CHAPTER 8

Comparison of Spending and Investment Requirements

Summary

This chapter compares the current spending for capital improvements described in Chapter 6 with the future investment requirement scenarios outlined in Chapter 7. **These comparisons are intended to be illustrative, rather than to endorse a specific level of future investment.** While the analysis identifies gaps between investment requirements and current spending levels, it does not take a position as to whether or not these gaps should be closed. The impacts of different levels of investment are discussed in Chapter 9.

The size of the gap between an investment requirement scenario and current spending is dependent on the investment requirement analysis and the underlying assumptions used to develop that analysis. Chapter 10 explores the impacts that varying some assumptions would have on the investment requirements.

Exhibit 8-1 compares the difference between investment requirements and spending in this report with the corresponding difference based on the data shown in the 2002 C&P report. The first column of figures contains values shown in the 2002 C&P report, which compared 2000 spending with the average annual investment requirements for 2001 to 2020.

Exhibit 8-1 *Highway, Bridge, and Transit Spending Versus Investment Requirements Compared with Data from the 2002 C&P Report*

Percent by which Investment Requirements Exceed Current Spending	Based on 2000 Data	Based on 2002 Data
Cost to Maintain		
Highways and Bridges	17.5%	8.3%
Transit	63.8%	26.8%
Cost to Improve		
Highways and Bridges (Maximum Economic Investment Level)	65.3%	74.3%
Transit	127.5%	95.1%

Highways and Bridges

The average investment requirements estimated for the "Cost to Maintain Highways and Bridges" scenario in the 2002 C&P report were 17.5 percent ($11.2 billion) higher than highway capital expenditures in 2000. The estimated gap decreased to 8.3 percent ($5.7 billion) in 2002. The difference between the "Maximum Economic Investment level (Cost to Improve Highways and Bridges)" and 2002 spending is 74.3 percent ($50.7 billion). This represents an increase over the 65.3 percent gap estimated in the 2002 C&P report ($42.2 billion), based on the spending figures for 2000 presented in that report.

The changes in the size of the estimated gap between spending and investment requirements are largely the result of improvements in the modeling of highway performance (most notably the consideration of the impacts of highway operations strategies) and the cost of capital improvements. These changes have the effect of reducing the estimated level of investment required to reach a given level of performance, while increasing the cost of more expensive improvements that are nevertheless cost beneficial.

As discussed in Chapter 6, the preliminary figures for highway capital expenditures in 2000 reported in Highway Statistics 2000 and used in the 2002 C&P report were subsequently revised downward in Highway Statistics 2001. If the revised 2000 figures had been available at the time that the 2002 report was prepared, the gap between spending and investment requirements in that report would have been larger.

Transit

The estimated gaps between current spending on transit capital investment and the investment required to Maintain" and "Improve" conditions and performance have declined since the 2002 report. These gaps declined principally because of a 35.8 percent increase in transit capital investment from 2000 to 2002, compared with an increase of 4.8 percent in the amount needed to maintain conditions and performance and an increase of 16.4 percent in the amount needed to improve conditions and performance (all in nominal terms). They also reflect lower projected ridership growth of 1.5 percent, compared with a projected 1.6 percent in 2002.

The Federal Transit Administration (FTA) estimates that an average of $15.6 billion annually is needed between 2003 and 2022 to maintain transit asset conditions and performance, or $3.3 billion (27 percent) more than actual spending in 2002; $24.0 billion annually is estimated to be needed to improve transit asset conditions and performance, or $11.7 billion (95.1 percent) more than actual spending in 2002. The FTA estimates for 2000 to 2020 provided in the 2002 report were 64 percent above actual capital spending in 2000 for the "Maintain Conditions and Performance" scenario and 127 percent above actual capital investment in 2000 for the "Improve Conditions and Performance" scenario.

Required capital investment in vehicles to maintain conditions and performance is estimated to be $6.9 billion annually, 68 percent more than actual expenditures in 2002; required capital investment in vehicles to improve conditions and performance is estimated to be $9.3 billion annually, or 127 percent more than actual expenditures of $4.1 billion in 2002. Required capital investment in nonvehicle transit infrastructure to maintain conditions and performance is estimated to be $8.7 billion annually, or 6 percent more than actual expenditures of $8.2 billion in 2002; required capital investment in nonvehicle transit infrastructure to improve conditions and performance is estimated to be $14.7 annually, or 79 percent more than actual expenditures in 2002.

Highway and Bridge Spending Versus Investment Requirements

This section compares the average annual investment requirements estimated in Chapter 7 with the 2002 highway and bridge capital spending outlined in Chapter 6. As noted in Chapter 7, it is important to consider the relationship between the future funding gaps identified in this chapter and the parameters used in the Highway Economic Requirements System (HERS) and National Bridge Investment Analysis System (NBIAS) models. In particular, if the sample section travel growth projections reported in the Highway Performance Monitoring System (HPMS) do not accurately reflect travel that would occur at a constant level of system performance as was assumed in this analysis, and instead implicitly reflect a deteriorating level of performance, then the funding gap would be larger. If an unexpected demographic or economic shift occurs that reduces the level of travel that would occur at a constant level of service, then the reverse would be true. The specific impacts that changes in the vehicle miles traveled (VMT) growth projections and other key parameters would have on the investment requirement estimates are discussed in Chapter 10.

Q. Does this report recommend any specific level of investment?

A. No. The analysis of investment requirements in this report is intended to estimate what the consequences may be of various levels of spending on highway system performance. The comparisons in this chapter between current spending and the highway and bridge investment requirement scenarios are intended to be illustrative only. They are not intended to endorse any of the investment requirement scenarios as the "correct" level of transportation investment.

Average Annual Investment Requirements Versus 2002 Spending

Exhibit 8-2 compares the average annual investment requirements under the "Cost to Maintain" and "Maximum Economic Investment" scenarios [*see Chapter 7*] with 2002 highway and bridge capital expenditures. The average annual "Cost to Maintain Highways and Bridges" projected for the 2003 to 2022 period is $5.7 billion (8.3 percent) higher than 2002 capital expenditures, while the estimated "Maximum Economic Investment for Highways and Bridges" exceeds current spending by $50.7 billion (74.3 percent). Expenditures for bridge preservation in 2002 exceeded the corresponding component of the "Cost to Maintain" scenario, which is drawn from the "Maintain Economic Backlog" scenario in NBIAS [*see Chapter 7*].

While the "gap" between 2002 highway preservation spending and the "Cost to Maintain" scenario is the largest shown, this does **not** indicate that current investment is inadequate to maintain pavement conditions. As noted in Chapter 7, the HERS-derived component of the "Cost to Maintain" scenario is aimed at maintaining user costs rather than maintaining pavement conditions. The larger "gap" shown for highway preservation indicates that HERS has identified a large pool of potential pavement improvements that could yield significant benefits in terms of reducing user costs. While the ride quality on many functional systems has been improving in recent years (as reported in Chapter 3), the models indicate that many pavement improvements in both the near-term and longer-term future will continue to have high rates of return. The impact of investment on highway conditions and performance is discussed in more detail in Chapter 9.

Exhibit 8-2 *Average Annual Investment Requirements Versus 2002 Capital Outlay*

	2002 Capital Outlay ($Billions)	Investment Requirements (Billions of 2002 Dollars)			
		Cost to Maintain	Percent Difference	Maximum Economic Investment	Percent Difference
Highway Preservation	$24.5	$31.1	26.5%	$43.2	76.0%
Bridge Preservation	$11.3	$8.9	-21.0%	$12.5	10.8%
System Expansion	$26.5	$27.5	3.9%	$52.9	99.9%
System Enhancements	$5.9	$6.4	8.3%	$10.2	74.3%
Total	**$68.2**	**$73.8**	**8.3%**	**$118.9**	**74.3%**

Types of Improvements

Exhibit 8-3 compares the distribution of highway and bridge capital outlay by improvement type for the "Maximum Economic Investment for Highways and Bridges" and the "Cost to Maintain Highways and Bridges" with the actual pattern of capital expenditures in 2002. In that year, 38.8 percent of highway and bridge capital outlay went for system expansion. The distribution of funding by investment type suggested by the investment requirement scenarios developed using the HERS and NBIAS models depends on the level of available funding. For the "Cost to Maintain Highways and Bridges," 37.2 percent of the projected 20-year investment requirements is for system expansion, slightly lower than its share of current capital spending. However, if funding were to rise significantly above this level, the analysis suggests that even more cost-beneficial system expansion expenditures would be found, so that for the "Maximum Economic Investment" scenario, 44.5 percent of the total investment requirements is for system expansion.

Q. How does the improvement mix for the investment scenarios in this report compare with those in the 2002 C&P?

A. The investment scenarios in this report are more heavily weighted toward preservation relative to capacity improvements than in the previous report. This is due largely to the key model revisions discussed in Chapter 7 and Appendix A, including the consideration of highway operations improvements and their impact on performance, updated modeling of pavement deterioration and estimated unit costs of the different types of capital improvements, and the introduction of work zone delay into the evaluation of alternative improvements. These changes all have the effect of making traditional highway capacity improvements relatively less attractive on benefit-cost grounds.

Exhibit 8-3 *Highways and Bridges Investment Requirements and 2002 Capital Outlay, Percentage by Improvement Type*

	System Preservation			System Expansion	System Enhance-ments	Total
	Highway	Bridge	Total			
Maximum Economic Investment for Highways and Bridges	36.4%	10.5%	46.9%	44.5%	8.6%	100.0%
Cost to Maintain Highways and Bridges	42.1%	12.1%	54.1%	37.2%	8.6%	100.0%
2002 Capital Outlay	36.0%	16.5%	52.6%	38.8%	8.6%	100.0%

As discussed in Chapter 7, investment requirements for nonmodeled items were determined by assuming that any future increase in this type of investment would be proportional to increases in total capital spending. For system enhancements, the percentages for the "Maximum Economic Investment for Highways and Bridges" and for the "Cost to Maintain Highways and Bridges" were set at 8.6 percent to match the percentage of expenditures in 2002.

Comparison with Previous Reports

Exhibit 8-4 compares the estimated differences between current spending and average annual investment requirements for this and the 1997, 1999, and 2002 C&P reports.

The percentage difference between current spending and the "Cost to Maintain Highways and Bridges" is approximately half that in the 2002 report. As shown in Exhibit 8-4, the 2002 C&P report estimated that average annual investment requirements were 17.5 percent above current spending. Estimates of the gap based on the 1999 and 1997 reports were in a similar range.

Based on the information in the 1997 C&P report, the difference between the "Cost to Improve Highways and Bridges" would have been 108.9 percent. This difference fell to 92.9 percent in the 1999 C&P report and 65.3 percent in 2002 report, but has rebounded slightly in this report.

Q. How do changes in the "funding gap" since the 1997 report relate to changes in highway capital expenditures over that time?

A. The "Cost to Maintain" gap has decreased from 21.0 percent (based on 1995 data) to 8.3 percent (based on 2002 data), while the "Cost to Improve" gap has decreased from 108.9 percent to 74.3 percent. From 1995 to 2002, constant dollar highway capital outlays increased by 27.0 percent.

Q. What options are available to reduce the "funding gaps" cited in this chapter?

A. As previously noted, this report does not endorse any of the investment requirement scenarios as the "correct" level of transportation investment. If one were to explore options for closing these "gaps", then the discussions in Chapter 6 describing current highway financing mechanisms and certain innovative finance programs could serve as useful background material. Note, however, that while that chapter focuses on Federal, State, and local government investment in highway infrastructure, it is important not to overlook the private sector. While the financial data currently available are much more thorough in capturing public sector highway spending than that of the private sector, the private sector is playing an increasing role in highway finance. Mechanisms such as public-private partnerships are intended to foster increasing private investment in the future.

While the discussion of congestion pricing in the Introduction to Part II of this report focused on the potential impacts that this type of tolling might have on future investment requirements, it is important to note that this could also provide a substantial stream of additional revenue, assuming such revenues were dedicated to be used for highway purposes, and that these user charges would be additive to those currently imposed (such as fuel taxes), rather than replacing them. Ongoing research described in the "Pricing" section of Part V of this report suggests that, if congestion pricing were adopted on a universal basis, the revenue generated would be sufficient to easily eliminate the gap between current spending and the "Cost to Maintain" scenario and to begin to address the "Maximum Economic Investment" scenario, assuming the proceeds from these tolls were used to increase highway capital expenditures.

Note that the "Cost to Improve" Highways and Bridges is presented in this report as a maximum level of investment above which it would not be cost-beneficial to invest, even if available funding were unlimited. As highway investment increases above current levels, the marginal returns for each additional dollar invested would be expected to decline.

Exhibit 8-4 *Average Annual Investment Requirements Versus Current Spending—1997, 1999, 2002, and 2004 C&P Reports*

Report Year	Relevant Comparison	Percent Above Current Spending	
		Cost to Maintain Highways & Bridges (Low Scenario*)	Cost to Improve Highways & Bridges (High Scenario*)
1997	Average annual investment requirements for 1996–2015 compared with 1995 spending	21.0%	108.9%
1999	Average annual investment requirements for 1998–2017 compared with 1997 spending	16.3%	92.9%
2002	Average annual investment requirements for 2001–2020 compared with 2000 spending	17.5%	65.3%
2004	Average annual investment requirements for 2003–2022 compared with 2002 spending	8.3%	74.3%

* The investment requirement scenarios are not fully consistent between reports. See Chapter 7 and Appendix A.

As noted in Chapter 6, preliminary figures for 2000 highway capital shown in the 2002 C&P report were subsequently revised downward by approximately 5 percent. As a result, the gap between estimated investment requirements and funding for that year under either investment scenario would have been higher than what was reported.

Transit Capital Spending Compared with Investment Requirements

2002 Capital Spending and Estimated Average Annual Investment Requirements

Total Capital Spending—In 2002, total capital investment in transit by Federal, State, and local governments was $12.3 billion, about 25 percent less than the amount estimated by the Federal Transit Administration (FTA) to be needed to maintain condition and performance annually between 2003 and 2022. FTA estimates that an additional investment of $3.3 billion annually (26.8 percent more than actual capital investment in 2002) would be required to maintain conditions and performance, and an additional annual investment of $11.7 billion annually (95.1 percent more than actual capital investment in 2002) would be required to improve conditions and performance *[Exhibit 8-5].* These estimates are based on TERM (Transit Economic Requirements Model).

Exhibit 8-5 *2002 Transit Capital Expenditures Versus Estimated Average Annual Investment Requirements*

(Billions of 2002 Dollars)		Average Annual Requirements Minus Actual Expenditures in 2002	Average Annual Requirements Percent Above Actual Expenditures in 2002
Actual 2002 Capital Expenditures	$12.3		
Estimated Annual Average Requirements 2003–2022			
Costs to:			
Maintain Conditions & Performance	$15.6	$3.3	26.8%
Improve Conditions & Maintain Performance	$17.1	$4.8	39.0%
Maintain Conditions & Improve Performance	$22.5	$10.2	82.9%
Improve Conditions & Performance	$24.0	$11.7	95.1%

Sources: National Transit Database (NTD), Transit Economic Requirements Model (TERM) and FTA staff estimates.

Capital Spending by Asset Type—In 2002, $4.1 billion was invested in transit vehicles and $8.2 billion in nonvehicle transit infrastructure, i.e., facilities, guideway elements, stations, and systems *[Exhibits 8-6* and *8-7].*

Capital Spending on Vehicles—The average annual amount estimated by TERM to be required to maintain the conditions and performance of the Nation's transit vehicle assets between 2003 and 2022 is $6.9 billion annually, 68 percent above the actual spending of $4.1 billion in 2002. The average annual amount estimated to be required to improve the conditions and performance of the Nation's transit vehicle assets is $9.3 billion annually, 127 percent above the 2002 amount.

The entire bus fleet will need to be replaced at least once during the period 2003 to 2022, in spite of a reduction in the number of overage bus vehicles since 2000. In 2002, approximately 16,500 buses were overage compared with 16,200 in 2000. The decline in the number of overage buses has resulted largely from a decline in the number of overage and full-size and articulated buses. Large and medium-sized buses have an expected life of 15 to 16 years (and a minimum of age of 12 years before they can be replaced with

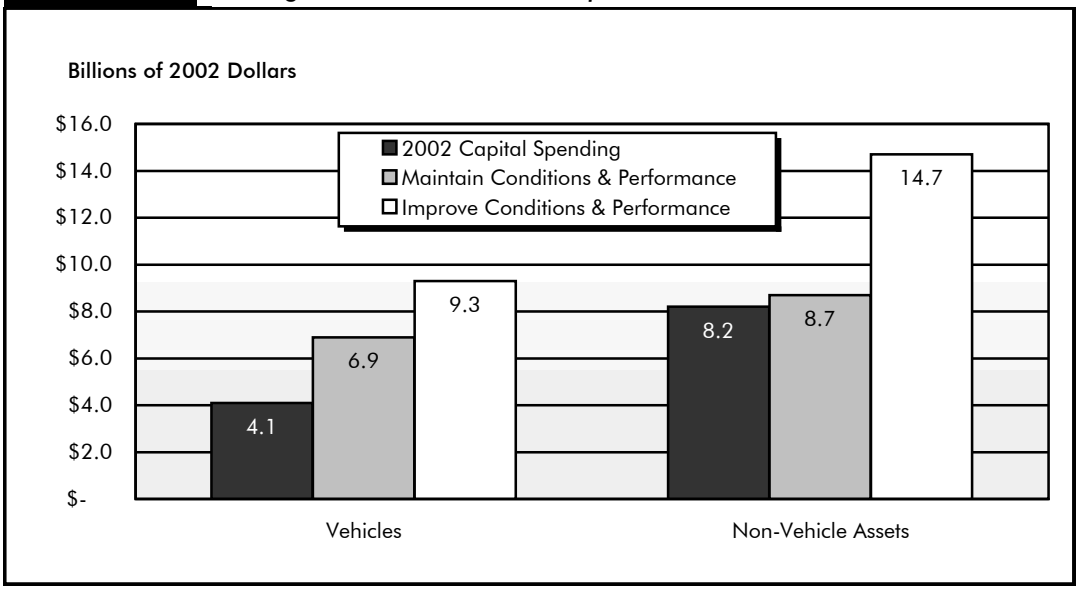
Exhibit 8-6 *Average Annual Transit Investment Requirements Versus 2002 Capital Spending by Asset Type*

	Vehicles			Nonvehicle Assets		
	Billions of 2002 Dollars	Percent Above Actual Spending	Percent of Total Capital Spending Requirements [1]	Billions of 2002 Dollars	Percent Above Actual Spending	Percent of Total Capital Spending Requirements [1]
2002 Capital Spending	**$4.1**		**31%**	**$8.2**		**69%**
Costs to						
Maintain Conditions & Performance	$6.9	68%	42%	$8.7	6%	58%
Improve Conditions & Performance	$9.3	127%	39%	$14.7	79%	61%

[1] Percent of total 2002 capital spending/ percent of total investment requirements to Maintain and Improve Conditions and Performance.

Source: Transit Economic Requirements Model and FTA staff estimates.

Exhibit 8-7 *Comparison of 2002 Transit Capital Spending with Average Annual Investment Requirements*



Source: Transit Economic Requirements Model and FTA staff estimates.

FTA funds), and small buses and vans have an expected life of 7 to 10 years (and a minimum age of 7 years before they can be replaced with FTA funds). The current average ages of these vehicles range from 7 to 8 years for larger buses and 3 to 4 1/2 years for smaller buses and vans.

With an average life expectancy of 25 to 30 years, a large proportion of the existing rail fleet will also need to be replaced between 2003 and 2022. The current average age for the nation's rail vehicles is 16 years for light rail vehicles, 20 years for heavy rail vehicles, and between 17 and 27 years for commuter rail vehicles, depending on the type. The number of overage rail vehicles increased from approximately 6,780 in 2000 to 6,980 in 2002. In 2002, 68 percent of commuter rail self-propelled passenger coaches, 36 percent of heavy rail vehicles, and 34 percent of commuter rail passenger coaches were overage, compared with 61 percent of commuter rail vehicles, 40 percent of heavy rail vehicles, and 29 percent of commuter rail passenger coaches in 2000.

In addition to rehabilitating and replacing existing bus and rail vehicles, the annual investment requirement for vehicles also includes investment for expansion to accommodate projected transit ridership growth and improve operating performance. To serve projected growth in bus passengers would require expanding the existing bus fleet by almost 42,000 vehicles from 2002 to 2022, approximately 45 percent. The investment required to improve service performance would expand the 2002 bus fleet by an additional 24,000 vehicles, or 24 percent. Similarly, expansion to serve projected growth in rail passengers would require close to 5,000 additional vehicles for the period 2002 to 2022, an increase of roughly 26 percent. To improve rail service would require about 4,500 additional vehicles, an increase of 25 percent. Given the life cycle needs of each vehicle type, many of the buses purchased to expand services will also require funds for rehabilitation and replacement, and many rail vehicles will require investment for rehabilitation before 2022. Each of these capital investment needs is included in the overall vehicle needs estimates.

Capital Spending on Nonvehicle Infrastructure—The annual amount estimated by TERM to be needed to maintain the conditions and performance of the Nation's nonvehicle transit infrastructure is $8.7 billion annually, 6 percent more than actual expenditures of $8.2 billion in 2002. The annual amount estimated to be needed to improve the conditions and performance of nonvehicle assets is $14.7 billion, 79 percent above actual expenditures in 2002. As discussed in Chapter 3, 20 percent of all rail maintenance facilities, 20 percent of all yards, 6 percent of all substations, 19 percent of all overhead wire, 14 percent of third rail, 15 percent of track, 9 percent of elevated structures, 17 percent of underground tunnels, and 56 percent of stations are estimated to be in poor or substandard condition. As discussed in Chapter 7, 31 percent of the nonvehicle investment estimated to be needed to maintain conditions and performance is for guideway elements (elevated structures [bridges, tunnels, and track]), approximately 22 percent is for maintenance facilities, 21 percent is for stations, and 15 percent is for systems. The remaining 11 percent is estimated to be for other project costs. The distribution of these amounts changes under the improve conditions and performance scenario. Thirty percent of the nonvehicle investment required to improve conditions and performance is estimated to be for guideway elements, 15 percent for maintenance facilities, 22 percent for stations, and 10 percent for systems. The remaining 21 percent is estimated to be for other project costs. As with the vehicle investment, the investment in nonvehicle transit infrastructure includes rehabilitation and replacement of existing assets; expansion investment to meet growth in the demand for transit services; and, for the performance improvement scenario, investment to improve operating speeds and capacity.

Comparison with Previous Reports

Exhibit 8-8 compares the percentage difference between current spending levels and investment requirements in 2002 with the percentage differences provided in the 1995, 1997, 1999, and 2002 C&P reports. As a result of methodological improvements, estimated investment requirements are not directly comparable from year to year. The estimated annual amount of investment required to maintain conditions and performance between 2003 and 2022 is 26 percent higher than actual capital expenditures in 2002. This compares with an estimated annual investment requirement ranging from 38 to 64 percent more than actual spending in earlier editions of the report. The decrease in the difference between estimated requirements and actual expenditures reflects a 16.5 percent average annual growth in transit capital expenditures between 2000 and 2002 from $9.1 to $12.3 billion, a lower ridership growth forecast of 1.5 percent compared with 1.6 percent in the 2002 report, and the application of a more rigorous benefit-cost test to identify future investments. A detailed account of the changes in investment requirements is provided in Chapter 7.

Exhibit 8-8 *Average Annual Transit Investment Requirements Versus Current Spending—1995, 1997, 1999, 2002, and 2004 C&P Reports*

Report Year	Spending Year	Investment Requirement Forecast Years	Percent Above Current Spending: Cost to Maintain Conditions and Performance	Percent Above Current Spending: Cost to Improve Conditions and Performance
1995	1993	1994-2013	37.6%	124.4%
1997	1995	1996-2015	38.3%	102.9%
1999	1997	1998-2017	41.0%	110.2%
2002	2000	2001-2020	63.8%	127.7%
2004	2002	2003-2022	26.8%	95.1%

Source: Transit Economic Requirements Model and FTA staff estimates.