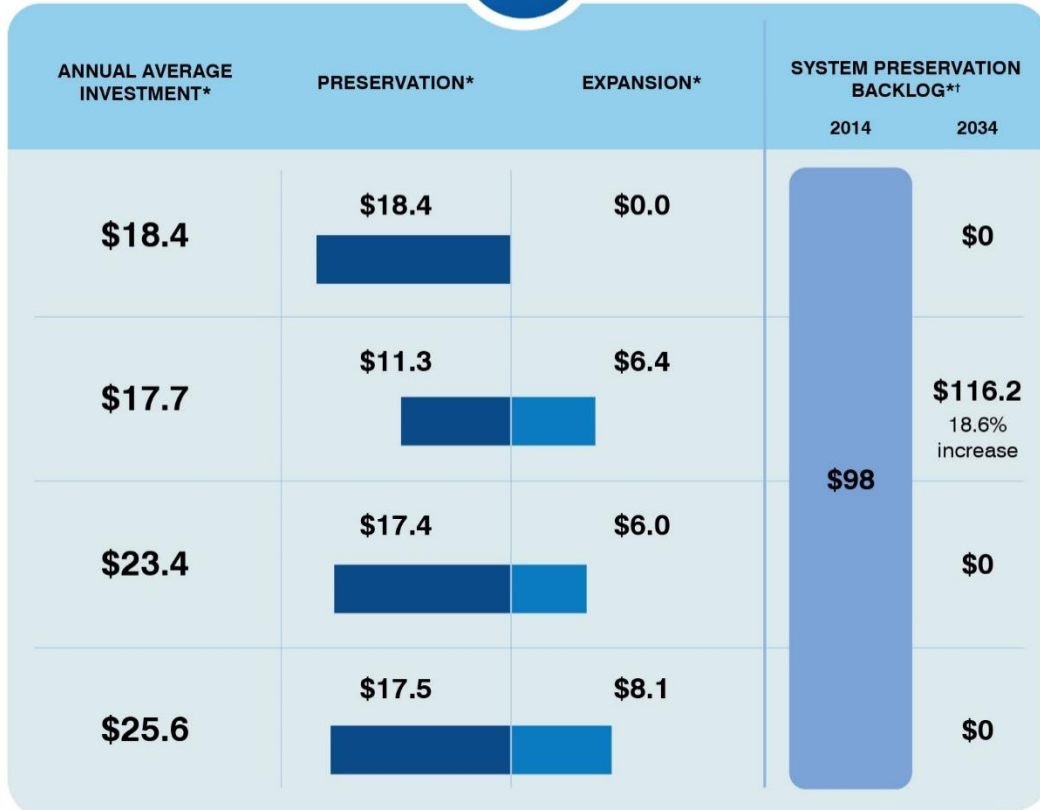
Included in this section for comparison purposes is an assessment of the investment level needed to replace all assets that are currently past their useful life or that will reach that state over the forecast period. This level of investment would be necessary to achieve and maintain a state of good 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 investment requirements. All 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 useful 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 are assumed to 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. 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.

## 2014–2034 Future Transit Capital Investment Scenarios



\*Billions of 2014 dollars

\*\*The Low-Growth and High-Growth scenarios in this report are based on 15-year ridership trends as of 2014, the cut-off year for this report. The Department does note that transit ridership has, in fact, not increased since 2014 through the early months of 2019. The causes of the decreased transit ridership since 2014 will be analyzed in the next edition of this report. The ridership trends since that time will also be incorporated into the capital investment needs forecasts presented in future editions of this report.

†Spending level of \$18.4 billion under the SGR scenario can clear the backlog by 2034, but the Sustain Spending scenario at current funding level of \$17.7 billion will add significantly to the backlog. This is due to the fact that under the Sustain Spending scenario, investments are made for expansion as well as preservation.

### Sustain 2014 Spending Scenario

- The **Sustain 2014 Spending scenario** assumes that capital spending by all levels of government is sustained in constant-dollar terms at the 2014 level (\$17.7 billion systemwide), including Recovery Act funds, through 2034. Assuming that the current split between expansion and preservation investments is maintained, this will allow for enough expansion to meet the national trend growth for the period 2004–2014 at 1.5 percent annual average increase, but will fall short of meeting system preservation needs. By 2034, this scenario will result in roughly \$116.2 billion in deferred system preservation projects. If Recovery Act funds are not included in the baseline spending, the baseline spending would fall to \$17.3 billion annually, with the deferred system preservation needs at approximately \$117.2 billion.

### Low-Growth Scenario

- The **Low-Growth scenario** assumes that transit ridership will grow at an average annual rate of 1.2 percent between 2014 and 2034. During that period, it also eliminates the current **\$98.0 billion** system preservation backlog. The annualized cost of this scenario is **\$23.4 billion**.

### High-Growth Scenario

- The **High-Growth scenario** assumes that transit ridership will grow at an annual rate of 1.8 percent between 2014 and 2034. It also eliminates the current **\$98.0 billion** system preservation backlog. The annualized cost of this scenario is **\$25.6 billion**.

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# 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, *Assets*, describes the existing extent of the highways, bridges, and transit systems. Highway and bridge data are presented for system subsets based on functional classification and Federal system designation, while transit data are presented for different types of modes and assets.
- Chapter 2, *Funding*, provides detailed data on the revenue collected and expended by different levels of governments to fund transportation construction and operations. The chapter also explores alternative financing and delivery of transportation projects.
- Chapter 3, *Travel*, discusses vehicle miles traveled and passenger miles traveled on highways and transit, drivers' licensing levels, and commute times. The chapter also analyzes the impact of income levels on travel.
- Chapter 4, *Mobility and Access*, covers highway congestion and reliability in the Nation's urban areas, and the economic costs of congestion. The transit section explores ridership, average speed, vehicle utilization, and maintenance reliability. The chapter also looks at accessibility to transit for persons with disabilities and the elderly, as well as transit accessibility more generally.
- Chapter 5, *Safety*, presents statistics on highway safety performance, focusing on the most common roadway factors that contribute to roadway 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

A key change under the Moving Ahead for Progress in the 21 Century Act (MAP-21), and the Fixing America's Surface Transportation (FAST) Act, is the transition to a performance- and outcome-based program. Performance measures will be established through rulemakings; grant recipients will set performance targets based on these measures, and will periodically report on their progress toward meeting these targets. FHWA has finalized six related rulemakings to implement the transportation performance management (TPM) framework established by MAP-21 and the FAST Act:

- Statewide and Metropolitan/Nonmetropolitan Planning Rule (defines coordination in the selection of targets, linking planning and programming to performance targets).
- Safety Performance Measures Rule (PM-1) (establishes performance measures to assess fatalities and 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 minimum condition standards).
- Asset Management Plan Rule (defines the contents and development process for an asset management plan).
- System Performance Measures Rule (PM-3) (includes measures for performance, freight movement, and the Congestion Mitigation and Air Quality program).

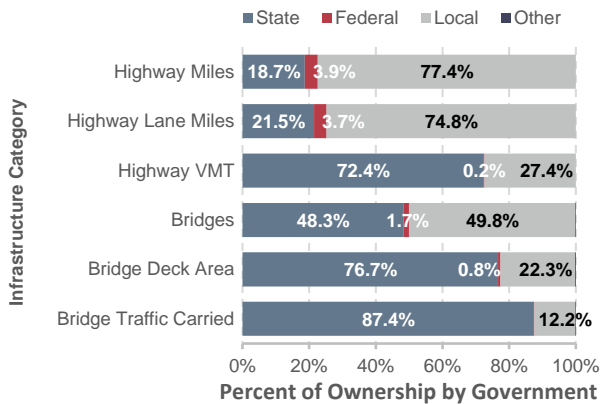
# Executive Summary

## CHAPTER 1: System Assets – Highways

In 2014, local governments owned 77.4 percent of the Nation’s 4,177,074 miles and 74.8 percent of its 8,766,049 lane miles. However, State-owned roads carried a disproportionate share of the Nation’s travel, accounting for 72.4 percent of the 3.040 trillion vehicle miles traveled (VMT) in 2014.

Ownership of bridges is more evenly split, as local governments owned slightly more (49.8 percent) of the Nation’s 610,749 bridges in 2015 than did State governments (48.3 percent). Although the Federal government provides significant financial support for the Nation’s highways and bridges, it owns relatively few of these facilities.

Highway (2014) and Bridge (2015) Ownership by Level of Government



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 the system, while collectors funnel traffic from local roads to arterials.

Nearly half the Nation’s road mileage was classified as rural local in 2014, part of the 71.2 percent of mileage located in rural areas. Although only 28.8 percent of the road mileage is located in urban areas, these roads carry 69.7 percent of VMT.

Highway Extent and Travel By Functional System, 2014

Functional System	Highway Miles	Highway VMT
<b>Rural Areas (4,999 or less in population)</b>		
Interstate	0.7%	7.6%
Other Freeway and Expressway	0.1%	0.9%
Other Principal Arterial	2.2%	6.2%
Minor Arterial	3.2%	4.6%
Major Collector	9.8%	5.2%
Minor Collector	6.2%	1.6%
Local	49.1%	4.1%
<b>Subtotal Rural Areas</b>	<b>71.2%</b>	<b>30.3%</b>
<b>Urban Areas (5,000 or more in population)</b>		
Interstate	0.4%	17.3%
Other Freeway and Expressway	0.3%	7.5%
Other Principal Arterial	1.6%	15.5%
Minor Arterial	2.7%	12.9%
Major Collector	3.1%	6.4%
Minor Collector	0.3%	0.4%
Local	20.4%	9.7%
<b>Subtotal Urban Areas</b>	<b>28.8%</b>	<b>69.7%</b>
<b>Total</b>	<b>100.0%</b>	<b>100.0%</b>

Sources: HPMS and NBI.

In general, public roads that are functionally classified as arterials, urban collectors, or rural major collectors 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 connect principal arterials to other transportation modes and defense installations.



# Executive Summary

## CHAPTER 1: System Assets – Transit

Most transit systems in the United States report to the National Transit Database (NTD). In 2014, 849 systems served 497 urbanized areas, which have populations greater than 50,000. In rural areas, 1,684 systems were operating. Thus, the total number of transit systems reporting to NTD in 2014 was 2,533.

**Modes.** Transit is provided through nine 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, commuter bus, bus rapid transit, demand response, vanpools, other less common rubber-tire modes, ferryboats, and aerial tramways. This edition of the C&P Report includes one new mode: aerial tramway.

**Organization Structure of Urban and Rural Agencies.** Nearly 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 24 percent. Eighteen percent are private operators, and the remaining 13 percent are other organizational structures such as state governments, area agencies on aging, MPOs, planning agencies, tribes, and universities.

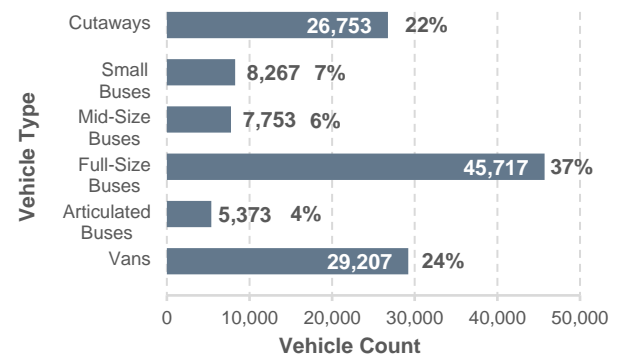
### National Transit Assets

- Of the 849 urban reporters, 428 were cities, counties, and local government transportation units.
- Of the 169,197 transit vehicles in urban and rural areas, most are nonrail vehicles (buses, demand response, and vanpool), while most rail vehicles are either heavy, commuter, or light rail passenger cars.
- Rail systems operate on 12,793 miles of track, of which 7,760 miles are for commuter rail. Bus

systems operate over 237,654 directional route miles.

- Urban and rural areas have 5,264 stations, of which 1,245 are for commuter rail, and 2,451 maintenance facilities.
- Full-size 40-foot buses (seating 45 people) are the most common road vehicle in transit, accounting for 37 percent of the national road fleet. Full- and mid-size buses are used primarily as fixed-route bus service. Small buses (seating 25 people) and cutaways (seating 15 people) are split between low-demand fixed-route systems and demand response. Vans are used mostly as vanpools and demand response.

Composition of Transit Road Vehicle Fleet, 2014



Note: There is not a one-to-one map between modes and vehicle types. For instance, cutaways are used for both fixed-route bus and demand response.

Source: Transit Economic Requirements Model (TERM) and National Transit Database.

**ADA Compliance.** The Americans with Disabilities Act of 1990 (ADA) prohibits discrimination and ensures equal opportunity and access for persons with disabilities. ADA requires transit agencies to ensure that vehicles and facilities are accessible to and usable by persons with disabilities, including wheelchair users. The level of accessibility is high for the national fleet, but lower for older heavy-rail systems built before the enactment of ADA.

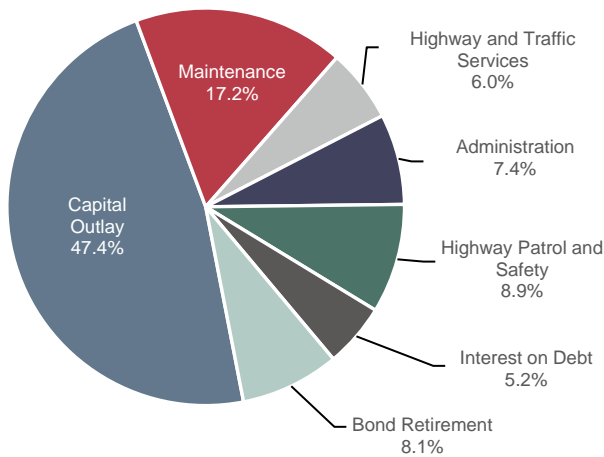
# Executive Summary

## CHAPTER 2: Funding – Highways

Combined expenditures for highways by all levels of government totaled \$222.6 billion in 2014, with the Federal government funding \$47.3 billion, States \$111.2 billion, and local governments \$64.1 billion. Most of the Federal funding was in the form of grants to State and local governments; direct Federal expenditures for federally owned roads, highway research, and program administration totaled \$3.2 billion.

Highway capital spending totaled \$105.4 billion, or 47.4 percent of total highway spending in 2014. Spending on maintenance totaled \$38.2 billion, \$13.2 billion was for highway and traffic services, \$16.4 billion was for administrative costs (including planning and research), \$19.8 billion was spent on highway patrol and safety, \$11.5 billion was for interest on debt, and \$17.9 billion was used to retire debt.

Highway Expenditure by Type, 2014



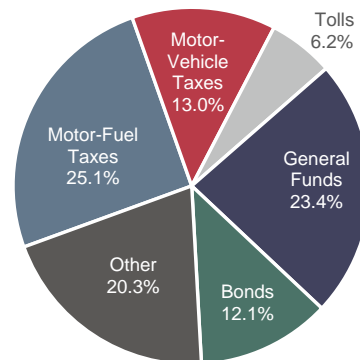
Sources: Highway Statistics 2015, Table HF-10A (preliminary), and unpublished FHWA data.

Total highway spending increased by 50.9 percent from 2004 to 2014, averaging 4.2 percent per year. (In inflation-adjusted constant-dollar terms,

highway spending grew by 0.9 percent per year.) Expenditures funded by local governments grew by 4.4 percent per year, outpacing annual increases at the State and Federal levels of 4.3 percent and 3.6 percent, respectively. Over this period, the share of total highway expenditures funded by the Federal government dropped from 22.4 percent to 21.2 percent, while the federally funded share of highway capital spending declined from 43.8 percent to 42.5 percent.

Combined revenues generated for use on highways by all levels of government totaled \$241.1 billion in 2014 (the \$18.6 billion difference between expenditures and receipts is the amount placed in reserves for future use). In 2014, \$106.4 billion (44.1 percent) of total highway revenues came from highway user charges, including motor-fuel taxes, motor-vehicle fees, and tolls. Other major sources for highways included general fund appropriations of \$56.5 billion (23.4 percent) and bond proceeds of \$29.2 billion (12.1 percent). All other sources, such as property taxes, other taxes and fees, investment income, and other receipts, totaled \$49.0 billion (20.3 percent).

Revenue Sources for Highways, 2014



Sources: Highway Statistics 2015, Table HF-10A (preliminary), and unpublished FHWA data.

# Executive Summary

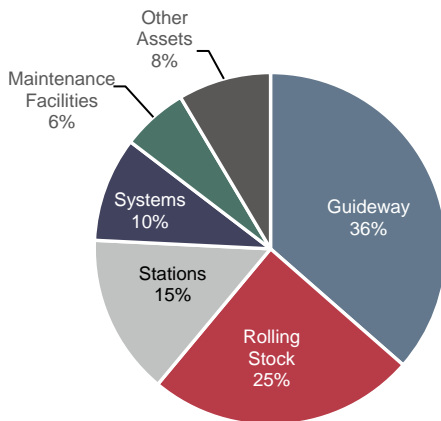
## CHAPTER 2: Funding – Transit

In 2014, \$65.2 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 2014, **71 percent came from public sources and 29 percent came from system-generated funds** (passenger fares and other system-generated revenue sources). The Federal share was \$11.6 billion (25 percent of total public funding and 17.7 percent of all funding).

In 2014, operating expenses consumed \$47.5 billion (73 percent) of all funding devoted to transit (\$65.2 billion).

**Guideway assets use the largest share of capital—36 percent (\$6.4 billion)—for expansion and rehabilitation projects.**

Urban Capital Expenditure by Asset Category, 2014

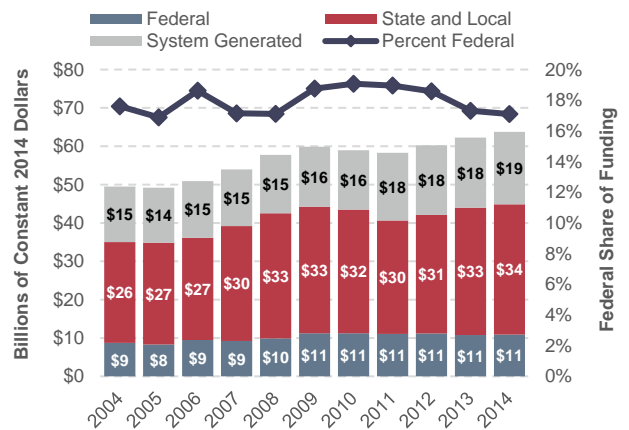


Source: National Transit Database.

**Between 2004 and 2014, all sources of public funding for transit increased by over 2.5 percent per year.**

**The Federal share remained relatively stable, varying in the range of 16–20 percent.**

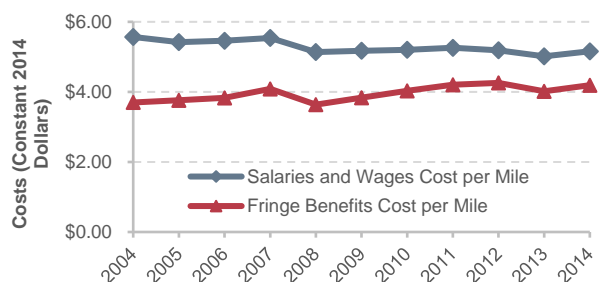
Funding for Urban Transit by Government Jurisdiction, 2004–2014



Source: National Transit Database.

**From 2004 to 2014, 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, fringe benefits increased at an annual compound average rate of 1.3 percent. Meanwhile, salaries and wages decreased by nearly 1 percent.

Salaries and Wages and Fringe Benefits, Average Cost per Mile—Top 10 Transit Agencies, 2004–2014



Source: National Transit Database.

# Executive Summary

## CHAPTER 3: Travel – National and Household Trends

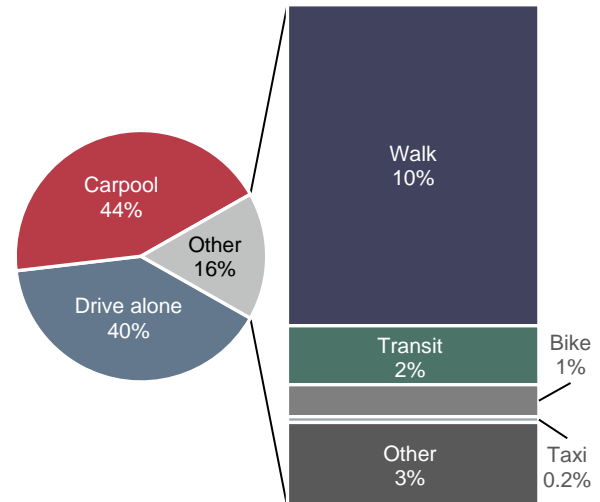
Total VMT on the Nation’s roads has rebounded from declines during and following the 2008–2009 recession, rising back above previous levels. Total VMT in 2014 was 3.03 trillion miles, dominated by passenger vehicles (81.4 percent) and personal purposes (81.7 percent). Approximately 90 percent of 2014 VMT was in light-duty vehicles (passenger cars, light trucks, vans, and sport utility vehicles).

Nationally, transit passenger miles traveled (PMT) reached 55.7 billion in 2014, as unlinked passenger trips (each journey on one transit vehicle) totaled 10.5 billion. Average passenger trip length increased from 4.8 miles in 1991 to 5.4 miles in 2014, as growth in PMT (2.1 percent annually) outpaced growth in unlinked passenger trips (1.7 percent).

The share of licensed drivers in the total population grew steadily from 1960 to 1990, and subsequently stabilized at about 70 percent. In 1960, drivers had very limited options in terms of which household vehicle to drive, because there were fewer automobiles than licensed drivers (the vehicle-to-driver ratio was below 1.0). The situation has reversed since 1980, with the average ratio of vehicles per licensed driver remaining close to 1.2, indicating on average more than one vehicle available per licensed driver.

Choice of travel modes is critical in understanding household travel behavior, which has great implications for transportation policy design. The 2009 National Household Travel Survey showed Americans took 191 billion person trips for all purposes. Driving was the dominant mode of household travel. Multi-occupant vehicles (carpools) accounted for 44 percent of all person trips, followed by single-occupant vehicles (40 percent), walking (10 percent), transit (2 percent) and bicycling (1 percent).

Person Trips By Transportation Modes, 2009



Source: National Household Travel Survey 2009.

Commuting was responsible for 28 percent of total personal VMT in 2009. The 2009 American Community Survey showed that approximately 86 percent of commuting trips were made in private vehicles for commuting (76 percent driving alone, 10 percent carpool). About 5 percent of workers traveled to work using transit, 2.9 percent walked, and 4.3 percent of workers teleworked from home.

Examined over a longer period, the share of workers driving alone was relatively constant at 76 to 77 percent from 2005 to 2014, while carpooling became less popular as its share slipped from 10.7 percent to 9.2 percent. The proportion of teleworkers expanded from 3.6 percent to 4.5 percent over the same period. The share of workers using transit rose from 4.7 percent to 5.2 percent from 2005 to 2014 (subsequently declining to 5.0 percent in 2017). Workers who commute by walking or biking are still a small part of the entire commuting labor force, and their mode shares barely changed.

# Executive Summary

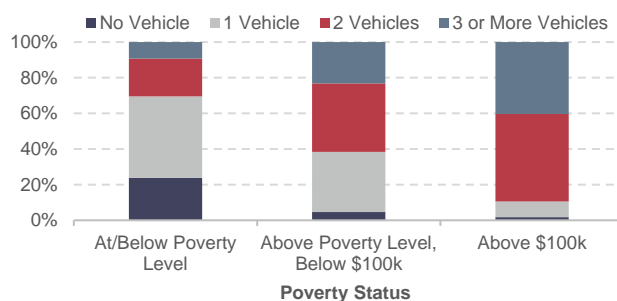
## CHAPTER 3: Travel – Impact of Income Distribution

Household income is a crucial factor in determining travel behavior. Only 74 percent of low-income households used a private vehicle in 2009, compared with 86 percent of households with incomes above poverty level. Walking accounted for a higher share of total personal trips among low-income households.

The average number of vehicles that households could access increased marginally from 1.66 in 2000 to 1.68 in 2014, while the total number of vehicles in the country went up from 174 million to 197 million.

Around 24 percent of households at or below poverty level in 2009 had no vehicle. The share of households without a vehicle was below 5 percent for households whose annual income was above poverty level but below \$100,000, and less than 2 percent for households with annual income above \$100,000.

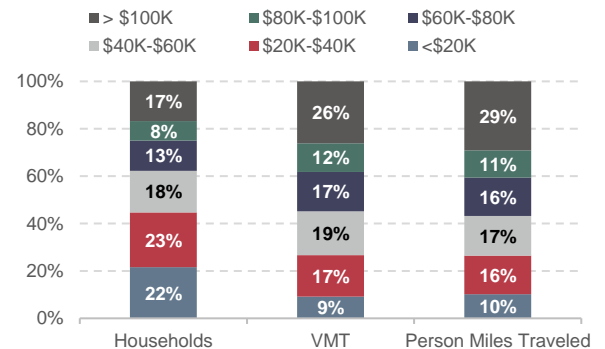
### Household Vehicle Access by Poverty Status, 2009



Source: National Household Travel Survey 2009.

Higher-income households benefited more from highway access compared with their lower-income counterparts. The 17 percent of households with an income above \$100,000 owned more vehicles, drove further, and represented a larger proportion of national vehicle miles and person miles of travel than any other income class.

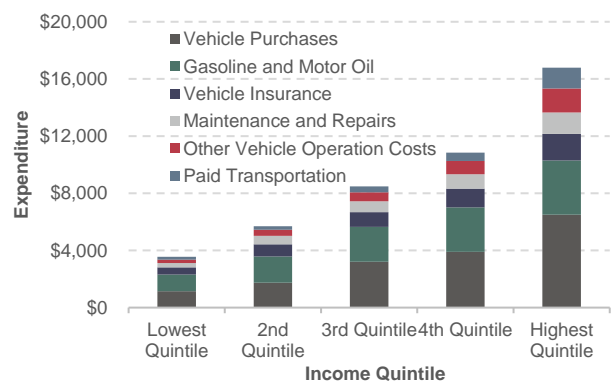
### Distribution of Households, VMT, and Person Miles Traveled by Income, 2009



Source: National Household Travel Survey 2009.

The average American household spent \$9,073 on transportation in 2014, about 17 percent of total household expenditures. The average annual transportation expenditure for households with the highest 20 percent of income was \$16,788 in 2014, 4.7 times the amount spent by households with the lowest 20 percent of income (\$3,555). High-income households tended to spend a higher proportion on paid transportation such as intercity travel than did low-income households.

### Average Transportation Expenditure by Income Quintile, 2014



Source: Consumer Expenditure Survey 2014.

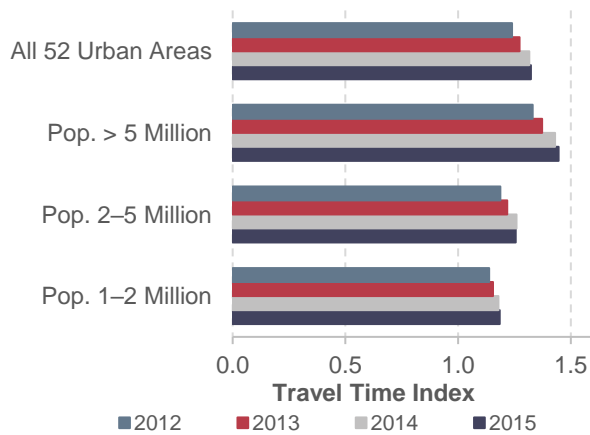
# Executive Summary

## CHAPTER 4: Mobility and Access – Highways

Based on the National Performance Management Research Data Set (NPMRDS), the Travel Time Index (TTI) was 1.32 in 2015 for Interstate highways in the 52 largest metropolitan areas, meaning that the average peak-period trip took 32 percent longer than the same trip under free-flow traffic conditions. The TTI value for 2012 (the first year data are available) was only 1.24, indicating that travel time delays increased from 2012 to 2015.

Among these 52 areas, larger areas experienced more severe congestion during this period. The 2015 TTI values were 1.45, 1.26, and 1.18 for areas with population greater than 5 million, between 2 to 5 million, and between 1 and 2 million, respectively.

Travel Time Index for Interstate Highways in the 52 Largest Metropolitan Areas, 2012–2015



Source: FHWA staff calculation from the NPMRDS.

The average number of hours per weekday that Interstate highways are congested also varies by size of area among these 52 metropolitan areas. Congested hours per weekday totaled 7.3, 4.3, and 3.3 for areas with population greater than 5 million, between 2 to 5 million, and between 1 and 2 million, respectively.

The Planning Time Index (PTI) is a measure of travel time reliability, capturing the amount of time drivers would need to plan for to ensure on-time arrival 95 percent of the time. In 2015, the average PTI of Interstate highways in the 52 largest metropolitan areas was 2.52, meaning that drivers making a trip would need to leave early enough each day to account for it taking 2.52 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. For example, if an Interstate trip takes 30 minutes on average, a traveler would need to plan for it by taking 75 minutes each time in order to arrive on time 19 out of 20 trips.

Travel delays and reliability for these 52 areas vary over the course of a year. For each year from 2012 to 2015, the TTI on Interstate highways dropped to a lower level in July then quickly rose to the highest monthly value in October, then dropped again in the last two months of the year. The PTI reached its lowest point in July or August, then moved up. Interstate highways usually experienced longer periods of congestion in winter and shorter periods in warmer months.

The NPMRDS also captures data on other freeways and expressways not on the Interstate System, dating back to 2013. Among the 52 largest metropolitan areas, average congestion and reliability for these routes appear worse than on Interstate highways, resulting in higher TTI and PTI values. The TTI for other freeways and expressways was 1.37 in 2015, while the PTI was 2.98.

The Texas Transportation Institute's 2015 Urban Mobility Scorecard indicates that congestion in the Nation's 471 urbanized areas added 6.8 billion hours to travelers' time in 2014, and the total cost of this congestion was \$160 billion. The annual average delay per commuter in these areas was 42 hours in 2014, up from 41 hours in 2004.

# Executive Summary

## CHAPTER 4: Mobility and Access – Transit

Transit data from the end of the past decade show steady increases in service provided and consumed, commensurate with the growth of the urbanized population.

**Between 2004 and 2014, the geographic coverage of transit increased significantly.** New and extended commuter modes, such as vanpools and commuter rail, reached areas with significant transit demand that were previously accessible only by automobile. Revenue service hours and unlinked passenger trips increased by 12 and 19 percent respectively, and passenger miles by 22 percent. The higher increase in ridership compared with service hours is indicative of the better service effectiveness of these modes, and the larger increase in passenger miles compared with unlinked trips is indicative of a growing demand for commuter trips to outlying suburbs and neighboring cities.

The vehicle utilization of commuter rail also increased, indicating higher passenger loads.

Vanpool vehicle utilization also increased, but at a smaller rate because vanpool expansion requires relatively more vehicles than in any other mode.

Light rail (including standard light rail, streetcars and hybrid rail) also expanded service significantly, both geographically and/or in terms of service intensity, and vehicle utilization increased by 14 percent. Fixed-route bus had a significant decrease in service utilization, and heavy rail decreased slightly.

Vehicle reliability is an important performance measure for analysis of replacement and rehabilitation needs of the national transit fleet. In 2004–2014, vehicle reliability fluctuated (based on vehicle revenue miles between mechanical failures). Over these 10 years, the average number of miles between failures decreased by nearly 1 percent, annually. Bus interruptions account on average for 65–70 percent of all interruptions.

Vehicle Service Utilization: Average Annual Vehicle Revenue Miles per Active Vehicle by Mode, 2004–2014

Mode	Vehicle Revenue Miles per Vehicle (Thousands of Miles)		% Change
	2004	2014	
<b>Rail</b>			
Heavy Rail	57.0	56.5	-0.7%
Commuter Rail	41.1	46.3	12.9%
Light Rail <sup>1</sup>	39.9	45.6	14.4%
<b>Nonrail</b>			
Fixed-Route Bus <sup>2</sup>	29.8	28.4	-4.7%
Vanpool	14.1	15.2	7.5%
Demand-Response <sup>3</sup>	19.8	20.4	3.3%

<sup>1</sup> Includes light rail, hybrid rail, and streetcar rail.

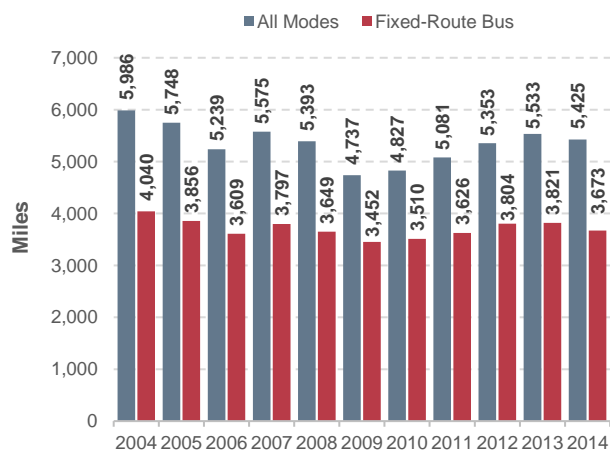
<sup>2</sup> Includes bus, bus rapid transit, and commuter bus.

<sup>3</sup> Includes demand-response and demand-response taxi.

Note: Rail category does not include Alaska railroad, cable car, inclined plane, or monorail/automated guideway. Nonrail category does not include aerial tramway or público.

Source: National Transit Database.

Mean Distance Between Urban Vehicle Failures, 2004–2014



Note: Only directly operated vehicle data were used to calculate mean distance between failures.

Note: The data for all years do not include agencies that qualified and opted to use the small systems waiver of the National Transit Database in 2014.

Source: National Transit Database.

# Executive Summary

## 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 the DOT (FHWA, NHTSA, and 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 while working toward the Nation's safety goal.

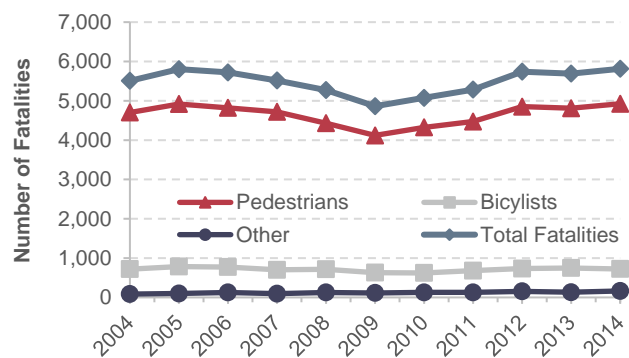
### Overall Fatalities and Injuries

There has been great progress in reducing overall roadway-related fatalities and injuries during the past two decades, despite increases in population and travel. Consistent with other data in this report, the focus here is on trends that occurred from 2004 to 2014.

- From 2004 to 2014, traffic fatalities decreased by nearly 24 percent despite an almost 9-percent increase in population and a 2-percent increase in travel.
- During the same period, pedestrian and bicyclists fatalities increased by 5.5 percent.
  - From 2004 until 2009, pedestrian and bicyclist fatalities experienced a decreasing trend, declining by 11.8 percent. The trend shifted direction dramatically from 2009 to 2014, increasing by 19.6 percent over that time.
  - In 2004, pedestrian and bicycle fatalities accounted for 12.9 percent of total roadway-related fatalities; this share rose to 17.8 percent in 2014.
- In 2014, rural roads accounted for 30.4 percent of travel and 51.3 percent of roadway fatalities, whereas urban roads accounted for 69.6 percent of travel and 48.6 percent of roadway fatalities.

- From 2004 to 2014, fatalities on rural roadways decreased by 33.3 percent and fatalities on urban roadways decreased by 9.5 percent.

Pedestrian, Bicyclist, and Other Nonmotorist Traffic Fatalities, 2004–2014



Source: Fatality Analysis Reporting System/National Center for Statistics and Analysis, NHTSA.

### Focused Approach to Safety

The Focused Approach to Safety addresses the most critical safety challenges surrounding roadway departure, intersection, and pedestrian/bicyclist-involved crashes. These three areas account for nearly 90 percent of traffic fatalities and represent an opportunity to significantly reduce the number of fatalities and serious injuries.

- In 2014, roadway departure, intersection, and pedestrian/bicyclist-involved crashes accounted for 54.4 percent, 26.5 percent, and 17.8 percent, respectively, of the 32,744 total roadway-related fatalities.
- From 2004 to 2014, fatalities involving roadway departures and intersections decreased by 24.8 percent and 17.0 percent, but fatalities involving pedestrians and bicyclists increased by 5.5 percent.



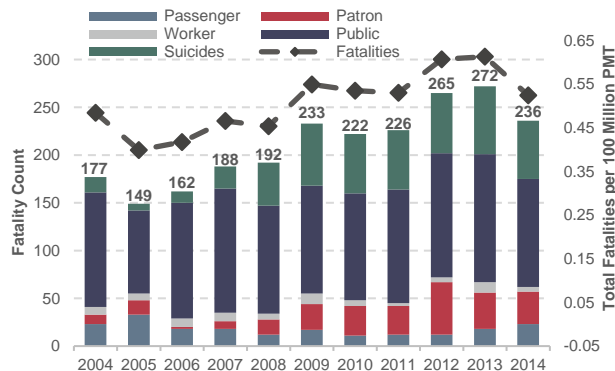
# Executive Summary

## CHAPTER 5: Safety – Transit

Rates of injuries and fatalities on public transportation generally are lower than for other modes of surface 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. They are pedestrians, automobile drivers, bicyclists, or trespassers. Patrons are individuals in stations who are waiting to board or just got off transit vehicles. In 2014, of the 236 fatalities, only 10 percent were passengers.

Annual Transit Fatalities, Including Suicides, 2004–2014<sup>1</sup>



<sup>1</sup> Per 100 million PMT Including suicides.

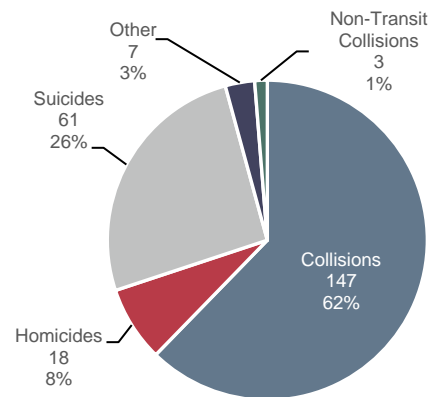
Note: Fatality totals include both directly operated (DO) and purchased transportation (PT) service types.

Source: National Transit Database, Transit Safety and Security Statistics and Analysis Reporting.

**Collisions are the most common type of fatal incident in rail transit.** In 2014, 147 persons, or 62 percent of all fatalities (excluding commuter rail), died in collision incidents. Suicides were the second most common type, with 61 fatalities in 2014.

Commuter rail fatalities accounted on average for 38 percent of all rail fatalities during the period 2004–2014.

Transit Fatality Event Types, 2014<sup>1</sup>



<sup>1</sup> Exhibit includes data for all transit modes, excluding commuter rail.

Note: Other Event Type includes fatalities due to smoke inhalation, slips & falls, electric shock events, and trespassers with an unknown cause of death.

Source: National Transit Database.

Annual Fatalities, Including Suicides and Commuter Rail, 2004–2014



Note: Fatality totals include both directly operated (DO) and purchased transportation (PT) service types.

Note: Data on commuter rail fatalities are not available by victim type and type of incident.

Note: Other fatalities include all other modes.

Sources: Federal Railroad Administration, Railroad Right-of-Way Incident Analysis Research (for commuter rail fatalities) and National Transit Database, Transit Safety and Security Statistics and Analysis Reporting (for all other rail fatalities).

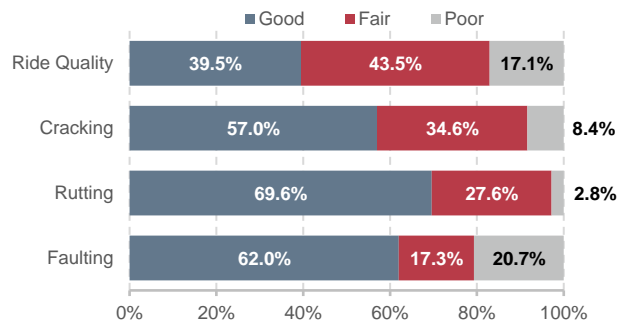
# Executive Summary

## 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. Data on pavement roughness are used to assess the quality of the ride that highway users experience. Other measures of pavement distress include pavement cracking, pavement rutting (surface depressions in the vehicle wheel path, generally relevant only to asphalt pavements), and pavement faulting (the vertical displacement between adjacent jointed sections on concrete pavements).

Weighted by lane miles, 17.1 percent of pavements on Federal-aid highways for which data were available had poor ride quality in 2014; the comparable shares for cracking, rutting, and faulting were 8.4 percent, 2.8 percent, and 20.7 percent, respectively.

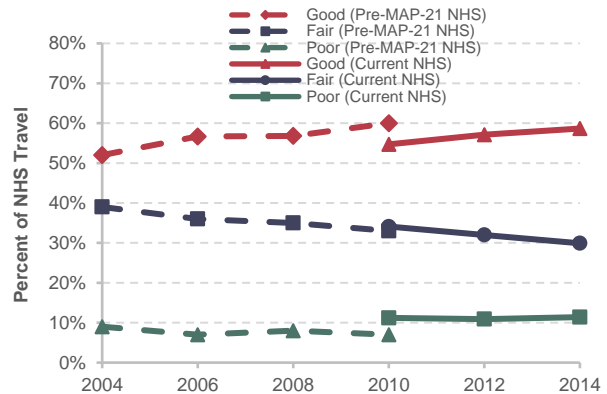
### Federal-aid Highway Pavement Conditions, 2014



Source: Highway Performance Monitoring System.

FHWA currently uses the share of VMT on NHS pavements with good ride quality as a metric for performance planning purposes; this rose from 52 percent in 2004 to 58.7 percent in 2014. This gain came despite the significant 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.

### NHS Pavement Ride Quality, Weighted by VMT, 2004–2014



Source: Highway Performance Monitoring System.

NBI contains data on bridge decks, superstructures, substructures, and culverts that can be combined to form an overall bridge condition rating. While the share of bridges rated good has gone down since 2004, the share rated as poor has been reduced even faster. It should be noted that a poor condition rating does not mean that a bridge is unsafe.

### Systemwide Bridge Conditions, 2004–2015

	2004	2014	2015
<b>Percent Good</b>			
By Bridge Count	48.2%	47.1%	47.3%
Weighted by Deck Area	46.1%	44.7%	45.5%
Weighted by Traffic	46.4%	44.5%	45.8%
<b>Percent Fair</b>			
By Bridge Count	40.6%	44.2%	44.4%
Weighted by Deck Area	44.3%	48.3%	48.2%
Weighted by Traffic	46.1%	50.6%	49.8%
<b>Percent Poor</b>			
By Bridge Count	11.0%	8.7%	8.3%
Weighted by Deck Area	9.4%	6.7%	6.4%
Weighted by Traffic	7.3%	4.7%	4.4%

Source: National Bridge Inventory.

# Executive Summary

## CHAPTER 6: Infrastructure Conditions – Transit

Transit asset infrastructure in the C&P Report includes five major asset groups.

### 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: Transit Economic Requirements Model.

**Condition Rating.** FTA uses a capital investment needs tool, TERM, to measure the condition of transit assets. The model uses a numeric scale that ranges from 1 to 5. When an asset crosses the middle of the scale (condition 2.5), which is based on age, it is assigned by TERM for replacement or rehabilitation.

### 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: Transit Economic Requirements Model.

The replacement value of the Nation’s transit assets was \$894.8 billion in 2014, 43 percent of which was guideway elements. Rail modes account for 88 percent of the guideway element amount.

**The relatively large proportion of facilities elements and systems assets that are in poor condition (rated 2.0 or below) and the magnitude of the \$174-billion investment required to replace them, represent major challenges to the rail transit industry.**

### Asset Categories in Poor Condition (Rated 2.0 or Below), 2014

Asset Category	Percentage in Poor Condition
Guideway Elements	6.4
Systems	21.4
Facilities	36.4
Vehicles	18.5
Stations	5.3

Source: Transit Economic Requirements Model.

**State of Good Repair (SGR).** An asset is deemed in a state of good repair 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.

**Trends in Urban Bus and Rail Transit Fleet not in SGR.** The average condition rating for bus and rail fleets did not change much between 2004 and 2014, ranging between 3.0 and 3.3 for buses and remaining relatively constant for rail, ranging between 3.5 and 3.6. The percentage of the bus fleet not in SGR also did not change much, ranging between 15 and 18.8 percent. For rail, the percentage not in SGR decreased during the 2004–2014 timeframe overall, although it increased slightly between 2012 and 2014.

# Executive Summary

## Part II: Investing for the Future

The four chapters in Part II of this report present and analyze general scenarios for future capital investment in highways, bridges, and transit. Each scenario is geared toward maintaining some indicator of physical condition or operational performance at its 2014 level, or achieving some objective linked to benefits versus costs. The average annual investment level over the 20 years from 2015 through 2034 is presented for each scenario, stated in constant 2014 dollars.

**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 directly address the potential contributions of different public or private revenue sources.

Chapter 7, Selected Capital Investment Scenarios, defines the core scenarios and examines the associated projections for condition and performance. **The scenarios are intended to be illustrative and do not represent comprehensive alternative transportation policies; the U.S. Department of Transportation does not endorse any scenario as a target level of investment.**

Chapter 8, Supplemental Scenario Analysis, explores some implications of the scenarios presented in Chapter 7 and contains some additional policy-oriented analyses. As part of this analysis, highway projections from previous editions of the C&P Report are compared with actual outcomes to illuminate the value and limitations of the projections presented in this edition. Chapter 9, Sensitivity Analysis, explores the impacts on scenario projections of changes to several key assumptions. Lastly, Chapter 10, Impacts of Investment, explains the derivation of the scenario projections from results obtained with the models that have been developed over the years to support the C&P Report.

A comprehensive benefit-cost analysis of a transportation investment considers all impacts of potential significance for society and values them in monetary terms, to the extent feasible. For some types of impacts, monetary valuation is facilitated by the existence of observable market prices. Such prices are generally available for inputs to the provision of transportation infrastructure, such as concrete for building highways or buses purchased for a transit system. The same is true for some types of benefits from transportation investments, such as savings in business travel time, which are conventionally valued at a measure of average hourly labor cost of the travelers.

For some other types of impacts for which market prices are not directly observable, monetary values can be reasonably inferred from behavior or expressed preferences. In this category are savings in personal travel time and reductions in the risk of crash-related fatality or other injury.

For other impacts, monetary valuation may not be possible because of problems with reliably estimating the magnitude of the improvement, placing a monetary value on the improvement, or both. Even when possible, reliable monetary valuation may require time and effort that would be out of proportion to the likely importance of the impact concerned.

Each of the models used in this report—the Highway Economic Requirements System (HERS), the National Bridge Investment Analysis System (NBIAS), and the Transit Economic Requirements Model (TERM)—omits various types of investment impacts from its benefit-cost analyses. To some extent, this omission reflects the national coverage of the models' primary databases. Such broad geographic coverage requires some sacrifice of detail to stay within feasible budgets for data collection.

## Types of Capital Spending Projected by HERS and NBIAS

NBIAS relies on the NBI, which covers bridges on all highway functional classes and evaluates improvements that generally fall within the system rehabilitation category defined in Chapter 2. HERS evaluates pavement improvements and highway widening; the types of improvements included in these categories roughly correspond to system rehabilitation and system expansion categories. Coverage of the HERS analysis is limited to Federal-aid highways, as the HPMS sample does not include data for rural minor collectors, rural local roads, or urban local roads. The term “nonmodeled spending” refers in this report to spending on highway and bridge capital improvements that are not evaluated in HERS or NBIAS. This includes capital improvements on highway classes omitted from the HPMS sample and expenditures classified in Chapter 2 as system enhancements.

models. The other \$30.9 billion was for nonmodeled improvement types.

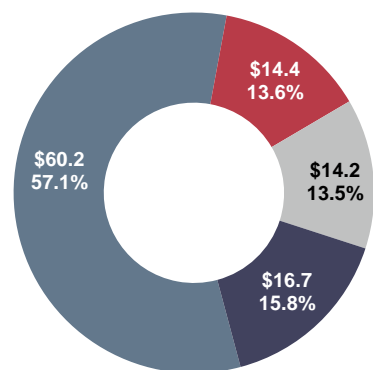
## Types of Capital Spending Projected by TERM

TERM is designed to forecast the following types of investment needs:

- **Preservation:** The level of investment in the rehabilitation and replacement of existing transit capital assets required to attain specific investment goals (e.g., to attain a state of good repair [SGR]) subject to potentially limited capital funding.
- **Expansion:** The level of investment in the expansion of transit fleets, facilities, and rail networks required to support projected growth in transit demand (i.e., to maintain performance at current levels as demand for service increases).

### Distribution of 2014 Capital Expenditures by Investment Type

- Improvement types modeled in HERS
- Improvement types modeled in NBIAS
- Improvement types not modeled in HERS or NBIAS
- Highway functional systems not reported in HPMS



All Public Roads (Billions of Dollars)

Source: Highway Statistics 2014 (Table SF-12A) and unpublished FHWA data.

In 2014, highway capital spending was \$105.4 billion. Of that spending, \$60.2 billion was for the types of improvement that HERS models and \$14.4 billion was for the types of improvement NBIAS

As reported to NTD, the level of transit capital expenditures peaked in 2009 at \$16.8 billion, experienced a slight decrease in 2011 to \$15.6 billion, and increased again in 2014 to \$17.7 billion. Although the annual transit capital expenditures averaged \$15.2 billion from 2004 to 2014, expenditures averaged \$16.8 billion in the most recent 5 years of NTD reporting (2010–2014).

### Annual Transit Capital Expenditures, 2004–2014

Year	(Billions of Current-Year Dollars)			(Billions of Constant 2014 Dollars)
	Preservation	Expansion	Total	Total
2004	\$9.4	\$3.2	\$12.6	\$15.8
2005	\$9.0	\$2.9	\$11.8	\$14.3
2006	\$9.2	\$3.5	\$12.7	\$14.9
2007	\$9.6	\$4.0	\$13.6	\$15.5
2008	\$11.0	\$5.1	\$16.0	\$17.6
2009	\$11.3	\$5.5	\$16.8	\$18.6
2010	\$10.3	\$6.2	\$16.6	\$18.0
2011	\$9.9	\$5.7	\$15.6	\$16.5
2012	\$9.7	\$7.1	\$16.8	\$17.4
2013	\$10.8	\$6.4	\$17.1	\$17.4
2014	\$11.0	\$6.4	\$17.4	\$17.4
Average	\$10.1	\$5.1	\$15.2	\$16.7

Source: National Transit Database.

# Executive Summary

## CHAPTER 7: Capital Investment Scenarios – Highways

This report presents a set of illustrative 20-year 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.

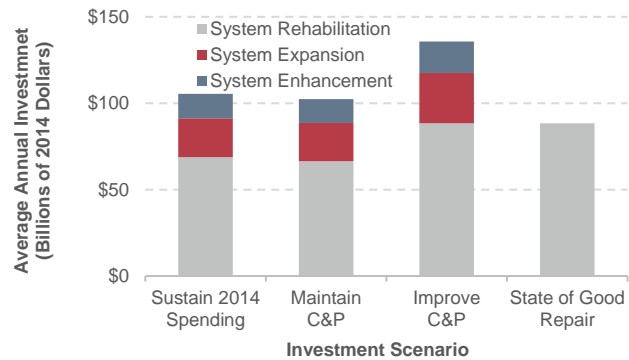
The Sustain 2014 Spending scenario assumes that annual capital spending is sustained in constant-dollar terms at the 2014 level of \$105.4 billion from 2015 through 2034. (In other words, spending would rise by exactly the rate of inflation during that period.) The model results suggest that it would 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 62.0 percent observed in 2014 to 64.9 percent (\$68.8 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 \$102.4 billion; this suggests that sustaining spending at the 2014 level of \$105.4 billion should result in improved overall conditions and performance in 2034 relative to 2014.

The Improve Conditions and Performance scenario seeks to identify the level of investment needed to implement all potential investments estimated to be cost-beneficial. This scenario can be viewed as an “investment ceiling,” above which it would not be cost-beneficial to invest. Of the \$135.7 billion average annual investment level under the Improve Conditions and Performance scenario, \$88.4 billion would be directed toward system rehabilitation; this portion is identified as the State of Good Repair benchmark. This scenario also includes

\$29.1 billion directed toward system expansion and \$18.3 billion for system enhancement.

### Highway Capital Investment Scenarios

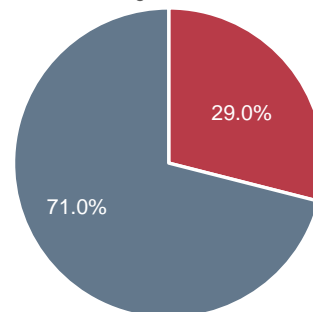


Sources: HERS and NBIAS.

Cumulative 20-year investment under the Improve Conditions and Performance scenario would total \$2.7 trillion. This includes an estimated \$786.4 billion (29.0 percent) needed to address an existing backlog of cost-beneficial highway and bridge investments as of 2014. The remainder would address future highway and bridge needs as they arise over 20 years.

### Composition of 20-Year Improve Conditions and Performance Scenario, Backlog vs. Emerging Needs

- Backlog (Existing Needs in 2014)
- Needs Arising From 2015–2034



Source: HERS and NBIAS.

# Executive Summary

## CHAPTER 7: Capital Investment Scenarios – Transit

Chapter 7 presents three transit investment scenarios covering all capital spending, and one benchmark covering only preservation spending.

**Sustain 2014 Spending:** Under this scenario, 2014 spending on transit asset preservation and expansion (\$11.3 billion and \$6.4 billion respectively) is sustained for the next 20 years.

- **Backlog:** \$11.3 billion in annual investment is insufficient to cover the cost of new preservation needs as they arise, resulting in a projected increase in the backlog from \$98.2 billion to \$116.2 billion by 2034 (an increase of \$18.0 billion or 19 percent).
- **Asset Conditions:** The backlog increase and the ongoing aging of rail systems results in an overall decline in asset conditions (from 3.1 to 2.8 by 2034).
- **Ridership:** The \$6.4 billion annual rate of investment is estimated to support a 1.3 percent annual increase in ridership, or 0.2 percent below the 1.5 percent rate of growth experienced since 2000—potentially resulting in increased vehicle crowding if such ridership growth were to continue in the future.

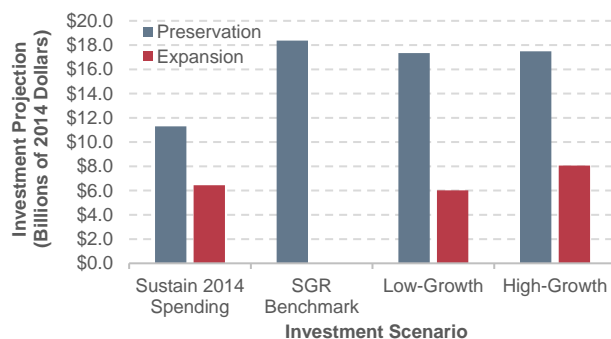
**SGR Benchmark:** The level of preservation expenditures required to eliminate the state of good repair (SGR) backlog over 20 years (by 2034).

- **Expenditures:** An estimated \$18.4 billion in annual reinvestment is required to fully eliminate the SGR backlog by 2034. This is 63 percent higher than actual 2014 reinvestment.
- **Asset Conditions:** Despite elimination of the backlog, average asset conditions are projected to remain near the lower bound of the adequate range (3.0–3.9).

**Low- and High-Growth Scenarios<sup>1</sup>:** The level of investment required both to eliminate the backlog by 2034 and to support ridership growth within ±0.3 percent of the 1.5 percent average annual rate experienced since 2000.

- **Ridership:** The estimated annual rate of expansion investment ranges from \$6.0 billion to \$8.1 billion under the Low- and High-Growth scenarios respectively. This range encompasses the \$6.4 billion expended on expansion in 2014. These investments support an additional 3.0 to 4.6 billion annual boardings by 2034.

### Scenarios Expenditures



Source: Transit Economic Requirements Model.

<sup>1</sup>The Low-Growth and High-Growth scenarios in this report are based on 15-year ridership trends as of 2014, the cut-off year for this report. The Department does note that transit ridership has, in fact, not increased since 2014 through the early months of 2019. The causes of the decreased transit ridership since 2014 will be analyzed in the next edition of this report. The ridership trends since that time will also be incorporated into the capital investment needs forecasts presented in future editions of this report.

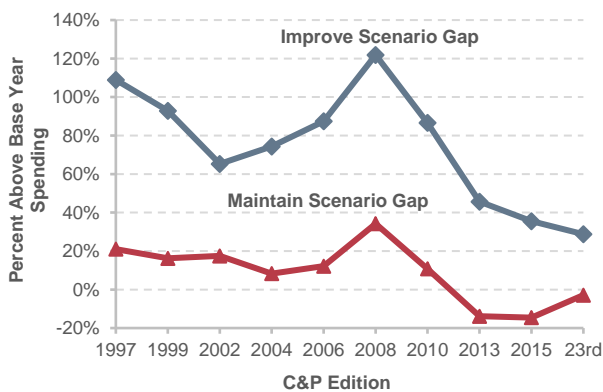
# Executive Summary

## CHAPTER 8: Supplemental Analysis – Highways

The 2015 C&P Report estimated the average annual investment level for the Maintain Conditions and Performance scenario as \$89.9 billion in 2012 dollars, or \$94.4 billion in 2014 dollars after adjusting for inflation. The comparable amount in this 23<sup>rd</sup> edition is \$102.4 billion in 2014 dollars, approximately 8.5 percent higher than the adjusted 2015 C&P Report estimate. The average annual investment level under the Improve Conditions and Performance scenario in this edition was 9.3 percent lower than the adjusted annual investment level based on the 2015 C&P Report.

Since the 1997 C&P Report, the “gap” between base-year spending and the average annual investment level for the primary “Maintain” and “Improve” scenarios has varied, reaching the highest level in the 2008 C&P Report. The gap under the Maintain Conditions and Performance scenario shrank in the 23<sup>rd</sup> edition, but remains negative (i.e., base-year spending is higher). The gap under the Improve Conditions and Performance scenario and base-year spending has declined continually since the 2008 C&P Report.

Comparison of Average Annual Highway and Bridge Investment Scenario Estimates with Base-Year Spending, 1997 to 23<sup>rd</sup> C&P Editions



Sources: HERS and NBIAS.

The pattern of investment assumed for the scenarios in this edition differed from that in the 2015 C&P Report, which assumed “ramped” highway capital investment, increasing at a constant annual rate starting with the base year. For this edition, the “Maintain” scenario assumes spending will remain constant at \$102.4 billion in each year, while the “Improve” scenario assumes all cost-beneficial investments will occur in the year in which they are identified. This benefit-cost ratio-driven approach resulted in a significant frontloading of investment in the early years of the analysis, due to the existence of a large existing backlog of potential cost-beneficial investments. Supplemental analyses of alternative investment timing patterns did not show significant variation in terms of system conditions and performance results after 20 years.

This edition includes a look back to the projections from the 1995 C&P Report, and compares them with actual performance over 20 years. The investment scenarios presented in the 1995 C&P Report assumed VMT would grow by 2.15 percent per year from 1993 to 2013, significantly higher than the actual annual VMT growth over that period of 1.33 percent. However, the predicted urban VMT growth was relatively close to actual VMT; most of the difference was due to a significant overprediction of rural VMT. Adjusted for inflation, actual highway capital spending for 1994 through 2013 was 15 percent below the level estimated for the Maintain Conditions and Performance scenario in the 1995 C&P Report, suggesting that conditions and performance would have been expected to decline. This proved to be true in terms of operational performance in urban areas from 2003 to 2013, as various congestion measures got worse. However, key measures of physical conditions and safety showed improvements over this 20-year period.



# Executive Summary

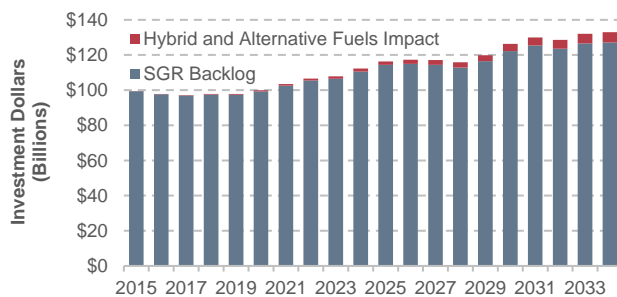
## CHAPTER 8: Supplemental Analysis – Transit

Chapter 8 covers analyses designed to help better understand the assumptions and outcomes underlying the scenarios presented in Chapter 9.

**Impact of the Sustain 2014 Spending scenario on asset conditions.** Continued reinvestment in preservation at the 2014 annual spending level yields a decline in overall asset conditions (from 3.1 in 2014 to 2.8 in 2034) and an increase in the backlog (from \$98.8 billion in 2014 to \$102.5 billion in 2018). This decline is due in part to deferred investments in rehabilitation and replacement, and in part on the aging of assets that will reach the end of their useful lives after 2034. The share of assets beyond their useful life would increase from 14 percent in 2014 to 19 percent in 2034 if the spending level is kept constant over the 20-year project horizon.

**New technologies impact transit investment needs.** New technologies often increase the cost of replacement assets and, in the absence of additional funding, the size of the state of good repair (SGR) backlog. As an example, alternative fuel buses add an additional cost as depicted in the figure below.

Impact of Technological Change on Backlog



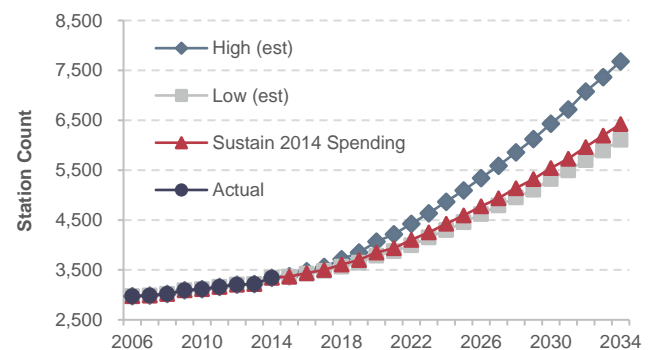
Source: Transit Economic Requirements Model.

As the chart shows, the cost impact on the backlog is negligible in the early years of the projection period but grows over time as the proportion of buses using alternative fuel and hybrid power increases. By 2034, the size of the backlog would increase to \$123.5 billion, an increase of \$7.3 billion above the original \$116.2 billion under the Sustain 2014 Spending scenario.

**Investment in expansion assets.**<sup>2</sup> Chapter 8 assesses the increase in transit assets required to support the additional 3.0 to 4.6 billion annual boardings by 2034, as projected by the Low- and High-Growth scenarios. This increase includes:

- **Fleet:** 60,400 to 85,900 additional vehicles (a 35-percent to 49-percent increase from 2014)
- **Rail Guideway:** 2,300 to 2,800 additional route miles (an 18-percent to 23-percent increase)
- **Stations:** 2,800 to 4,300 additional stations (an 83-percent to 130-percent increase)

Growth Scenario Investment in Stations



Note: Data through 2014 are actual; data after 2014 are estimated based on trends.

Source: Transit Economic Requirements Model.

<sup>2</sup> The Low-Growth and High-Growth scenarios in this report are based on 15-year ridership trends as of 2014, the cut-off year for this report. The Department does note that transit ridership has, in fact, not increased since 2014 through the early months of 2019. The causes of the decreased transit ridership since 2014 will be analyzed in the next edition of this report. The ridership trends since that time will also be incorporated into the capital investment needs forecasts presented in future editions of this report.

# Executive Summary

## CHAPTER 9: Sensitivity Analysis – Highways

Sound practice in modeling includes analyzing the sensitivity of key results to changes in assumptions. Chapter 9 analyzes how the baseline scenarios presented in Chapter 7 would be affected by changing some HERS and NBIAS parameters.

Among the parameters analyzed, the Improve Conditions and Performance scenario is most sensitive to changes in the 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. Changing the discount rate from the 7 percent assumed in the baseline analysis to 3 percent would increase the average annual investment level under this scenario from \$135.7 billion to \$174.0 billion.

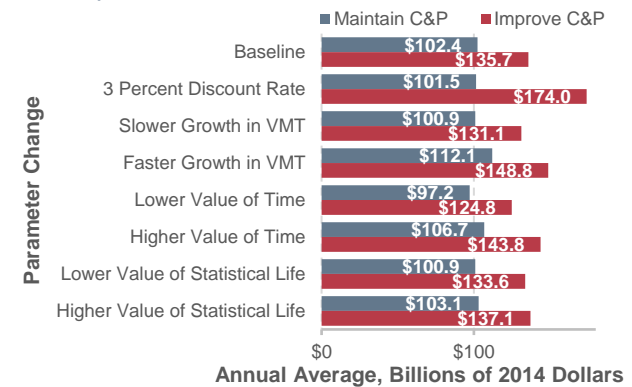
For purposes of computing the baseline scenarios, future travel forecasts for individual highway sections and bridges reported by States in the HPMS and NBI were each proportionally reduced so that the national average annual growth over 20 years would match the 1.07 percent figure from the May 2017 release of the FHWA National Vehicle Miles Traveled projection. Had the 0.92 percent annual growth figure from the May 2016 release been used instead, the average annual investment level under the Improve Conditions and Performance scenario would have decreased to \$131.1 billion annually. Eliminating this proportional adjustment and directly applying the annual growth forecasts from the HPMS (1.40 percent on average) and the NBI (1.45 percent) increases the annual cost of this scenario to \$148.8 billion.

The valuation of travel time savings assumed in the baseline scenarios is linked to average hourly income; personal travel is valued at 50 percent of income, while business travel is valued at 100 percent. Alternative tests were run reducing these shares to 35 percent and 80 percent,

respectively, and increasing them to 60 percent and 120 percent. Applying a lower value of time reduces the benefits associated with travel time savings and reduces the average annual investment level under the Improve Conditions and Performance scenario to \$124.8 billion. Assuming a higher value of time increases the annual cost of this scenario to \$143.8 billion.

The baseline scenarios assume the value of a statistical life is \$9.4 million when computing safety-related benefits, consistent with DOT guidance. Reducing this value to \$5.2 million would reduce the annual cost of the Improve Conditions and Performance scenario to \$133.6 billion; increasing the value to \$13.0 million would increase the annual cost to \$137.1 billion.

Sensitivity of Highway Scenarios to Alternative Assumptions



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

The impacts of alternative assumptions on the Maintain Conditions and Performance scenario are generally smaller and are linked to the models' distribution of spending among different capital improvement types. Among the parameters analyzed, this scenario was most sensitive to higher assumptions about future VMT.

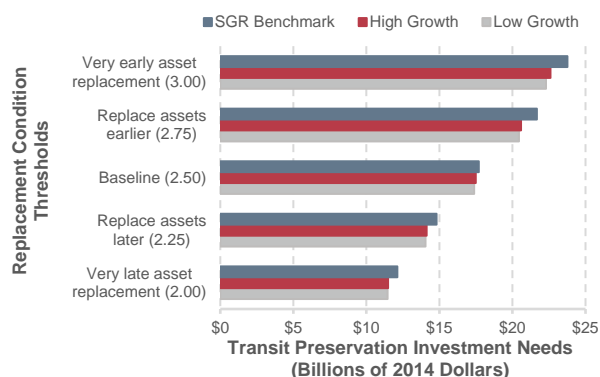
# Executive Summary

## CHAPTER 9: Sensitivity Analysis – Transit

The Transit Economics Requirements Model (TERM) relies on several key input parameters, variations of which can significantly influence the model’s needs and backlog estimates.

**Impact of alternative replacement thresholds on transit preservation needs.** TERM uses a “replacement threshold” to specify the condition at which aging assets are replaced. The benchmark threshold value is 2.5. A 0.5-point change in the thresholds yields a roughly ±30-percent change in replacement needs.

Sensitivity to Replacement Threshold



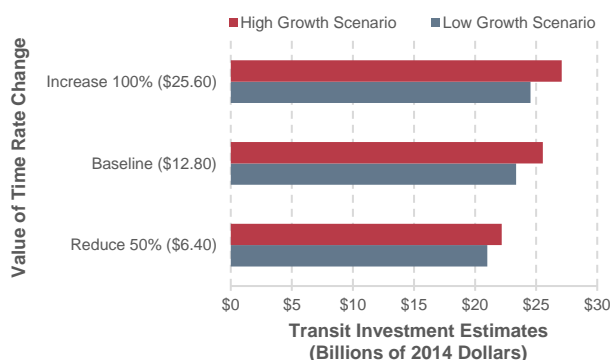
Source: Transit Economic Requirements Model.

**Impact of increases in capital costs on transit preservation needs.** The sensitivity of scenario needs estimates to changes in capital costs is dependent on whether TERM’s benefit-cost test is applied for that scenario. Under the Low- and High Growth scenarios, which both 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 forced some reinvestment actions to fail the benefit-cost test.

<sup>3</sup> Circular No. A-94 – Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs.

**Impact of changes in the value of time on preservation needs.** The per-hour value of travel time for transit riders is a key model input, and a key driver of total investment benefits. 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 results in increases of 5.0 percent and 6.0 percent in needs for the Low- and High-Growth scenarios, respectively. Reducing the rate by half results in decreases of 10.1 percent and 13.2 percent, respectively.

Sensitivity to Value of Time



Source: Transit Economic Requirements Model.

**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.<sup>3</sup> The analysis using a rate of 3 percent (57 percent smaller) leads to an increase of 4.0 percent in investment needs in the High-Growth scenario, and a 5.6 percent increase in the Low-Growth scenario.

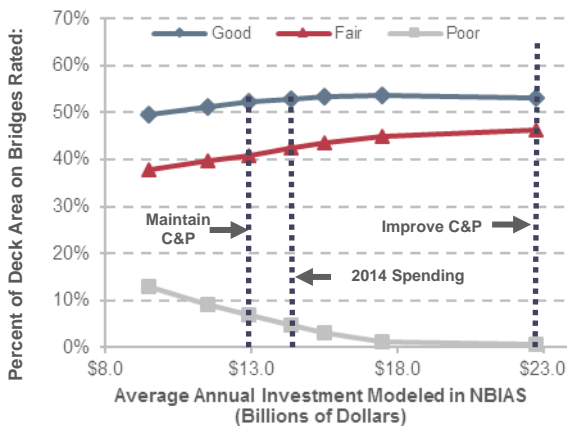
# Executive Summary

## CHAPTER 10: Impacts of Investment – Highways

Of the \$135.7 billion average annual investment level for all public roads under the Improve Conditions and Performance scenario presented in Chapter 7, 16.7 percent (\$22.7 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; 54.0 percent (\$73.2 billion) of this scenario was derived from HERS. The remaining 29.3 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 actual 2014 spending.

Sustaining NBIAS-modeled investment at \$14.4 billion (the portion of 2014 spending directed toward improvement types modeled in NBIAS) in constant-dollar terms over 20 years is projected to result in deck area-weighted bridge conditions of

Projected Impact of Alternative Investment Levels on 2034 Bridge Condition Ratings

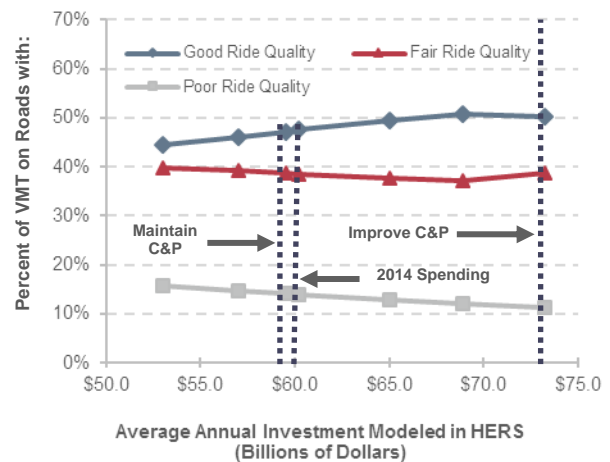


Source: National Bridge Investment Analysis System.

52.9 percent good, 40.8 percent fair, and 6.3 percent poor. Increasing annual investment to \$22.7 billion would increase the deck area-weighted share rated as good to 53.9 percent, and reduce the share rated as poor to 0.5 percent.

Sustaining HERS-modeled investment at \$60.2 billion (the portion of 2014 spending directed toward improvement types modeled in HERS) in constant-dollar terms over 20 years is projected to result in 47.5 percent of VMT in 2034 occurring on pavements with good ride quality, 38.5 percent on pavements with fair ride quality, and 13.9 percent occurring on pavements with poor ride quality. Increasing annual investment to \$73.2 billion would increase the VMT-weighted share rated as good to 50.2 percent and reduce the share rated as poor to 11.2 percent.

Projected Impact of Alternative Funding Levels on 2034 Federal-aid Highway Pavement Ride Quality



Source: Highway Economic Requirements System.

Other projected impacts of investing at the Improve scenario level include reducing VMT-weighted average pavement roughness by 5.6 percent in 2034 relative to 2014 and reducing average delay per VMT by 19.3 percent.

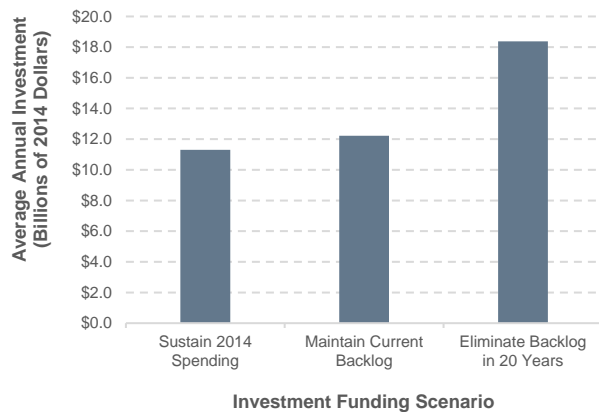
# Executive Summary

## CHAPTER 10: Impacts of Investment – Transit

### The current level of investment in transit asset preservation is insufficient to prevent ongoing growth in the state of good repair (SGR) backlog.

Assuming preservation expenditures are sustained at the 2014 level (\$11.3 billion annually), the backlog is projected to increase from \$98.8 billion to \$116.2 billion by 2034. Based on current estimates, \$12.2 billion in annual investment is required to prevent further increases in the SGR backlog, while \$18.2 billion in annual investment is required to fully eliminate the SGR backlog in 20 years (by 2034).

#### Investment Funding Scenarios



Source: Transit Economic Requirements Model.

### A much higher rate of investment 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.

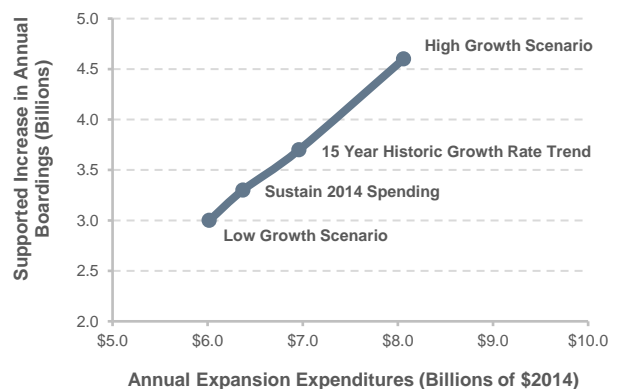
If the current rate of reinvestment is sustained at the 2014 level (\$11.3 billion), overall average asset conditions are projected to decline from 3.1 in 2014

to 2.8 by 2034 (near the upper bound of the “marginal” range). In contrast, annual preservation expenditures of \$18.2 billion are required to sustain an overall average condition of 3.1, with higher rates of annual investment required to attain significant improvements in overall asset conditions.

### The 2014 level of expansion investment supports ridership growth that is marginally below the historical rate.<sup>4</sup>

Investment in transit expansion investments was \$6.4 billion in 2014. If maintained into the future, this annual investment amount is estimated to support roughly 1.3 percent in annual ridership growth, which is marginally below the 1.5 percent average rate experienced since 2000. Assuming this historical trend continues (it has not since 2014), the limited underinvestment could result in a gradual increase in vehicle occupancy rates through 2034, with increasing incidences of vehicle crowding and longer dwell times during this period.

#### Growth Scenarios: Expansion Expenditures vs. Increase in Annual Boardings



Source: Transit Economic Requirements Model.

<sup>4</sup> The Low-Growth and High-Growth scenarios in this report are based on 15-year ridership trends as of 2014, the cut-off year for this report. The Department does note that transit ridership has, in fact, not increased since 2014 through the early months of 2019. The causes of the decreased transit ridership since 2014 will be analyzed in the next edition of this report. The ridership trends since that time will also be incorporated into the capital investment needs forecasts presented in future editions of this report.

# Executive Summary

## CHAPTER 11: Freight Transportation

Freight transportation is vital to the U.S. economy and the daily needs of Americans throughout the country. Households and businesses depend on the efficient and reliable delivery of freight to both urban and rural areas. Federal support for freight increased under the Fixing America’s Surface Transportation (FAST) Act, as the FAST Act included provisions to define, establish, and provide funding for a national highway freight program. The FAST Act freight provisions were designed to address significant needs in the transportation system to ensure that projected increases in freight volumes can be handled efficiently across all transportation modes.

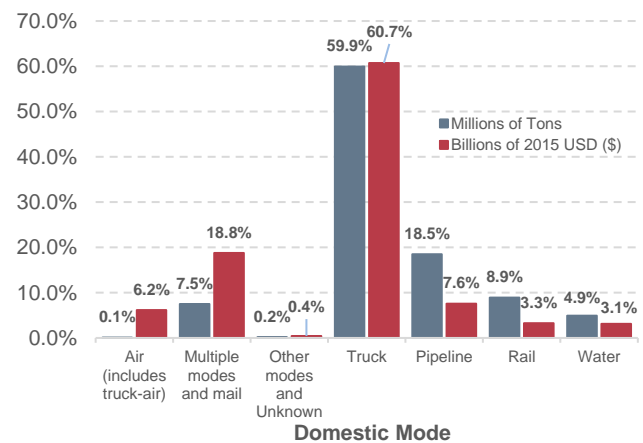
In 2015, the transportation system handled a record amount of freight—including a daily average of approximately 55 million tons of freight, worth approximately \$49.5 billion. The freight transportation industry employed 4.6 million workers and contributed 9.5 percent of the Nation’s economic activity as measured by gross domestic product (GDP).

Although freight moves on all modes of transportation, trucks are involved in the movement of most goods. The highway system is the most-used mode of transport for freight by tonnage and value of goods moved. Commodities moved by truck have a higher value per weight, which gives trucking a higher share of freight dollar value.

Trucking accounted for nearly 30.5 percent of total transportation and warehousing sector employment. Truck driving is by far the largest freight transportation occupation, with approximately 2.83 million truck drivers. About 57.5 percent of these professional truck drivers operate heavy trucks and 28.2 percent drive light trucks.

As freight movements increase, the number of available safe truck parking spaces diminishes and is a growing concern.

Mode Share by Tonnage and Value, 2015



Note: USD=U.S. dollars

Source: Bureau of Transportation Statistics and FHWA, Freight Analysis Framework, version 4.2, 2016.

### Truck Parking

Truck drivers need safe, secure, and accessible truck parking. With the projected growth in truck traffic, demand for truck parking will continue to outpace supply. In 2014, FHWA worked with States and industry partners on the *Jason’s Law Truck Parking Survey Results and Comparative Analysis* to assess these needs. The resulting information quantified the commercial motor vehicle parking shortage at public and private facilities along the National Highway System. The survey provided direct insight into parking issues: more than 75 percent of truck drivers surveyed said they regularly experienced problems with finding “safe parking locations when rest was needed.”

# Executive Summary

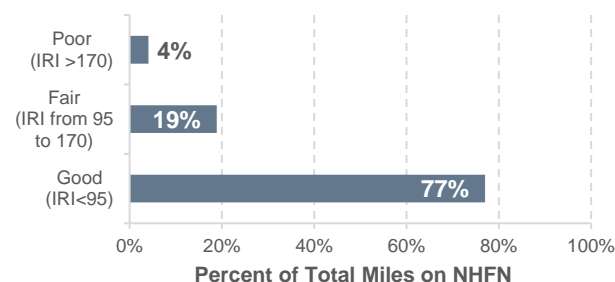
## CHAPTER 12: Conditions and Performance of the National Highway Freight Network

The Fixing America's Surface Transportation (FAST) Act designated the National Highway Freight Network (NHFN) and established a national policy of maintaining and improving the conditions and performance of this new network. Furthermore, it required the development of a regular report on the conditions and performance of the NHFN. This chapter serves as the first of these reports.

### Conditions

In 2012, the NHFN consisted of 51,029 centerline miles, including 46,947 centerline miles of Interstate and 4,082 centerline miles of non-Interstate roads. Based on 2014 international roughness index (IRI) data from the Highway Performance Monitoring System (HPMS), approximately 77 percent of pavement miles were rated as having good ride quality, 19 percent had fair ride quality, and 4 percent had poor ride quality.

Pavement Ride Quality (IRI) Based on Mileage on NHFN

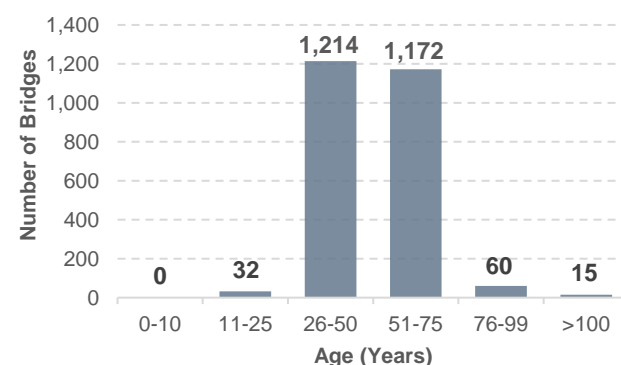


Source: IRI data in 2014 HPMS files.

The National Bridge Inventory is used to identify current bridge ratings for bridges on the NHFN. This analysis showed there are approximately 57,600 bridges on the NHFN. Around 4.3 percent of those bridges were rated as structurally deficient. Most of these structurally deficient bridges are 25 years and

older, and over half are more than 50 years old. These findings have implications for future maintenance and funding needs as well as impacts to operations.

Age of Structurally Deficient Bridges on NHFN, 2014



Source: Bridge condition data contained in 2014 NBI files.

### Performance

Travel time, speed, and safety are three measures of performance. Slower speeds and unreliable travel times caused by congestion increase fuel cost and affect operations and productivity, which adds expense to the freight transportation system. In 2014, congestion created stop-and-go conditions on 5,800 miles of the NHFN and caused traffic to travel below posted speed limits on an additional 4,500 miles of the high-volume truck portions of the NHFN. The projected growth in freight and its reliance on trucks will increase congestion and make it more difficult and costly to move freight.

A total of 3,633 fatal crashes occurred on the Interstate portion of the NHFN in 2014, resulting in 4,094 fatalities. In 2015, fatal crashes and fatalities increased by 5.7 percent and 6.1 percent, respectively.

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Status of the Nation's Highways, Bridges, and Transit  
Conditions and Performance

23<sup>rd</sup> Edition



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