2008 Status of the Nation's Highways, Bridges, and Transit:

Conditions & Performance

REPORT TO CONGRESS
Executive Summary

U.S. Department of Transportation

Federal Highway Administration

Federal Transit Administration

Introduction

This document is a summary of the *2008 Status of the Nation's Highways, 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 highway, bridge, and transit systems based both on the current state of these systems and on the projected future state of these systems under a set of alternative future investment scenarios. This edition of the C&P report is the eighth in the series that combines information on the Nation's highway and transit systems.

The main body of the report is organized into four major sections. Part I, "Description of Current System," includes the core retrospective analyses in the report, including chapters on the role of highways and transit, system characteristics, system conditions, operational performance, safety, and finance.

Part II, "Investment/Performance Analysis," includes the core prospective analyses of the report, including projections of future highway, bridge, and transit capital investment under certain defined scenarios. This section also explores how these scenarios would be affected by changing the assumptions about travel growth, financing mechanisms, and other key variables.

The highway investment scenarios presented in this report are developed in part from the Highway Economic Requirements System (HERS), which uses marginal benefit-cost analysis to optimize highway investment. The HERS model quantifies user, agency, and societal costs for various types and combinations of improvements, including travel time, vehicle operating, safety, capital, maintenance, and emissions costs.

Bridge investment scenario estimates were developed from the National Bridge Investment Analysis System (NBIAS) model, which was used for the first time in the 2002 edition of the C&P report. Unlike previous 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). The TERM consolidates older engineering-based evaluation tools and introduces a benefit-cost analysis to ensure that investment benefits exceed investment costs. Specifically, 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 and then evaluates these needs in order to select future investments.

Part III, "Special Topics," explores further some topics related to the primary analyses in the earlier sections of the report. Some of these chapters reflect recurring themes that have been discussed in previous editions of the C&P report, while others address new topics of particular interest that will be included in this edition only. Part IV, "Afterword: A View to the Future," identifies potential areas for improvement in the data and analytical tools used to produce the analyses contained in this report and describes ongoing research activities.

Highlights

In order to correctly interpret the analyses presented in this report, it is important to understand the framework in which they were developed and to recognize their limitations. As stated in the "Introduction," this document is intended to provide Congress with an objective appraisal of the physical conditions, operational performance, and financing mechanisms of highways, bridges, and transit systems based both on the current state of these systems and on the projected future state of these systems under a set of alternative future investment scenarios. The trends identified in this report reflect more recent data than the last edition, as well as enhancements to the analyses based on ongoing work by the Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA). These enhancements improve the estimation of the conditions and performance of highways, bridges, and transit and better forecast the impact that future investment may be expected to have on maintaining and improving this transportation infrastructure.

Since this edition of the C&P report is based primarily on data through the year 2006, it does not yet fully reflect the effects of the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU), which authorized Federal highway and transit funding for Federal fiscal years 2005 through 2009. This "Highlights" section generally compares 2006 statistics with those for 1997, the last year preceding the enactment of the Transportation Equity Act for the 21st Century (TEA-21). As discussed in the "Introduction," other sections within this report assess recent trends over different time periods.

Cautionary Note on Using This Report

It is important to note that this document is not a statement of Administration policy and that the future investment scenarios presented in this report are intended to be illustrative only. **The report does not endorse any particular level of future highway, bridge, or transit investment**; it does not address questions as to what future Federal surface transportation programs should look like, or what level of future surface transportation funding can or should be provided by the Federal government, State governments, local governments, the private sector, or system users. Making recommendations on policy issues such as these would go beyond the legislative mandate for the report and would violate its objectivity. Outside analysts can and do make use of the statistics presented in the C&P report to draw their own conclusions, but any analysis attempting to use the information presented in this report to determine a target Federal program size would require a whole series of additional policy and technical assumptions that go well beyond what is reflected in the report itself.

What is a "Need"?

The current legislative requirement for an "Infrastructure Investment Needs Report" in 23 USC 502(h), and the comparable legislative requirements for this type of report in the past (dating back to 1968 on the highway side and 1984 on the transit side), do not define exactly what a "need" is; economists largely reject a concept of a "need" that is divorced from demand and price considerations. The report series began as a combined "wish list" of State highway needs. Over time, national engineering standards were defined and utilized to develop a set of "needs" on a uniform national basis. As the report series evolved further, economic considerations were brought into the analysis, looking at the impact of system conditions and performance on highway and transit users as well as on highway agencies and transit operators. The current generation of analytical tools attempt to combine engineering and economic procedures, determining deficiencies based on engineering standards while applying benefit-cost analysis procedures to identify potential capital improvements to address those deficiencies that may have positive net benefits.

The investment scenario estimates presented in this report represent an estimate of what level of performance **could** be achieved with a given level of funding, not what **would** be achieved with it. While the models assume that projects are prioritized based on their benefit-cost ratios, that assumption is not consistent with actual patterns of project selection and funding distribution that occur in the real world. Consequently, the level of investment identified as the amount required to maintain a certain performance level should be viewed as the minimum amount that would be required if all other modeling assumptions prove to be accurate.

It is important to note that the benefit-cost analysis procedures currently employed are not equally robust among all of the different types of infrastructure investments covered in this report. Further, this approach does not subject potential capital improvements to the type of rate of return analysis that would typically be employed in the private sector. The United States Department of Transportation (DOT) continues to look for ways to address the limitations of the existing analytical procedures.

Uncertainty in Transportation Investment/Performance Modeling

As in any modeling process, simplifying assumptions have been made to make analysis practical and to meet the limitations of available data. Since the ultimate decisions concerning highways, bridges, and transit systems are primarily made by their owners at the State and local level, they have a much stronger business case for collecting and retaining detailed data on individual system components. The Federal government collects selected data from States and transit operators to support this report, as well as a number of other Federal activities, but these data are not sufficiently robust to make definitive recommendations concerning specific transportation investments in specific locations. While potential improvements are evaluated based on benefit-cost analysis, not all external costs (such as noise pollution) or external benefits (such as the impact of transportation investments on productivity) are fully considered. Across a broad program of investment projects, such external effects may cancel each other; but, to the extent that they do not, the true "needs" may be either higher or lower than would be predicted by the models. This topic is discussed in the Introduction to Part II.

A State or local government performing an investment analysis for a real-world project would presumably have better information concerning the capital costs associated with the project, as well as localized information that would influence the evaluation of the project's potential benefits and external societal costs. To the extent that State and local governments include other factors beyond economic considerations in their investment decision-making process, benefit-cost ratios will not be maximized. In fact, there is mounting evidence that the benefit-cost ratios of highway and public transportation investments have declined significantly in recent years. Moreover, current processes and approaches do little to ensure that investment resources are appropriately targeted.

Impact of Financing Structures on Transportation Investment/Performance Analysis

This report has traditionally identified the amount of additional spending above current levels that would be required to achieve certain performance benchmarks, without incorporating the impact of the types of revenues that would support this additional spending. This approach was in keeping with the general philosophy referenced earlier that the assignment of responsibility for the costs associated with a given scenario to any particular level of government or funding source falls beyond the legislative mandate for this report. However, the implicit assumption built into this approach has been that the financing mechanisms would not have any impact on investment scenarios themselves. In reality, however, increasing funding from general revenue sources (such as property taxes, sales taxes, income taxes, etc.) would have different implications than increased funding from user charges (such as fuel taxes, tolls, and fares).

For this report, a series of parallel highway investment/performance analyses have been developed to compare the implications of funding potential increases in capital spending through non-user based financing mechanisms, fixed rate user financing mechanisms, or variable rate user financing mechanisms. The analyses assuming fixed rate or variable rate user financing presume that any funding to support increases in highway and bridge investment above 2006 levels would be financed by highway users on a per-VMT basis. A feedback loop has been added to the modeling process to account for the impact that this change in the "price" of travel experienced by individual system users would have on projected future travel volumes and overall system performance. The methodology used for these analyses is presented in greater detail in Appendix A.

When highway users make decisions about whether, when, and where to travel, they consider both implicit costs (such as travel time and safety risk) and explicit, out-of-pocket costs (such as fuel costs and tolls). Under uncongested conditions, their use of the road will not have an appreciable effect on the costs faced by other users. As traffic volumes begin to approach the carrying capacity of the road, however, traffic congestion and delays begin to set in and travel times for all users begin to rise, with each additional vehicle making the situation progressively worse. However, individual travelers do not take into account the delays and additional costs that their use of the facility imposes on other travelers, focusing instead only on the costs that they bear themselves. To maximize net social benefits, users of congested facilities would be levied charges precisely corresponding to the economic cost of the delay they impose on one another, thereby more efficiently spreading traffic volumes and allowing the diverse preferences of users to be expressed. In the absence of efficient pricing, options for reducing congestion externalities and increasing societal benefits are limited. In addition, the efficient level of investment in highway capacity is larger under the current system of highway user charges (primarily fuel and other indirect taxes) than would be the case with full-cost pricing of highway use.

The variable rate user financing analyses presented in this report assume the immediate widespread adoption of congestion pricing on all Federal-aid Highways, with peak period charges set independently for individual congested highway sections based on the estimated cost of the negative impact that each driver has on all other users of that section. The projected revenue that would be generated from such congestion charges was then applied to cover the difference between the investment level being studied and the current 2006 level of combined public and private highway capital investment. If the revenue from these variable rate charges would not be sufficient for this purpose, the analyses assumed the imposition of an additional fixed rate charge. In cases where projected congestion pricing revenue exceeded the level needed to support the level of investment being studied, a negative fixed rate charge was applied, simulating the effects of lowering existing fuel taxes, fixed rate tolls, or other fees imposed on highway users.

While the above discussion focuses on highway pricing, the same considerations may apply to transit investments. Anecdotal evidence suggests that transit routes in major metropolitan areas are approaching their passenger-carrying capacities during peak travel hours, with a commensurate deterioration in the quality of service. Some of this crowding could be reduced by increasing fares during peak hours. Certain considerations, however, may limit the ability of transportation authorities to price transit services more efficiently, such as the ability of the fare system to handle peak pricing, and the desire to provide transit as a low-cost service to transit-dependent riders. Additionally, the fact that overcrowded transit lines are often in corridors with heavily congested highways makes a joint solution to the pricing problems on both highways and transit more complicated to analyze, devise, and implement. Measuring the actual crowding on transit systems during peak periods, and the development of a more sophisticated crowding metric than the one currently used by FTA, are areas for further research.

Impact of New Technologies

The highway investment analysis procedures used to develop the investment scenarios for this report have been modified to reflect the impact that certain types of operational strategies and intelligent transportation systems (ITS) deployments may have on system performance in the future, based on current deployment trends. However, any more aggressive and effective deployment of ITS and other technologies beyond that modeled in this analysis is expected to further reduce the level of future capacity investment required to achieve any specific level of performance. The sensitivity analysis in Chapter 10 explores the potential impacts of more rapid deployment of existing technologies.

New technology holds promise in other areas as well. Improved pavement and bridge technologies have the potential to reduce future system rehabilitation costs, while improved highway and transit vehicle technologies could interact with ITS deployments to enhance operating efficiency. The baseline analyses presented in this report do not attempt to assume the future impacts of these types of technological improvements, but it is important to recognize their potential when considering the findings of this report. The sensitivity analysis in Chapter 10 explores the potential impacts of a significant extension of pavement life. Further discussion of new technologies is included in Part IV.

What Does it Mean to "Maintain?"

There are many different ways to measure well how various components of the transportation system are operating; no single performance metric captures all aspects of system conditions and performance. The "Maintain" scenarios presented in this report each point to a level of capital investment that could keep the conditions and performance of the overall system 20 years from now in roughly the same shape that it is in today. The "Maintain" scenarios are defined differently in this report for different system components. This is because of the different characteristics of the highway, bridge, and transit systems; the capability of the different analytical tools to analyze highway, bridge, and transit investment for this report; and the limitations of the underlying data.

The highway investment/performance analyses presented in this report identify the potential impacts of a range of alternative investment levels on varying indicators of system conditions and performance. The primary "Maintain" scenarios for highways focus on maintaining adjusted highway user costs, reflecting the impact that the physical conditions and operational performance of the highway system has on highway users. An alternative "Maintain" scenario for highways identifies levels of investment in pavement improvements that could be adequate to sustain average pavement conditions for various subsets of the highway system at base year levels, and the level of system expansion investment that could be adequate to keep average traveler delay from rising. The "Maintain" scenarios for bridges reflect estimated levels of investment that could be sufficient to keep the backlog of economically justifiable bridge improvements in 20 years at the same size as it is today. The "Maintain" scenarios for transit reflect the estimated level of investment that would be sufficient to accelerate the rehabilitation and replacement of transit assets to achieve the following objectives: (1) to keep the average transit asset condition in 20 years equal to the average transit asset condition in the base year, and (2) to have the average occupancy rate for each mode, as measured by passenger miles per peak vehicle, remain the same in 20 years as in the base year.

In each case, the investment scenarios outlined in this report represent an estimate of what level of performance **could** be achieved with a given level of funding, not what **would** be achieved with it. While the models assume that projects are prioritized based on their benefit-cost ratios, that assumption is not consistent with actual patterns of project selection and funding distribution that occur in the real world. Consequently, the level of investment identified as the amount sufficient to maintain a certain performance level should be viewed as the minimum amount that would be sufficient if all other modeling assumptions prove to be accurate.

While the investment scenarios presented in this report focus on sustaining conditions at base-year levels, the base year is different for each edition of the report; i.e., the prevailing conditions and performance in the 2006 base year analyzed in this report differ from those for the 2004 base year presented in the 2006 edition of the report. Hence, as the level of current system conditions and performance varies over time, the investment scenarios that are based on maintaining the status quo are effectively targeting something different each time. It is important to recognize this when comparing the results of different reports in the series.

It should be noted that some of the investment scenarios in this report have been renamed using the term "sustain" rather than "maintain." This change was made to reduce confusion as all of the scenarios pertain to capital improvements only, and none includes the costs associated with routine maintenance.

What Does it Mean to "Improve?"

In theory, if the estimated investment level associated with a "Maintain" scenario is accurate, and the "correct" projects are chosen, then spending $1 more than that level would result in an improved system. In practice, the "Improve" scenarios in this report have been more aggressive, picking some higher target level of future conditions and performance. Three alternative "Improve" scenarios for highways are presented, which focus on identifying levels of investment at which all potential projects with benefit-cost ratios of 1.5, 1.2, and 1.0, respectively, could be implemented. The scenarios reflecting a minimum benefit-cost ratio of 1.0 can be viewed as an "investment ceiling" above which it would not be cost beneficial to invest, even if unlimited funding were available. The scenarios reflecting higher minimum benefit-cost ratios are included in recognition that available funding is not unlimited, and many decisions on highway funding levels must be weighed against potential cost beneficial investments in other government programs and across various industries within the private sector that would produce more benefits to society.

Due to limitations in data availability and current analytical modeling capabilities, the "Improve" scenarios for bridges and transit are defined differently from those for highways. The "Improve" scenarios for bridges reflect the estimated level of investment that would be sufficient to eliminate the backlog of economically justifiable bridge improvements by the end of 20 years. The "Improve" scenarios for transit reflect the estimated level of investment that would be sufficient to accelerate the rehabilitation and replacement of transit assets to achieve the following objectives: (1) to reach an average condition of "good" for transit assets at the end of the 20-year period, (2) to reduce vehicle occupancy levels in agency-modes with occupancy levels one deviation above the national average to that level, and (3) to increase speeds in urbanized areas with average speeds one deviation below the national average to that level by investing in new rail or bus rapid transit service. Two sets of "Improve" transit scenarios are presented which reflect costs associated with those agency-modes passing an initial benefit-cost ratio screen of 1.0 or 1.2, respectively. [Note the term agency-mode refers to each mode (e.g. passenger rail, motor bus, etc.) within each transit agency.]

It is important to recognize several key limitations of the "Improve" scenarios presented in this report. First, while the models assume that projects are prioritized based on their benefit-cost ratios, that assumption is not consistent with actual patterns of project selection and funding distribution that occur in actual practice. Consequently, if investment rose to the levels identified in the "Improve" scenarios, there are few mechanisms to ensure that these funds would be invested in projects that would be cost beneficial. As a result, the impacts on actual conditions and performance may be far less significant than what is projected for these scenarios. Second, simple benefit-cost analysis is not a commonly utilized capital investment model in the private sector. Instead, firms utilize a rate of return approach focusing on cash revenues and costs and compare various investment options and their corresponding risk. In other words, a project that is barely cost beneficial would almost certainly not be undertaken when compared to an array of investment options that potentially produce higher returns at equivalent or lower risk. Third, these scenarios do not address practical considerations concerning whether the highway and transit construction industries would be capable of absorbing such a large increase in funding within the 20-year analysis period. Such an expansion of infrastructure investment could significantly increase the rate of inflation within these industry sectors, a factor that is not considered in the constant dollar investment analyses presented in this report. Fourth, the legal and political complexities frequently associated with major highway capacity projects might preclude certain improvements from being made, even if they could be justified on benefit-cost criteria. In particular, the time required to move an urban capacity expansion project from "first thought" to actual completion may well exceed the 20-year analysis period.

Highlights: Highways and Bridges

In nominal dollar terms, combined investment by all levels of government in highway and bridge infrastructure has increased sharply since TEA-21 was enacted. Total highway expenditures by Federal, State, and local governments increased by 58.0 percent between 1997 and 2006, to $161.1 billion. Highway capital spending alone rose from $48.4 billion in 1997 to $78.7 billion in 2006, a 62.7 percent increase. However, recent sharp increases in highway construction costs have eroded the purchasing power of this investment; in constant dollar terms, capital spending fell by 4.4 percent over this period. The FHWA Composite Bid Price Index increased by 43.3 percent between 2004 and 2006 due to sharp increases in the prices of materials such as steel, asphalt, and cement.

Because the Federal-aid Highway program is a multiple-year reimbursable program, the impact of increases in obligation levels phases in gradually over a number of years. The portion of total highway capital spending funded by the Federal government rose from 41.6 percent to 44.0 percent between 1997 and 2006. This share dipped below 40 percent in 1998 for the first time since 1959; TEA-21's passage relatively late in fiscal year 1998 reduced its impact on cash expenditures during that initial year, but subsequently this share rebounded up to 46 percent in 2002 before tailing back off more recently to the 44 percent to 45 percent range.

The TEA-21 era and the early portion of the SAFETEA-LU era have also coincided with a shift in the types of capital improvements being made by State and local governments. The portion of capital investment going for "system rehabilitation" (the resurfacing, rehabilitation, or reconstruction of existing highway lanes and bridges) increased from 47.6 percent in 1997 to 51.3 percent in 2006. The percentage of capital spending directed towards "system expansion" (the construction of new highways and bridges and lane additions to existing highways) decreased from 44.4 percent to 38.2 percent over this period, while the portion used for "system enhancement" (including safety enhancements, traffic control facilities, and environmental enhancements) increased from 8.0 percent to 10.5 percent.

Investment in system rehabilitation rose by 0.4 percent in constant dollar terms between 1997 and 2006, despite the overall decline of 4.4 percent for all capital spending over this period noted above. Funding for system enhancement rose by 22.7 percent in constant dollar terms over this period, while investment in system expansion decreased by 14.2 percent in constant dollar terms.

Physical Conditions Have Improved in Some Areas

The increase in system rehabilitation investment since 1997 has had a positive effect on the physical condition of key subsets of the Nation's highway and bridge infrastructure. The National Highway System (NHS) includes those roads that are most important to interstate travel, economic expansion, and national defense. While the NHS makes up only 4.0 percent of total mileage, it carries 44.6 percent of total travel in the United States. The percentage of NHS VMT on pavements with "good" ride quality rose from 39 percent in 1997 to 57 percent in 2006. The share of NHS VMT on roads with "acceptable" ride quality (a lower standard that includes roads classified as "good") has also increased over this period, from 89 percent to 93 percent. The percentage of deck area on NHS bridges classified as deficient declined from 33.0 percent in 1997 to 29.2 percent in 2006. About three-quarters of deficiencies on NHS bridges relate to functional obsolescence rather than to structural issues; some NHS bridges are narrower than current design standards would call for given the traffic volumes they currently carry.

Looking beyond the NHS to all arterials and collectors for which pavement condition data are collected reveals less favorable trends. While the percentage of all VMT on pavements with "good" ride quality rose from 39.4 percent in 1997 to 47.0 percent in 2006, the share of VMT on roads with "acceptable" ride quality fell from 86.4 percent to 86.0 percent. While the percentage of pavements with acceptable ride quality has been growing in rural and small urban areas, urbanized areas have experienced declines.

The raw share (not weighted by deck area) of all bridges classified as deficient dropped from 32.7 percent in 1997 to 27.6 percent in 2006. Most of this decline was the due to reductions in the percent of structurally deficient bridges. Bridge conditions tend to vary by functional system; for example, the percentage of Interstate bridges classified as structurally deficient or functionally obsolete is lower than the comparable percentages for bridges on collectors or local roads.

Operational Performance Has Declined, But Shows Signs of Stabilizing

Despite improving conditions on many roads and bridges, operational performance—the quality of use of that infrastructure—has deteriorated since 1997. This is reflected in measures of congestion in all urbanized areas developed for FHWA by the Texas Transportation Institute (TTI). From 1997 to 2005, the estimated percentage of travel occurring under congested conditions rose from 24.9 percent to 28.7 percent; however, this statistic increased by only 0.1 percentage point between 2004 and 2005. The average length of congested conditions increased from 5.9 hours per day in 1997 to 6.4 hours per day, but has remained constant at that level since 2002. TTI estimates that drivers experienced over 4.2 billion hours of delay and wasted approximately 2.9 billion gallons of fuel in 2005.

Highway Safety Has Improved

Considerable progress has been made in reducing fatality rates and injury rates over time, including the period from 1997 through 2006. The fatality rate per 100 million VMT has declined from 1.64 to 1.41 over that period. The actual number of highway fatalities has remained relatively constant over this period, remaining in a range from 41,500 to 43,500 per year. The injury rate per 100 million VMT declined from 131 in 1997 to 85 in 2006. Preliminary data for 2007 show a decline in both fatalities and injuries.

Highway safety remains a top priority within the DOT, and the improvement of the Nation's roadway infrastructure is an important component of the effort to reduce highway fatalities and injuries.

Future Capital Investment Scenarios

This report includes a series of highway and bridge investment/performance analyses examining 24 alternative levels of future combined public and private capital spending for the period from 2007 through 2026, each of which assumes a uniform annual rate of increase or decrease relative to the $78.7 billion of combined highway capital spending in 2006. These alternatives covered a wide range of possible future spending, extending from a level consistent with a decrease in capital spending in constant dollar terms of 7.64 percent per year (equating to an average annual investment level of $37.9 billion over 20 years) up to a level consistent with an annual constant dollar increase in capital spending of 7.76 percent per year (equating to an average annual investment level of $188.9 billion for the period from 2007 through 2026).

Drawing upon these investment/performance analyses, a series of illustrative scenarios were selected for further exploration and presentation in more detail. For each type of scenario, two versions were developed assuming any increases in investment would be supported by either a fixed rate user financing mechanism (such as tolls, VMT charges, or fuel taxes) or a variable rate user financing mechanism (such as congestion pricing). The scenario criteria were applied separately to the Interstate System, the NHS, and the highway system overall.

The **Sustain Current Spending scenarios** assume that capital spending is maintained in constant dollar terms at base year 2006 levels between 2007 and 2026. The **Sustain Conditions and Performance scenarios** assume that capital investment gradually changes in constant dollar terms over 20 years to the point at which future conditions and performance would be maintained at a level sufficient to keep adjusted average user costs and the economic backlog of potential bridge investments from rising above their 2006 levels, based on projections of future highway use.

Three scenarios are presented that would each improve overall system conditions and performance. The **MinBCR=1.5 scenario** assumes that investment gradually increases in constant dollar terms over 20 years up to the point at which all potential capital improvements with a benefit-cost ratio of 1.5 or higher are funded by 2026, and the economic backlog of potential bridges investment is reduced to zero. The **MinBCR=1.2 scenario** makes the same assumptions, but at a benefit-cost ratio of 1.2 or higher. The **MinBCR=1.0 scenario**, meanwhile, assumes that investment gradually increases over 20 years up to the point at which all potentially cost beneficial investments are funded by 2026; the version of this scenario assuming variable rate user financing (i.e., congestion pricing) is also described as the **Maximum Economic Investment scenario**.

Interstate System Scenarios

All levels of government spent a combined $16.5 billion in 2006 on capital improvements to the Interstate Highway System. Assuming fixed rate user financing, system conditions and performance are projected to decline below base-year levels at this level of investment. Achieving the **Sustain Conditions and Performance scenario** objectives would require an annual spending increase of 3.71 percent in constant dollar terms, translating into an average annual investment level of $25.8 billion over the period from 2007 through 2026, stated in constant 2006 dollars. The average annual investment levels for this period associated with the **MinBCR=1.5**, **MinBCR=1.2**, and **MinBCR=1.0 scenarios** are $39.0 billion, $43.5 billion, and $47.0 billion, respectively, translating into annual constant dollar spending growth rates

Derivation of the Highway Capital Investment Scenarios

The highway capital investment scenarios presented in this report are derived from separate analyses developed using the Highway Economic Requirements System (HERS), the National Bridge Investment Analysis System (NBIAS), combined with estimates for types of highway capital investments that are not presently modeled. Separate versions of each scenario are presented based on alternative assumptions about future financing mechanisms (as the manner in which future investment is financed would have an impact on future VMT), and the scenario criteria are applied separately to the Interstate Highway System, the National Highway System, and all roads combined.

1) The first step in developing the highway capital investment scenarios is determining the portion of current highway capital spending that is equivalent to the investment types that are modeled in HERS, modeled in NBIAS, or not currently modeled. [*See Exhibit 7-1.*]
2) The second step is to specify a series of alternative spending levels for HERS or NBIAS to analyze.
   a) Each alternative is determined by applying a uniform annual rate of growth (or decline) in constant dollar terms relative to actual expenditures in 2006 for the system component being analyzed. [*See Exhibit 7-2.*]
   b) For example, highway capital spending totaled approximately $78.7 billion in 2006. If spending were to grow by 1 percent per year in constant dollar terms, this would translate into annual levels (all stated in constant 2006 dollars) of $79.5 billion in 2007, $80.3 billion in 2008, $81.1billion in 2009, etc., reaching $96.0 billion in 2026, producing a 20-year total of $1.75 trillion, which would translate into an average annual investment level of $87.5 billion in constant 2006 dollars.
   c) Each individual HERS model run tied to a specified alternative spending level produces a series of outputs, including projections of future measures of system conditions and performance such as average pavement condition, average delay, adjusted average user costs, and the economic backlog of bridge investments; HERS also identifies the benefit-cost ratio of the last project implemented (as the model assumes available funding will be directed to projects with the highest values first). NBIAS produces output on the economic bridge investment backlog, representing bridge investments that would be cost-beneficial.
3) The third step is to identify the individual HERS and NBIAS runs that would meet the criteria defined for a specific scenario. This step must be repeated for each financing mechanism (fixed rate user financing or variable rate user financing) and system subset (Interstate, NHS, or all roads) being analyzed.
   a) By definition, the **Sustain Current Spending scenario** assumes no growth in constant dollar spending (i.e., that spending will keep pace with future inflation), and that future investments in the types of improvements modeled in HERS and NBIAS would remain unchanged for the system subset being analyzed.
   b) The HERS component of the **Sustain Conditions and Performance scenario** is defined as the level of investment that results in adjusted average user costs in 2026 matching those in 2006. [*See Exhibits 7-5, 7-15, and 7-18 for information on all roads, the NHS, and the Interstate System, respectively.*] The NBIAS component is defined as the level of investment at which the economic bridge investment backlog in 2026 would match that in 2006. [*See Exhibits 7-21, 7-12, and 7-23.*]
   c) The HERS component of the **MinBCR=1.5 scenario** is defined as the level of investment for which the lowest benefit-cost ratio for any project implemented would be exactly 1.5. The HERS component of the **MinBCR=1.2** and **MinBCR=1.0 scenarios** are defined in the same manner, except that their benefit-cost ratio cutoffs are 1.2 and 1.0, respectively. [*See Exhibit 7-14.*] The NBIAS component of all three of these scenarios is defined as the level of investment that would eliminate the economic bridge investment backlog by 2026. [*See Exhibits 7-21, 7-12, and 7-23.*]
4) The final step is to combine the investment levels identified for the separate HERS and NBIAS analyses meeting the criteria for the scenario; the combined results are then adjusted upwards to account for types of capital investments that are not captured in either model. [*See Exhibits 8-1, 8-6, and 8-11.*]

of 7.61 percent, 8.52 percent, and 9.15 percent. Each of these higher investment levels would achieve progressively larger improvements to Interstate System conditions and performance, but would be subject to diminishing returns, because each would incorporate a progressively larger share of projects with relatively smaller net benefits.

Assuming variable rate user financing, with congestion charges imposed immediately on a widespread basis and with rates set at a level consistent with the cost each driver imposes on other drivers on a congested facility, system conditions and performance would be projected to improve if spending were sustained at $16.5 billion per year in constant dollar terms. The objectives of the **Sustain Conditions and Performance scenario** could be achieved even if annual spending were to decrease by 3.49 percent in constant dollar terms, translating into an average annual investment level of $11.6 billion over the period from 2007 through 2026. The average annual investment levels for this period associated with the **MinBCR=1.5**, **MinBCR=1.2**, and **MinBCR=1.0 scenarios** are $24.0 billion, 27.5 billion, and $30.4 billion, respectively, translating into annual constant dollar spending growth rates of 3.43 percent, 4.64 percent, and 5.49 percent. Each of these investment levels is stated in constant 2006 dollars.

The estimated annual revenue that would be generated by the congestion charges on the Interstate System range from $20.1 billion for the **MinBCR=1.0 scenario** up to $29.9 billion for the **Sustain Conditions and Performance scenario**, stated in constant 2006 dollars. The scenarios with higher overall spending levels would generate less revenue, because the additional capacity expansion investments included in these scenarios would cause the overall level of congestion to be lower, so that drivers have smaller negative impact on each other. For all of these scenarios, the amount of congestion pricing revenue generated would be more than sufficient to cover the additional spending associated with that scenario. While these analyses assumed that such surplus revenues would be rebated to highway users in the form of reductions to existing fixed rate user charges (such as fixed rate tolls or fuel taxes), they could also be used to support increased investment in transit, or for other purposes.

NHS Scenarios

All levels of government spent a combined $37.1 billion in 2006 on capital improvements to the NHS. Assuming fixed rate user financing, system conditions and performance are projected to decline below base-year levels at this level of investment for the period through 2026. Achieving the **Sustain Conditions and Performance scenario** objectives would require an annual spending increase of 0.41 percent in constant dollar terms, translating into an average annual investment level of $38.7 billion over the period from 2007 through 2026, stated in constant 2006 dollars. The average annual investment levels for this period associated with the **MinBCR=1.5**, **MinBCR=1.2**, and **MinBCR=1.0 scenarios** are $60.7 billion, $69.2 billion, and $76.1 billion, respectively, translating into annual constant dollar spending growth rates of 4.49 percent, 5.62 percent, and 6.43 percent. As these growth rates are smaller than those identified for the comparable Interstate scenarios above, this suggests that current spending on the non-Interstate portions of the NHS is addressing a greater share of capital investment needs than is current spending on the Interstate System.

Assuming variable rate user financing (i.e., widespread congestion pricing), system conditions and performance would be projected to improve if spending were sustained at $37.1 billion per year in constant dollar terms. The objectives of the **Sustain Conditions and Performance scenario** could be achieved even if annual spending were to decrease by 6.54 percent in constant dollar terms, translating into an average annual investment level of $19.6 billion over the period from 2007 through 2026. The average annual investment levels for this period associated with the **MinBCR=1.5**, **MinBCR=1.2**, and **MinBCR=1.0 scenarios** are $38.9 billion, $44.9 billion, and $50.1 billion, respectively, translating into annual constant dollar spending growth rates of 0.46 percent, 1.80 percent, and 2.79 percent. Each of these investment levels is stated in constant 2006 dollars.

The estimated annual revenue that would be generated by the congestion tolls on the NHS system range from $30.0 billion for the **MinBCR=1.0 scenario** up to $42.9 billion for the **Sustain Conditions and Performance scenario**, stated in constant 2006 dollars. For all of these scenarios, the amount of congestion pricing revenue generated would be more than sufficient to cover the additional spending associated with that scenario.

Systemwide Scenarios

All levels of government spent a combined $78.7 billion in 2006 on capital improvements to roads and bridges. Assuming fixed rate user financing, system conditions and performance are projected to decline below base year levels at this level of investment for the period through 2026. Achieving the **Sustain Conditions and Performance scenario** objectives would require an annual spending increase of 2.72 percent in constant dollar terms, translating into an average annual investment level of $105.6 billion over the period from 2007 through 2026, stated in constant 2006 dollars. The average annual investment levels for this period associated with the **MinBCR=1.5**, **MinBCR=1.2**, and **MinBCR=1.0 scenarios** are $137.4 billion, $157.1 billion, and $174.6 billion, respectively, translating into annual constant dollar spending growth rates of 5.05 percent, 6.21 percent, and 7.10 percent. As these growth rates are higher than those identified for the comparable NHS scenarios above, this suggests that current spending on the NHS is addressing a greater share of capital investment needs than is current spending off of the NHS.

Assuming variable rate user financing, system conditions and performance would be projected to improve if spending were sustained at $78.7 billion per year in constant dollar terms. The objectives of the **Sustain Conditions and Performance scenario** could be achieved even if spending were to decrease by 0.94 percent per year in constant dollar terms, translating into an average annual investment level of $71.3 billion over the period from 2007 through 2026. The average annual investment levels for this period associated with the **MinBCR=1.5**, **MinBCR=1.2**, and **MinBCR=1.0 scenarios** are $101.8 billion, $117.2 billion, and $131.3 billion, respectively, translating into annual constant dollar spending growth rates of 2.40 percent, 3.65 percent, and 4.66 percent. Each of these investment levels is stated in constant 2006 dollars.

The estimated annual revenue that would be generated by the congestion tolls on the system as a whole range from $38.1 billion for the **MinBCR=1.0 scenario** up to $47.0 billion for the **Sustain Conditions and Performance scenario**, stated in constant 2006 dollars. In this case, the level of revenue generated under the **MinBCR=1.0 scenario** was insufficient to cover the full cost of the scenario, so the analysis assumed an additional fixed rate user charge would be applied to cover the difference.

While the **Sustain Current Spending scenario** and the **Sustain Conditions and Performance scenario** are not defined in terms of specific minimum benefit-cost ratio thresholds, the underlying analyses used to develop these scenarios do indicate the benefit-cost ratio of the last project selected. The fixed rate user financing and variable rate user financing versions of the **Sustain Current Spending scenario** for all roads are associated with benefit-cost ratio cutoffs of 2.89 and 1.90, respectively. The comparable values for the fixed rate user financing and variable rate user financing versions of the **Sustain Conditions and Performance scenario** for all roads are 1.98 and 2.25, respectively.

Supplemental Systemwide Scenarios

Two supplemental scenarios were developed at the systemwide level only. The **Sustain Conditions and Performance of System Components scenario** represents a more aggressive "Maintain" scenario than the **Sustain Conditions and Performance scenario** discussed above. Rather than targeting average conditions and performance on a systemwide basis, the **Sustain Conditions and Performance of System Components scenario** would sustain average pavement condition and traveler delay on each individual highway functional system at 2006 levels where it is cost beneficial to do so.

The **Sustain Conditions and Improve Performance scenario** represents a hybrid between a "Maintain" and an "Improve" scenario, combining system rehabilitation investments from the **Sustain Conditions and Performance of System Components scenario** with system expansion investments from the **MinBCR=1.0 scenario**.

Assuming fixed rate user financing, achieving the goals of the **Sustain Conditions and Performance of System Components scenario** would require an annual spending increase of 3.83 percent in constant dollar terms, translating into an average annual investment level of $119.5 billion over the period from 2007 through 2026. The average annual investment level for this period associated with the **Sustain Conditions and Improve Performance scenario** is $145.3 billion stated in constant 2006 dollars, translating into an annual constant dollar spending growth rate of 5.54 percent.

Assuming variable rate user financing, the objectives of the **Sustain Conditions and Performance of System Components scenario** could be achieved if spending were to increase by 0.55 percent per year in constant dollar terms, translating into an average annual investment level of $83.4 billion over the period from 2007 through 2026. The average annual investment level for this period associated with the **Sustain Conditions and Improve Performance scenario** is $104.9 billion stated in constant 2006 dollars, translating into an annual constant dollar spending growth rate of 2.67 percent.

Highlights: Transit

Record levels of Federal investment in transit under TEA-21 were not only matched, but exceeded by the combined investments of State and local governments from 1997 through 2006. Total funding by Federal, State, and local governments reached its highest level of $30.9 billion in 2006, a 76.9 percent increase in current dollars from $17.5 billion in 1997, equal to a 40.9 percent increase in constant dollar terms (the gross domestic product deflator was used to develop constant dollar estimates). Federal funding in current dollars increased by 70.3 percent, from $4.7 billion in 1997 to $8.1 billion in 2006, equal to a 35.6 percent increase in constant dollar terms. State and local funding in current dollars increased by 79.4 percent, from $12.7 billion in 1997 to $22.8 billion in 2006, equal to a 42.8 percent increase in constant dollar terms Total funding for transit, including system-generated revenues, increased by 66.8 percent, from $26.0 billion in 1997 to $43.4 billion in 2006, an increase of 32.8 percent in constant dollars.

In 2006, total transit agency expenditures for capital investment were $12.8 billion in current dollars, accounting for 29.3 percent of total transit spending. Federal funds provided $5.6 billion of total transit agency capital investments, State funds provided $1.7 billion, and local funds provided $5.5 billion. Capital investment funding for transit from the Federal government increased by 34.2 percent from 1997 to 2006, and capital investment funding for transit from State and local sources increased by 105.7 percent from 1997 to 2006. Between 2004 and 2006, State and local funding for transit capital expenditures declined by 6.5 percent. Federal funding for transit capital investment was $4.1 billion in 1997 and $5.6 billion in 2006.

Transit Infrastructure Has Expanded

The significant growth in total capital investment under TEA-21 is reflected in an expansion of the Nation's transit infrastructure. Between 1997 and 2006, the number of active urban transit vehicles as reported to the National Transit Database increased by 25.3 percent, from 102,258 to 128,132. Track mileage grew by 18.9 percent, from 9,922 miles in 1997 to 11,796 miles in 2006. The number of stations increased by 13.9 percent, from 2,681 in 1997 to 3,053 in 2006; and the number of urban maintenance facilities increased by 11.5 percent, from 729 in 1997 to 813 in 2006.

Transit Use Has Increased

With new and modernized transit vehicles and facilities, passenger use has also increased, particularly transit rail use. Passenger miles traveled (PMT) on transit increased by 23.1 percent, from 40.2 billion in 1997 to 49.5 billion in 2006. PMT on nonrail transit (primarily buses) increased by 18.4 percent, from 19.0 billion in 1997 to 22.5 billion in 2006. PMT on rail increased by 28.0 percent, from 21.1 billion in 1997 to 27.0 billion in 2006. The distance traveled by all transit vehicles in revenue service, adjusted for differences in carrying capacities, increased by 31.8 percent, from 3.5 billion full-capacity bus miles in 1997 to 4.6 billion equivalent miles in 2006.

Physical Conditions for Most Assets Have Improved

The FTA uses a numerical scale ranging from 1 to 5 to describe the condition of transit assets. A rating of 5, or "excellent," indicates that the asset is in nearly new condition or lacks visible defects. At the other end of the scale, a rating of 1 indicates that the asset needs immediate repair and may have one or more seriously damaged components. In between, 2 indicates "poor," a condition rating of 3 indicates "adequate" condition, and a condition rating of 4 indicates the asset is in "good" condition. It is important to note that the numerical scale used by FTA is continuous, meaning that condition ratings may take on any value within the 1 to 5 interval. For the purposes of this report, state of good repair was defined using TERM's numerically based system for evaluating transit asset conditions. Specifically, this report considers an asset to be in a state of good repair when the physical condition of that asset is at or above a specific condition rating value of 2.5 (the mid-point between adequate and marginal). Similarly, an entire transit system would be in a state of good repair if all of its assets have an estimated condition value of 2.5 or higher. The level of investment required to attain and maintain a state of good repair is therefore that amount required to rehabilitate and replace all assets with estimated condition ratings that are less than this minimum condition value.

Bus and rail vehicle conditions have improved since 1997. Bus vehicle condition ratings increased from 2.94 in 1997 to 3.01 in 2006. However, it should be noted that average bus vehicle conditions have declined since 2004, with an average estimated condition of 3.08. Rail vehicle condition ratings increased from 3.42 in 1997 to 3.51 in 2006, representing the highest condition rating over that time period.

Urban bus maintenance facility condition ratings improved slightly from 3.23 in 2000 to 3.26 in 2006. Average condition is not available for 1997. Sixty-four percent of all urban bus maintenance facilities were in adequate (3) or better condition in 2006, compared with 67 percent in 2000 and 77 percent in 1997. Rail facility condition ratings improved from 3.18 in 2000 to 3.68 in 2006. As with buses, average condition is not available for 1997. Approximately 74 percent of rail facilities were estimated to be in adequate or better condition in 2006, compared with 80 percent in 2002 and 77 percent in 1997. (Note that the deterioration schedules used to estimate 1997 facility conditions were revised and that 1997 conditions are not directly comparable to those for 2002 and 2004.)

Between 2004 and 2006, the conditions of track and structures declined, with vehicle storage yards improving slightly. The average condition rating estimates for systems, including traction power, communications, and revenue collection, declined from 2004 to 2006. However, one component of systems, train control, improved slightly during this time period from 3.39 to 3.50. The condition ratings of rail stations increased from 3.37 in 2004 to 3.53 in 2006. The changes in the conditions of nonvehicle assets reflect both actual changes and changes based on new information. The nonvehicle transit asset data used by FTA to estimate conditions are updated for selected operators with each report cycle. Most of this information is not reported to the NTD and must be collected directly from transit agencies.

Comparison: Rail Modernization and the Conditions and Performance Report

In February of 2009, FTA released a Report to Congress on Rail Modernization. The objective of that study was to assess what steps would be needed to overcome capital investment backlogs at the nation's seven largest transit rail operators. Data from those operators that were used for that study are consistent with data used for this report. However, the C&P report also includes data representing the rest of the Nation's transit systems. The two reports vary in terms of scope, scenarios, key assumptions, and types of analyses.

The key distinguishing factor between the reports is the selection of scenarios. For the Rail Modernization analysis, the focus centered upon determining the level of investment required to bring all assets to a **State of Good Repair,** which for the purposes of the report was defined as:

- **State of Good Repair:** A state of good repair was defined using TERM's numerically based condition rating scale of 1 to 5 (poor to excellent) for evaluating transit asset conditions. An asset or a transit system is considered be in a state of good repair if the asset or system has an estimated condition value of 2.5 or higher (the mid-point between adequate (3) and marginal (2)). The level of investment required to attain and maintain a state of good repair is therefore that amount required to rehabilitate and replace all assets with estimated condition ratings that are less than this minimum condition value. The backlog to achieve a state of good repair includes the cost of postponed rehabilitations.

The C&P report traditionally focuses upon four primary investment scenarios, including:

- **Maintain Conditions:** Transit assets are replaced and rehabilitated over the 20-year period such that the average condition of the assets existing at the beginning of the period remains the same at the end of the period.
- **Maintain Performance**: New transit vehicles and infrastructure investments are undertaken to accommodate increases in transit ridership so that the vehicle utilization rate existing at the beginning of the period remains the same at the end of the period.
- **Improve Conditions:** Transit asset rehabilitation and replacement is accelerated to improve the average condition of all transit assets to a "good" level (4) at the end of the 20-year period (2026). However, if an average condition of good can be reached only by replacing assets that are still in operationally acceptable condition, then the "Improve Conditions" scenario instead targets a slightly lower condition level.
- **Improve Performance:** The performance of the Nation's transit system is improved as additional investments in bus rapid transit, light rail, or heavy rail are undertaken in urbanized areas with the most crowded vehicles and the systems with the slowest speeds to reduce vehicle utilization rates (and crowding) and increase average transit operating speeds.

Further, the C&P report scenarios have differing maintain and improve condition rating standards by asset category (guideway, facilities, systems, stations, and vehicles). One limitation of these scenarios is that the concept of backlog is not well defined, and the estimates do not include postponed rehabs.

In addition to the differences in the scenarios, the two studies vary in the base year dollars employed (2008 vs. 2006) and the application of benefit-cost tests. TERM's benefit-cost test was not used for the Rail Modernization study; thus, the cost effectiveness of the investments required to attain a state of good repair was not considered. The Rail Modernization study can be described as an "engineering approach" while the C&P report takes more of an "economic approach." They are equally valid, within the limits of their assumptions. Future C&P reports will include a version of the **State of Good Repair** scenario.

Operational Performance

FTA analyzes speed and vehicle utilization on the basis of the direction of their change only, as the optimal levels are unknown. While transit speed and utilization are frequently inversely related, this relationship may not always hold; it appears to hold most consistently for major rail modes. Vehicle speed on nonrail modes may be affected by road congestion, and capacity utilization may be affected by changes in agency-reported vehicle passenger-carrying capacities.

Vehicle speed is calculated by dividing vehicle revenue miles by vehicle revenue hours and, therefore, takes into account the effects of the number of stops, vehicle dwell times, road congestion, and operational deficiencies on average vehicle speed. In 2006, average vehicle speed was 20.0 miles per hour compared with 20.1 in 2004 and 19.6 miles per hour in 2002. Average nonrail vehicle speed was 14.4 miles per hour in 2006 compared with 14.0 miles per hour in 2004. Average rail vehicle speed in 2006 was 24.8 miles per hour, which was lower than the 25.0 miles per hour observed in 2004.

Vehicle utilization is measured by the ratio of passenger miles traveled to vehicles operated in maximum service, adjusted to take into account differences in vehicle capacity. The utilization of heavy rail, commuter rail, and light rail overall increased from 1997 to 2000 and declined from 2001 to 2003, moving inversely with rail speeds. For 2006, utilization for heavy rail and commuter rail declined while utilization for light rail increased in comparison to 2004 levels.

Vehicle utilization of motor bus was higher in 2006 than in 1997. For all other nonrail modes, including demand response, ferryboat, trolleybus, and vanpool, vehicle utilization has declined since that time.

Potential Transit Capital Investment Impacts

Select Capital Investment Scenarios

The average annual **Maintain Conditions and Performance scenario** for transit asset conditions and operating performance is estimated to be $15.1 billion, compared with the $12.8 billion in actual 2006 capital spending. Asset expansion accounts for 28 percent of these projected funding requirements.

This estimated $15.1 billion investment to maintain transit conditions and performance is based on maintaining transit asset conditions and on expanding service to meet an increase in ridership consistent with metropolitan planning organization (MPO) estimates of 1.5 percent per year.

Urban areas with populations of more than 1 million make up 88.6 percent of transit investment estimates, reflecting the fact that, in 2006, 92 percent of the Nation's passenger miles were in those areas. Under the **Maintain Conditions and Performance scenario**, 68.2 percent of total transit investment in large urban areas, or $8.8 billion annually, is for rail infrastructure.

Fifty-nine percent of the total amount estimated by the **Maintain Conditions and Performance scenario** ($8.9 billion dollars annually) and 60.2 percent of the total amount estimated by the **Improve Conditions and Performance scenario** ($12.7 billion annually) are for rail infrastructure. Under the **Maintain Conditions and Performance scenario,** vehicles account for the highest proportion, approximately 36.3 percent, of projected capital outlays for both rail and nonrail modes. Guideways account for 19.0 percent of rail and nonrail investments. Changes in investment needs by asset type have not changed materially from those reported in the 2006 C&P Report.

The average annual cost to **Improve Conditions and Performance** for both the physical condition of transit assets and transit operational performance to targeted levels by 2026 is estimated to be $21.1 billion in constant 2006 dollars, 64.8 percent higher than transit capital spending of $12.8 billion in 2006. The **Improve Conditions and Performance scenario** is an upper limit of the economically justifiable level of transit investments. The **Improve Conditions and Performance scenario** assumes that all assets are close to good condition (4) by the end of the investment period. Of this $21.1 billion total, $5.9 billion is estimated as a measure to increase passenger speeds and reduce crowding in systems not operating at a condition of good performance threshold levels. Similarly to the **Maintain Conditions and Performance scenario,** vehicles make up the highest proportion of investments, at 35.5 percent across rail and nonrail asset types.

The variable rate user financing scenarios examined in the highway analysis assume a reduction in peak period VMT, a portion of which could be diverted to transit. Continuing with the pricing scenarios presented in the highway sections of this report, as VMT are diverted from highways to transit, expansion investment is required to support the increase in transit ridership while maintaining current performance at today's levels. The analysis assumes that between 25 percent and 50 percent of diverted auto users shift to transit as their preferred modal choice, based on the projected VMT for the highway **Sustain Current Spending** and **Maximum Economic Investment scenarios.** In summary, at a benefit-ratio of greater than or equal to 1.0 in the **Improve Conditions and Performance scenario**, this range increases to $24.6 billion to $28.8 billion per year. In addition to impacting the investment requirements for transit expansion needs, the diversion of highway VMT to transit would reduce the resultant emissions from automobiles for the diverted travelers by nearly 50 percent across all scenarios evaluated.

The projected investment scenarios are sensitive to forecasts of PMT. The investment scenario estimates presented in this report are based on an average annual increase in ridership of 1.5 percent, an average of transit travel forecasts from 92 MPOs. At this level, the annual cost to **Maintain Conditions and Performance** is projected at $15.1 billion, with the projected annual cost to **Improve Conditions and Performance** is $21.1 billion. As the PMT growth rate increases by 50 percent to 2.25 percent, an additional 11.0 percent is required in the **Maintain Conditions and Performance scenario,** with an additional 10.2 percent required for improvement. Similarly, if the PMT growth rate is reduced by 50 percent (to 0.75 percent), the impact is a reduction of 14.6 percent to **Maintain** and 8.0 percent to **Improve Conditions and Performance.**

Chapter 1

An Introduction to Highways and Transit

Highways and public transit in the U.S. form the foundation for one of the most extensive and complicated transportation networks in the world.

The Essential Functions of Highway and Transit Infrastructure

There are several ways that highways and transit interact to provide service for the American people.

First, highways and transit provide the American people with a high degree of personal mobility. Many of the Nation's social, governmental, and legal principles were built around the concept of freedom of movement.

Second, the Nation's surface transportation system plays an essential role in moving freight. Most goods are moved by truck over the Nation's highways. By reducing traffic volume, transit can reduce congestion and free up highway capacity for freight movement.

Third, transportation plays an essential role in the economic viability of communities. Highway and transit corridors support commerce and employment and allow cities to target investment in areas that best promote livable and sustainable urban development. Property values are higher in areas with the best access to transportation.

Fourth, highways and transit systems play an important role in protecting the American public. The Nation's highway system is essential for much of the Nation's military mobilization. Highways must also be able to quickly accommodate police, fire, and rescue vehicles. Both highways and transit can help evacuate cities when there are emergencies.

The Complementary Role of Highways and Transit

Highways and transit are complementary, serving distinct but overlapping markets in the Nation's transportation system. An efficient transit system gives people living in dense, urban environments increased mobility. An effective highway system does the same for people in suburban or rural areas.

Highway investments can benefit those transit modes that share roadways with private automobiles, such as buses, vanpools, and demand response vehicles. Having good highway access to transit stations in outlying areas, meanwhile, increases accessibility to transit.

Transit improvements can enhance the operational performance of highways by attracting private vehicle drivers off the road during peak periods of congestion.

Public and private assets also complement one another. Although the Nation's highways are typically publicly owned, many people use the system through privately owned automobiles. Transit is generally provided by public agencies, either directly or through private contractors.

Chapter 2

System Characteristics: Highways and Bridges

In 2006, a network of 4.03 million miles of public roads provided mobility for the American people. (The terms "roads" and "highways" are used interchangeably in this report). Rural areas accounted for 74.2 percent of this mileage. While urban mileage constitutes only 25.8 percent of total mileage, these roads carried 66.3 percent of the 3.0 trillion vehicle miles traveled (VMT) in the United States in 2006. In 2006, there were 597,562 bridges throughout the Nation; 75.5 percent of these were in rural areas.

Rural local roads made up 50.8 percent of total mileage, but carried only 4.3 percent of total VMT. In contrast, urban Interstate highways made up only 0.4 percent of total mileage but carried 16.3 percent of total VMT.

Percentage of Highway Miles, Bridges, and Vehicle Miles Traveled by Functional System, 2006

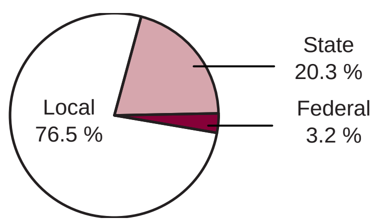
Functional System	Miles	Bridges	VMT
Rural Areas			
Interstate	0.8%	4.5%	8.4%
Other Principal Arterial	2.4%	6.0%	7.5%
Minor Arterial	3.4%	6.6%	5.3%
Major Collector	10.4%	15.7%	6.3%
Minor Collector	6.5%	8.1%	1.9%
Local	50.8%	34.7%	4.3%
Subtotal Rural	**74.2%**	**75.5%**	**33.7%**
Urban Areas			
Interstate	0.4%	4.8%	16.3%
Other Freeway and Expressway	0.3%	3.0%	7.5%
Other Principal Arterial	1.6%	4.4%	15.4%
Minor Arterial	2.6%	4.4%	12.6%
Collector	2.7%	2.9%	5.8%
Local	18.3%	4.9%	8.8%
Subtotal Urban	**25.8%**	**24.4%**	**66.3%**
Total	**100.0%**	**100.0%**	**100.0%**

Total highway mileage increased at an average annual rate of 0.2 percent between 1997 and 2006, while total VMT grew at an average annual rate of 1.9 percent. Rural road mileage has declined since 1997, due in part to the reclassification of some Federal roads as nonpublic and the expansion of urban area boundaries as a result of the decennial Census. Urban areas are defined to include all places with a population of 5,000 or greater; all other locations are classified as rural.

Rural VMT grew at an average annual rate of 0.4 percent from 1997 to 2006, compared with an average annual increase of 1.7 percent in small urban areas (population 5,000 to 50,000) and 2.9 percent in urbanized areas.

In 2006, 76.5 percent of highway miles were locally owned, 20.3 percent were owned by States, and 3.2 percent were owned by the Federal government. The share of locally owned roads grew slightly between 1997 and 2006, increasing from 75.3 percent. During that same period, the share of State-owned mileage remained mostly constant and Federally owned road mileage decreased from 4.3 percent in 1997 to 3.2 percent in 2006.

Highway Mileage by Jurisdiction, 2006



In 2006, 50.5 percent of bridges were locally owned, 47.6 percent were owned by States, 1.4 percent were owned by the Federal government, and 0.5 percent were either privately owned (including highway bridges owned by railroads) or had unknown or unclassified owners. About 46.8 percent of all bridges were built before 1966.

The 163,462-mile National Highway System (NHS) includes the Nation's key corridors and carries much of its traffic. In 2006, NHS included only 4.0 percent of the Nation's total route mileage, but its roads carried 44.6 percent of VMT.

The Interstate System is the core of NHS and includes the most-traveled routes. All Interstates are part of the NHS, as are 83.5 percent of rural other principal arterials, 87.2 percent of urban other freeways and expressways, and 36.3 percent of urban other principal arterials. Interstate travel represented the fastest-growing portion of VMT between 1997 and 2006.

Chapter 2

System Characteristics: Transit

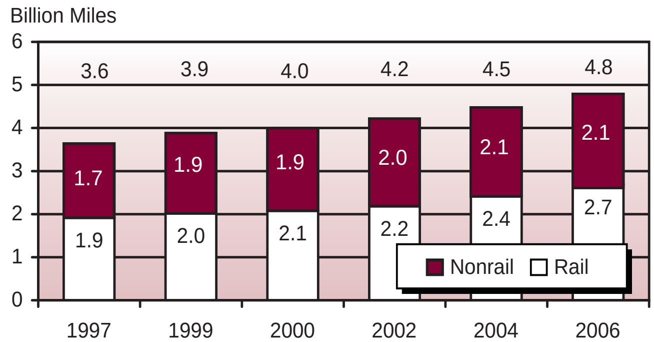
Transit system coverage, capacity, and use in the United States continued to increase between 2004 and 2006. In 2006, there were 657 agencies in urbanized areas reporting to the National Transit Database (NTD), of which 588 were public agencies, including seven State Departments of Transportation. Of the 657 reporting agencies, 83 received either a temporary reporting waiver or a reporting exemption for operating nine or fewer vehicles. The remaining 575 reporting agencies provided service on 1,398 different modal networks; 162 agencies operated a single mode and 495 transit agencies operated more than one mode. In 2006, there were an additional 1,327 transit operators serving rural areas.

In 2006, urban transit systems, excluding special service providers, operated 128,132 vehicles compared with 120,659 vehicles in 2004, an increase of 6.2 percent. In 2006, transit providers operated 11,796 miles of track and served 3,053 stations, compared with 10,892 miles of track and 2,961 stations in 2004. In 2006, there were 813 maintenance facilities for all transit modes in urban areas, compared with 793 in 2004. In 2006, the first year for which rural data are available through the NTD, there were 1,327 rural transit operators, a significant increase over 1,215 in 2000. In 2006, 80 percent of all transit vehicles reported to the NTD were compliant with the Americans with Disabilities Act (ADA). In 2006, 72 percent of total transit stations were ADA-compliant.

In the United States in 2006, 223,489 urban route miles were provided by nonrail modes, which is consistent with 2004 data (at 216,619 urban route miles). Rail modes provided 10,865 urban route miles, an increase from 9,782 in 2004.

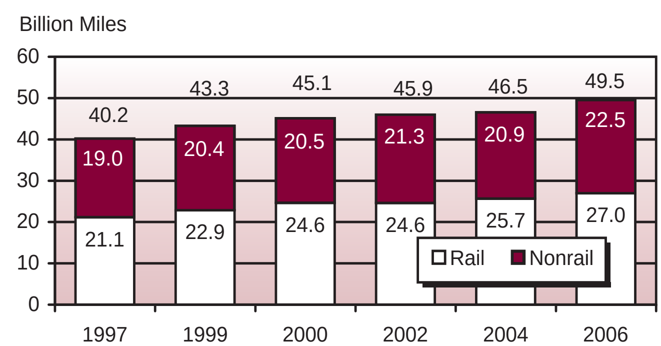
For all modes, capacity-equivalent vehicle revenue miles (VRMs) increased at an average annual rate of 3.5 percent between 1997 and 2006 and 3.5 percent between 2004 and 2006. Rail capacity-equivalent VRMs provided 2.7 billion capacity-equivalent miles, and nonrail provided 2.1 billion miles in 2006.

Urban Capacity-Equivalent Revenue Vehicle Miles



Transit passenger miles traveled (PMT) increased by 6.4 percent between 2004 and 2006, from 46.5 billion to 49.5 billion. PMT traveled on nonrail modes increased from 20.9 billion to 22.5 billion, or 7.9 percent. PMT on rail transit modes increased from 25.7 billion in 2004 to 27.0 billion in 2006, or by 5.1 percent.

Urban Passenger Transit Miles



Approximately 56.2 percent of unlinked trips were on motor buses, 31.2 percent were on heavy rail, 4.7 percent were on commuter rail, 4.3 percent on light rail, and 3.5 percent categorized as other. By comparison, 41.2 percent of PMT in 2006 were on motor bus, 29.7 percent were on heavy rail, 20.9 percent were on commuter rail, and 3.8 and 4.4 percent respectively were on light rail and other. Percentages across modes can differ as average trip length can vary by mode. While unlinked passenger trips and PMT both increased by approximately 6 percent, the allocation across the modes remained relatively unchanged.

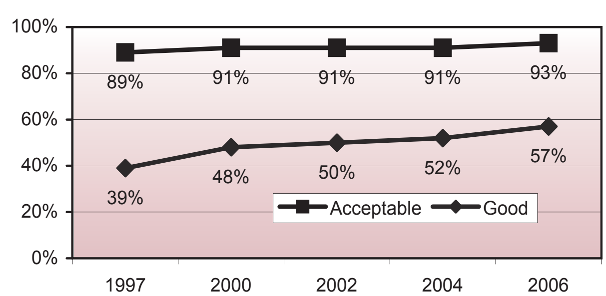
Chapter 3

System Conditions: Highways and Bridges

Poor pavement condition imposes economic costs on highway users in the form of increased wear and tear on vehicle suspensions and tires, delays associated with vehicles slowing to avoid potholes, and crashes resulting from unexpected changes in surface conditions. While transportation agencies consider many factors when assessing the overall condition of highways and bridges, surface roughness most directly affects the ride quality experienced by drivers.

On NHS, the percentage of VMT on pavements with good ride quality has risen sharply over time, from approximately 39 percent in 1997 to about 57 percent in 2006. The VMT on NHS pavements meeting the acceptable standard of ride quality grew more slowly, from approximately 89 percent in 1997 to approximately 93 percent in 2006.

Percentage of VMT on NHS Pavements With Acceptable Ride Quality



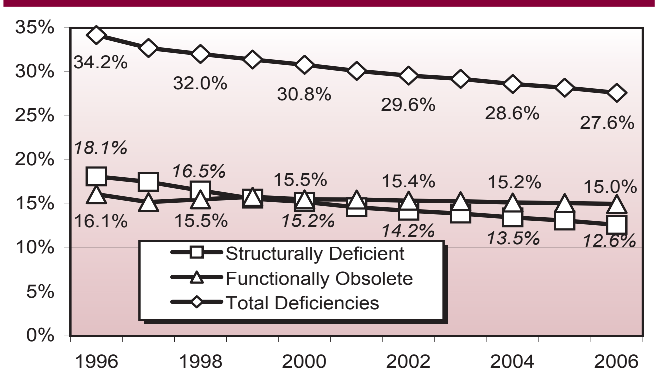
Rural NHS routes tend to have better pavement conditions than urban NHS routes. In 2006, for example, about 98 percent of all VMT on rural pavements was traveled on routes with acceptable ride quality. By contrast, the portion of urban NHS VMT on acceptable pavements was 90 percent that same year.

For Federal-aid highways as a whole, including the NHS and other arterials and collectors eligible for Federal funding, the VMT on pavements with good ride quality increased from 39.4 percent in 1997 to 47.0 percent in 2006. The VMT on pavements meeting the less stringent standard of acceptable ride quality decreased slightly from 86.4 percent in 1997 to 86.0 percent.

Most bridges are inspected every 24 months and receive ratings based on the condition of various bridge components. Two terms used to summarize bridge deficiencies are "structurally deficient" and "functionally obsolete." Structural deficiencies are characterized by deteriorated conditions of significant bridge elements and reduced load-carrying capacity. A "structurally deficient" designation does not imply that a bridge is unsafe, but such bridges typically require significant maintenance and repair to remain in service, and would eventually require major rehabilitation or replacement to address the underlying deficiency. A bridge is considered functionally obsolete when it does not meet current design standards, either because the volume of traffic carried by the bridge exceeds the level anticipated when the bridge was constructed and/or the relevant design standards have been revised. Addressing functional deficiencies may require the widening or replacement of the structure. Rural bridges tend to have a higher percentage of structural deficiencies, while urban bridges have a higher incidence of functional obsolescence due to rising traffic volumes.

The share of bridges classified as deficient fell from 34.2 percent in 1996 to 27.6 percent in 2006. Most of this decline was the result of reductions in the percent of structurally deficient bridges.

Percentage of All Bridges Classified as Deficient



Chapter 3

System Conditions: Transit

The overall physical condition of the U.S. transit system can be evaluated by examining the age and condition of the various components of the Nation's infrastructure. This infrastructure includes vehicles in service, maintenance facilities, the equipment they contain, and other supporting infrastructure such as guideways, power systems, rail yards, stations, and structures (bridges and tunnels). Since the 2006 C&P Report, asset data for approximately 71 percent of the Nation's transit assets have been updated.

Definitions of Transit Asset Conditions

Rating	Condition	Description
Excellent	5	No visible defects, near new condition.
Good	4	Some slightly defective or deteriorated components.
Adequate	3	Moderately defective or deteriorated components.
Marginal	2	Defective or deteriorated components in need of replacement.
Poor	1	Seriously damaged components in need of immediate repair.

The Federal Transit Administration (FTA) has undertaken extensive engineering surveys and collected a considerable amount of data on the U.S. transit infrastructure to evaluate transit asset conditions. FTA uses a rating system of 1, "poor," to 5, "excellent," to describe asset conditions. The Rail Modernization study, released by FTA in April 2009, considered an asset to be in a **state of good repair** when the physical condition of that asset is at or above a specific condition rating value of 2.5 (the mid-point between adequate and marginal). This replaces the over-age criteria used in previous C&P reports, which were based on FTA's minimum vehicle replacement ages.

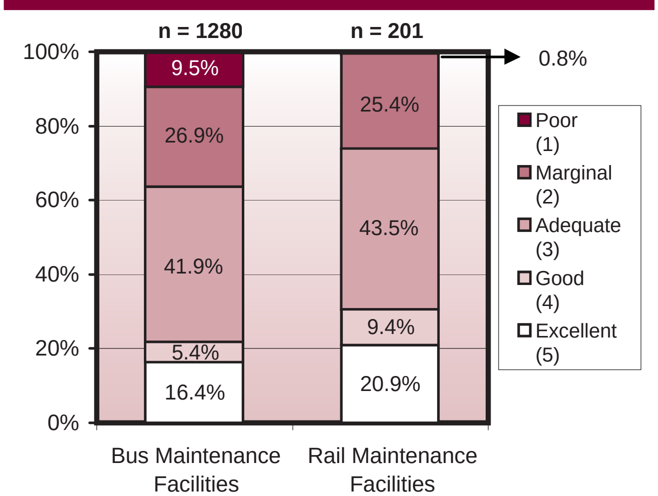
The estimated average condition rating of urban bus vehicles declined slightly from a rating of 3.08 in 2004 to 3.01 in 2006. The average age of urban bus vehicles remained constant at 6.1 years, with 21.8 percent of the fleet considered over-age. The average estimated condition of bus maintenance facilities declined from 3.41 in 2004 to 3.26 in 2006. In 2006, 63.7 percent of bus maintenance facilities were in adequate, good, or excellent condition, a decline from 68.1 percent in 2004.

The estimated average condition rating of rail vehicles continued to increase from 3.50 in 2004 to 3.51 in 2006. The average age of rail vehicles remained relatively consistent at 19.8 years in 2006 compared with 19.7 years in 2004, with 32.1 percent of the fleet defined as over-age. The estimated average condition of rail maintenance facilities decreased from 3.82 in 2004 to 3.68 in 2006. In 2006, 73.8 percent of rail maintenance facilities were estimated to be in adequate, good, or excellent condition.

The estimated average condition rating of rail stations improved from 3.37 in 2004 to 3.53 in 2006. In 2006, 99.3 percent of communications systems, 80.2 percent of train control systems, and 88.5 percent of traction power systems were in adequate, good, or excellent condition. The estimated average conditions of elevated structures, underground tunnels, and track declined from 2004 and 2006; however, the condition of vehicle storage yards improved slightly.

The total value of the U.S. transit infrastructure was estimated at $607.2 billion in 2006. Of this total, rail assets comprise $500.8 billion, with nonrail and joint assets comprising the remaining $106.4 billion. The data collected for these efforts represent a significant improvement in data availability and are significantly more comprehensive in comparison to previous C&P reports.

Condition of Bus and Rail Maintenance Facilities, 2006



Chapter 4

Operational Performance: Highways

Americans continue to grapple with gridlock on the Nation's highways, leading to travel delays, wasted fuel, and billions of dollars in congestion costs. From an economic perspective, travel time accounts for almost half of all costs experienced by highway users (other key components of user costs include vehicle operating costs, and costs associated with crashes).

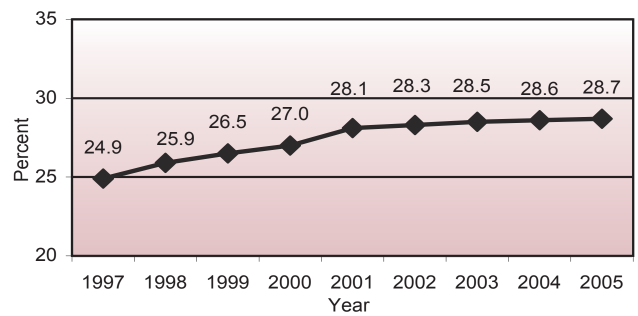
Congestion occurs when traffic demand approaches or exceeds the available capacity of the highway system. Three key aspects of congestion are severity, extent, and duration. **Severity** refers to the magnitude of the problem at its worst. The **extent** of congestion is the geographic area or number of people affected. **Duration** of congestion is the length of time that the traffic is congested.

Since there is no universally accepted definition of exactly what constitutes a congestion "problem," this report uses several metrics to explore different aspects of congestion.

The Texas Transportation Institute (TTI) collects data for 437 urban communities of different sizes across the Nation. The TTI 2007 Urban Mobility Report estimates that drivers experienced over 4.2 billion hours of delay and wasted approximately 2.9 billion gallons of fuel in 2005. The total congestion cost for these areas was $78.2 billion.

The average daily percentage of VMT under congested conditions is a metric that indicates the portion of daily traffic on freeways and other principal arterials in an urbanized area that moves at less than free-flow speeds. The measure increased by 3.8 percentage points from 24.9 percent in 1997 to 28.7 percent in 2005 for all urbanized areas combined. However the increase between 2004 and 2005 was only 0.1 percentage point, which suggests the growth of congestion is slowing. **The largest increase during this period was in medium-sized urbanized areas with population between 500,000 and 999,999.**

Average Daily Percent of VMT Under Congested Conditions for All Urbanized Areas, 1997–2006



Another metric, the Travel Time Index, measures the amount of additional time required to make a trip during the congested peak travel period. Using the year 1987 as the base for comparison, the Travel Time Index for all urbanized areas increased from 1.16 to 1.28 in 2005. In 1997, a trip that would take 20 minutes during off-peak non-congested periods would take 4.6 minutes longer during the peak period. The same trip in 2005 would require 25.6 minutes during the peak period. The largest increase between 1997 and 2005 was experienced in medium-sized urbanized areas.

Travel Time Index by Urbanized Area Size, 1997–2005

Urbanized Area Population	Base Year 1987	Year 1997	Year 2005
Less Than 500,000	1.04	1.09	1.13
500,000 to 999,999	1.09	1.15	1.21
1,000,000 to 3,000,000	1.15	1.21	1.27
Over 3,000,000	1.26	1.33	1.40
All Urbanized Areas	**1.16**	**1.23**	**1.28**

The measure of annual hours of delay per capita represents the average amount of time lost due to congested conditions per urbanized area resident. The annual person-hours of delay per capita for all urbanized areas grew from 17.1 hours in 1997 to 21.8 hours in 2005.

The average length of congested conditions is a measure of the amount of time during a 24-hour period when traffic is operating under congested conditions. The average congested travel period increased from 5.9 hours in 1997 to 6.4 hours in 2005, although it has stabilized since 2002.

Chapter 4

Operational Performance: Transit

Transit operational performance can be measured and evaluated using a number of different factors, including the speed of passenger travel, vehicle utilization, and service frequency.

Average operating speed in 2006 remained consistent with 2004 levels at 20.0 miles per hour across all transit modes. Average operating speed is an approximate measure of the speed experienced by transit riders and is affected by dwell times and the number of stops. The average speed of nonrail modes was 14.4 miles per hour in 2006, improved from 14.0 miles per hour in 2004. Conversely, rail mode operating speeds decreased from 25.0 miles per hour in 2004 to 24.8 miles per hour in 2006.

Average vehicle occupancy levels increased across all rail and nonrail modes (excluding demand response and other rail) between 2004 and 2006 on an adjusted basis. The most significant increases were realized in light rail and ferryboat, at 7.5 and 9.0 percent, respectively.

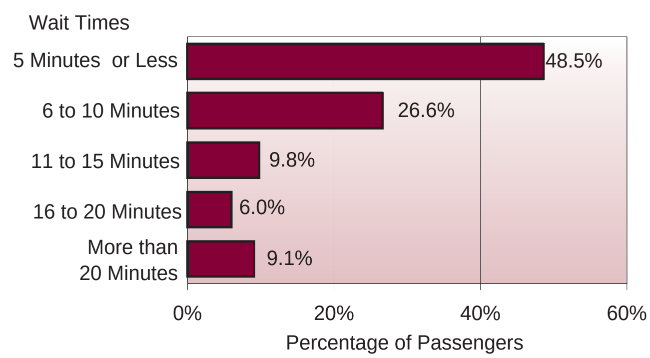
With the exception of light rail, motorbus and trolleybus, average vehicle utilization levels were lower in 2006 than in 2004. Vehicle utilization is measured as passenger miles per vehicle operated in maximum service, adjusted to reflect differences in the passenger-carrying capacities of transit vehicles. On average, rail vehicles operate at a higher level of utilization than nonrail vehicles. Commuter rail has consistently had the highest vehicle utilization rate, and demand response the lowest.

Vehicle Utilization Passenger Miles per Capacity-Equivalent Vehicle

(Thousands of Passenger Miles)

Mode	Utilization 2004	Utilization 2006
Commuter Rail	754.8	658.3
Heavy Rail	652.4	632.4
Vanpool	501.7	490.1
Light Rail	467.7	543.4
Motorbus	373.5	402.9
Ferryboat	328.4	287.8
Trolleybus	236.7	246.2
Demand Response	180.7	162.6

Passengers by Waiting Times



Most passengers who ride transit wait in areas that have frequent service. The 2001 National Household Travel Survey found that 49 percent of all passengers who ride transit wait for 5 minutes or less for a vehicle to arrive, and 75 percent wait 10 minutes or less. Nine percent of passengers wait for more than 20 minutes. To some extent, waiting times are correlated with incomes. Passengers with annual incomes above $65,000 are more likely to wait less time for a transit vehicle than passengers with incomes lower than $30,000. Higher-income passengers are more likely to be choice riders; passengers with lower incomes are more likely to use transit for basic mobility and to have more limited alternative means of travel.

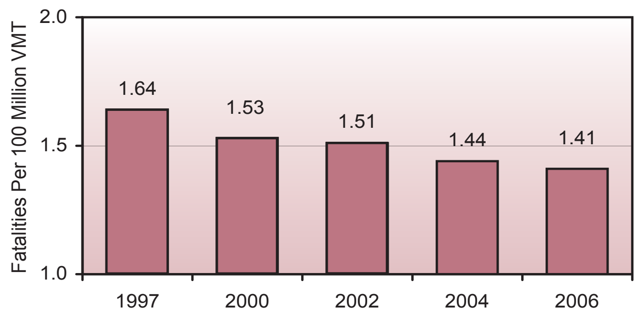
Chapter 5

Safety: Highways

There has been considerable progress in reducing the number of highway fatalities since 1966, when Federal legislation first addressed highway safety. Since that time, the highest number of traffic deaths was 54,589 in 1972, while the lowest was 39,250 in 1992. Highway fatalities decreased from 42,836 in 2004 to 42,642 in 2006.

The fatality rate per 100 million vehicle miles traveled (VMT) has declined over time, as the number of VMT has increased. In 1966, the fatality rate per 100 million VMT was 5.50; this figure dropped to 1.64 in 1997, 1.44 in 2004, and 1.41 in 2006.

Change in Fatality Rate Between 1997 and 2006



Fatality rates declined on every urban functional system between 1997 and 2006. Urban Interstate highways were the safest functional system, with a fatality rate of 0.55 per 100 million VMT in 2006. Urban minor arterials, however, recorded the sharpest decline in fatality rates. The fatality rate for urban minor arterials in 2006 was about 21.7 percent lower than in 1997.

There are many ways to examine the total number of highway-related crashes. One way is to look at roadway departure fatalities, where a vehicle leaves its lane and crashes. In 2006, there were 24,806 of these fatalities. About 43.1 percent involved the rollover of a passenger vehicle.

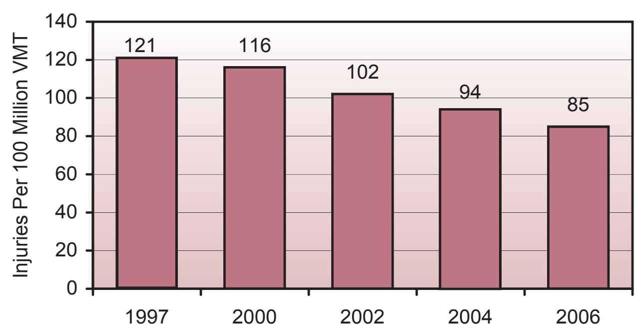
Another way is to examine fatalities that occur at intersections. Of the 42,642 fatalities that occurred in 2006, 19.6 percent—or 8,797—were related to intersections. Older drivers and pedestrians are particularly at risk at intersections. Half of the fatal crashes for drivers aged 80 or older and about one-third of the pedestrian deaths among people aged 70 or older occurred at intersections.

Another way to evaluate crashes is to analyze data related to crashes and fatalities caused by speeding. The National Highway Traffic Safety Administration estimates that 13,543 lives were lost in speed-related crashes in 2006.

Despite intense education and enforcement efforts, alcohol-impaired driving remains a serious public safety problem in the United States. In 2006, 17,602 Americans were killed in alcohol-related crashes on the Nation's highways. Alcohol was involved in 41 percent of fatal crashes and 9 percent of all crashes in 2006.

The overall number of traffic-related injuries has decreased over time, from about 3.4 million in 1988 to about 2.6 million in 2006. In 1988, the injury rate was 169 per 100 million VMT; by 2006, the number had dropped to 85 per 100 million VMT.

Change in Injury Rate Between 1997 and 2006



In terms of vehicle type, the number of occupant fatalities that involved passenger cars decreased from 22,199 in 1997 to 17,800 in 2006. Occupant fatalities involving light and large trucks, motorcycles, and other vehicles all increased.

In recent years, much attention has been focused on the safety of drivers at either extreme of the age spectrum. Motor vehicle crashes are the leading cause of death for Americans between the ages of 15 and 20 years old, and drinking is often a factor. Americans aged 65 and older, however, are among the safest drivers. They tend to be some of the most experienced drivers, and they are also less likely to drive while intoxicated.

Chapter 5

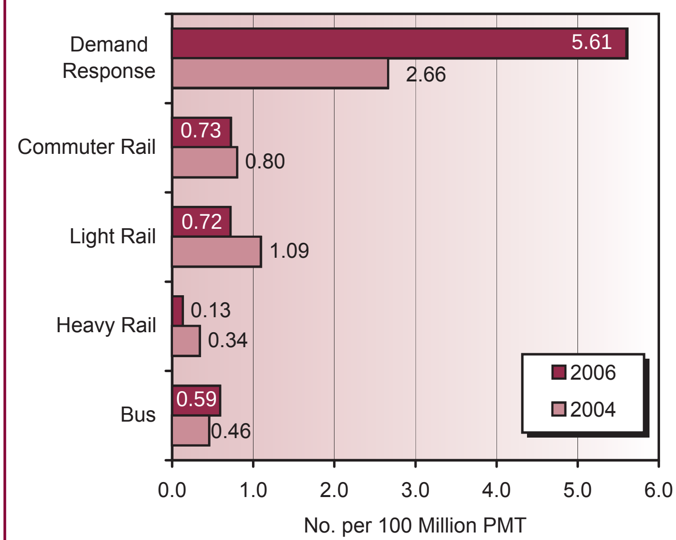
Safety: Transit

Public transit in the United States has been and continues to be a highly safe mode of transportation, as evidenced by the statistics on incidents, injuries, and fatalities that have been reported by transit agencies for the vehicles they operate directly. Reportable safety incidents include collisions and any other type of occurrence that results in death, a reportable injury, or property damage in excess of a threshold. Injuries and fatalities include those suffered by riders as well as by pedestrians, bicyclists, and people in other vehicles. Reportable security incidents include a number of serious crimes (robberies, aggravated assaults, etc.), as well as arrests and citations for minor offenses (fare evasions, trespassings, other assaults, etc.). Injuries and fatalities may occur not only while traveling on a transit vehicle, but also while boarding, alighting, or waiting for a transit vehicle or as a result of a collision with a transit vehicle or on transit property.

The definition of fatalities has remained the same. Fatalities decreased from 217 in 2004 to 213 in 2006, and fell from 0.52 per 100 million passenger miles travelled (PMT) in 2004 to 0.49 per 100 million PMT in 2006. Fatalities, adjusted for PMT, are lowest for heavy rail systems and motorbuses. Fatality rates for commuter and light rail have, on average, been higher than fatality rates for heavy rail. Commuter rail has frequent grade crossings with roads and shares track with freight rail vehicles; light rail is often at grade level and has minimal barriers between streets and sidewalks. Fatalities on demand response vehicles have consistently been the highest across all modes, increasing from 2.66 fatalities per 100 million PMT in 2004 to 5.61 in 2006.

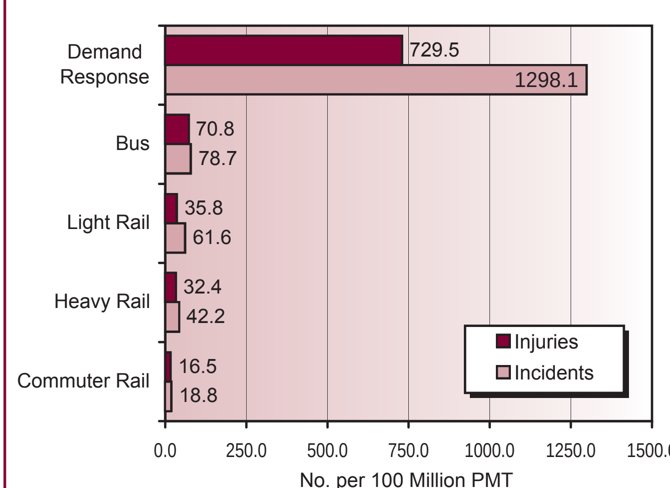
Incidents (safety and security combined) and injuries per 100 million PMT increased for all modes combined from 2004 to 2006. Incidents and injuries, when adjusted for PMT, are consistently the lowest for commuter rail and highest for demand response systems.

Fatalities per 100 Million PMT, 2004 and 2006



While commuter rail has a very low number of incidents per PMT, these incidents are more likely to result in a fatality than incidents occurring on any other mode at 3.85 fatalities per 100 incidents. Further, while light rail and motor bus have similar rates of incidents per PMT, an incident on light rail is more likely to produce a fatality (1.17 fatalities per 100 incidents for light rail compared with 0.75 for motor bus in 2006).

Incidents and Injuries per 100 Million PMT, 2006



Chapter 6

Finance: Highways

In recent years, governments throughout the United States have experimented with new ways of financing transportation projects. As costs have increased, officials have often tried to replicate some of the most successful strategies of the private sector.

Public-Private Partnerships (PPPs) are increasingly applied to a large range of transportation functions across all modes. These functions may include project conceptualization, design, finance, construction, toll collection, and maintenance. Among the broad spectrum of PPP models, the most traditional is the private contract-fee services approach, where an agency transfers limited functions to a private company. In more advanced PPP models, a private company may control some or all of these functions through a lease of an asset over some period. Outright private ownership of highway assets remains rare.

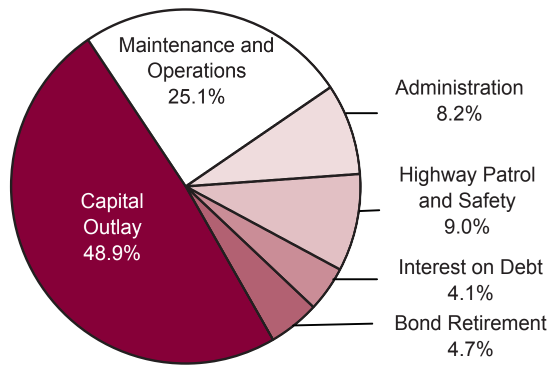
Another innovative finance tool is the use of credit assistance. The Transportation Infrastructure Finance and Innovation Act of 1998 (TIFIA) provides Federal credit assistance for major transportation projects of national importance. So far, 17 projects have received commitments of TIFIA credit assistance. In addition, the State Infrastructure Bank Pilot Program offers direct loans and loan guarantees. As of June 2007, 33 States had taken advantage of this program.

Federal legislation has introduced additional ways to take advantage of debt financing. A Grant Anticipation Revenue Vehicle (GARVEE) generates up-front capital for major highway projects that the State may otherwise be unable to build in the near term. As of December 2007, the amount of GARVEE debt issued nationally had reached over $7.3 billion.

The trend toward tolling as an innovative finance technique has continued. Not only is there renewed emphasis on existing programs, such as the Congestion Pricing Pilot Program, but SAFETEA-LU also established several new innovative programs.

Governments throughout the United States spent $161.1 billion on highways in 2006. About $78.7 billion (48.8 percent) of this total was spent on capital projects. Another $40.4 billion was targeted toward maintenance (25.1 percent), while $14.5 billion (9.0 percent) was used for highway patrol and safety activities and $13.2 billion (8.2 percent) was spent on administrative costs; $14.2 billion (8.8 percent) was used for interest and bond retirement.

Highway Expenditure by Type, 2006



Of the $78.7 billion of capital spending in 2006, $40.4 billion was spent for rehabilitating the existing system; $16.2 billion was used to construct new roads and bridges; $13.8 billion was used for widening existing facilities; and $8.2 billion supported system enhancements such as safety, operational, and environmental enhancements. The portion of total capital outlay funded by the Federal government rose from 41.6 to 44.0 percent between 1997 and 2006; Federal support for capital projects climbed from $20.1 billion to $34.6 billion, while State and local capital investment increased from $28.3 billion to $44.1 billion. However, recent sharp increases in the prices of construction materials have reduced the purchasing power of this investment; in constant dollar terms, capital spending fell by 4.4 percent over this period.

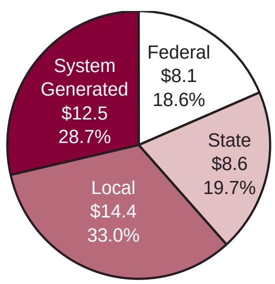
In 2006, user charges including motor fuel taxes, motor-vehicle fees, and tolls were the source of 56.3 percent of all highway funding. The remaining 43.7 percent of revenues came from other sources, such as general fund appropriations, property taxes, assessments, and bond sales.

Chapter 6

Finance: Transit

In 2006, $43.4 billion was available from all sources to finance transit capital investments and operations, compared with $39.5 billion in 2004. Transit funding comes from *public funds* allocated by Federal, State, and local governments and *system-generated revenues* earned by transit agencies from the provision of transit services. In 2006, Federal funds accounted for 18.6 percent of all transit revenue sources, State funds for 19.7 percent, local funds for 33.0 percent, and system-generated funds for 28.7 percent.

2006 Transit Revenue Sources (Billions of Dollars)

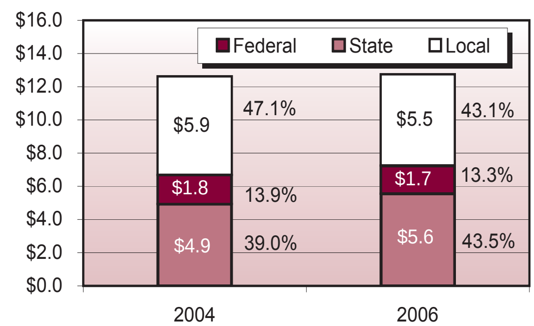


Eighty percent of the Federal funds allocated to transit are from a dedicated portion of the Federal motor-fuel tax receipts, and 20 percent are from general revenues. Federal funding for transit increased from $7.0 billion in 2004 to $8.1 billion, and State and local funding increased from $21.5 billion in 2004 to $22.8 billion in 2006.

In 2006, $12.75 billion, or 29.4 percent of total available transit funds, was spent on capital investment. Federal capital funding was $5.6 billion, or 43.5 percent of total capital expenditures; State capital funding was $1.7 billion, or 13.3 percent of total capital expenditures; and local capital funding was $5.5 billion, or 43.1 percent of total capital expenditures. The share of those funding sources shifted slightly from 2004 to 2006, with Federal funds increasing to 43.5 percent from 39.0 percent in 2004, and local funding declining from 47.1 percent to 43.1 percent during that same time period.

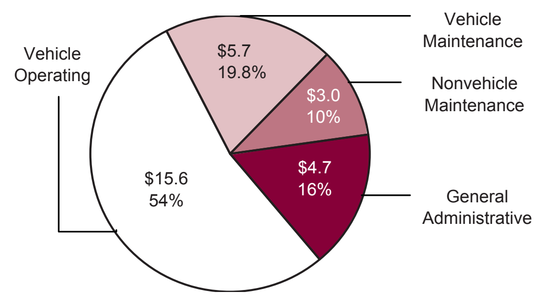
In 2006, $4.5 billion (35.3 percent) of total capital expenditures was for guideway, $3.1 billion (24.3 percent) of the total was for rolling stock, and $2.2 billion (17.2 percent) of the total was for stations.

Transit Capital Investment Funding Sources, 2004 and 2006 (Billions of Dollars)



In 2006, actual operating expenditures were $29.0 billion. Vehicle operating expenses were $15.6 billion, 53.7 percent of total operating expenses and 35.9 percent of total expenses; vehicle maintenance expenses were $5.7 billion, 19.8 percent of total operating expenses and 13.2 percent of total expenses; nonvehicle maintenance expenses were $3.0 billion, or 10.4 percent of total operating expenses and 6.9 percent of total expenses; and general administrative expenses were $4.7 billion, or 16.2 percent of total operating expenses and 10.8 percent of total expenses.

2006 Transit Operating Expenditures (Billions of Dollars)



In 2006, $30.6 billion was available for operating expenses, accounting for 70.6 percent of total available funds; the Federal government provided $2.5 billion, or 8.2 percent of total operating expenses; State governments $6.9 billion, or 22.5 percent of total operating expenses; local governments $8.9 billion, or 29.0 percent of total operating expenses; and system-generated revenues $12.3 billion, or 40.3 percent of total operating expenses.

Part II

Investment/Performance Analysis

Traditional engineering-based analytical tools focus mainly on estimating transportation agency costs and the value of resources required to maintain or improve the conditions and performance of infrastructure. This type of analytical approach can provide valuable information about the cost effectiveness of transportation system investments from the public agency perspective, including the optimal pattern of investment to minimize life-cycle costs. However, this approach does not fully consider the potential benefits to users of transportation services from maintaining or improving the conditions and performance of transportation infrastructure.

The investment/performance analyses presented in Chapters 7 through 10 of this report were developed using the Highway Economic Requirements System (HERS), the National Bridge Investment Analysis System (NBIAS), and the Transit Economic Requirements Model (TERM). Each of these tools has a broader focus than traditional engineering-based models and takes into account the value of services that transportation infrastructure provides to its users as well as some of the impacts that transportation activity has on non-users.

An economics-based approach will likely result in different decisions about the catalog of desirable improvements than would be made using a purely engineering-based approach. For example, if a highway segment, bridge, or transit system is greatly underutilized, benefit-cost analysis might suggest that it would not be worthwhile to fully preserve its condition or to address its engineering deficiencies. Conversely, a model based on economic analysis might recommend additional investments to expand capacity or improve travel conditions above and beyond the levels dictated by an analysis that simply minimized engineering life-cycle costs, if doing so would provide substantial benefits to the users of the system.

An economics-based approach also provides a more sophisticated method for prioritizing potential improvement options when funding is constrained. By identifying investment opportunities in order of the net benefits they offer, economic analysis helps provide guidance in directing limited resources toward those improvements that provide the largest benefits to transportation system users. Projects are ranked in order by their benefit-cost ratios, then successively implemented until the funding constraint is reached. Projects that produce lesser net benefits are deferred for reconsideration in the future.

For purposes of computing a benefit-cost ratio for a transportation project, the "costs" would reflect only the direct capital costs associated with that project. As defined in this report, the "benefits" would include reductions in costs of (1) transportation agencies (such as for maintenance), (2) users of the transportation system (such as savings in travel time or vehicle operating costs, or reductions in crashes), and (3) others who are affected by the operation of the transportation system (such as reductions in environmental or other societal costs). Increases in any of these costs would be treated as a negative benefit.

HERS, NBIAS, and TERM each use benefit-cost analysis as part of their decision-making process, but their approaches are very different. Each model relies on separate databases, making use of specific data available for only one part of the transportation network and addressing issues unique to that particular mode. The procedures for developing the investment scenario estimates have evolved over time, to incorporate new research, new data sources, and improved estimation techniques relying on economic principles. The methodologies used to analyze investment for highways, bridges, and transit are discussed in greater detail in Appendices A, B, and C.

While some new analysis has been added to this edition indirectly linking certain transit scenarios to specific highway scenarios involving shifts of peak period travelers between modes, **the models have not evolved to the point where direct multimodal analysis is possible for the full range of scenarios.**

Chapter 7 analyzes the projected impacts of different levels of future capital investment on a series of measures of physical condition, operational performance, and other benefits to system users. These levels are based on alternative annual rates of increase or decrease in constant dollar investment over 20 years.

The highway investment/performance analyses also examine the impacts of alternative financing mechanisms. Parallel analyses were constructed for each funding level assuming that any increases in investment above 2006 levels would be funded from non-user sources, user charges imposed on a fixed-rate per-mile basis (such as a VMT charge), or user charges imposed on a variable rate basis (such as congestion pricing). Any excess revenues stemming from decreases in highway and bridge investment below 2006 levels were assumed to be rebated to users in the form of reductions to existing fixed rate user charges.

Chapter 8 presents a set of **illustrative** 20-year capital investment scenarios building upon the analyses presented in Chapter 7. **The Department does not endorse or recommend any particular scenario.** Some of these scenarios are oriented toward maintaining different aspects of system conditions and performance, while others would improve the system to varying degrees. **The investment levels associated with each scenario represent combined public and private capital spending; the scenarios do not identify how much might be contributed by each level of government to support such spending.**

Chapter 9 provides supplemental analyses aimed at putting the scenarios presented in Chapter 8 into their proper context. It compares historic capital funding levels to recent conditions and performance trends and relates historic system use patterns to State and metropolitan planning organization (MPO) forecasts of future system use. The chapter also discusses the potential impacts of inflation, the timing of investments, and carbon dioxide emissions.

As in any modeling process, assumptions have been made in the models to make analysis practical and meet the limitations of available data. Chapter 10 explores the impact that varying some of these key assumptions would have on the overall results projected by HERS, NBIAS, and TERM. These include alternative assumptions regarding future deployments of operations technology, future levels of travel demand, the elasticity of travel demand to changes in user costs, future capital costs, discount rates, the valuation of nonmonetary benefits such as travel time savings, and the expected life span of pavements and structures.

While the economics-based approach applied in HERS, NBIAS, and TERM would suggest that projects be implemented in order based on their benefit-cost ratios (BCRs) until the funding available under a given scenario is exhausted, **the reality is that other factors influence Federal, State, and local decisionmaking**. If some projects with lower BCRs were carried out in favor of projects with higher BCRs, then the actual amount of investment required to achieve any given level of performance would be higher than the amount predicted in this report. Consequently**, increasing spending to the level specified for one of the "maintain" scenarios would not guarantee that the targeted measures of conditions and performance would actually be sustained at base year levels.**

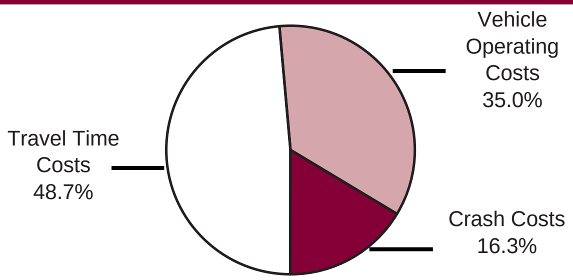
Similarly, while the HERS, NBIAS, and TERM models all screen out potential improvements that are not cost-beneficial from the "improve" scenarios, simply increasing spending to the level associated with that scenario would not in itself guarantee that these funds would be expended in a cost-beneficial manner. There may also be some projects that, regardless of economic merits, may be infeasible as a practical matter due to factors beyond those considered in the models. Because of this, the supply of feasible cost-beneficial projects could be exhausted at a lower level of investment than indicated by these scenarios. Consequently, **the improvements to future conditions and performance projected under the "improve" scenarios may not be fully obtainable in practice.**

Chapter 7

Potential Capital Investment Impacts: Highways and Bridges

Chapter 7 explores the potential impacts of 24 alternative levels of future highway capital investment on various measures of conditions and performance. Each level is expressed as an annual percent change in constant dollar spending relative to 2006 levels. The NBIAS economic bridge investment backlog metric represents the level of potential bridge investments that would be cost-beneficial to implement. The HERS adjusted average highway user costs metric quantifies the impact that changes in system conditions and performance have on travel time costs (estimated to comprise 48.7 percent of total user costs in 2006), vehicle operating costs (35.0 percent), and crash costs (16.3 percent).

Estimated Distribution of Highway-User Costs, 2006

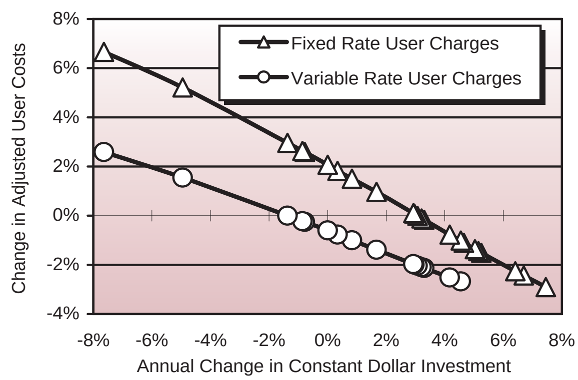


Of the $78.7 billion of total capital outlay in 2006, $48.2 billion was used for types of capital improvements modeled in HERS, including pavement resurfacing and reconstruction, and system expansion investments. Chapter 7 presents parallel analyses of alternative investment levels based on alternative financing mechanisms including funding from fixed rate user charges, and funding from variable rate user charges (direct pricing systems on congested highways).

Assuming variable rate user financing, adjusted average user costs are projected to decrease if spending were sustained at 2006 levels; if constant dollar spending were to decrease by 0.86 percent per year, this metric would still be sustained at 2006 levels through 2026. An increase of 4.55 percent per year in constant spending would yield a reduction in adjusted user costs of 5.1 percent; spending above this level would not be cost-beneficial. By 2026, each one percent reduction in user costs would translate into user savings of approximately $40 billion annually.

Regardless of the level of investment being analyzed, average user costs associated with fixed rate user financing would always be higher than if a variable rate user charge had been applied. Maintaining adjusted average user costs would require a 3.07 percent annual increase in spending assuming fixed rate user financing.

Projected Changes in 2026 Adjusted Average User Costs Compared with 2006 Levels for Different Spending Growth Rates and Financing Mechanisms



In 2006, $10.1 billion was spent by all levels of government on types of capital improvements modeled in NBIAS, including bridge repair, rehabilitation, and replacement actions. If combined public and private spending for the types of capital improvements modeled in NBIAS were sustained at 2006 levels in constant dollars, the economic bridge investment backlog is projected to rise from an initial level of $98.9 billion to a level of $112.6 billion, stated in 2006 dollars. This metric could be maintained at the 2006 base year level assuming annual spending growth of 0.83 percent per year in constant dollar terms; eliminating the backlog would require a 5.15 percent annual increase in constant dollar expenditures.

Chapter 7

Potential Capital Investment Impacts: Transit

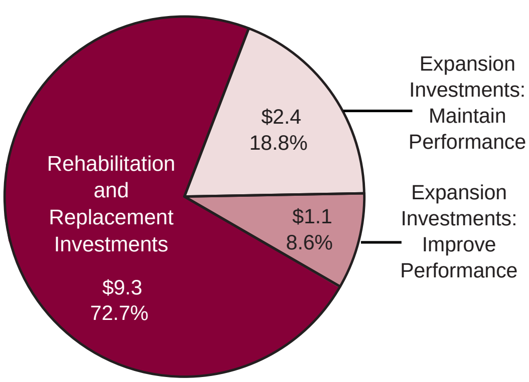
Chapter 7 analyzes how different types and levels of annual capital spending would affect different future measures of transit system condition and performance.

U.S. transit agencies spent $9.3 billion in 2006 to rehabilitate and replace antiquated and/or worn equipment. To maintain current average transit asset conditions into the future, providers of transit services would need to spend $11.4 billion annually on rehabilitation and replacement projects. (Note that this estimate is not comparable to the estimate shown in Chapter 8 because it includes capital investments in safety and other forms of capital spending not modeled by the Transit Economic Requirements Model [TERM].)

Transit operators expended $2.4 billion in 2006 on investments intended to maintain existing performance levels. If continued annually, this level of expenditure would cause crowding on transit vehicles to increase. To maintain current performance levels, U.S. transit operators would need to allocate $4.3 billion on performance maintenance (asset expansion) investments on a yearly basis.

In an effort to improve existing performance levels, U.S. transit agencies expended $1.1 billion in 2006. To improve performance through 2026, as defined by TERM, providers of transit services would need to increase annual capital spending on performance improving investments to $6.1 billion.

2006 Transit Capital Expenditures (Billions of Dollars)



In addition to reviewing investment needs on a national basis, Chapter 7 identifies capital spending requirements for different segments of urbanized areas.

In large urbanized areas with heavy rail transit systems, transit agencies collectively spent $6.5 billion on rehabilitation and replacement investments in 2006. To maintain average conditions into the future, agencies in these cities would need to spend $8.0 billion annually. Agencies in large urbanized areas without heavy rail transit systems jointly spent $1.3 billion on these types of investments but would need to spend $1.6 billion annually to maintain average conditions. Finally, public transportation service providers in small cities and rural areas invested $0.7 billion rehabilitating and replacing transit assets. These agencies, however, would need to increase capital spending to $1.3 billion to maintain existing conditions.

Transit agencies also make investments intended to accommodate growth in demand for transit services.

Agencies operating in large metropolitan areas with heavy rail transit systems spent $0.2 billion in 2006 to expand service capacity. To keep pace with demand, however, agencies in these cities would need to increase capital expenditures on service-expanding investments to $3.3 billion annually.

In large cities without heavy rail transit systems, agencies invested $2.0 billion to expand capacity. If continued annually, this level of investment would allow agencies in these cities to maintain and even improve existing performance levels into the future.

Transit agencies in small cities and rural areas spent $0.1 billion to expand capacity in 2006. To maintain performance levels, however, agencies would need to increase annual capital spending on expansion projects to $0.3 billion.

Select analyses in this chapter include a **Replace at Condition 2.5** scenario to help readers of the Rail Modernization Study that FTA released in April, 2009, place that study in the context of this report. The Rail Modernization Study considered seven select large transit rail agencies, a significant subset of the large urbanized areas with heavy rail transit systems discussed in this chapter.

Chapter 8

Selected Highway Capital Investment Scenarios

Chapter 8 presents a set of illustrative highway capital investment scenarios, building on the HERS and NBIAS analyses presented in Chapter 7, and taking into account other types of capital spending that are not currently modeled. The scenario criteria were applied separately to the Interstate System, the NHS, and the highway system as a whole. For each scenario, there is one version that assumes funding would be derived solely from fixed rate user based sources, and another that assumes funding would come from variable rate user based sources such as congestion pricing. **This report does not endorse any of these scenarios as a target level of funding**, nor does it make any recommendations concerning future levels of Federal funding.

The **Sustain Current Spending scenario** assumes that capital spending is maintained in constant dollar terms at base year 2006 levels between 2007 and 2026. (In other words, spending would rise by exactly the rate of inflation over that period). Of the $78.7 billion spent by all levels of government for highway capital improvements in 2006, $16.5 billion was directed to the Interstate System and $37.1 billion was directed to the NHS.

The **Sustain Conditions and Performance scenario** assumes that capital investment gradually changes in constant dollar terms over 20 years to the point at which adjusted average user costs and the economic bridge investment backlog in 2026 are maintained at their base year 2006 levels. Assuming fixed rate user financing, the average annual investment levels associated with meeting these goals are estimated to be $24.8 billion for the Interstate System, $38.7 billion for the NHS, and $105.6 billion for all roads. Assuming variable rate user financing, the average annual investment levels under this scenario would be $11.6 billion for the Interstate System, $19.6 billion for the NHS, and $71.3 billion for all roads. These values are lower than the amounts currently being spent on these systems, as the analysis indicates that current spending would be more than adequate to maintain system conditions and performance if congestion charges were widely applied.

Three scenarios are presented that would improve overall system conditions and performance. The **MinBCR=1.5 scenario** assumes that investment gradually increases in constant dollar terms over 20 years up to the point at which all potential capital improvements with a benefit-cost ratio of 1.5 or higher are funded by 2026 and the economic backlog for bridge investment is reduced to zero. The **MinBCR=1.2** and **MinBCR=1.0 scenarios** make the same assumptions, but apply benefit-cost ratio cutoffs of 1.2 and 1.0, respectively. Assuming fixed rate user financing, the average annual investment level for all roads for the **MinBCR=1.5**, **MinBCR=1.2**, and **MinBCR=1.0 scenarios**, respectively, were estimated to be $137.4 billion, $157.1 billion, and $174.6 billion; assuming variable rate user financing, the comparable levels would be $101.8 billion, $117.2 billion, and $131.3 billion. (The MinBCR=1.0 scenario is equivalent to the Cost to Improve Highways and Bridges described in previous editions of this report).

Summary of Selected Highway Capital Investment Scenarios for 2007 to 2026 (Billions of 2006 Dollars)

Functional System	Interstate	NHS	All Roads
Scenarios Assuming Fixed Rate User Financing			
Sustain Current Spending	$16.5	$37.1	$78.7
Sustain Conditions and Performance	$24.8	$38.7	$105.6
Invest up to MinBCR=1.5	$39.0	$60.7	$137.4
Invest up to MinBCR=1.2	$43.5	$69.2	$157.1
Invest up to MinBCR=1.0	$47.0	$76.1	$174.6
Scenarios Assuming Variable Rate User Financing			
Sustain Current Spending	$16.5	$37.1	$78.7
Sustain Conditions and Performance	$11.6	$19.6	$71.3
Invest up to MinBCR=1.5	$24.0	$38.9	$101.8
Invest up to MinBCR=1.2	$27.5	$44.9	$117.2
Invest up to MinBCR=1.0	$30.4	$50.1	$131.3

The fixed rate user financing and variable rate user financing versions of the **Sustain Current Spending scenario** for all roads are associated with benefit-cost ratio cutoffs of 2.89 and 1.90, respectively. The comparable values for the fixed rate user financing and variable rate user financing versions of the **Sustain Conditions and Performance scenario** for all roads are 1.98 and 2.25, respectively.

Chapter 8

Selected Transit Capital Investment Scenarios

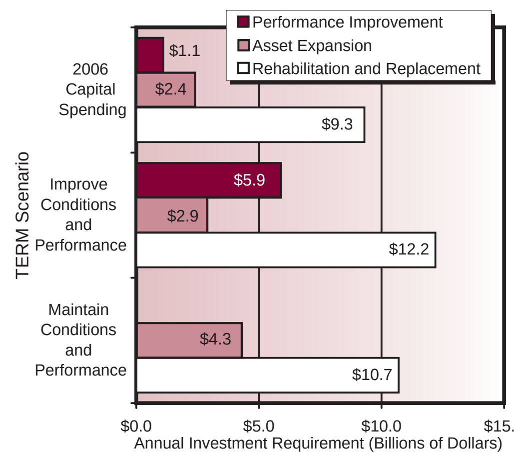
Chapter 8 provides a more in-depth analysis of specific investment scenarios. This chapter assesses the expected impact of maintaining current transit capital expenditure levels on future transit asset conditions and service performance, as well as considers how variations in the pass-fail threshold for TERM's benefit-cost ratio impact investment forecasts. In addition to consideration of the maintain and improve scenarios for transit asset conditions and service performance as considered in prior year reports, this section also considers the level of transit investment required to serve ridership potentially diverted from automobile usage due to the influence of congestion pricing. Current investment estimates are for the period 2007 to 2026 and are stated in 2006 constant dollars.

If current funding levels of $9.3 billion per year on rehabilitation and replacement were maintained over 2007 to 2026, TERM estimates that the average condition would decline from 3.72 in 2006 to 3.36 in 2026. Further, the percent of assets in operation in excess of their useful life would increase from 14.7 percent in 2006 to 26.9 percent in 2026.

If the funding level for expansion and performance improvement investments of an additional $3.5 billion per year were maintained through 2026, funding levels would be insufficient to maintain performance in aggregate across rail transit modes and compound existing overcrowding problems for some high demand operators.

Since 1997, the C&P report has included a consistent set of TERM investment scenarios that assess the level of investment required to attain specific asset conditions and performance targets. The levels of investment required to attain these targets have been combined to construct a range of investment scenarios. The **Maintain Conditions and Performance scenario** projects the level of investment to maintain current average asset conditions over the 20-year period and to maintain current vehicle occupancy levels as transit passenger travel increases. In looking at the **Maintain Conditions and Performance scenario**, with a benefit-cost ratio of 1.0, a total of $15.1 billion per year is required. The **Improve Conditions and Performance scenario** projects the level of investment to raise the average condition of each major transit asset type to at least a level of "good," reduce average vehicle occupancy rates, and increase average vehicle speeds. In this scenario, annual requirements for rehabilitation and replacement are projected to be $12.2 billion, with asset expansion and performance improvements estimated at $2.9 and $5.9 billion respectively to total an annual estimate of $21.1 billion.

TERM Investment Scenarios



The variable rate user financing scenarios examined in the highway analysis assume a reduction in peak period VMT, a portion of which could be diverted to transit. The level of expansion investment required to support this increase in transit ridership while maintaining current transit performance at today's levels is examined. To do so, the analysis assumes that between 25 percent and 50 percent of diverted auto users shift to transit as their preferred modal choice, based on the projected VMT for the highway "Sustain Current Spending" (SCS) and "Maximum Economic Investment" (MEI) scenarios. Annual investment requirements modeled in TERM are significantly impacted by the increase in PMT on transit under all investment scenarios.

Chapter 9

Scenario Implications: Highways and Bridges

Chapter 9 provides supplemental discussion and analysis of key issues to assist in the interpretation of the selected capital investment scenarios presented in Chapter 8.

All of the investment/performance analyses in the C&P report are presented in constant 2006 dollars. It is difficult to predict inflation rates, and adjusting the constant dollar figures to nominal dollar values would add to the uncertainty of the overall results, particularly if inflation assumptions later proved incorrect. However, when applying these analytical findings in other contexts, such as comparing a particular scenario with nominal dollar revenue projections, it is sometimes necessary to adjust for inflation to ensure an accurate comparison.

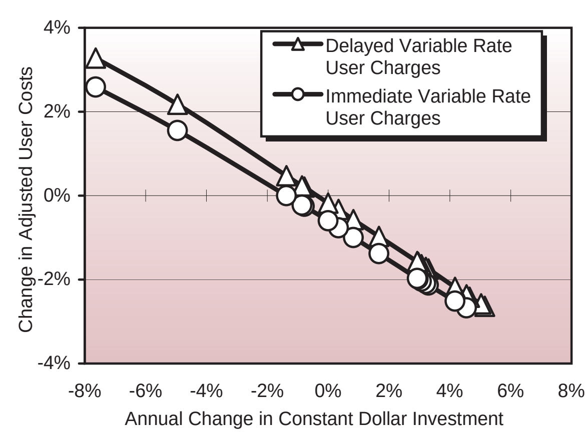
Capital spending by all levels of government increased by 62.7 percent between 1997 and 2006, but did not keep pace with the 69.4 percent increase in the FHWA Composite Bid Price Index (BPI) over this period, due to a sharp increase in the cost of construction materials between 2004 and 2006.

The fixed rate financing version of the Sustain Conditions and Performance scenario implies that $40.0 billion per year of system expansion investment would be needed to achieve the scenario's goals; actual spending in 2006 by all levels of government for these types of improvements was only $30.0 billion. This finding is consistent with declines in operational performance noted in Chapter 4. The annual investment level identified for the system rehabilitation component of this scenario is $40.4 billion, which is close to the $43.5 billion of actual system rehabilitation spending in 2006. However, this gap is not evenly distributed across all types of roads and is wider for lower-ordered urban functional systems; this appears consistent with the decline in pavement conditions in recent years noted for these systems in Chapter 3.

The analyses in Chapters 7 and 8 assume gradual changes in investment at a fixed annual rate over time. Previous editions of the C&P had either assumed that investment would immediately jump to the average annual investment levels associated with each investment scenario or assumed that investment in any given year would be driven solely by benefit-cost ratio criteria. The latter approach frequently resulted in a significant front-loading of capital investment in the early years as the existing backlog of cost-beneficial improvements was addressed. The HERS model identifies $523.5 billion of cost-beneficial investments that could be made based on the current conditions and operational performance of the system, without regard to future travel growth; this is in addition to the $98.9 billion bridge backlog identified by NBIAS. If resources were available to immediately reduce the backlog in this fashion, HERS projects that there would be significant savings to users, even if annual investment later dropped off.

The variable rate financing analyses in Chapters 7 and 8 assume the immediate imposition of congestion pricing on a widespread basis. If the imposition of such charges were delayed by 10 years, HERS estimates that a higher level of investment would be needed to sustain adjusted annual average user costs, but that this could be achieved without increasing spending above the 2006 base year level in constant dollar terms. Regardless of the level of investment being analyzed, the projected average user costs associated with a delayed implementation of variable rate user charges would be higher than if such a financing mechanism were to be applied immediately.

Projected Changes in 2026 Adjusted Average User Costs Compared With 2006 Levels for Different Spending Growth Rates and Timing of Variable Rate User Charges



Chapter 9

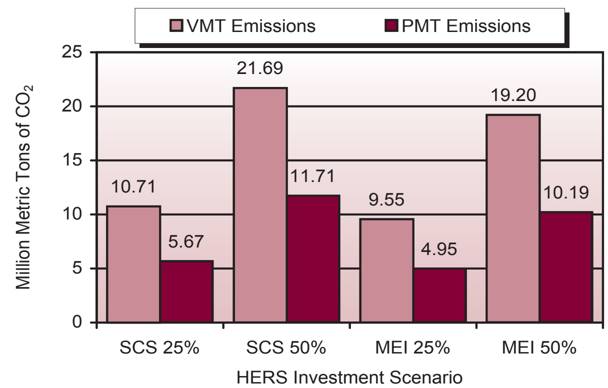
Scenario Implications: Transit

Chapter 9 considers a number of potential implications and limitations of the transit scenario analyses presented in Chapters 7 and 8. The intention is to provide a more comprehensive understanding of the assumptions used in scenario development as well as some alternative interpretations of the scenario results. Specifically, this section includes discussion of the following topics: ridership response to TERM investments; the potential impact of highway congestion pricing on CO_2 emissions from both autos and transit vehicles; a comparison of PMT growth rates used by TERM's asset expansion module with the recent, actual PMT growth rates; and the potential impact of recent construction commodity price increases on transit investment costs.

Each of the three investment types considered by TERM—including the rehabilitation and replacement of existing assets, asset expansion, and performance improving investments—may draw varying levels of new transit ridership. First, the rehabilitation and replacement of aging transit assets results in improving the quality and reliability of transit services, improvements that are believed to attract new transit riders. At present, the responsiveness of ridership to changes in asset conditions is not well understood and, for this reason, these impacts are not currently modeled within TERM. Second, for TERM's annual asset expansion investments, given the weighted-average annual national growth rate of 1.5 percent, it is estimated that TERM's $4.7 billion investment in annual transit expansion (i.e., Maintain Performance) would support an additional 3.3 billion annual boardings by 2026, roughly 35 percent more than the current 9.5 billion annual boardings. Third, for the Improve Performance scenario, the estimate of $6.1 billion would generate 4.4 billion annual transit boardings by 2026, or 46 percent over current ridership levels.

Continuing with the presentation of congestion pricing in Chapter 8, Chapter 9 examines the impact that the portion of highway VMT that would shift away from peak period highway travel to transit alternatives in response to congestion pricing initiatives would have on CO_2 emissions. This analysis indicates there is significant potential to reduce CO_2 emissions by almost half for the assumed commuters diverting to transit from highways.

Annual CO_2 Emissions Comparison of Highway VMT Diverted to Transit PMT



SCS: Sustain Current Spending
MEI: Maximum Economic Investment

The "Transit Travel Growth" section describes how observed recent changes in PMT (historic growth rates) have diverged from the long-range demand forecasts used by TERM. The variance in PMT rates of change can be attributed to a variety of factors, including the strength of the U.S. economy, the prevalence of public transportation, and the price of gasoline. From 1997 to 2006, annual transit PMT increased from 39.2 billion to 49.5 billion, growing at an average annual rate of 2.6 percent.

Forecasting demand for public transportation services is an inexact science. TERM's projections of investments required to support the projected, natural growth in transit ridership are driven entirely by ridership and PMT forecasts provided by a sample of the nation's metropolitan planning organizations (MPOs). The average rate of PMT growth for 1991 to 2005 was 1.7 percent. The actual rate of increase for 2006 to mid-2008 well exceeds the forecast rate based on MPO projections of 1.5 percent on average for 2009 to 2026.

Pricing for materials and labor used in the construction industry have increased significantly in recent years, pushing the costs for constructing all types of capital projects upward. A discussion of construction material and labor inflation is also provided in Chapter 9.

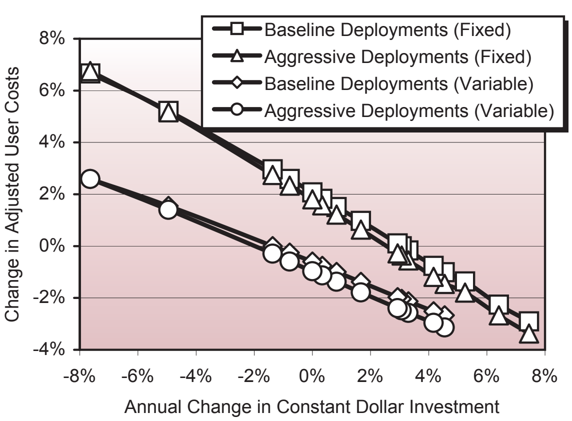
Chapter 10

Sensitivity Analysis: Highways and Bridges

The usefulness of any investment scenario analysis depends on the validity of the underlying assumptions used to develop the analysis. Since there may be a range of appropriate values for several of the model parameters used in the HERS and NBIAS analyses presented in Chapter 7, this section explores the impacts of changing some of these assumptions pertaining to technology, travel growth, economic assumptions, the valuation of non-monetary benefits, and life span of bridges.

The baseline investment/performance analyses reflect the impacts of a continuation of existing trends in the deployment of operations strategies and intelligent transportation systems (ITS) technologies on highway performance. If a portion of the spending for system expansion in the baseline analyses were redirected to cover the capital and operating costs associated with a more aggressive rate of operations/ITS deployments, HERS projects that adjusted average user costs would be reduced for most of the investment levels analyzed. The baseline existing deployment trends assumption would result in superior performance outcomes only if total capital spending were to decrease significantly relative to 2006 levels. This analysis suggests that, if combined public and private investments were to be sustained at current levels or increased above those levels, serious consideration should be given to accelerating the rate of operations deployments.

Projected Changes in 2026 Adjusted Average User Costs Compared With 2006 Levels for Different Spending Growth Rates, Operations Deployment Rates, and Financing Mechanisms



Pavement technology can greatly extend the lifetime of a highway system. Assuming a one-third increase in typical pavement lives, HERS recommends directing a larger share of total funding to capacity expansion because pavement actions would not be needed as frequently. This would allow for improvements in both average pavement roughness and average traveler delay for most of the investment levels analyzed.

HERS assumes that the State-provided forecast for each sample highway segment represents the level of travel that will occur if a constant level of service is maintained on that facility. As noted in Chapter 4, however, the level of service has generally declined over time. Modifying the forecasts to match actual travel growth for the past 20 years would increase both overall congestion and the rate of pavement deterioration, both of which would cause the adjusted average highway user costs associated with any given level of capital investment to rise. Assuming fixed rate user financing, annual constant dollar spending would need to increase by between 6.41 percent and 7.45 percent to maintain average user costs in 2026 at base year 2006 levels, significantly higher than the 3.07 percent rate in the baseline analyses. Assuming variable rate user financing, spending would need to increase between 1.67 percent and 2.93 percent annually. Alternatively, if the trends that have caused travel growth per capita to rise over time were to cease and VMT were to grow only by the projected rate of increase in the total population, then current funding levels would be more than adequate to maintain adjusted user costs at base year levels.

The baseline investment/performance analyses are tied to the Energy Information Agency's reference case values for fuel prices; substituting in their high price forecast would result in lower projections for 2026 travel for all funding levels, regardless of the financing mechanism. This would lead to lower levels of average delay and average pavement roughness for any given funding level than were computed for the baseline analyses.

Chapter 10

Sensitivity Analysis: Transit

Chapter 10 examines the sensitivity of projected transit investment estimates by the Transit Economic Requirements Model (TERM) to variations in the values of exogenously determined model inputs including passenger miles traveled (PMT), capital costs, the value of time, and user travel cost elasticities.

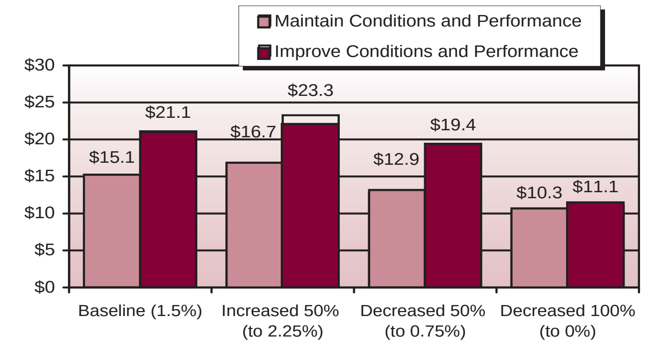
TERM relies on forecasts of PMT in large urbanized areas to determine estimates of projected investment in the Nation's transit systems for the Maintain Performance scenario (i.e., current levels of passenger travel speeds and vehicle utilization rates) as ridership increases and the Improve Performance scenario (i.e., increase passenger travel speeds and reduce crowding).

PMT forecasts are generally made by metropolitan planning organizations (MPOs) in conjunction with projections of VMT. **The average annual growth rate in PMT of 1.5 percent used in this report is a weighted average of the most recent MPO forecasts available.** Transit investment estimates in the 2004 report were based on a projected PMT growth rate of 1.57 percent, from 92 of the Nation's largest metropolitan areas. PMT has increased at an average annual rate of 2.3 percent between 1997 and 2006 and by 3.1 percent between 2004 and 2006.

Varying the assumed rate of growth in PMT affects estimated transit investment both for the Maintain and Improve scenarios. A 50-percent change in growth will impact the cost to Maintain Conditions and Performance by an 11.0 percent increase or a 14.6 percent decrease, and the cost to Improve Conditions and Performance by a 10.2 percent increase or an 8.0 percent decrease. Investment estimated by both the Maintain and Improve scenarios would decrease significantly if PMT was assumed to remain constant.

Given the uncertainty of capital costs, a sensitivity analysis was performed to examine the effect of higher capital costs on the projected transit investment. A 25-percent increase in capital costs increases the investment estimated by the **Maintain**

The Effect of Variations in PMT Growth on Transit Annual Investment Scenario Estimates (Billions of 2006 Dollars)



Conditions and Performance scenario by 9.9 percent and decreases the investment estimated by the **Improve Conditions and Performance scenario** by 20.7 percent. With this increase in costs, fewer investments are economically viable under this scenario compared with the **Maintain Conditions and Performance scenario.**

The value of time is used to determine the total benefits accruing to transit users from transit investments that reduce passenger travel time. Three scenarios were examined in relation to the base value of time of $11.20 per hour: (1) value of time is double, (2) value of time is half, and (3) value of time in constant 2006 dollars. Variations in the value of time were found to have a limited effect on the investment estimates because changes in the value of time have inverse effects on the demand for transit services. An increase in the value of time was found to reduce projected investment in modes with relatively slower transit services and to increase projected investment in modes with relatively faster transit services. The opposite occurs in response to a decrease in the value of time.

TERM considers user cost elasticities to estimate the changes in ridership, fare, and travel time costs resulting from infrastructure investment to increase speeds, decrease vehicle occupancy levels, and increase frequency. A doubling or halving of these elasticities was found to have a minimal effect (an increase of 0.4 percent and decrease of 6.5 percent, respectively) on projected investment.

Chapter 11

NHS Bridge Performance Projections

All bridges are important to the communities along the Nation's transportation system; however, the National Highway System (NHS) bridge network is extremely important because of the amount of traffic it carries.

Chapter 11 examines the impact of combining several bridge management strategies with different funding alternatives over a period of 50 years. The analyses presented in this chapter do not directly correspond to the 20-year capital investment scenarios referenced in other chapters.

Several metrics are considered: the bridge's average Sufficiency Rating (a composite measure taking into account factors such as a bridge's structural adequacy, functionality, and essentiality, on a scale of 0 to 100), the average Health Index (a measure of the structural integrity of individual bridge elements, on a scale of 0 to 100); and the percentage of NHS bridges with condition ratings of 5 or greater for deck, superstructure, and substructure (a measure of the general condition of major bridge components, on a scale of 0 to 9).

The **Sufficiency Rating 50 strategy** assumes that structures that reach a sufficiency rating of 50 or less are selected for replacement. The **Age 50 strategy** assumes that any structure that becomes 50 years or older during the analysis period will be replaced. The **Health Index 75 strategy** assumes that any structure with a health index equal to or less than 75 during the analysis period will be replaced. The **Health Index 80 strategy** assumes that any structure with a health index equal to or less than 80 during the analysis period will be replaced. **The Health Index 85 strategy** assumes that any structure with a health index equal to or less than 85 during the analysis period will be replaced.

An additional management strategy was included in the analysis to reflect selection of actions on bridges based on any action having a benefit-cost ratio of 1.0 or greater. This is the **No Special Rules strategy.**

Four funding alternatives were combined with one or all of the proposed management strategies – the **Maximum Flat Funding** alternative, the **Maximum Ramped Funding** alternative, the **Unconstrained Funding** alternative, and the **Current Funding** alternative.

The **Maximum Flat Funding** alternative provides funding at the maximum annual amount at which all allocated funds will be expended during the analysis period. The **Maximum Ramped Funding** alternative assumes an increase in spending at a fixed annual rate over 50 years. The **Unconstrained Funding** alternative assumes spending will be allocated on the management criteria in use and there is no limit to annual spending. The **Current Funding** alternative assumes funding will remain at the amount allocated for 2006. All amounts are in 2006 dollars.

In general, when comparing the various strategies, those that yield the higher values of the individual metrics both over the long term and the short term will provide a more desirable system.

The **Sufficiency Rating 50 – Current Funding** combination yielded the lowest values for all metrics except for substructure condition rating. The **Age 50 – Maximum Flat Funding** combination yielded the lowest substructure value in 2056. The remaining approaches provide much higher metric levels in 2056 and, depending on the minimum acceptable performance levels selected, yield a much higher performance level for the total NHS bridge network.

It is critical to understand the funding stream needed to implement any of the approaches. The ramped spending approach gradually increases investment, addressing an increasing number of needs each year. The flat spending approach may not provide enough funding to reduce the backlog. The **No Special Rules** approach projects a large influx of funding in 2007, followed by relatively flat funding.

Chapter 12

Transportation Serving Federal and Indian Lands

Federal and Indian lands have many uses. These include recreation, range and grazing, timber, minerals, watersheds, fish and wildlife, and wilderness. In recent years, recreational use has significantly increased, while resource extraction and cutting of timber have declined. These lands are also managed to protect their natural, scenic, scientific, and cultural value.

Roads on Indian lands provide access and mobility for residents and provide access to regional and national transportation systems. Tribal roads are essential for economic development and community development on reservations, providing critical access between housing and education, emergency centers, and places of employment.

Transportation plays a key role in the way people access and enjoy Federal lands. Approximately 329,000 miles of public roads are located on Federal lands, including 93,000 miles of State and local roads that provide access to and within these lands. Use of roads by private vehicles and tour buses continues to be the primary method of travel to and within Federal and Indian lands.

Although the Federal Highway Administration (FHWA) and its predecessors have worked to improve access to Federal lands for over a century, the Federal Lands Highway Program (FLHP) was only created in 1983. Today's FLHP is subdivided into four core areas: the Indian Reservation Roads, Park Roads and Parkways, Refuge Roads, and Public Lands Highway (Forest Highway and the Public Lands Highway Discretionary) Programs.

The primary purpose of the FLHP is to provide financial resources and technical assistance to support a coordinated program of public roads that service the transportation needs of Federal and Indian lands. The SAFETEA-LU authorizations for 2005 through 2009 for the FLHP total over $4.5 billion. During the past five fiscal years, the FLHP has improved, on average, about 1,000 miles of roads and 35 to 40 bridges per year.

The FHWA works with numerous Federal Land Management Agencies (FLMAs) while overseeing the FLHP. The four FLMAs that are most directly involved in the core areas of the FLHP are known as core partners; these include the U.S. Forest Service (USFS), the National Park Service (NPS), the Bureau of Indian Affairs (BIA), and the U.S. Fish and Wildlife Service (FWS).

The USFS estimates that, of the 29,200 miles of paved National Forest System Roads in 2006, approximately 39 percent were in good condition, compared with 29 percent in fair condition and 32 percent in poor condition. The NPS estimates that, of 5,450 miles of paved Park Roads and Parkways, approximately 11 percent were in good condition, while 48 percent were rated as fair and 41 percent were considered poor. The condition ratings estimated by the BIA for nearly 37,000 paved miles of Indian Reservation Roads are 16 percent good, 39 percent fair, and 45 percent poor. The FWS estimates that, of 415 miles of paved Refuge Roads, approximately 39 percent were in good condition, 32 percent were in fair condition, and 30 percent were in poor condition.

The FLHP supports the FLMAs beyond design and construction oversight by also providing funding and expertise for integrated transportation planning, road and bridge inspections, and other technical assistance activities. FLHP funds can be used for transportation planning, research, engineering, and construction of highways, roads, parkways, and transit facilities.

SAFETEA-LU established a $97 million Alternative Transportation in Parks and Public Lands Program. This program authorizes FTA grants for projects that improve mobility in parks and public lands. Eligible projects include the purchase of buses for new transit service, replacement of old buses and trams, construction of bicycle and pedestrian pathways, ferry dock replacement, intelligent transportation system components, and planning studies.

Chapter 13

Freight Transportation

The economy of the United States depends on freight transportation to link businesses with suppliers and markets. The transportation system in the United States moved an average of 53 million tons of freight worth $36 billion per day in 2002. Over the next three decades, the tonnage of goods to be moved is expected to increase by 2.0 percent each year, almost doubling between now and 2035.

Demands on the Transportation System

Most of the Nation's freight transportation infrastructure was developed before 1960. This older system moved goods from farm to market and from fort to port, and served industrial and population centers concentrated in the Northeast and the Midwest. Since 1960, however, population and manufacturing have grown in the South and on the West Coast, and international trade has changed the complexion of traditional corridors. Railroads and steamship companies accommodate enormous numbers of containers—a technological novelty five decades ago. Trucks serve new inland distribution centers beyond the urban fringe. Air carriers deliver parcels between any locations in the country over night.

The freight system must serve an economy that is increasingly decentralized and organized around just-in-time delivery. Much of this delivery is done by truck. The Interstate System carries half of truck travel and three-fourths of freight-hauling truck traffic that serves places at least 50 miles apart.

Freight and Congestion

As freight demand grows, it often creates congestion. Congested freight hubs include international gateways such as ports, airports, and border crossings, as well as domestic terminals and transfer points such as Chicago's rail yards. On the Nation's road network, the top 10 highway interchange bottlenecks cause an average of 1.5 million annual truck hours of delay each, compared to less than 250,000 annual hours of truck delay for other truck bottlenecks. Trucks are also a source of congestion when space and time for pickups and deliveries are limited. An estimated 947,000 hours of vehicle delay is attributable to delivery trucks parked curbside in dense urban areas.

Safety and Environmental Concerns

Freight transportation is not just an issue of throughput and congestion. Policymakers are increasingly focused on how freight transportation impacts air quality, and how hazardous materials can be safely moved. Policymakers are deliberating how to move the Nation's increasing volume of goods without compromising public safety and the quality of the environment.

The Economic Costs of Freight Transportation

Freight transportation has become cheaper over the past quarter century, contributing significantly to the Nation's economic productivity and growth. Several forces, however, are combining to increase costs in the years ahead. Congestion, higher fuel prices, and a shortage of labor in some sectors has increased the costs to carriers, and impacted the prices of goods. Over the three years ending in 2006, prices increased 13 percent for truck transportation, 27 percent for rail transportation, and 8 percent for scheduled air freight.

The Freight Challenge

SAFETEA-LU included several provisions designed to improve freight infrastructure. Among other provisions, SAFETEA-LU authorized $4.6 billion for certain freight-oriented investments, expanded eligibility under the Transportation Infrastructure Finance and Innovation Act (TIFIA) for freight projects, and modified the tax code to encourage investment through private activity bonds. Still, meeting the freight challenge is difficult due to the high cost of many improvements and the fact that much of the Nation's freight infrastructure is privately owned.

Chapter 14

Congestion Reduction Strategies

Congestion generally reflects a fundamental imbalance of supply and demand. Economists have long understood that such an imbalance stems from inefficient pricing, where the true costs of use are not reflected in the prices paid by users. This imbalance is also affected by the absolute volume of traffic (demand) on a given facility relative to its physical capacity (supply).

There are four broad ways to reduce congestion: add more capacity, use capacity more productively, reduce system demand, and create an efficient transportation market.

Strategic Addition of Capacity

Traditionally, transportation officials have dealt with congestion by expanding the capacity of the road network. Today, however, concerns about air pollution, noise, and urban sprawl often stand in the way of capacity additions. Equally significant, adding new capacity can be enormously expensive and physically challenging. Despite these challenges, major projects that reduce bottlenecks, add lanes, or modify traffic patterns can often provide system performance benefits that outweigh these costs.

System Operations and Management

Another approach is to use the transportation system more productively. Transportation officials can increase productivity by maximizing system performance in the first place and being prepared to recover as quickly as possible when disruptions occur.

Several tools are greatly improving system operations and management. **Real-time traveler information** allows travelers to decide how they will (or will not) use the transportation system. **Traffic incident management** is a planned and coordinated process to detect, respond to, and remove traffic incidents and restore capacity as safely and quickly as possible.

Work zones are second only to incidents as a source of delay from temporary capacity loss, and more effective management can minimize disruptions to the traveling public. **Better monitoring of weather conditions** and **improved traffic signal timing and coordination** can also enhance the productivity of the highway network.

Providing Better Transportation Choices

Another effective way to reduce the level of demand for using highways is to ensure that travelers have a variety of high-quality alternatives to choose from that meet their transportation needs. Travel Demand Management (TDM) increases the use of travel alternatives; spreads the timing of travel to less-congested periods; reduces the need for travel; and shifts the routing of vehicles to less-congested facilities. A more robust public transportation system, high-occupancy vehicle lanes, better bicycling and pedestrian facilities, flexible work schedules, and telecommuting are a few of the other alternatives to traditional highway transportation.

Road Pricing

Although the building of new facilities and better management and operation of roads are effective strategies in relieving congestion, they do not address one of its root causes: that most travelers do not pay the full cost of receiving transportation services. Congestion pricing—charging a price that will bring supply and demand into balance—relies on market forces and recognizes that trip values vary by individual.

Congestion pricing can take many forms. At the present time, variable pricing is typically applied on a limited access facility, such as a bridge, or in a congestion charging zone around a central business district. In the future, charging systems that use special technology may make it feasible to efficiently price entire road networks. Congestion pricing may also be applied to parking, encouraging travelers to alter their travel habits during peak periods.

Chapter 15

National Household Travel Survey

Since 1969, the National Household Travel Survey (NHTS) and related studies have provided key information on how the American public uses the Nation's highway system. The NHTS provides detailed data on the characteristics of travelers, trips, and vehicles. Data collection for the 2008 survey is currently underway. This Chapter includes selected findings from the 2001 survey.

Long-Distance Travel

Overall, about 2.6 billion long distance trips are taken by U.S. residents every year. These are trips of 50 miles or more away from home; in any given year, 169 million people (61 percent of the population) do not make any trips of this length. Business trips comprise nearly 30 percent of the long distance trips. Another 25 percent of trips involve visiting friends and relatives, while leisure trips, sight-seeing, and vacations make up another 25 percent.

Older Drivers

Americans aged 65 and older represent the fastest-growing segment of the U.S. population. The total mileage driven by these older Americans is projected to increase by 50 percent by 2020 and more than double by 2040. While older drivers tend to drive far fewer miles than younger drivers, they are more vulnerable to severe injuries. Per mile driven, elderly drivers (those over 80 years old) are more likely to die in a crash than any other age group.

Rising Fuel Cost

Almost 70 percent of all petroleum used in the United States goes for transportation. Recent increases in fuel costs have raised questions about the impact of higher fuel prices on driver behavior. In 2001, the average household spent $1,461 a year on motor fuel; by 2006, this cost had risen to an estimated $3,261. Despite higher fuel prices, passenger travel has continued to grow. This is due to population growth; the increased purchasing power of American households; and the continued dispersion of housing, workplace, and recreational locations.

Travel Characteristics of New Immigrants

For the first time since the early 1900s, immigrants comprise more than 10 percent of the American population, a total of 32 million people. Immigrants will provide a larger share of the labor force in the future, requiring agencies to rethink transportation options. Immigrants are five times more likely to take transit to work than native-born Americans. There is also a high use of carpools by Hispanic commuters, especially men.

Commuting

One in 12 American workers spent an hour or more commuting each way per day in 2001, up from one in 20 in 1995. The number of hour-long commutes has skyrocketed not only because workers are taking jobs farther from home, but because the same commutes are taking longer. More than one-quarter of workers with commutes of one hour or longer leave before 6 a.m. for their trip to work.

Travel Time and Congestion

Commuting is a major factor in metropolitan congestion. According to the 2001 NHTS, two-thirds of all commuters usually leave for work between 6:00 and 9:00 a.m., and more than 88 percent of these workers travel in private vehicles.

A significant number of non-work vehicle trips, however, are made during peak periods. From 1990 to 2001, morning peak period non-work trips on Mondays through Thursdays increased by 100 percent. Shopping trips (including those for the purpose of getting a meal) adds 31 billion VMT to morning peak volumes.

Travel to School

The percentage of children ages 6 to 12 driven to school in a private vehicle rose from 15 percent in 1969 to 50 percent in 2001. This change in travel behavior has led many transportation professionals to consider policies and programs that encourage walking and biking to school, especially for grade school children.

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Publications

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