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) to improve the estimation of the conditions and performance of highways, bridges, and transit and to 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 2004, it does not reflect any 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 2004 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. During the legislative development process culminating in SAFETEA-LU, a certain figure was widely cited as being the six-year Federal program size recommended by the 2002 C&P report; however, that figure did not actually appear anywhere in the report. 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. Despite this, 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 Department 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 are likely to 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 in their investment decision-making process beyond just economic considerations, 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, the modeling procedures for estimating the highway investment scenarios have been modified to assume that the funding to support increases in highway and bridge investment above 2004 levels would be financed in a manner consistent with the current financing structure, which is primarily supported by user fees. A feedback loop has also been added 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 the future investment scenario estimates.

While the assumption of increased levies on users via the current tax and fee structure draws revenues, investment, and travel demand together, the inherent economic inefficiencies of the current structure would remain, whereby travel on uncongested facilities is charged at the same rate as those with significant congestion issues. Previous editions of this report have identified congestion pricing as an alternative financing and travel demand management tool that could significantly improve economic efficiency and reduce the distortionary effect that the current financing structure has on highway use and investment.

When highway users make decisions about whether, when, and where to travel, they consider both the implicit costs (such as travel time and safety risk) and explicit, out-of-pocket costs (such as fuel costs and tolls) of the trip. 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.

For this report, the Highway Economic Requirements System (HERS) has been adapted to illustrate the theoretical impact that more efficient pricing could have on the future highway investment scenario estimates. This preliminary analysis, presented in Chapter 10, assumes that congestion pricing would be implemented universally on all congested roads. As discussed below, improving the economic efficiency of the highway pricing structure would yield significant benefits in the form of reduced congestion and traveler delay. The methodology used for this analysis is presented in greater detail in Appendix A. The "Pricing Effects" section in Part IV of this report also provides a further discussion of other ongoing research activities in this area that will be reflected in future editions of this report.

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 which has been modeled in this analysis is expected to further reduce the level of future capacity investment that would be 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 further improve operating efficiency. This report does 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. A discussion of new technologies is included in Part IV.

What Does it Mean to "Maintain"?

Due to the nature of the different analytical tools to analyze highway, bridge, and transit investment for this report, and the limitations of the underlying data, the "maintain" scenarios are defined differently in this report for different system components. The Cost to Maintain highways reflects the estimated average annual level of investment required so that the physical conditions and operational performance of the highway system will remain at a level such that their impact on highway users (measured in terms of average costs experienced by users) in 20 years would be the same as today. The Cost to Maintain bridges reflects the estimated level of investment that would be sufficient to keep the backlog of economically justifiable bridge improvements in 20 years at the same size as it is today. The Cost to Maintain transit reflects the estimated level of investment that would be sufficient to keep the average transit asset condition in 20 years equal to the average transit asset condition in the base year, and to have the average occupancy rate for each mode, as measured by passenger miles per peak vehicle, the same in 20 years as in the base year.

While the analytical approaches differ, all of these scenarios point to a level of 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. However, it is important to recognize that the conditions of "today" (i.e., 2004) in this report differ from the conditions of "today" (i.e., 2002) as presented in the 2004 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 is also important to note that the investment scenario estimates 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.

What Does it Mean to "Improve"?

In theory, if the estimated Cost to Maintain level is accurate, and the "correct" projects are chosen, then spending $1 more than that level would result in an improved system. In practice, the "Cost to Improve" scenarios in this report have been more aggressive, picking some higher target level of future conditions and performance. The Cost to Improve highways (described as the "Maximum Economic Investment" scenario) reflects the maximum average annual level of investment that could be utilized while still investing only in cost-beneficial highway improvements over 20 years. The Cost to Improve bridges reflects 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 Cost to Improve transit reflects 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. [Note the term agency-mode refers to each mode within each transit agency.] In this report, the Cost to Improve transit comes close to, but does not fully achieve, an average condition of "good" for transit assets, because to do so would require replacing assets that are still in operationally acceptable condition.

Particularly for highways and bridges, the "Cost to Improve" scenarios in this report can be viewed as "investment ceilings" above which it would not be cost beneficial to invest, even if unlimited funding were available. The transit scenario is predicated on the ambitious condition and performance criteria specified above. While these scenarios are interesting from a theoretical technical standpoint, they do not represent practical target levels of investment, for several reasons. First, available funding is not unlimited, and many decisions on highway and transit 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. Simple cost-benefit analysis is not a commonly utilized capital investment model in the private sector. Instead, firms utilize a rate of return approach 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. Second, these scenarios do not address practical considerations as to 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. Third, 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.

It is important to again note that, 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, if investment rose to the Cost to Improve level, there are few mechanisms to ensure 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 as part of this scenario.

Highlights: Highways and Bridges

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 44.7 percent between 1997 and 2004, to $147.5 billion. This equates to a 22.7 percent increase in constant dollar terms. Highway capital spending alone rose from $48.4 billion in 1997 to $70.3 billion in 2004, a 45.2 percent increase, equating to a 22.9 percent increase in constant dollar terms. Federal cash expenditures for highway capital purposes increased 52.9 percent from 1997 to 2004, while State and local capital investment increased by a smaller (though still robust) rate of 39.9 percent (increases of 29.4 and 18.3 percent in constant dollar terms, respectively). It is important to note that, owing to the nature of the Federal-aid highway program as a multiple-year reimbursable program, the impact of increases in obligation levels phases in gradually over a number of years. The Federally funded portion of total highway capital investment for all levels of government had dipped below 40 percent in 1998 for the first time since 1959, as TEA-21's passage relatively late in fiscal year 1998 reduced its impact on cash expenditures during that initial year. However, this share subsequently rebounded sharply, reaching 46 percent in 2002 (consistent with the high end of the range of 41 to 46 percent that was observed for each year between 1987 and 1997) before tailing off to 44 percent in 2004.

The TEA-21 era has also coincided with a shift in the types of capital improvements being made by State and local governments. The percentage 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 51.8 percent in 2004. The combined result of the increase in total capital investment and the shift in the types of improvements being made was a 58 percent increase (33.9 percent in constant dollar terms) in spending on system rehabilitation, from $23.0 billion in 1997 to $36.4 billion in 2004. Compared with system expansion projects, system rehabilitation projects tend to have shorter lead times and are often less controversial, which made many of them attractive candidates as Federal funding increased over this period. Investment in system expansion (the construction of new roads and bridges and the widening of existing roads) grew more slowly during this period, rising 28 percent (8.3 percent in constant dollar terms) from $21.5 billion in 1997 to $27.5 billion in 2004.

Physical Conditions Have Improved in Some Areas

The large increase in system preservation investment since 1997 has had a positive effect on the overall physical condition of the Nation's highway and bridge infrastructure. The percentage of vehicle miles traveled (VMT) on pavements with "good" ride quality rose from 39.4 percent in 1997 to 44.2 percent in 2004. Rural areas showed the most improvement, as the share of rural VMT on roads with good ride quality rose from 47.9 percent to 58.3 percent over the same period. It should be noted that the share of VMT on roads with "acceptable" ride quality (a lower standard that includes roads classified as "good") has fallen from 86.4 percent to 84.9 percent, mainly due to a decline in urbanized areas. (The preceding figures are based on all arterials and collectors for which data are available).

The percentage of bridges considered deficient dropped from 29.6 percent in 1998 to 26.7 percent in 2004, with most of the progress made on bridges with structural deficiencies, rather than on bridges considered to be functionally obsolete. Bridge condition also differs 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.

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 4.1 percent of total mileage, it carries 44.8 percent of total travel in the United States. The physical conditions of NHS routes are better on average than other roads. The percentage of NHS VMT on pavements with "good" ride quality rose from 37 percent in 1997 to 52 percent in 2004. The percentage of NHS bridges considered deficient dropped from 26.1 percent in 1997 to 20.5 percent; almost three-fourths of these bridges are functionally obsolete, while only one-fourth are structurally deficient.

Operational Performance Has Declined, But at a Slower Rate

Despite the historic investment in highway infrastructure and improving conditions on many roads and bridges, operational performance—the quality of use of that infrastructure—has continued to deteriorate. This is reflected in measures of congestion in all urbanized areas developed for FHWA by the Texas Transportation Institute (TTI). From 1997 to 2004, the estimated percentage of travel occurring under congested conditions has risen from 27.4 percent to 31.6 percent. The average length of congested conditions has risen from 6.2 hours per day in 1997 to 6.6 hours per day. [Note that these statistics are different than those found in TTI's annual *Urban Mobility Study*, which is based on a subset of urbanized areas weighted toward the most heavily populated areas.] On a more positive note, the rate at which these indicators are getting worse has been slowing in recent years.

The Department of Transportation's (DOT) *National Strategy to Reduce Congestion on America's Transportation Network* provides a blueprint for Federal, State, and local officials to follow in addressing critical operational performance issues. Several of the topics identified in the plan are also discussed in this report, including congestion pricing, freight bottlenecks, the deployment of new technologies to improve operations, and private sector partnering and financing opportunities. Congestion mitigation is also a major component of the *Framework for a National Freight Policy* that has been developed by DOT and its public and private partners.

Highway Safety Has Improved

Considerable progress has been made in reducing fatality rates and injury rates over time, including the period from 1997 through 2004. The fatality rate per 100 million VMT has declined from 1.64 to 1.44 over that period, but increased to 1.47 in 2005. The actual umber 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 94 in 2004.

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 Investment Scenarios

Absent increased implementation of congestion pricing, accelerated deployment of operational technologies, or any innovation in construction methods or materials, maintaining the overall conditions and performance of highways and bridges at current levels would require an increase in the combined amount of investment from all levels of government and the private sector, relative to current expenditures. The "Cost to Maintain Highways and Bridges" scenario describes a level of investment at which future conditions and performance would be maintained at a level sufficient to keep average highway user costs from rising above their 2004 levels, based on projections of future highway use. The average annual investment level for this scenario is projected to be $78.8 billion (in constant 2004 dollars) for 2005 to 2024, which is 12.2 percent more than the $70.3 billion of capital spending in 2004. Note that this "gap" reflects future investments stated in constant dollars; additional annual increases in investment would be necessary to offset the effects of inflation. Note also that capital expenditures for bridge preservation in recent years have exceeded the bridge preservation component of the "Cost to Maintain Highways and Bridges" scenario, a trend that has led to reductions in the percentage of bridges classified as deficient. [See the "What Does it Mean to 'Maintain'?" section earlier in these Highlights for critical caveats to consider in evaluating the implications of this scenario.]

Assuming resources are deployed to maximize net benefits as opposed to achieve other non-economic objectives, additional increases in highway capital investment would result in positive net benefits to the American public through further reductions in travel time, vehicle operating costs, crashes, emissions, and highway agency costs. The "Maximum Economic Investment (Cost to Improve Highways and Bridges)" scenario presented in this report describes an "investment ceiling" above which it would not be cost beneficial to invest. The average annual Maximum Economic Investment level is projected to be $131.7 billion for 2005 to 2024 (stated in constant 2004 dollars). This is 87.4 percent higher than the $70.3 billion of total capital investment by all levels of government in 2004. As stated previously, however, current investment methodologies do little to ensure maximization of net benefits. [See the "What Does it Mean to 'Improve'?" section earlier in these Highlights for critical caveats to consider in evaluating the implications of this scenario.]

The investment scenario estimates in this report are slightly higher than the estimates for 2003 to 2022 found in the 2004 edition of this report, due largely to the impact of inflation in highway construction costs between 2002 and 2004. Accounting for inflation, the estimated Cost to Maintain is 2.3 percent greater, while the estimated Maximum Economic Investment level for highways and bridges is 6.2 percent higher. These other changes in projected investment scenario estimates from the 2004 report are attributable both to changes in the underlying characteristics, conditions, and performance of the highway system as reported in the available data sources, and to changes in the methodology and models used to generate the estimates.

Impacts of Future Investments

In addition to the two main investment scenarios outlined above, this report also predicts the impacts of numerous alternative future investment levels on a variety of condition and performance indicators.

If investment were to remain at 2004 levels in constant dollar terms, and no additional operational strategies or innovations are implemented beyond those assumed as part of the scenarios, it is projected that recent trends observed in the conditions and performance of the highway system would continue. At this range of investment levels, and assuming current tax and fee structures for system users, the operational performance of the highway system is expected to further deteriorate: average speeds would decline and the amount of delay experienced by drivers would increase. Recent trends toward improvements in bridge conditions are expected to continue; however, the aging of the Nation's bridges, particularly on the Interstate System, will present additional challenges in the future.

Composition of Future Investments

The analyses of future investment/performance relationships in this report suggest that (1) there is substantial room for cost-beneficial investment in system rehabilitation that would reduce average highway user costs and (2) if funding levels were to be raised significantly, an increasing number of potential system capacity investments would be among the most cost-beneficial options.

The recommended mix of investments under the "Cost to Maintain" scenario is very similar to current spending patterns in terms of the relative percentages of investments in system rehabilitation compared with system expansion. However, the "Maximum Economic Investment for Highways and Bridges" scenario would devote a larger share of total investment toward capacity expansion than would the "Cost to Maintain" scenario. While capacity improvements are generally more expensive than rehabilitation improvements, proportionally more of them could be economically justified at high levels of investment.

Potential Impacts of Congestion Pricing

This edition of the C&P report includes some preliminary analysis estimating the potential impacts of applying universal congestion pricing to all congested roadways. This underlying analytical approach will be refined further and peer reviewed by outside experts prior to the development of the 2008 C&P report; future reports will include pricing scenarios that may show larger or smaller effects. However, from even this preliminary analysis, it is clear that **congestion pricing has the potential to significantly improve the operational performance of the Nation's highway system, while significantly reducing the level of future capital investment that would be necessary to achieve any specific level of performance**. Instituting congestion pricing on a widespread basis would also send clear signals concerning travelers' willingness to pay to travel in certain corridors at certain times, which would inform decisions about where future capital investment should be directed in order to maximize net benefits. Such signals would be expected to improve the transportation planning process.

The application of universal congestion pricing to the "Cost to Maintain" scenario would reduce the average annual investment level by $21.6 billion (27.5 percent) to $57.2 billion. This is well below the $70.3 billion of capital spending by all levels of government in 2004. The congestion tolls applied under this scenario would average 20.5 cents per mile, based on the estimated economic costs that individual users of congested facilities impose on one another in terms of increased delay. On some extremely congested sections, the optimal congestion tolls would be considerably higher, while the optimal congestion tolls would be lower on less congested sections. No congestion tolls were applied to uncongested highway sections.

The application of universal pricing to the "Maximum Economic Investment" scenario would both reduce the average annual investment level by $20.9 billion (15.9 percent) to $110.8 billion, and improve the overall operating performance of the highway system, reducing the average delay experienced by highway users. Since the overall level of congestion would be lower under this scenario than under the "Cost to Maintain" scenario, individual drivers have less of a negative impact on each other, causing the average congestion tolls applied under this scenario to be lower, averaging 17.4 cents per mile.

The estimated annual revenues produced by the congestion tolls are approximately $34 billion for the "Maintain" scenario and $24 billion for the "Maximum Economic Investment" scenario. Average toll rates and annual revenues would be higher in the latter portions of the 20-year analysis period, as baseline traffic levels increase and contribute to congestion. The larger average tolls and revenues under the "Maintain User Cost" scenario reflect the fact that congestion would be higher under this scenario, so that drivers have larger negative impact on each other. For the "Maximum Economic Investment" scenario, the additional capacity expansion at the higher investment levels result in reduced congestion, so that drivers' impact on each other is not as severe; thus, the efficient congestion toll rates would be lower. This analysis suggests an important dichotomy between the revenues that would be produced under congestion pricing if tolls were levied in the manner assumed in this scenario and the revenues that would be required to support increased investment levels; in fact, the two are in some sense counter to one another. Note that this dichotomy might not exist under alternative approaches to setting congestion-based tolls, such as maximizing the estimated revenue yield. Such alternative approaches would affect the level of revenues produced, but would also change the impact of the congestion tolls on the investment scenario estimates.

Note that this preliminary analysis does not take into account the start-up or administrative costs that would be required to implement a congestion pricing strategy of this nature. The level of these costs could vary significantly, depending on the type of technology employed to collect these tolls.

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 2004. Total funding by Federal, State, and local governments reached its highest level of $28.4 billion in 2002, a 62.6 percent increase in current dollars from $17.5 billion in 1997, equal to a 45.6 percent increase in constant dollar terms. Federal funding in current dollars increased by 46.7 percent, from $4.7 billion in 1997 to $7.0 billion in 2004, equal to a 31.3 percent increase in constant dollar terms. State and local funding in current dollars increased by 68.5 percent, from $12.7 billion in 1997 to $21.5 billion in 2004, equal to a 50.9 percent increase in constant dollar terms. Total funding for transit, including system-generated revenues, increased by 52.2 percent, from $26.0 billion in 1997 to $39.5 billion in 2004, an increase of 36.3 percent in constant dollars.

In 2004, total transit agency expenditures for capital investment were $12.6 billion in current dollars, accounting for 33.2 percent of total transit spending. Federal funds provided $4.9 billion of total transit agency capital expenditures, State funds provided $1.8 billion, and local funds provided $5.9 billion. Capital investment funding for transit from the Federal government increased by 19.1 percent from 1997 to 2004, and capital investment funding for transit from State and local sources increased by 120.0 percent from 1997 to 2004. Due to the sharp increase in transit capital funds from State and local sources, the Federal government's portion of total transit capital investment from all levels of government fell from 54.2 percent in 1997 to 39.0 percent in 2004. Federal funding for transit capital investment was $4.1 billion in 1997 and $4.9 billion in 2004.

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 2004, the number of active urban transit vehicles as reported to the National Transit Database increased by 18.0 percent, from 102,258 to 120,659. Track mileage grew by 9.8 percent, from 9,922 miles in 1997 to 10,892 miles in 2004. The number of stations increased by 10.4 percent, from 2,681 in 1997 to 2,961 in 2004; and the number of urban maintenance facilities increased by 8.8 percent, from 729 in 1997 to 793 in 2004.

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 15.8 percent, from 40.2 billion in 1997 to 46.5 billion in 2004 (compared to an 18.1 percent increase in PMT on highways over the same period). PMT on nonrail transit (primarily buses) increased by 9.6 percent, from 19.0 billion in 1997 to 20.9 billion in 2004. PMT on rail increased by 21.4 percent, from 21.1 billion in 1997 to 25.7 billion in 2004. The distance traveled by all transit vehicles in revenue service, adjusted for differences in carrying capacities, increased by 27.2 percent, from 3.5 billion full-capacity bus miles in 1997 to 4.5 billion equivalent miles in 2004.

Physical Conditions for Most Assets Have Improved

Bus and rail vehicle conditions have improved since 1997. On a rating of 1 (poor) to 5 (excellent), bus vehicle conditions increased from 2.94 in 1997 to 3.08 in 2004, and rail vehicle conditions increased from 3.42 in 1997 to 3.50 in 2004.

Bus facility conditions improved from 3.23 in 2000 to 3.41 in 2004. Average condition is not available for 1997. Sixty-nine percent of bus maintenance facilities were in adequate (3) or better condition in 2004, compared with 67 percent in 2000 and 77 percent in 1997. Rail facility conditions improved from 3.18 in 2000 to 3.82 in 2004. As with buses, average condition is not available for 1997. Ninety-two percent of rail facilities were estimated to be in adequate or better condition in 2004, 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 2002 and 2004, the conditions of track, structures, and yards improved. The percentage of communications systems and traction power systems in adequate or better conditions increased between 2002 and 2004, and the percentage of train control systems in adequate or better condition decreased. The conditions of rail stations improved from 2.87 in 2002 to 3.84 in 2004. The conditions of nonrail stations, which are assumed to follow the same deterioration schedule as light rail stations, declined from 4.37 in 2002 to 4.23 in 2004. 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.

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 2004, average vehicle speed was 20.1 miles compared with 19.9 miles per hour in 2002 and 20.3 miles per hour in 1997. Average nonrail vehicle speed was 13.8 miles per hour in 1997, decreasing to 13.7 miles per hour in 2002, and increasing to 14.0 miles per hour in 2004. Average rail vehicle speed declined from 26.1 miles per hour in 1997 to 24.9 miles in 2000, increasing steadily to 25.4 miles per hour in 2003, and then declining to 25.0 miles per hour 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 increased from 1997 to 2000 and declined from 2001 to 2003, moving inversely with rail speeds. As the utilization of heavy rail and commuter rail continued to increase from 2003 to 2004, average rail speed decreased, outweighing a continued decline in light rail utilization.

Vehicle utilizations of all major nonrail modes were lower in 2002 than in 1997. The utilizations of motorbus and trolleybus vehicles continued to decline from 2002 to 2004, while the utilizations of demand response, vanpool, and ferryboat vehicles increased.

Future Investment Scenarios

The estimated average annual "Cost to Maintain" transit asset conditions and operating performance is estimated to be $15.8 billion, 25.4 percent more than 2004 capital spending. Asset rehabilitation and replacements account for between 49 percent and 66 percent of these projected funding requirements. Asset rehabilitation and replacements would account for a larger portion of total investment if performance is maintained and a smaller portion if performance is improved. These investment scenario estimates have not changed materially from $15.6 billion, the amount estimated for the 2004 C&P report.

This estimated $15.8 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 of 1.57 percent per year. This amount is unlikely to have much of an impact of transit's share of total passenger travel or to draw many passengers from highways to transit given that growth on both is expanding.

Eighty-seven percent of the projected transit investment under this scenario is expected to be in urban areas with populations over 1 million, and 92 percent of PMT on transit systems are in these areas. Fifty-eight percent of the total amount needed to maintain conditions and performance, or $9.0 billion dollars annually, is estimated to be for rail infrastructure. In 2004 PMT on rail accounted for 55 percent of PMT on transit. Vehicles account for the highest proportion, but less than half, of projected capital outlays for both rail and nonrail modes. Guideways account for almost as much of the estimated investment under this scenario as vehicles. Changes in investment needs by asset type have not changed materially from those reported in the 2004 C&P report.

The average annual Cost to Improve both the physical condition of transit assets and transit operational performance to targeted levels by 2024 is estimated to be $21.8 billion in constant 2004 dollars, 73.0 percent higher than transit capital spending of $12.6 billion in 2004. This scenario is an upper limit of the economically justifiable level of transit investments. The scenario assumes that all assets are close to good condition (4) by the end of the investment period. Eighty-seven percent of the additional amount for the Cost to Improve, or $5.2 billion annually, is to increase average operating speeds as experienced by passengers and to lower average vehicle occupancy levels to threshold levels by 2024, by undertaking investments in systems with slower passenger speeds and higher occupancy rates.

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 1.57 percent, an average of transit travel forecasts from 92 metropolitan planning organizations (MPOs). The previous report used projected growth of 1.57 percent per year based on the forecasts of 76 MPOs. The projected rate is above the actual 0.65 percent average annual rate of growth between 2000 and 2002, but below the actual average annual growth of 2.29 percent occurring between 1995 and 2004.

Conclusion

Increased Federal funding for transit capital investment under TEA-21, combined with a substantial increase in State and local government funding, has expanded transit infrastructure and permitted the condition of most transit assets to be maintained or improved between 1997 and 2004. PMT increased substantially from 1997 to 2004, but more slowly between 2000 and 2004. Vehicle utilization rates for most modes peaked in 2000 or 2001, leading to lower passenger travel speeds. Passenger speeds were slightly higher in 2002 and 2004, reflecting utilization levels below the 2000 and 2001 peaks. Since 2003 the utilizations of heavy rail and commuter rail have increased, leading to a decrease in average rail speed. The amount to maintain conditions and performance has increased marginally in current dollars from the amount in the 2004 C&P report, but declined in real dollars; the slight downward revision in amount required to maintain conditions and performance resulted from revisions to maintenance facility replacement costs and station replacement costs, revisions to asset deterioration schedules for stations and systems, and improvements to the benefit-cost analysis and new NTD data. The amount to improve conditions and performance declined by about $3.0 billion from the amount in the 2004 C&P report, principally due to a downward revision in the estimated cost of congestion delay to align more closely with the *1997 Federal Highway Cost Allocation Study* and reflect congestion levels by population stratum.