



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

Rail Modernization Study **REPORT TO CONGRESS**



April 2009

Prepared by:
Federal Transit Administration



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

1201 New Jersey Avenue S.E.
Washington DC 20590

The Honorable Nancy Pelosi
Speaker of the House of Representatives
Washington, DC 20515

Dear Madam Speaker:

The Federal Transit Administration (FTA) is pleased to present its *Rail Modernization Study*, prepared in response to the FY2008 Transportation-HUD Appropriations bill conference report and further elucidated in a letter dated December 7, 2007, from Senator Richard Durbin and 11 other senators to FTA. We believe this report to be fully responsive in terms of both the requested content and schedule.

The report assesses the level of capital investment required to attain and maintain a state of good repair (SGR) for the Nation's seven largest rail transit operators. The study estimates the total value of the existing backlog of over-age assets at these agencies. It also considers reinvestment needs within the context of past levels of Federal funding support as well as potential changes to the current Federal program.

Summary of Key Findings

The Rail Modernization Study finds that more than one-third of agencies' assets are either in marginal or poor condition, indicating that these assets are near or have already exceeded their expected useful life. Assuming assets are permitted to remain in service beyond their expected useful life for a limited time (a realistic assumption based on current agency practices), there is an estimated SGR backlog of roughly \$50 billion (2008 dollars) for the agencies under consideration.

The study also finds that, between 1991 and 2009, although the actual dollar amount of capital funding from Federal sources to the seven agencies increased, their share of Fixed Guideway Modernization funds—to "old rail cities" in particular—actually *declined* as new fixed guideway systems, such as busways and HOV lanes, entered the program.

In addition, the study examined the seven agencies' current utilization of asset management practices. Such practices are intended to help organizations with large infrastructure holdings to more efficiently manage their reinvestment needs. FTA found that, while all seven agencies maintain comprehensive asset inventories for capital planning purposes, other asset management practices are lacking. For example, only 1 of 7 uses decision support tools to help conduct "what if" analysis; only 2 of 7 use a rigorous process to help rank and prioritize their investment needs; and only 3 of 7 have committed to conducting comprehensive asset condition assessments on an ongoing basis.

Overview of Methodology

The methodology used for the analysis in this report is consistent with the Department of Transportation (DOT) *2008 Status of the Nation's Highways, Bridges, and Transit Conditions & Performance* report to

Congress (the C&P Report) that was being prepared simultaneously. Sidebars have been included in this report to clarify the differences between them. Most notable is the focus of this report on maintaining assets at a key set of older transit rail agencies while the C&P Report evaluates all transit agencies and considers expansion as well as maintenance needs. The narrower focus has allowed our investigators to visit most of these agencies to collect updated asset information and compare needs estimates with transit agency staff.

Options for Congress

Based on the report's analysis, the Rail Modernization Study offers four options that Congress and FTA may wish to consider.

- 1) **Modification to the existing fixed guideway modernization fund formula.** Congress should consider revisions to the Section 5309 Fixed Guideway Modernization apportionment structure in order to attain a more even match between funding allocation and the capital reinvestment needs of program recipients based on differences in mode, alignment characteristics, and, to the extent possible, system age. The objective of these revisions should be to cover a roughly equal proportion of capital needs for all grantee types.
- 2) **Implementation of a temporary funding source designed to eliminate the existing SGR backlog.** The seven study agencies and the rail transit industry as a whole would benefit from the development of a temporary funding program designed to eliminate the existing SGR backlog. In practice, this temporary program could cover two or three six-year reauthorization periods (given the size of the existing backlog and the industry's capacity to accommodate additional construction on such a large scale, a single reauthorization period does not provide sufficient time to address the problem). Apportionment of these funds could follow the same needs-based principles as those laid out for modifying the Fixed Guideway Modernization apportionment formula as discussed above.
- 3) **Technical support for asset management.** FTA should develop technical assistance programs, similar to those offered to State highway departments by the Federal Highway Administration (FHWA) to help the nation's operators develop comprehensive and effective asset management programs. Initial areas of focus should include the development and use of asset inventories (for capital planning purposes), condition assessment monitoring systems, decision support tools, and multi-factor investment prioritization methods.
- 4) **Capital asset reporting.** FTA's ability to repeat the analysis contained in this study, either for the seven study agencies or for a broader group of operators, would greatly benefit from and be facilitated by a National Transit Capital Asset Reporting System that ensured (1) regular asset reporting and (2) a consistent structure and level of reporting across all urban transit agencies. The availability of this data would support better-quality national needs assessments and transit asset condition monitoring than is currently possible.

Sincerely,



Matthew J. Welbes
Executive Director

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EXECUTIVE SUMMARY

Overview

The nation's seven largest rail transit agencies deliver over three billion passenger trips each year, relying on over 6,000 miles of track, 1,700 passenger stations and close to 15,000 rail vehicles to do so. In a period of rising congestion and fuel prices, these services, and the infrastructure and rolling stock that support them, are critical to the transportation needs and quality of life of the communities they serve. At the same time, this infrastructure is aging and the level of reinvestment appears insufficient to address a growing backlog of deferred investment needs.

The main objective of this Rail Modernization Study is to assess the level of capital investment required to attain and maintain a state of good repair (SGR) for the nation's seven largest rail transit operators (see **Exhibit ES-1**). The study also considers these reinvestment needs within the context of past levels of Federal funding support as well as potential changes to the current Federal program.

Exhibit ES-1
Study Agencies and Rail Modes

Agency	Modes
Chicago Transit Authority (CTA)	Heavy Rail
Massachusetts Bay Transportation Authority (MBTA)	Commuter Rail, Light Rail and Heavy Rail
Metropolitan Transportation Authority (MTA)	Commuter Rail and Heavy Rail
New Jersey Transit Corporation (NJ TRANSIT)	Commuter Rail and Light Rail
San Francisco Bay Area Rapid Transit District (BART)	Heavy Rail
Southeastern Pennsylvania Transportation Authority (SEPTA)	Commuter Rail, Light Rail and Heavy Rail
Washington Metropolitan Area Transit Authority (WMATA)	Heavy Rail

Background

On December 7, 2007, FTA Administrator James Simpson received a letter from Senator Richard Durbin and 11 other Senators¹ requesting that FTA conduct a study to determine the infrastructure needs of our country's largest rail transit systems. This letter also referenced an amendment to the FY 2008 Transportation-HUD Appropriations bill which included the following text:

"Rail Modernization Study – The Appropriations Committees direct the FTA to conduct a study within one year of enactment of transit agencies in urbanized areas to determine the status of our Nation's commuter rail infrastructure. The study should include a funding history over the last three highway authorization acts; the estimated cost of bringing the infrastructure up to a state of good repair, and an analysis of the necessary formula modifications to achieve a state of good repair."

At the same time, FTA has also received direct requests from several major U.S. transit operators to consider their recapitalization needs and the potential Federal role in helping to address those needs. The Rail Modernization Study presented in this report was completed in response to these requests.

¹ Senators Evan Bayh, Robert Casey, Hillary Clinton, Christopher Dodd, John Kerry, Edward Kennedy, Joe Lieberman, Robert Menendez, Barack Obama, Charles Schumer, and Arlen Specter

Study Agency Selection

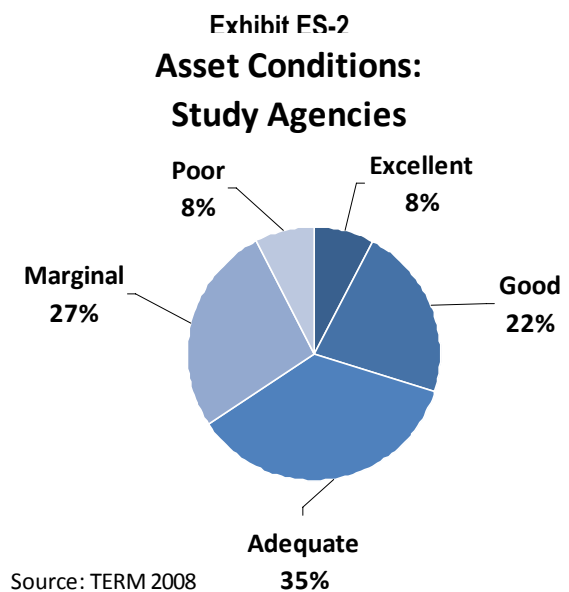
The seven rail agencies (and fourteen different rail mode systems) included in this study were selected based on an analysis of National Transit Database (NTD) records of ridership of U.S. rail transit agencies operating commuter rail, heavy rail and light rail systems. The rail transit agencies with the largest total rail ridership were then selected and are listed in Exhibit ES-1. These agencies' combined assets encompass roughly two-thirds of the nation's total investment in rail transit assets as well as the majority of the nation's oldest rail transit infrastructure (including rail transit investments in New York, Boston, Chicago and Philadelphia). The study agencies also include several large rail systems that are just entering their first significant rehabilitation cycles, such as the rail systems in San Francisco, New Jersey and Washington, DC. Together, the seven rail agencies serve more than 80 percent of all rail transit riders.



Current Asset Conditions

This study begins with a preliminary assessment of the agencies' reinvestment needs based solely on the physical condition of their existing transit assets. A summary of this analysis, developed using FTA's Transit Economic Requirements Model (TERM) and using asset inventory data supplied by the study agencies, is presented in **Exhibit ES-2**.

More than one-third of the study agencies' assets (weighted by replacement value) are in either marginal or poor condition, implying that these assets are near or have already exceeded their expected useful life. By way of comparison, the proportion of transit assets in marginal or poor condition for the nation as a whole *and excluding the seven study agencies* is less than 20 percent. This comparison suggests that the reinvestment needs for these seven operators is measurably higher (per dollar invested) than the rest of the transit industry.

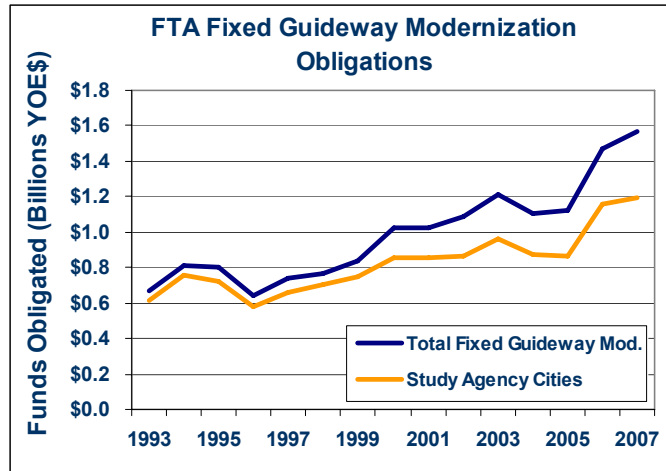


Past Trends in Federal Funding Support

The study also reviews the level of Federal funding for capital reinvestment available to the seven study agencies over the past three Surface Transportation Bills (ISTEA, TEA-21 and SAFETEA-LU), covering the eighteen-year period from 1991 to 2009. Over this period, the seven study agencies received roughly half of their capital funding from Federal sources (primarily from Section 5309 Fixed Guideway Modernization funds and Section 5307 Urbanized Area funds). While the actual dollar amount has increased over this time period, the share of Fixed Guideway Modernization Funds allocated to the seven study agencies and to the "old rail cities" in particular, has declined as new fixed guideway systems (including busways and HOV lanes) have entered the program (see **Exhibit ES-3**).

Exhibit ES-3

The seven study agencies currently receive \$2.9 billion in Federal funds annually that can be reinvested in existing infrastructure. Of this amount, the agencies spend roughly \$2.7 billion on rehabilitation and replacement activities, with a similar amount coming from state, local and dedicated sources. The remaining funds (less than 7% of all capital funds) are spent on expanding service. Roughly 50 percent of all transit capital expenditures are federally funded while roughly 90 percent of eligible Federal funds are spent on SGR-related investments. These funding and expenditure relationships have remained relatively constant over the past 18 years.



Study Approach: TERM and State of Good Repair

The Transit Economic Requirements Model (TERM): The study's estimates of the level of investment required to bring the study rail systems up to a state of good repair (SGR) were produced using FTA's Transit Economic Requirements Model (TERM). TERM is an analysis tool designed to estimate transit capital investment needs and has been used since 1995 to support preparation of U.S. DOT's biennial *Report to Congress on the Condition and Performance of the Nation's Highways, Bridges and Transit* (C&P Report). TERM was selected for this analysis because the model has been thoroughly tested and independently reviewed, and because the use of one analytical model such as TERM ensures that the needs of all seven operators are being assessed on a single, consistent basis.

While the core of this study's reinvestment needs estimates are derived from TERM, the figures have also been corroborated using each agency's own unconstrained needs estimates. These agency estimates were used as an independent check of those produced by TERM and TERM's estimates have been adjusted as appropriate to better reflect the costs and asset life expectancies of each study agency. In addition, staff from the study agencies participated in these comparisons.

State of Good Repair (SGR): For the purposes of this study, state of good repair was defined using TERM's numerically based system for evaluating transit asset conditions. TERM uses deterioration schedules to rate an asset's condition on a scale of 5 (excellent), 4 (good), 3 (adequate), 2 (marginal) through 1 (poor) based on the asset's type, age, rehabilitation history and other factors. Specifically, this study 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).² 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.

Study Estimates of SGR Needs

The study's estimates of the current investment backlog for the seven study agencies and the level of investment required to address that backlog over various time periods is provided below in **Exhibit ES-4**. Assuming assets are permitted to remain in service beyond their expected useful life for a limited time (a more realistic assumption based

² A complete description of TERM's condition rating system and how the model uses asset condition deterioration schedules, life-to-date mileage, maintenance histories and other factors to estimate an asset's physical condition are provided in Chapter 3.

on current agency practices), TERM estimates a current SGR backlog of roughly \$50.0 billion (\$2008). Once this backlog has been addressed, an estimated annual average of \$5.9 billion in normal replacement expenditures would be required to maintain that state of good repair. Alternatively, an annual investment of \$8.4 billion is estimated as sufficient to attain SGR over a twenty-year period while simultaneously addressing normal replacement needs (or \$2.5 billion to address the backlog alone).

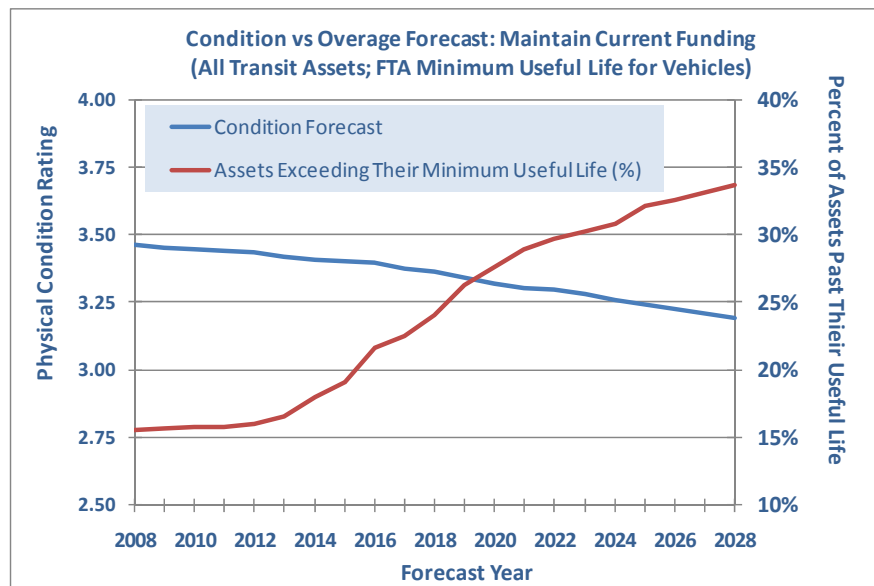
Exhibit ES-4
Study Agencies' SGR Backlog and Annual Normal Replacement Needs (Billions of \$2008)

Mode	SGR Backlog	Average Annual Normal Replacement Needs	Annual Investment to Attain SGR over (including normal replacement):			Annual Investment to Eliminate SGR Backlog over:		
			6 Years	12 Years	20 Years	6 Years	12 Years	20 Years
Rail	\$46.8	\$5.0	\$12.9	\$9.0	\$7.4	\$7.8	\$3.9	\$2.3
Non-Rail	\$3.2	\$0.9	\$1.4	\$1.1	\$1.0	\$0.5	\$0.3	\$0.2
Total	\$50.0	\$5.9	\$14.3	\$10.1	\$8.4	\$8.3	\$4.2	\$2.5

Needs vs. Current Expenditures: The actual level of investment in the rehabilitation, replacement and improvement of the seven agencies' existing transit assets was \$5.4 billion in 2006.³ This amount is well below the \$8.4 to \$14.3 billion required to address SGR backlog and normal replacement needs over any of the time periods considered in either of the scenarios shown in Exhibit ES-4. It is also less than the \$5.9 billion required to simply *maintain* a state of good repair after the backlog is addressed, suggesting the investment backlog for these seven agencies may be increasing.

The potential consequences of the continuation of the current reinvestment rate are shown in **Exhibit ES-5**. This analysis suggests that continued reinvestment at current rates will result in a continuing decline in the overall condition of the study agencies' assets (left-axis), and the proportion of assets exceeding their useful life (right-axis) will increase from the current 16 percent to more than 30 percent by 2028.

Exhibit ES-5



Potential Changes to the Federal Fixed Guideway Modernization Funding Formula

The existing Fixed Guideway Modernization funding formula represents a complex mix of funding tiers, lump-sum funding allocations and formula-based allocations. While intended to capture the differing needs of program recipients, the current allocation process tends to favor newer systems and commuter rail operators by covering a

³ Source: 2006 NTD; Note that the study's needs estimates do not include many types of improvement investments, hence the actual amount spent strictly on rehabilitation and replacement activities is less than the full \$5.4 billion.

greater proportion of their capital reinvestment needs as compared to other systems. This Rail Modernization Study identifies several potential changes to this allocation process, as well as potential new allocation mechanisms, intended to more closely align Federal funding to capital needs across all rail modes and rail system ages.

Asset Management Practices of the Study Agencies

This Rail Modernization Study also documented the transit asset management (TAM) practices of the seven rail transit agencies included in this study. This analysis focused on a set of four key TAM practices designed to help organizations with large infrastructure holdings more efficiently manage their reinvestment needs given limited funding availability. At the same time, it has also been noted that the transit industry's adoption of these practices has been slow relative to that in other transportation sectors. Hence, a second objective was to obtain a better understanding of the transit industry's current utilization of asset management practices in general. The completed scan revealed the following:

- Asset Inventory Development (capital planning): While few transit agencies had capital asset inventories in the recent past, seven of the seven study agencies (or their oversight bodies) now maintain comprehensive asset inventories for capital planning purposes. This development is positive because asset inventories represent a minimum requirement for the development of a more comprehensive asset management program. However, there is wide variation in the level of detail and types of data reported in these inventories, and the transit industry may benefit from comparisons of best practices.
- Asset Condition Monitoring: At the present time, only three of the study agencies have committed to conducting comprehensive asset condition assessments on an ongoing basis. A fourth study agency has completed two major condition assessments since the mid-1990s, but does not plan to do so on a regular basis. The transit industry lags other sectors in this respect; in contrast, virtually all state DOTs maintain detailed and current condition records of at least their pavement and bridge assets.
- Decision Support Tools/Processes: Decision support tools (e.g., needs assessment models) help capital planning staff conduct “what-if” analyses and scenario planning to answer questions such as “what level of investment is required to attain SGR in 10 years” or “what happens to asset conditions if funding levels remain unchanged.” Only one of the seven agencies currently maintains a decision support tool permitting these types of analyses.
- Investment Prioritization: The seven study agencies' approaches to prioritizing capital investments also vary widely. Each agency allocates resources between different asset types (for rehabilitation and replacement investments) and between different investment types, including SGR, expansion, core capacity improvements, safety or technology improvements. These prioritization approaches include:
 - “Mission Critical” assets first (e.g., vehicles and trackwork)
 - Safety first
 - Coordination of related line segment investments (to ensure efficiency)
 - Maintenance of historical funding levels

Only two of the seven agencies use an objective, multi-factor project scoring process to help rank and prioritize their investment needs.

Options

The results of this Rail Modernization Study suggest four key options that Congress and FTA may want to consider:



- Fixed Guideway Funding Formula Modifications: Congress should consider revising the current funding apportionment structure for the Section 5309 Fixed Guideway Modernization program to help redirect existing funds to where they are needed most. These changes should strive for a more even match between funding allocations and the capital reinvestment needs of grantees based on differences in mode, alignment characteristics, and, to the extent possible, system age. After these revisions, the funding formulas would cover a roughly equal proportion of each grantee's capital needs (i.e., with needs being higher for larger and older systems).
- Temporary SGR Investment Fund: The rail transit industry would benefit from a temporary funding program designed to eliminate the existing SGR backlog. In practice, this temporary program could last for two or three six-year reauthorization periods (given the size of the existing backlog and "constructability" constraints, a single reauthorization does not provide sufficient time to address the problem). In concept, the existing Fixed Guideway Modernization program would remain in place to cover rail transit's normal replacement needs, while this temporary program would focus entirely on addressing the SGR reinvestment backlog. As shown in Exhibit ES-4, a temporary SGR investment program of \$4.2 billion annually for 12 years (two authorization cycles) or \$2.5 billion annually over 20 years would address the investment backlog of the seven study agencies. At the same time, the level of expenditures for normal replacement needs would need to increase to roughly \$5.9 billion annually to ensure that the state of good repair is maintained into the future. The assumption is that the funds for these programs would originate from a mix of Federal, state and local sources.
- Technical Support for Asset Management: FTA should consider helping the transit industry catch up to other transportation sectors (most notably highways) in the implementation of transportation asset management practices by developing technical assistance programs, similar to those offered to State highway departments by the Federal Highway Administration (FHWA). Initial areas of focus should include the development and use of asset inventories (for capital planning purposes), condition assessment monitoring systems, decision support tools and multi-factor investment capital prioritization methods. The objective should not be to advocate for specific solutions, but to provide technical support in the development and use of these tools and techniques.
- Capital Asset Reporting: FTA should consider using the National Transit Database as the basis for national capital asset data. This Rail Modernization Study has benefited from the availability of good quality asset inventory data for the seven study agencies. FTA's ability to repeat this analysis nationally or for the seven study agencies would greatly benefit from the presence of a National Transit Capital Asset Reporting System that ensured (1) regular asset reporting and (2) a consistent structure and level of reporting across all urban transit agencies. This data would support better national needs assessments and transit asset condition monitoring than is currently possible. The National Transit Database represents the most logical reporting mechanism for this data. Enactment of this reporting requirement would also encourage agencies to develop and maintain their own asset inventory and condition monitoring systems (potentially supported by the asset management technical support recommendation identified above).

SECTION 1.0 – INTRODUCTION

1.1 Study Background

The Federal Transit Administration (FTA) is one of the eleven modal administrations within the U.S. Department of Transportation (DOT) and carries out the Federal mandate to improve public transportation. The FTA is the principal source of Federal financial assistance to America's communities for the planning, construction, improvement, and maintenance of public transportation systems.

On December 7, 2007, FTA Administrator James Simpson received a letter from Senator Richard Durbin and 11 other Senators⁴ requesting that FTA conduct a study to determine the infrastructure needs of our country's largest rail transit systems. This letter also referenced an amendment to the FY 2008 Transportation-HUD Appropriations bill amendment which included the following text:

“Rail Modernization Study – The Appropriations Committees direct the FTA to conduct a study within one year of enactment of transit agencies in urbanized areas to determine the status of our Nation’s commuter rail infrastructure. The study should include a funding history over the last three highway authorization acts; the estimated cost of bringing the infrastructure up to a state of good repair, and an analysis of the necessary formula modifications to achieve a state of good repair.”

In response to this request, FTA has conducted this Rail Modernization Study to assess the level of capital investment required to bring the assets of the nation's seven largest rail transit agencies to a state of good repair (SGR). The selected agencies and the rail modes they operate are identified below in **Exhibit 1-1**. Together, the collection of transit assets utilized by these seven agencies encompasses roughly two-thirds of the nation's total investment in rail transit assets and a still higher proportion of the nation's oldest rail transit infrastructure. Consistent with the text of the FY 2008 Transportation-HUD Appropriations bill, this study has also considered the level of Federal capital funding available to these seven agencies over the last three transit transportation authorization cycles (including ISTEA, TEA-21 and SAFETEA-LU) as well as an analysis of potential changes to the existing Section 5309 Fixed Guideway Modernization funding program to help better address the nation's rail transit capital reinvestment needs. In addition, the study has documented the capital planning and related asset management processes utilized by the seven agencies. This report presents the results of this Rail Modernization Study.

Exhibit 1-1
Study Agencies and Rail Modes

Agency	Modes
Chicago Transit Authority (CTA)	Heavy Rail
Massachusetts Bay Transportation Authority (MBTA)	Heavy Rail, Light Rail and Commuter Rail
Metropolitan Transportation Authority (MTA)	Commuter Rail and Heavy Rail
New Jersey Transit Corporation (NJ TRANSIT)	Commuter Rail and Light Rail
San Francisco Bay Area Rapid Transit District (BART)	Heavy Rail
Southeastern Pennsylvania Transportation Authority (SEPTA)	Commuter Rail, Light Rail and Heavy Rail
Washington Metropolitan Area Transit Authority (WMATA)	Heavy Rail

⁴ Senators Evan Bayh, Robert Casey, Hillary Clinton, Christopher Dodd, John Kerry, Edward Kennedy, Joe Lieberman, Robert Menendez, Barack Obama, Charles Schumer, and Arlen Specter

Completion of a transit rail modernization study is well considered at this time. First, in addition to the Senate request outlined above, FTA has received direct requests from local agencies for additional financial assistance to help meet their outstanding capital reinvestment needs. Second, it has been more than twenty years since FTA completed the last Rail Modernization Study.⁵ In the past, these studies have helped to determine the appropriate level of Federal assistance for the Fixed Guideway Modernization component of FTA's Capital Program (Section 5309). The level of national investment in rail and the age and condition distribution of the nation's rail transit infrastructure have changed significantly over the past two decades; hence, it is appropriate that FTA revisit this issue. Finally, the nation's surface transportation legislation is scheduled for reauthorization in 2010 and a reassessment of current rail modernization needs, and the appropriate Federal role in supporting those needs, is timely. The U.S. Department of Transportation (initially through UMTA and now FTA) has provided support to rail modernization activities since 1965.

1.2 Study Approach: TERM and State of Good Repair

The study's estimates of the level of investment required to bring the seven study rail systems up to a state of good repair (SGR) were produced using FTA's Transit Economic Requirements Model (TERM). TERM is a decision support tool designed originally to estimate the capital investment needs for the entire U.S. transit industry – including investments in asset rehabilitation and replacement, expansion to meet ongoing growth in transit travel demand, and investments to improve core capacity and operating speeds. TERM has been used since 1995 to support preparation of the transit component of the biennial *Report to Congress on the Condition and Performance of the Nation's Highways, Bridges and Transit* (C&P Report).

For this study, TERM was only used to estimate the rehabilitation and replacement needs of the seven study agencies. Hence, TERM's estimates of investments needed to expand transit service and improve capacity of the seven study agencies have been excluded from the analysis, as have the capital investments for all agencies not included in the study (the latter analyses would be included in TERM analyses for the C&P Report)⁶. At the same time, while the study is intended to focus primarily on rail reinvestment needs, the needs analysis does include the capital reinvestment needs for the non-rail modes operated by the seven study agencies – including SGR needs for bus, paratransit and ferry assets. A more detailed discussion of TERM and its use for this study is provided in Section 3.

While TERM's estimates form the core of this study's evaluation of capital reinvestment needs, this study also incorporates a great deal of new local information about the unique characteristics and needs of each of the seven agencies. For example, this study has compared TERM's modeled estimates of capital needs with each agency's own internal estimates of unconstrained capital reinvestment needs. These independent needs estimates, typically generated independently by each agency and with specific local knowledge, acted as an independent check of the needs estimates generated by TERM using FTA's national methodology. With participation from planners and maintenance managers at each of the seven agencies, this study identified where (and why) the TERM estimates differed materially from each agency's own needs assessments, and has adjusted TERM's estimates as appropriate to better reflect the costs, asset life expectancies and other unique characteristics of each study agency. Staff from each of the study agencies also participated in these comparisons.

State of Good Repair (SGR): At present there is no universally-accepted definition of “state of good repair” for public transit assets. For the purposes of this study, state of good repair or “SGR” has been defined using TERM's numerical system for evaluating transit asset conditions. Specifically, the TERM model includes a set of over sixty different deterioration schedules that estimate an asset's current condition based on that asset's type, age,

⁵ Prior FTA rail modernization studies were completed in 1979 and in 1987: *The UMTA Rail Modernization Program*, UMTA, May 1979 and the *Rail Modernization Study*, FTA, April 1987.

⁶ Note that TERM's current estimates of the rehabilitation and replacement needs of all US rail and bus agencies are, in fact, included in the analysis of potential changes to the existing Fixed Guideway Modernization funding program. With this exception, all other chapters of this report only consider the rehabilitation and replacement needs of the seven study agencies.

maintenance history and past utilization (e.g., life-to-date miles for vehicles). These deterioration schedules rate an asset's condition on a scale of 5 (excellent) through 1 (poor), and are based on empirical data on actual transit conditions. These deterioration schedules are used to assess both the *current* condition of existing transit assets as well as their *future* projected conditions under various rehabilitation and replacement assumptions.

For this study, an asset will be considered in a state of good repair when its estimated physical condition is greater than or equal to 2.5. Similarly, an entire transit mode will be considered in a state of good repair when all the assets that make up that system have a physical condition rating of 2.5 or higher. The level of capital investment required to attain and maintain a state of good repair is therefore that amount required to rehabilitate and replace all assets with a condition rating below 2.5.

1.3 Study Agencies

The agencies included in this Rail Modernization Study were selected based primarily on their large share of the nation's rail ridership. As shown in **Exhibit 1-2**, these agencies and their fourteen rail modes serve four out of every five rail transit trips in the country by operating and maintaining more than half of the nation's transit rail track miles and passenger stations, and three-quarters of the nation's rail vehicles. Finally, these agencies are recognized for their responsibility for a significant share of the nation's oldest transit assets, with some rail assets being more than a century old. In short, the rail agencies selected for this study represent the majority of the nation's oldest rail assets and serve the vast majority of the nation's rail transit riders.

Exhibit 1-2
Study Agencies' Rail Mode Characteristics

Study Agency	Rail Modes	Annual Passenger Boardings (Millions)	Track Miles	Passenger Stations	Fleet Vehicles
MTA - New York City Transit (NYCT)	Heavy Rail	1,804	835	468	6,202
Washington Metropolitan Area Transit Authority (WMATA)	Heavy Rail	259	270	86	954
Massachusetts Bay Transportation Authority (MBTA)	Heavy Rail	142	108	53	408
	Light Rail	74	78	70	211
	Commuter Rail	38	649	126	488
Chicago Transit Authority (CTA)	Heavy Rail	187	288	144	1,190
Southeastern Pennsylvania Transportation Authority (SEPTA)	Heavy Rail	88	100	57	369
	Light Rail	25	219	46	141
	Commuter Rail	32	610	156	357
San Francisco Bay Area Rapid Transit District (BART)	Heavy Rail	99	267	43	660
MTA - Long Island Rail Road (LIRR)	Commuter Rail	96	701	124	1,161
New Jersey Transit Corporation (NJ TRANSIT)	Light Rail	14	103	52	93
	Commuter Rail	73	1,016	167	1291
MTA - Metro-North Railroad (MNCR)	Commuter Rail	74	805	109	1,104
Study Agency Total	All	3,004	6,049	1,701	14,629
Industry Total (commuter, heavy and light rail)	All	3,775	11,796	2,975	19,655
Study Agency Share of Industry Total	All	80%	51%	57%	74%

Source: 2006 NTD

While the study focuses on the capital reinvestment needs of these rail operators, six of the seven operators also supply bus and paratransit service and two operate ferry services. Together, these operators also represent a significant share of the asset holdings for non-rail modes including 20 percent of all motor buses, 10 percent of transit vans and 32 percent of autos used in transit service.

1.4 Current Conditions

A key motivation for the Rail Modernization Study is the concern that a significant proportion of the nation's rail transit assets are in need of capital reinvestment. Analysis of the transit assets of the seven study agencies using FTA's Transit Economic Requirements Model (TERM) tends to confirm this concern. As discussed above, TERM is designed to provide an assessment of the current physical conditions of existing transit assets based on the assets' types, ages, maintenance histories and past utilization (e.g., life-to-date miles for a transit vehicle). The numeric condition rating scale on which these deterioration schedules are based is presented below in **Exhibit 1-3**.

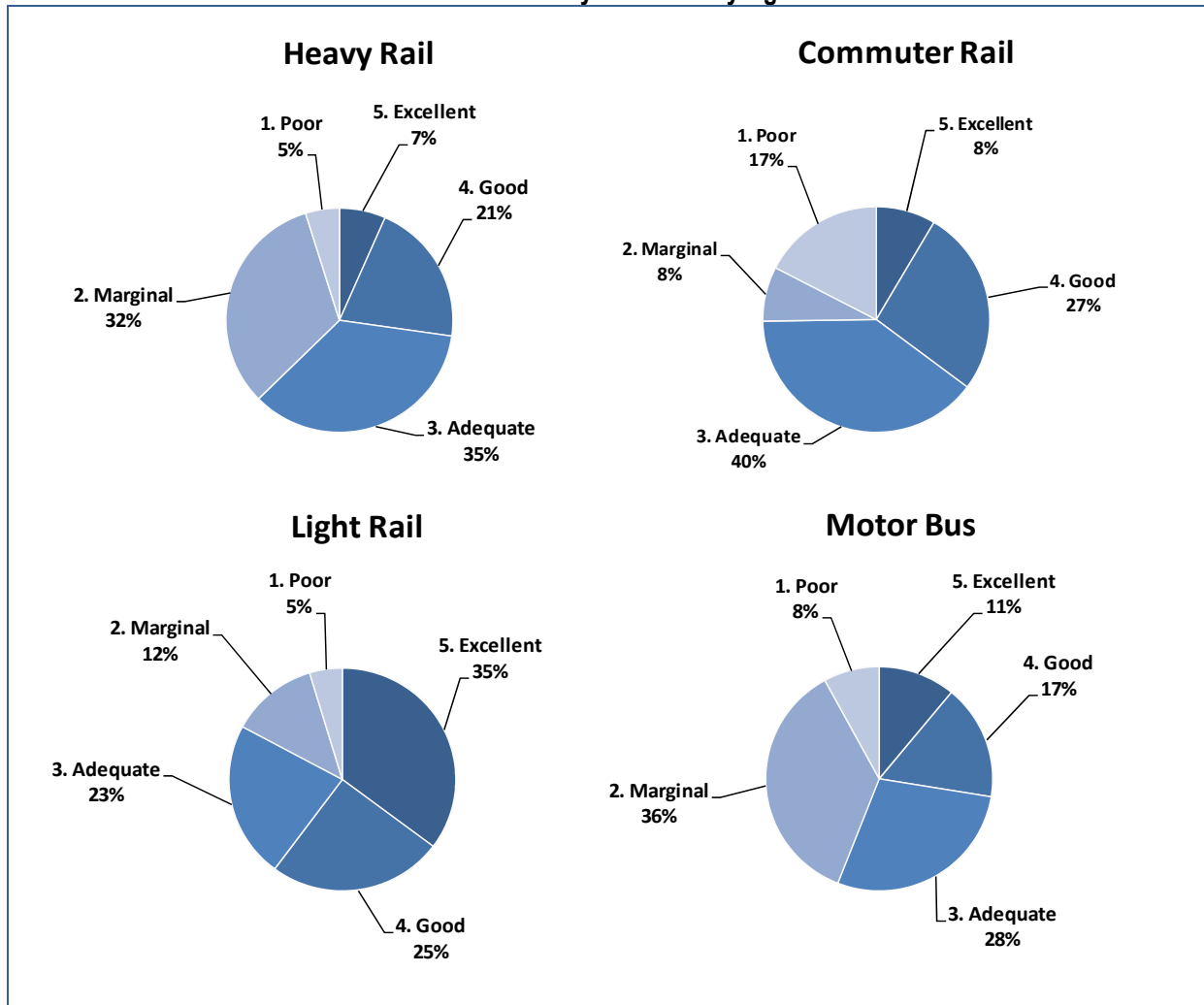
Exhibit 1-3
TERM Condition Rating Scale

Condition	Ratings	Description
Excellent	5.0 to 4.8	New asset; no visible defects
Good	4.7 to 4.0	Asset showing minimal signs of wear; some (slightly) defective or deteriorated component(s)
Adequate	3.9 to 3.0	Asset has reached its mid-life (condition 3.5); some moderately defective or deteriorated component(s)
Marginal	2.9 to 2.0	Asset reaching or just past the end of its useful life; increasing number of defective or deteriorated component(s) and increasing maintenance needs
Poor	1.9 to 1.0	Asset is past its useful life and is in need of immediate repair or replacement; may have critically damaged component(s)

Exhibit 1-4 below presents TERM's assessment of the physical condition of the study agencies' assets segmented by mode. This analysis shows that roughly one-third of the assets at the seven agencies are in marginal or poor condition, and that the assets with the poorest condition are concentrated most heavily in heavy rail (36%) and motor bus (44%) systems. By contrast, for all other U.S. transit operators outside of these seven agencies, the proportion of transit assets in marginal or poor condition is less than 20 percent. This finding highlights the relative maturity of the agencies in this study and suggests that the assets they operate may have relatively higher capital needs than the U.S. transit industry as a whole.

Similarly, **Exhibit 1-5** presents the distribution of asset conditions for the seven study agencies segmented into five basic asset types, weighted by each asset's replacement value: guideway elements (track and structures), facilities, stations, systems (including train control, traction power and communications systems), and vehicles. Each bar in this exhibit represents the total value of the seven agencies' investment (replacement value in \$2008) in each of the five asset categories. This exhibit suggests that guideway elements, stations and systems represent the majority of marginal and poor asset conditions, and also represent the largest share of the agencies' investment in transit infrastructure. In other words, the poorest conditions tend to be concentrated in the same types of infrastructure which also carry the greatest replacement cost.

**Exhibit 1-4
Asset Conditions by Mode: Study Agencies**



1.5 Other SGR Initiatives

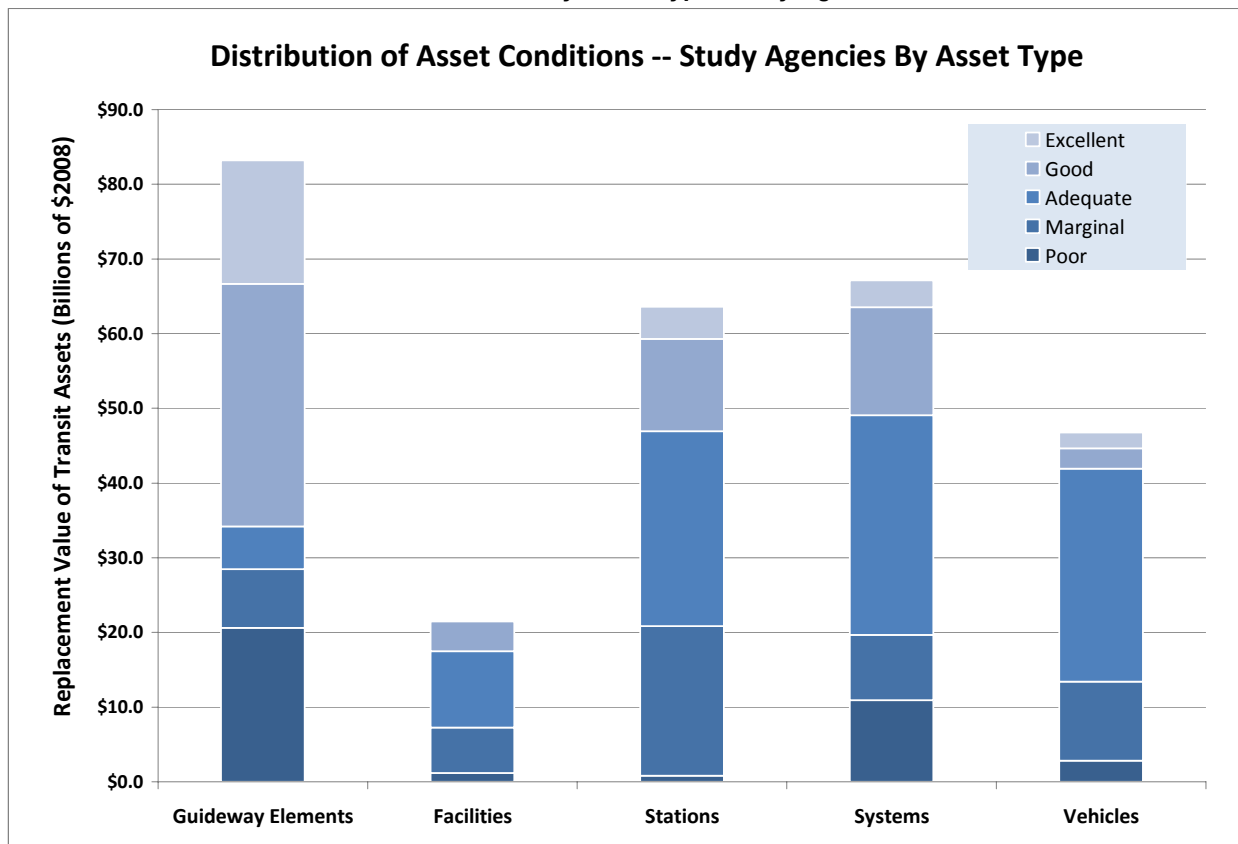
This Rail Modernization Study is one component of FTA's larger effort to focus attention on transit infrastructure renewal. FTA has adopted the goal of moving the industry towards an overall "state of good repair" as a key agency objective. In doing so, FTA has proposed several questions, many of which are directly addressed by this study:

- What is a "state of good repair" (SGR) and how can we measure it?
- What is the magnitude of the SGR investment backlog?
- What is the gap between reinvestment needs and available resources?
- What strategies are agencies using to address SGR needs?
- How can and should the Federal government help achieve SGR?

Other FTA initiatives that address these challenges include the following:

- SGR Workshop:** On August 13 and 14, 2008, FTA convened a two-day workshop with senior engineers and capital planning staff from fourteen bus and rail agencies. The SGR Workshop provided these agency staff an opportunity to discuss the magnitude of their SGR needs, potential strategies to address this problem and the problem of limited resources.
- FTA SGR Working Group:** FTA has established an internal working group that meets regularly to consider SGR-related issues and potential initiatives.
- SGR Roundtables and Advisory Groups:** FTA is considering convening an “SGR Roundtable” with industry engineering professionals to address common issues impacting the design and construction of New Starts projects. Similar to the existing Construction Roundtables, these SGR Roundtables would include industry engineering and capital planning experts, and would aim to share approaches and solutions to common state of good repair problems. These roundtables would also help ensure that FTA’s strategies for attaining state of good repair accurately reflect real-world reinvestment realities. The possibility of an SGR Roundtable received strong support from the transit agency staff attending FTA’s recent SGR workshop.

**Exhibit 1-5
Asset Conditions by Asset Type: Study Agencies**



1.6 Document Structure

The remaining sections of this report describe the analysis methods and present the findings of this study. Section 2 considers the level of Federal capital funding which was available to these seven agencies over the past three authorization cycles and the uses to which these funds were applied. Section 3 estimates the level of investment

required to bring these agencies' rail transit assets to a state of good repair and presents the assumptions and analysis methods used to develop those estimates. Section 4 considers potential modifications to FTA's Section 5309 Fixed Guideway Modernization funding program to help rail agencies better address their reinvestment needs. Section 5 provides an overview of the capital planning and asset management processes used by the seven study agencies, with particular emphasis on best practices in these areas. Finally, Section 6 presents options that FTA and Congress might consider based on the analysis results and conclusions from the first five sections.

SECTION 2.0 - FEDERAL FUNDING HISTORY OF STUDY AGENCIES

This section reviews the level of Federal funding for capital reinvestment available to each of the seven study agencies over the past three Surface Transportation Bills (ISTEA, TEA-21 and SAFETEA-LU), covering the eighteen year period from 1991 through 2009. More specifically, the funding analysis in this section addresses each of the following questions:

- **Federal Funding Availability:** How much Federal funding was *available* to the seven agencies over the past three Surface Transportation Bills for rail capital reinvestment? Federal funds eligible for capital reinvestment come primarily from the Section 5309 Fixed Guideway Modernization and Section 5307 Urbanized Area Formula programs.
- **Federal Funding Applied to Rail Reinvestment:** Of the available and eligible funds, how much Federal funding did these agencies actually *apply* to rail capital reinvestment? Because some types of Federal funds are eligible for multiple uses (e.g., Section 5307 Urbanized Area funds can be used for capital reinvestment, capital expansion and preventive maintenance), this analysis examines how the seven study agencies distributed their available funds between rail system preservation, expansion and preventive maintenance.
- **Total Capital Expenditures and the Federal Funding Share:** How much have the seven study agencies spent on capital reinvestment, including non-federal funds? While the two prior questions focus solely on the level of *Federal* funding, this analysis considers the *total* level of annual rail capital expenditures for each of the seven study agencies, including funds from state, local and other sources. The analysis considers: (1) the proportion of capital expenditures that is devoted to capital reinvestment purposes and (2) the Federal share of this capital reinvestment.

This analysis of the capital funding histories of the seven study agencies relies heavily on data from two FTA sources: the Transportation Electronic Award Management (TEAM) database and the National Transit Database (NTD). The TEAM database houses data on the level of Federal funding obligated to local transit agency grantees, including the grant amount and its intended use (type of project, transit mode, Federal and non-Federal shares, etc). In contrast, NTD houses data on a broad variety of local transit agency capital and operating statistics, including total annual capital expenditures by agency and by agency-mode.

2.1 Federal Funding for Transit Capital Reinvestment

The Federal Transit Administration makes funding for transit capital reinvestment available to all U.S. transit agencies from three primary sources: Section 5309 Fixed Guideway Modernization Funds,⁷ Section 5309 Bus and Bus Facility Capital Funds and Section 5307 Urbanized Area Formula Funds. Although many transit agencies receive Federal funds from a variety of other sources (such as other FTA grant programs and the Department of Homeland Security's Urban Area Security Initiative grant program), these grants are typically relatively small compared to the three primary sources and are not strictly applied to SGR activities. As **Exhibit 2-1** shows, transit agencies can use all three of these funding sources for capital reinvestment, but can also use the funds for other purposes at their discretion. Section 5309 Fixed Guideway Modernization funds are most directly applicable to addressing the rail reinvestment or "state of good repair" needs of the seven study agencies, but these funds are also used for busways and HOV lanes. Section 5307 Urbanized Area funds are eligible for rail capital reinvestment, but agencies can

⁷ A "fixed guideway" refers to any transit service that uses exclusive or controlled rights-of-way or rails, entirely or in part. The term includes heavy rail, commuter rail, light rail, monorail, trolleybus, aerial tramway, inclined plane, cable car, automated guideway transit, ferryboats, the portion of motor bus service operated on exclusive or controlled rights-of-way, and high-occupancy-vehicle (HOV) lanes.

choose to use them for capital expansion and preventive maintenance. Bus and Bus Facility Capital funds are distributed on a discretionary basis and are intended solely for bus capital needs.

**Exhibit 2-1
Primary Federal Funds Eligible for Transit Capital Reinvestment Uses**

Characteristics	Fixed Guideway Modernization (Section 5309)	Urbanized Area Formula (Section 5307)	Bus and Bus Facility Capital (Section 5309, 5318)
Allocation	Formula	Formula	Discretionary
Intended Modes	Rail, Busway/HOV	All Transit Modes	Bus only
Eligible Uses	Investments to modernize or improve existing fixed guideway systems	Transit capital (replacement and expansion) assistance, preventive maintenance and transportation related planning ⁸	New and replacement buses and related equipment and facilities
Eligible Recipients	Urbanized areas with fixed guideway in operation for at least seven years	State and local transit authorities for use in urbanized areas with population ≥ 50,000	State and local transit authorities; other public bodies
Federal Match	80%	80% for capital uses; 50% for operating where eligible	Varies

Exhibit 2-2 shows that the total amount of authorized funding for these three major funding programs has increased steadily over the last three Surface Transportation Bills in year-of-expenditure terms. However, this growth has also been accompanied by an increase in the number of eligible recipients. While Urbanized Area Formula funding represents the largest of these funding sources, it is also available to all modes, to all urbanized operators and for multiple uses.

The funding amounts in Exhibit 2-2 provide a sense of the funding priorities assigned to each source and their related uses over the past three authorization cycles for *all* U.S. transit operators eligible for these funding sources, and not simply the seven agencies that are the focus of this study. The remaining sections focus solely on the Federal funding obligations and related annual capital expenditures of the seven study agencies.

**Exhibit 2-2
Total Authorized Funding Eligible for Transit Capital Reinvestment Uses (\$Billions)***

Surface Transportation Legislation	Fixed Guideway Modernization (Section 5309)	Urbanized Area Formula (Section 5307)	Bus and Bus Facility Capital (Section 5309)	Total Authorized Funds
ISTEA (1991)	\$5.0	\$16.1	\$2.5	\$23.6
TEA-21 (1998)	\$6.6	\$18.0	\$3.6	\$28.2
SAFETEA-LU (2005)	\$8.5	\$22.2	\$4.9	\$35.6

* Includes all eligible funding recipients, not just the seven rail agencies which are the focus of this study

2.2 Availability and Application of Federal Rail Capital Funds: Study Agencies

This section considers the total level of Federal funding available to the seven study agencies that was eligible for rail capital reinvestment purposes over the past three Surface Transportation Bills. Given that some of these funds were also eligible for other uses (e.g., Section 5309 funds), this section considers how the seven agencies chose to allocate these funds between competing uses, including capital replacement, capital expansion and preventive maintenance. The intention is to calculate the maximum level of Federal support that *could* have been applied to rail capital reinvestment purposes had these agencies chosen to do so and the level of funding that *was* actually applied to reinvestment needs. The fact that the seven agencies did not apply all of these funds to reinvestment uses does

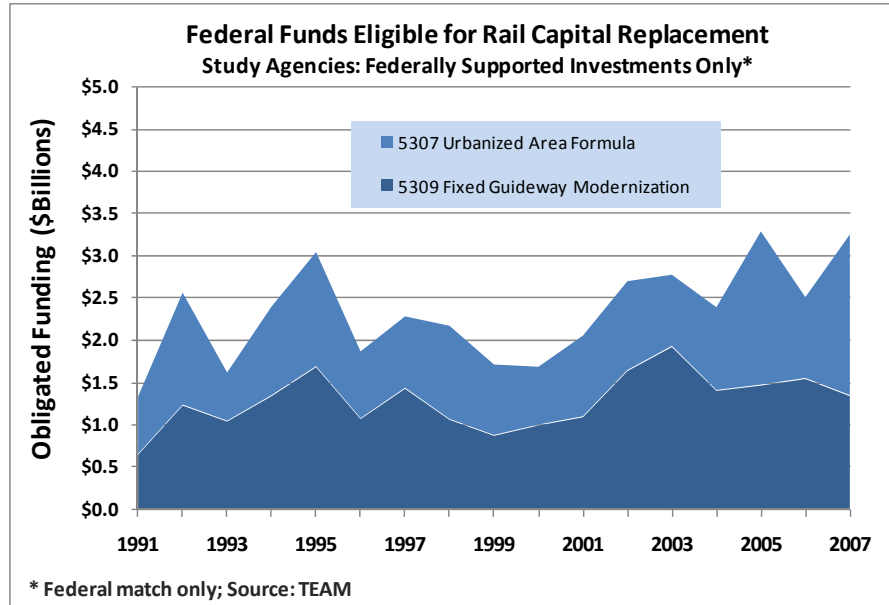
⁸ Urbanized areas with population under 200,000 may use Section 5307 funds for operating expenditures.

not imply that all reinvestment needs were met during this period. Rather, this is more likely an indication that these agencies face a variety of other needs (e.g., reinvestment, expansion and preventive maintenance) which compete for the same funds.

Federal Funds Eligible for Rail Capital Reinvestment:

The total level of annual Federal funding obligated to the seven study agencies and eligible for (but not necessarily applied to) rail capital reinvestment uses is presented in Exhibit 2-3. Of the total amount eligible for rail reinvestment, roughly half comes from Section 5309 Fixed Guideway Modernization and half from Section 5307 Urbanized Area Formula Funds.⁹ After increasing steadily between 1991 and 1995 in year-of-expenditure terms, total eligible Federal funding from these sources

Exhibit 2-3



declined and reached a minimum in roughly 1999 (approximately towards the middle of the TEA-21 authorization period). The level of obligated eligible funding has been increasing since that time. The average annual obligations from these two sources are presented for each of the three authorization periods in Exhibit 2-4.

Exhibit 2-4

Average Annual Federal Funding Obligations Eligible for Rail Capital Reinvestment (\$Billions)

Authorization Period	5309 Fixed Guideway Modernization		5307 Urbanized Area Funds	Total
	Modernization			
ISTEA	\$1.2		\$0.9	\$2.1
TEA-21	\$1.3		\$0.9	\$2.2
SAFETEA-LU	\$1.4		\$1.5	\$2.9
Full Period Average	\$1.3		\$1.0	\$2.3
Full Period Total	\$3.9		\$3.3	\$7.2

Source: TEAM

Exhibit 2-4 shows that rail SGR-eligible Federal funds to the seven agencies were relatively flat in year-of-expenditure terms for nearly 13 years under ISTEA and TEA-21. Exhibit 2-4 also suggests that since 1991, FTA has provided only 23 percent of its rail SGR-eligible Federal funds for the seven largest rail agencies in this study. The study agencies received \$7.2 billion of the \$30.7 billion total made available under the Fixed Guideway Modernization and Urbanized Area Formula funding programs.

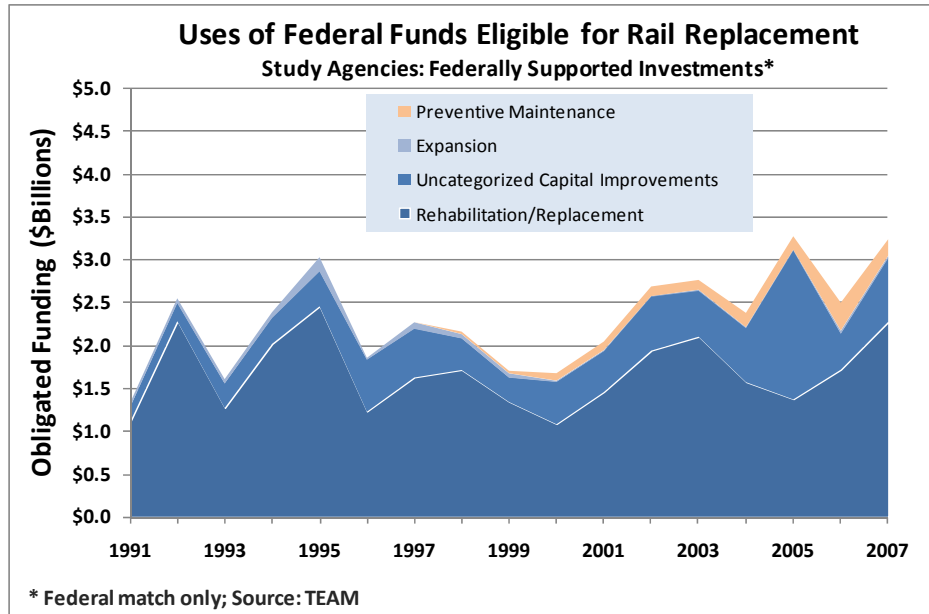
Note that the funding amounts in Exhibit 2-4 represent Federal dollars only, i.e. the Federal share of those agency investments to which Federal funds were applied (the Federal share for the total investments is just under 80 percent). Hence, the exhibit does not include either (1) investments with no Federal funding component or (2) the non-Federal share of those investments that do have Federal funding support.

⁹ Note: Section 5309 Bus Capital funds cannot be applied to rail capital investments.

Use of Federal Funds Eligible for Rail Capital Reinvestment:

Exhibit 2-5 presents the uses to which the funds in Exhibit 2-3 were applied. As expected, most of these funds (at least 72%) were applied directly to rehabilitation and replacement activities. This represents a minimum average annual Federal investment of \$1.7 billion in the rehabilitation and replacement or rail assets for the seven study agencies. In addition, close to one-quarter (23%) of the funds represented in Exhibit 2-3, or roughly \$0.5 billion

Exhibit 2-5



annually, were obligated to capital improvements that could support SGR-related activities but which cannot be “purely” categorized by investment type. FTA’s TEAM database does not clearly indicate the exact investment type for some obligations, meaning that these amounts could include expenditures on replacements, betterments, expansions or all three of these investment types. Hence, the actual level of rehabilitation and replacement expenditures for the seven agencies is somewhere between \$1.7 and \$2.2 billion per year (i.e., the sum of the rehab/replace and uncategorized funds). The remaining funds were applied to expansion (\$42 million annual average) or to preventive maintenance (\$130 million annual average since 1998). Note that the share of funding utilized for preventive maintenance purposes (an operating and not a capital cost) has increased steadily since 1998. This increasing use of capital funds for operating purposes (permitted under the current guidance) has the effect of reducing the level of capital funds available for actual reinvestment purposes.

The average annual obligations devoted to each of these uses are presented for each of the three authorization periods in **Exhibit 2-6**. While the total expenditures on rehabilitation and replacement projects have remained roughly constant over this time period, the proportion of “uncategorized” expenditures has increased, as has the level of expenditures on preventive maintenance (see Exhibit 2-5).

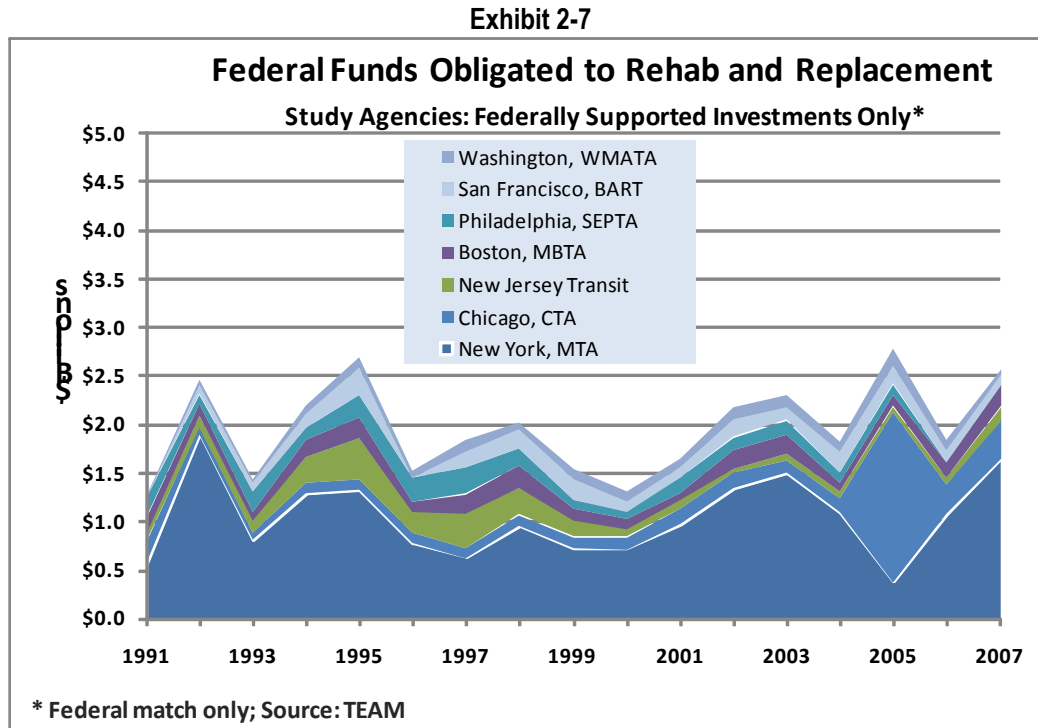
Exhibit 2-6
Average Annual Federal Funding: Uses of Funds (\$Billions)

Authorization	Rehab/Replace	Un-Categorized	Other Uses	Total
ISTEA	\$1.7	\$0.3	\$0.1	\$2.1
TEA-21	\$1.6	\$0.5	\$0.1	\$2.2
SAFETEA-LU	\$1.8	\$1.0	\$0.1	\$2.9
Full Period Average	\$1.7	\$0.5	\$0.1	\$2.3
Full Period Total	\$5.1	\$1.8	\$0.3	\$7.2

Source: TEAM

Use of Federal Funds Eligible by Agency: **Exhibit 2-7** presents the distribution of Federal funds applied to rehabilitation and replacement investments (including most uncategorized funds from Exhibit 2-5) by study agency.

Note that the obligations for New York Metropolitan Transportation Authority (MTA) represent the total funds obligated to rehabilitation and replacement investments for the three New York MTA rail operators, including New York City Transit (NYCT), Long Island Rail Road (LIRR) and Metro-North Rail Road (MNR). Together, these three New York City agencies account for just over 50 percent of the Federal funds obligated to rehabilitation and replacement investments. Based Exhibit 2-7, the total level of annual reinvestment for these seven agencies has varied significantly from year-to-year since 1991, but has otherwise remained at roughly \$2.0 billion (YOE) annually during this period.



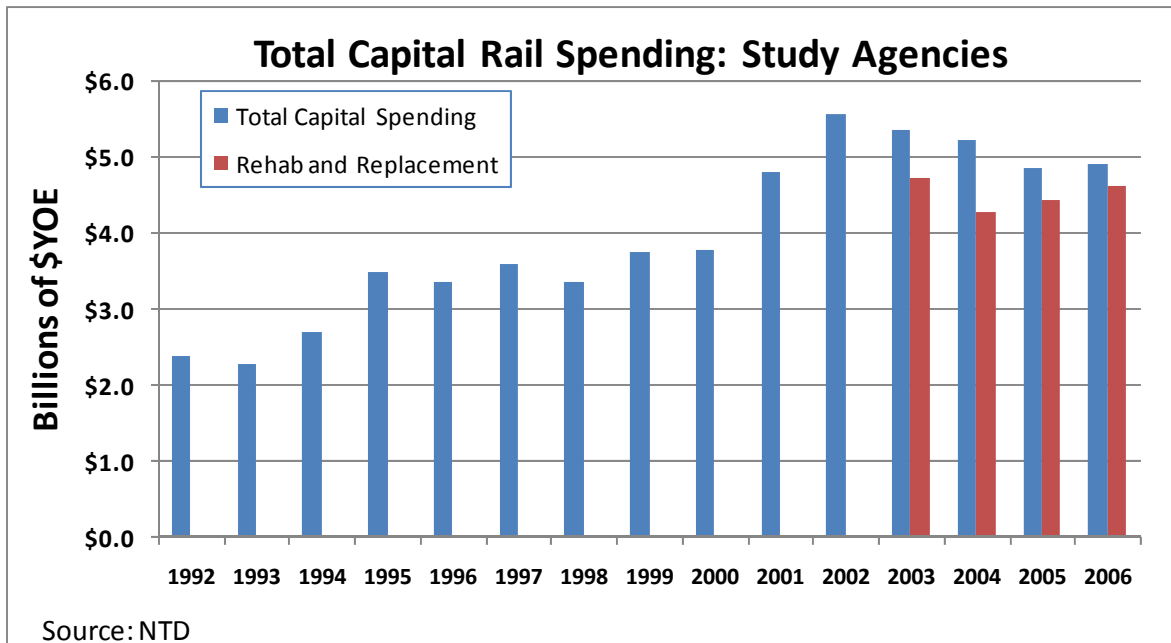
2.3 Total Capital Spending: Study Agencies

This section has so far analyzed only Federal funds. This subsection, however, considers the *total actual* rail capital expenditures for the study agencies, regardless of funding source (i.e., including Federal funds and the non-Federal portion of those Federal projects).

Exhibit 2-8 presents total rail capital expenditures for the seven study agencies from 1992 to 2006 (including rehab/replace, expansion and other capital uses) in blue. For the period 2003 to 2006, the red bars represent the portion of total expenditures applied solely to rehabilitation and replacement uses (2003 is the first year for which this data is available). Over this last four-year period, rehabilitation and replacement expenditures account for about 90 percent of these agencies' total rail capital expenditures. This high proportion of expenditures on rail capital reinvestment suggests the following:

- **Minimal Investment in Expansion:** The seven agencies studied here were investing relatively little in new rail lines between 2003 and 2006
- **Focus on Rehab/Replace:** The study agencies placed a high priority on rehabilitation and replacement needs

Exhibit 2-8

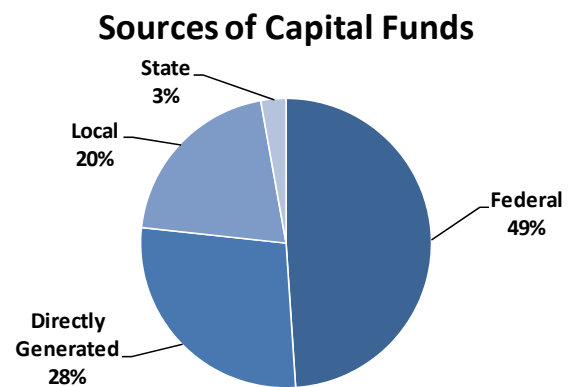


2.4 Total Capital Funding: Study Agencies

Finally, the funding analysis above focused on the level of capital funding available from Federal sources, and the 5307 Urbanized Area and 5309 Fixed Guideway Modernization Formula funds in particular. Hence this analysis has not placed the Federal capital funding for the seven study agencies in context with the total capital funding received by these agencies.

Exhibit 2-9 shows that almost half of the total \$5.9 billion of total capital funding for all seven study agencies in 2006 came from the Federal government. The \$5.9 billion total counts capital funds from all sources including both capital reinvestment and expansion projects for all modes (including bus, paratransit and ferry). The seven agencies vary considerably in the proportion of funding they get from each source but, on average, slightly more than one quarter of this capital funding comes from directly generated funding sources (including dedicated taxes and tolls), with most remaining funds coming from local sources. State sources only cover about 3 percent of total capital expenditures.

Exhibit 2-9



Source: NTD

2.5 Conclusions

The Federal Transit Administration provides substantial funding that may be used to maintain a state of good repair for the rail systems at the seven study transit agencies. The agencies' past record of allocating nearly all of these funds to rehabilitation and replacement confirms that financial needs of the existing rail infrastructure are high.

However, several trends over the past 18 years of Federal Surface Transportation Bills have made it increasingly difficult for these oldest and largest rail systems to keep pace.

Federal funding for reinvesting in our nation's transit infrastructure has increased significantly on a national level since ISTEA began in 1991. The three primary SGR-related funding programs (Section 5309 Fixed Guideway Modernization, Section 5307 Urbanized Area formula and bus capital programs) have grown from \$23.6 to \$35.6 billion per authorization cycle (YOE \$). However, the seven study rail systems, which carry 80 percent of the nation's rail riders and maintain 50 to 75 percent of the nation's rail infrastructure, have received only 23 percent of the total Federal funding eligible for rail SGR reinvestment. Federal support to these agencies has remained relatively flat since 1991 (resulting in a decline in inflation-adjusted real terms), and the agencies' percentage share of total Federal rail SGR funds has declined. In short, while total Federal support for transit infrastructure has increased, the nation's oldest and largest systems' share of these funds has lost ground.

These challenging trends have taken place against the backdrop of significant infrastructure needs, as suggested by this section's analysis of expenditures. As the study agencies grapple with the significant needs of their existing assets, they have used the majority of Federal funds available for rail SGR investment. Although some uses are difficult to allocate between expansion, SGR and other purposes, analysis in this section suggests that study agencies used 75 to 90 percent of available Federal funds for SGR purposes, and the proportion may be similarly high when examining capital expenditures from all sources. However, because transit agencies face competing needs for capital funds, agencies rarely invest 100 percent of their available resources in existing infrastructure.

SECTION 3.0 - COST TO BRING STUDY AGENCIES TO A STATE OF GOOD REPAIR

This section considers the level of investment required to bring the capital assets of the seven study agencies to a state of good repair. It does not address sources of funding for this investment, though it may be expected that would represent a similar mix of Federal, state, and local sources as current investments. In addition, the section also describes the approach used to develop these estimates, including the underlying data sources and assumptions and the types of investment costs included in – and excluded from – the SGR needs estimates. The section concludes by predicting how increases or decreases in the current rate of capital reinvestment can be expected to impact the long-term physical conditions of the seven study agencies' transit assets. Specifically, this section considers the following:

- Needs estimation approach
- Data sources
- Cost assumptions
- Study definition of SGR
- SGR needs estimates
- Constrained funding analysis

3.1 Needs Estimation Approach – FTA's Transit Economic Requirements Model (TERM)

The study estimates of the level of investment required to bring the seven study agencies up to a state of good repair (SGR) were developed using FTA's Transit Economic Requirements Model (TERM). TERM is a decision support tool initially designed to estimate capital investment needs for the entire U.S. transit industry – including investments in asset rehabilitation and replacement, expansion to meet ongoing growth in transit travel demand, and investments to improve core capacity and operating speeds. TERM has been used since 1995 to support preparation of the transit component of the biennial *Report to Congress on the Condition and Performance of the Nation's Highways, Bridges and Transit* (C&P Report).



For this study, TERM has only been used to estimate the rehabilitation and replacement needs of the seven study agencies. Estimates of the asset expansion and capacity improvement needs of the seven study agencies as well as the capital needs of all other U.S. transit agencies (including all other rail transit operators) have been excluded from this study's estimates of SGR reinvestment needs. At the same time, while the study focuses primarily on rail reinvestment needs, it includes estimates for non-rail modes at the seven study agencies (e.g., bus and paratransit).

SGR Needs Estimates: What's Included

This study considers the level of investment required to bring all transit assets of the seven study agencies to a state of good repair – including all rail and bus assets. Estimates of the asset expansion and capacity improvement needs of the seven study agencies as well as the capital needs of all other U.S. transit agencies (including all other rail transit operators) are excluded.

Non-rail needs are included because of their integral contribution to an agency's overall state of good repair, and because many transit assets support rail and non-rail operations. An agency's ability to address its SGR needs is determined by its total agency-wide reinvestment needs and not just those of

an individual mode or group of modes. In addition, numerous assets – including administrative buildings, some types of non-revenue vehicles, communications systems and some transit stations – jointly support both rail and non-rail operations and cannot be easily allocated between various modes. For these reasons, the total needs estimates include reinvestment needs for the rail and non-rail assets of the seven study agencies.

Why TERM? FTA has chosen to use the TERM model as the analytical approach for several reasons. First, as noted above, TERM has been used to assess capital reinvestment needs at the national level since 1995. Over that time period, the model has undergone continuous improvement and now represents a well developed and robust analytical platform that has undergone extensive testing and independent review (including reviews by independent contractors and by the Office of the Secretary of Transportation). Output from TERM is regularly tested using detailed comparisons with the internal, financially-unconstrained needs estimates prepared by a broad sample of U.S. transit operators to ensure that TERM's output is consistent with the sample agencies' own needs estimates. In this study, TERM's SGR needs estimates have been thoroughly contrasted and compared to the unconstrained needs estimates of the seven study agencies to ensure their reliability. These ongoing processes of testing and review provide confidence in TERM's ability to reliably assess the needs of multiple local agencies.

Second, the use of a single needs assessment analysis tool ensures that the recapitalization of all seven study agencies and their individual modes have been assessed on a consistent basis. An alternative approach to this study might have been to merely obtain and sum the financially-unconstrained needs estimates from the capital plans of the seven study agencies. However, this approach would have yielded inconsistent results given the wide diversity of analytical approaches and assumptions the seven study agencies use to generate their internal needs estimates:

- **Useful Life Assumptions:** For example, the useful life assumptions behind each internal needs estimates vary widely from agency to agency. While some of this variation in asset life expectancies is justified given differences in agency conditions (e.g., climate or annual hours of service), many reflect differences in subjective assessments of what is acceptable or even what is ultimately affordable.
- **Project Screening:** Similarly, some agencies have developed their unconstrained needs based primarily on unconstrained project listings prepared by the agency's engineering departments (e.g., track and structures, rolling stock, facilities, etc). Others pre-screen the submitted project listings to eliminate those that are deemed marginal or not cost-beneficial.
- **Constructability Constraints:** Some agencies construct financially-unconstrained needs estimates, but impose practical "constructability" constraints to reflect how the agency could realistically increase its capital program dramatically given available construction, labor, scheduling and program management considerations. This study's estimates are "purely" unconstrained.
- **Differing Time Horizons:** Finally, the seven study agencies have developed their internal SGR needs estimates over a range of time horizons, including 5-, 10- and 20-year time periods.

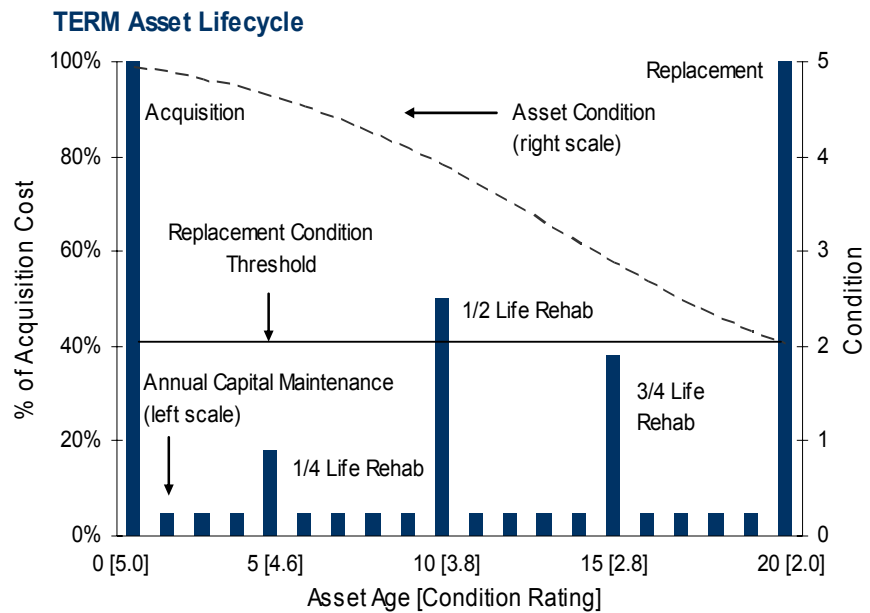
Given these many differences, simply summing the seven agencies' own internal needs estimates would necessarily involve adding "apples to oranges" and would not yield an accurate assessment of the total SGR needs for these agencies. Therefore, using TERM as a single analytical process across all seven agencies ensures that the SGR needs of these agencies are assessed using common assumptions and methodologies.

TERM's Rehabilitation and Replacement Module: Estimates of long-term capital replacement needs are generated by TERM's "Rehabilitation and Replacement Module". This module begins with an inventory of the total capital asset holdings at each of the seven study agencies and simulates the future replacement and rehabilitation needs of each asset over its life-cycle for a 20-year period. Specifically, this module is designed to estimate the total level of investment required for the ongoing rehabilitation and replacement of any group of transit assets over a 20-

year forecast period. This includes reinvestment in fleet vehicles, maintenance facilities, stations, guideway and trackwork, and train control and traction power systems. For this study, the basis for these estimates is an inventory of the total capital asset holdings of the seven study agencies over which reinvestment needs are assessed (developed from asset inventory data obtained directly from the study agencies). For each asset in the inventory, the inventory documents the asset's

type, date of acquisition / initial service date, expected useful life, replacement cost and, when available, rehabilitation history and life-to-date utilization (e.g., life-to-date mileage for a transit vehicle). TERM's "Rehabilitation and Replacement Module" then uses this inventory data to simulate the current and future life-cycle investment needs of each asset. This module estimates those points (over the next twenty years) at which each individual asset will require rehabilitation and replacement activities to be performed and the cost of these life-cycle activities. A generalized representation of these life-cycle events, their timing and their cost as a percent of the initial acquisition cost is presented graphically in **Exhibit 3-1**.

Exhibit 3-1

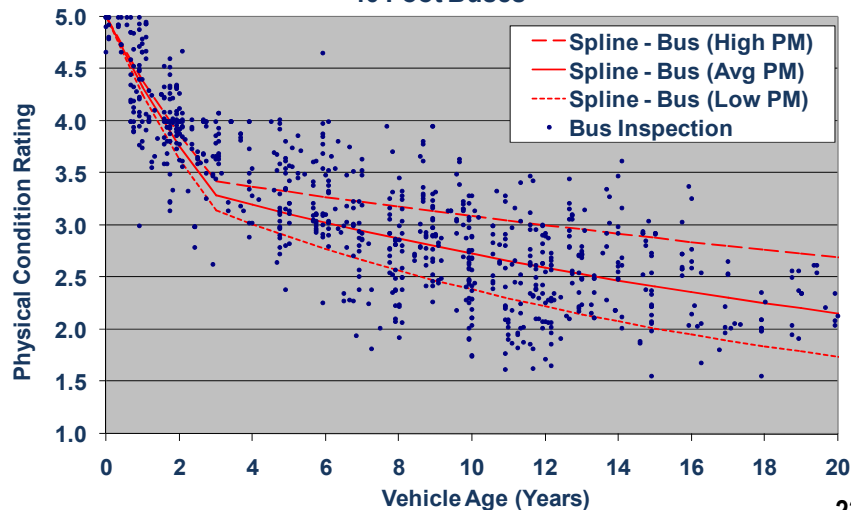


The Role of TERM's Decay Curves: In addition to estimating the cost and timing of major life-cycle events, TERM's "Rehabilitation and Replacement Module" also assesses both the current and potential future physical condition of each transit asset under analysis. This capability relies on a set of asset deterioration schedules, an example of which is represented by the dotted line in **Exhibit 3-2** (for 40-foot transit buses). The downward slope of these deterioration schedules captures the ongoing decay of a transit asset as it passes through its total life cycle. The rating scale for this example deterioration schedule is presented on the vertical axis of Exhibit 3-2 (the definitions of these numerical ratings values were presented in Exhibit 1-3). TERM employs over 100 deterioration schedules, the majority of which were estimated using empirical asset condition data obtained from on-site asset condition inspections of bus and rail transit assets at more than 50 different U.S. transit properties.

Because TERM uses the five point condition rating system for all asset types, and since its asset deterioration schedules can predict current (and future) asset conditions, the model can also assess asset conditions for any grouping or aggregation of assets in the future. For example, these decay curves can be used to

Exhibit 3-2

**Observed Physical Condition Versus Age:
40 Foot Buses**



estimate and monitor asset conditions for:

- Individual assets,
- Groups of similar assets (e.g., all vehicles or all facilities),
- Entire modes, or
- Entire agencies or groups of agencies

TERM's ability to estimate conditions for any grouping of assets is used later in this section to assess how variations in the future funding availability for the seven study agencies can be expected to impact the physical conditions of these agencies' transit assets.

Study Agency Input: While TERM's estimates form the core of this study's evaluation of the seven agencies' capital reinvestment needs, the study also reviewed each agency's own internal, financially-unconstrained estimates of capital reinvestment needs. These local agency needs estimates were used both as an independent check of the needs estimates generated by TERM and to identify where (and why) the TERM estimates differed materially from the study agencies' own needs assessments. Based on these comparisons, TERM's needs estimates were then adjusted as appropriate to better reflect the costs, asset life expectancies and other unique characteristics of each study agency. Staff from the seven study agencies participated in these comparisons.

3.2 Agency Asset Inventories

This study obtained and processed an individual asset inventory for each of the seven agencies for use in TERM, and hence reflects the most recent native data available for the nation's largest and oldest rail systems. TERM's rehabilitation and replacement needs assessment process is designed to estimate an agency's current investment backlog and future reinvestment needs based on the age and condition of that agency's major asset holdings. At present, U.S. transit agencies are not required to report to the Federal government on the quantities, ages and condition of their asset holdings. Hence, to support development of the SGR estimates for this study, FTA requested, and each of the seven study agencies provided, listings of their current holdings of transit capital assets. The submitted asset inventory records typically included the following data:

- Asset Type
- Mode supported
- Date built / acquired
- Replacement cost
- Unit costs
- Unit quantities
- Expected useful life

A partial listing of the types of assets included in these inventories provided by the seven study agencies is provided in **Exhibit 3-3**.

The quality of the asset inventories submitted by seven of the study agencies was very good, mostly because those inventories have been developed expressly for agency capital planning purposes. One of the two remaining agencies was working to develop this type of inventory data, while the other has initiated planning for inventory development. However, even among those with good-quality asset inventories, there is still wide variation in the level of detail and the types of asset data (e.g., some include replacement cost data but most do not). Also, each agency has used a somewhat different process to collect its asset data, plans to update the data at different frequencies and intends to employ the data in different manners. A more detailed discussion of these differences and their implications is presented in Section 5 of this report.

3.3 Cost Assumptions and Issues

**Exhibit 3-3
Truncated Listing of Asset Types Recognized by TERM**

This study's SGR needs estimates addressed assumptions and issues related to the following asset capital cost factors:

- Unit Costs
- Cost Factors
- Inflation

Unit Costs: To ensure that the study's SGR needs estimates best represent each agency's actual reinvestment needs, the study used unit cost data supplied by the agency wherever possible, since each agency best understands its own asset replacement cost structure. Therefore, some costs for similar capital items differed significantly between agencies reflecting differences in labor costs, asset characteristics, replacement conditions and other factors. However, where the agencies provided no unit cost data, the study relied on average cost data obtained from prior FTA studies documenting unit costs from completed transit projects or from the asset cost data of other study agencies (with similar characteristics).

Cost Factors: In addition to

the direct physical cost of asset rehabilitations and replacements (including materials, labor and equipment), the study's needs estimates also include some additional costs to reflect the total capital cost of a project beyond the value of the asset. For example, while the asset value of a power substation may be \$5 million, a project to replace the substation would likely cost the transit agency more than \$5 million, since the asset's value does not include project management costs, design costs, the staff time required to replace the equipment under active operations, and other factors. Therefore, TERM's cost estimates include the following types of project costs:

- Planning and Design – the cost to plan for and design rehabilitation or replacement of an asset or group of assets

Asset Types			
Category	Sub-Category	Element	Sub-Element
Guideway Elements	Guideway	Elevated Structure	-
Guideway Elements	Guideway	Subway Tunnel	-
Guideway Elements	Trackwork	Direct Fixation	-
Guideway Elements	Trackwork	Ballasted	-
Guideway Elements	Trackwork	Embedded	-
Guideway Elements	Trackwork	Special	Crossover
Guideway Elements	Trackwork	Special	Turnout
Guideway Elements	Bus Guideway	Turnaround	
Guideway Elements	Special Structures	Retaining Walls	
Facilities	Buildings	Administration	-
Facilities	Buildings	Maintenance	Bus
Facilities	Buildings	Maintenance	Rail
Systems	Train Control	Wayside Train Control	-
Systems	Electrification	Substations	-
Systems	Electrification	Breaker House	-
Systems	Electrification	Contact Rail	
Systems	Electrification	Power Cable	-
Systems	Electrification	Building	-
Systems	Electrification	AC Switchgear	
Systems	Electrification	Battery	
Systems	Electrification	Building	
Systems	Electrification	Charger	
Systems	Electrification	DC Switchgear	
Systems	Electrification	Rectifier	
Systems	Electrification	SCADA	
Systems	Communications	-	
Systems	Revenue Collection	In-Station	-
Systems	Revenue Collection	On-Vehicle	-
Stations	Rail	Building	At-Grade
Stations	Rail	Building	Elevated
Stations	Rail	Building	Subway
Stations	Rail	Elevators	-
Stations	Rail	Escalators	-
Stations	Rail	Parking	Garage
Stations	Rail	Parking	Lot
Stations	Rail	Parking	Park & Ride
Stations	Rail	Signage & Graphics	-
Vehicles	Revenue Vehicles	Heavy Rail	-
Vehicles	Revenue Vehicles	Motor Bus	-
Vehicles	Non-Revenue	Car	-
Vehicles	Non-Revenue	Truck	-
Vehicles	Non-Revenue	Special	-

- Project management – agency costs to manage a rehabilitation or replacement project
- Contingencies – provisions to cover unexpected costs or outcomes
- Force account vs. Contracted – factors to account for cost differences between agency and contractor staff
- Replacement conditions – factor to reflect difference in cost between replacement under full service, partial service or full shut-down

Each of these costs was applied as a percentage cost factor added to the base value or acquisition cost of each investment. As with unit costs (as discussed above), the study employed the specific cost factors actually used by each of the seven study agencies wherever possible, and industry averages where specific data was not available. This resulted in the application of different cost factors both by agency and usually by asset type as well. Wherever cost factors were not provided by a study agency, industry average values were applied (in some cases based on the submissions of those study agencies that did provide this cost information). Where the transit agency had already embedded these costs in the base unit cost, no additional cost factors were applied.

Inflation: This study's SGR needs estimates are all presented in constant 2008 dollars and therefore include no provision for future cost inflation. At the same time, it should be noted that the rate of inflation for many key inputs to transit capital projects – including concrete, steel, copper and other key materials – has been unusually high in recent years. Because of this, many of the study agencies indicated that they continue to obtain bid prices for capital projects that are significantly higher than in prior years. At the same time, if the U.S. transit industry were to engage in a multi-year program to eliminate the existing SGR backlog, it is possible that the resulting increase in the demand for materials and skilled labor would contribute to further cost increases. These factors may result in a downward bias in the SGR needs estimates provided in this report.

Costs Excluded from the Analysis: Because TERM's needs assessment process is primarily designed to consider the rehabilitation and replacement needs of existing transit assets, the model essentially conducts an "in-kind" replacement analysis. The needs estimates in this study reflect what it would cost a transit agency to replace an asset with the same piece of equipment incorporating today's technological standards. Therefore, the capital needs estimates presented here utilize recent unit costs that reflect the cost of current technologies. However, with the exception of these technological improvements, this study essentially excludes significant "betterment" or improvement components – such as platform enlargements, facility expansions, system capacity enhancements, and ADA related investments. Rather, this analysis focuses on the level of capital investment required to preserve and replace these agency's existing assets, with some provision for technological improvements. This assumption may result in a second potential downward bias to the SGR needs estimates in this report.

3.4 Study Definition of SGR

Study Definition of SGR

An asset is in SGR when its estimated condition exceeds a value of 2.5. A group of assets (including an entire mode or agency) is in a state of good repair when all assets in that group have an estimated condition of 2.5 or higher.

At present, there is no universally-accepted definition of "state of good repair" for public transit assets. Rather, individual transit agencies typically employ their own internal definitions (if a definition has in fact been adopted) and these definitions can vary appreciably from one operator to the other. Most agency definitions are based either on direct measures of asset condition, such as the proportion of assets that exceed their useful life, or on indirect performance measures, such as the presence of track slow zones.

For the purposes of this study, state of good repair was defined using TERM's numerically based system for evaluating transit asset conditions. As described in more detail in Section 1, TERM uses deterioration schedules to rate an asset's condition on a scale of 5 (excellent), 4 (good), 3 (adequate), 2 (marginal) through 1 (poor) based on that asset's type, age, rehabilitation history and other factors. Specifically, this study 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 2.50 (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 2.50 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.

Conceptually, replacement at condition 2.50 implies that assets remain in service for a short time period after they have exceeded their useful life. For example, under this assumption, a 40-foot bus with an expected minimum useful life of 12 years would be replaced at an average age of roughly 14 years (with the exact replacement age depending on other factors such as the vehicle's annual mileage and maintenance history). More generally, most assets will be replaced at roughly 110 percent to 115 percent of their expected useful life under this assumption. Given that few agencies replace their assets "on schedule" (even when funding is not constrained), this assumption is considered more realistic than an earlier replacement at the precise date that each asset attains its expected useful life. At the same time, use of this assumption necessarily results in *lower* estimates of reinvestment needs (including the investment backlog) than would be the case if the analysis were to assume "on schedule" replacement at precisely 100% of each asset's expected useful life.

Finally, the analysis here does not consider replacements driven by issues of technological obsolescence. Hence, while the replacement costs used for this analysis consider the cost of replacement using modern technologies, the need to replace assets is driven by age and conditions and not technological obsolescence.

3.5 Investment to Bring Study Agencies to SGR

This subsection presents the study's estimates of the level of investment required from all sources, including Federal, State, local, and directly generated revenues, to bring the seven study agencies to a state of good repair. This SGR needs analysis also distinguishes between two types of rehabilitation and replacement needs:

Comparisons with 2008 C&P Report

In early 2009, U.S. DOT is expected to release the 2008 edition of the biennial *Report to Congress on the Condition and Performance of the Nation's Highways, Bridges and Transit* (C&P Report). While the 2008 C&P Report also contains detailed estimates of the level of investment required to address the transit industry's capital needs, there remain sufficient differences between that report and this Rail Modernization Study such that needs estimates in the two reports are related but not directly comparable:

Cost Year: Needs estimates in the 2008 C&P report are in \$2006 versus \$2008 for the Rail Modernization Study.

Rehab/Replace Only: The C&P report considers all types of capital needs, including those for rehab/replace, expansion to address growth and capacity improvements. The Rail Modernization Study focuses solely on rehabilitation and replacement.

Needs Assumptions: The C&P Report considers the level of investment required to (1) maintain current asset conditions or (2) improve conditions to a level of "good". In contrast, the Rail Modernization Study considers the level of investment required to attain SGR while simultaneously addressing normal replacement needs.

Agency Sample: The C&P Report considers the capital needs of all urban and rural rail and bus operators. The Rail Modernization Study only considers the nation's seven largest rail operators.

New Data: The C&P Report utilized NTD and asset data from 2006. The Rail Modernization Study obtained more recent, 2008 asset inventory data for the seven study agencies.

- **SGR Backlog:** This is the level of investment required for:
 - i. Immediate replacement of all assets whose condition falls below the minimum threshold of 2.50, or which currently exceed their useful life
 - ii. Immediate completion of all major station rehabilitations that are currently past due
- **Normal Replacement (NR):** This is the level of investment for normal rehabilitation and replacement of transit assets as they naturally attain the end of their useful life (after all SGR needs have been addressed)

The “SGR Backlog” is an analytical concept which measures the size of the study agencies’ unmet reinvestment needs. In practice, even with unlimited funds, no agency has access to the labor and other resources required to address the existing backlog of SGR investment needs over a short timeframe and many of the needed rehabilitation and replacement projects would themselves take many years to complete. Hence, all agencies must prioritize their resources to address a mix of SGR and NR needs simultaneously.

Estimates of the level of investment needed to bring the seven target agencies to a state of good repair are presented in **Exhibits 3-4** and **3-5**. Once again, this analysis assumes that SGR is attained when all assets have a condition rating of 2.50 or higher (and future normal replacement occurs once an asset’s condition falls below 2.50). Given these assumptions, TERM estimates a current SGR backlog of roughly \$50.0 billion (\$2008). In other words, a “lump sum” investment of roughly \$50.0 billion would be required for the immediate replacement of all assets that currently exceed their useful life and to complete all outstanding station rehabilitations. Once this backlog has been addressed, an annual average of \$5.9 billion would be required to maintain that state of good repair thereafter.

As noted above, this SGR needs analysis does not include any capital needs relating to the expansion and core capacity needs of the seven study agencies. Also, it does not consider the capital needs of any other rail transit and bus transit operators.

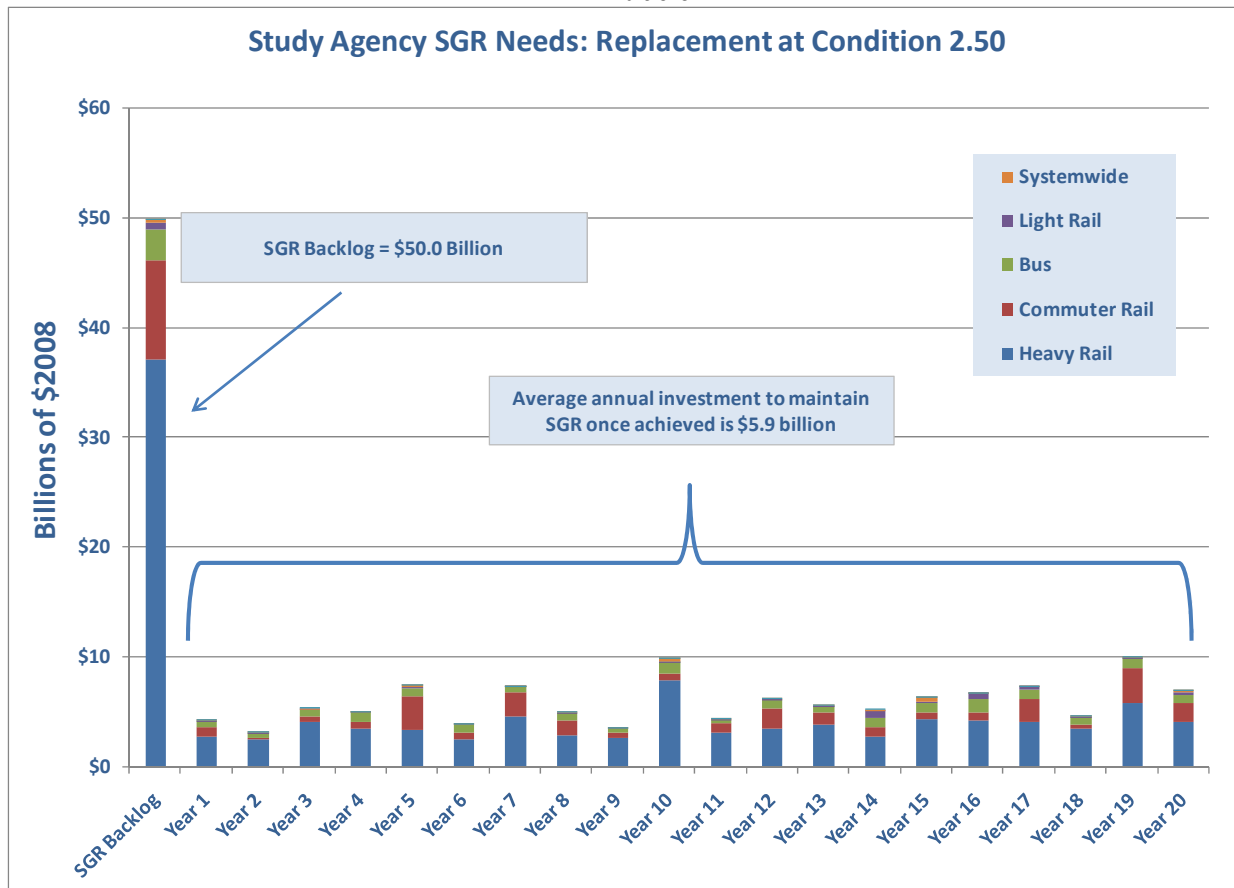
Exhibit 3-4
Study Agency SGR Needs (Billions of \$2008): Replacement Condition = 2.50

Mode	Current SGR Backlog	Annual Normal Replacement Once SGR is Attained	Annual Investment to Attain SGR over (including normal replacement):			Annual Investment to Attain SGR over (excluding normal replacement):		
			6 Years	12 Years	20 Years	6 Years	12 Years	20 Years
Heavy Rail	\$37.1	\$3.7	\$9.9	\$6.8	\$5.6	\$6.2	\$3.1	\$1.9
Commuter Rail	\$9.1	\$1.2	\$2.7	\$2.0	\$1.7	\$1.5	\$0.8	\$0.5
Bus	\$2.8	\$0.7	\$1.2	\$1.0	\$0.9	\$0.5	\$0.2	\$0.1
Light Rail	\$0.6	\$0.1	\$0.2	\$0.2	\$0.2	\$0.1	\$0.0	\$0.0
Systemwide	\$0.4	\$0.1	\$0.2	\$0.1	\$0.1	\$0.1	\$0.0	\$0.0
Total	\$50.0	\$5.9	\$14.3	\$10.1	\$8.4	\$8.3	\$4.2	\$2.5

The current SGR backlog and NR needs (as presented in the leftmost columns of Exhibit 3-4 and in Exhibit 3-5) assume that the existing backlog can somehow be eliminated in the short term. In reality, this backlog would need to be addressed over an extended period of time. To help address this issue, the three middle columns of Exhibit 3-4 consider the level of average annual investment required to simultaneously eliminate the existing backlog while concurrently meeting ongoing NR needs over various time horizons: the 6- and 12-year time horizons are designed to correspond to the length of time covered by one and two federal reauthorization periods respectively, while the 20-year horizon reflects a longer-term plan. The three rightmost columns present the level of investment required to eliminate the backlog *only* over each time period, *above and beyond* the cost of ongoing normal replacement. The level of annual investment required to attain SGR over a period of six years is \$14.3 billion (including normal replacement needs and assuming replacement of assets in condition 2.50 and lower), of which \$8.3 billion annually would address the backlog alone. Similarly, the level of average annual investment is \$10.1 billion to attain SGR over

a 12-year time horizon (\$4.2 billion in addition to NR) and \$8.4 billion to attain SGR over a 20-year time horizon (\$2.5 billion in addition NR). As a point of comparison, the actual total level of annual capital expenditures for rehabilitation and replacement (including SGR, NR and system improvement investments) in 2006 was roughly \$5.4 billion for the seven study agencies and \$9.3 billion for the transit industry as a whole.

Exhibit 3-5



Exhibits 3-4 and 3-5 also segment the backlog and normal replacement needs by mode. The investment backlog and ongoing normal replacement needs are dominated by heavy rail, reflecting the high investment in heavy rail and the large proportion of heavy rail assets that are over age, followed by commuter rail and bus. The investment needs for light rail are fairly minor by comparison, but the seven agencies have a relatively limited investment in light rail. Finally, the systemwide “mode” represents investments in assets that service multiple modes, such as administrative facilities and some types of communications systems and non-revenue vehicles.

3.6 Constrained Funding Analysis

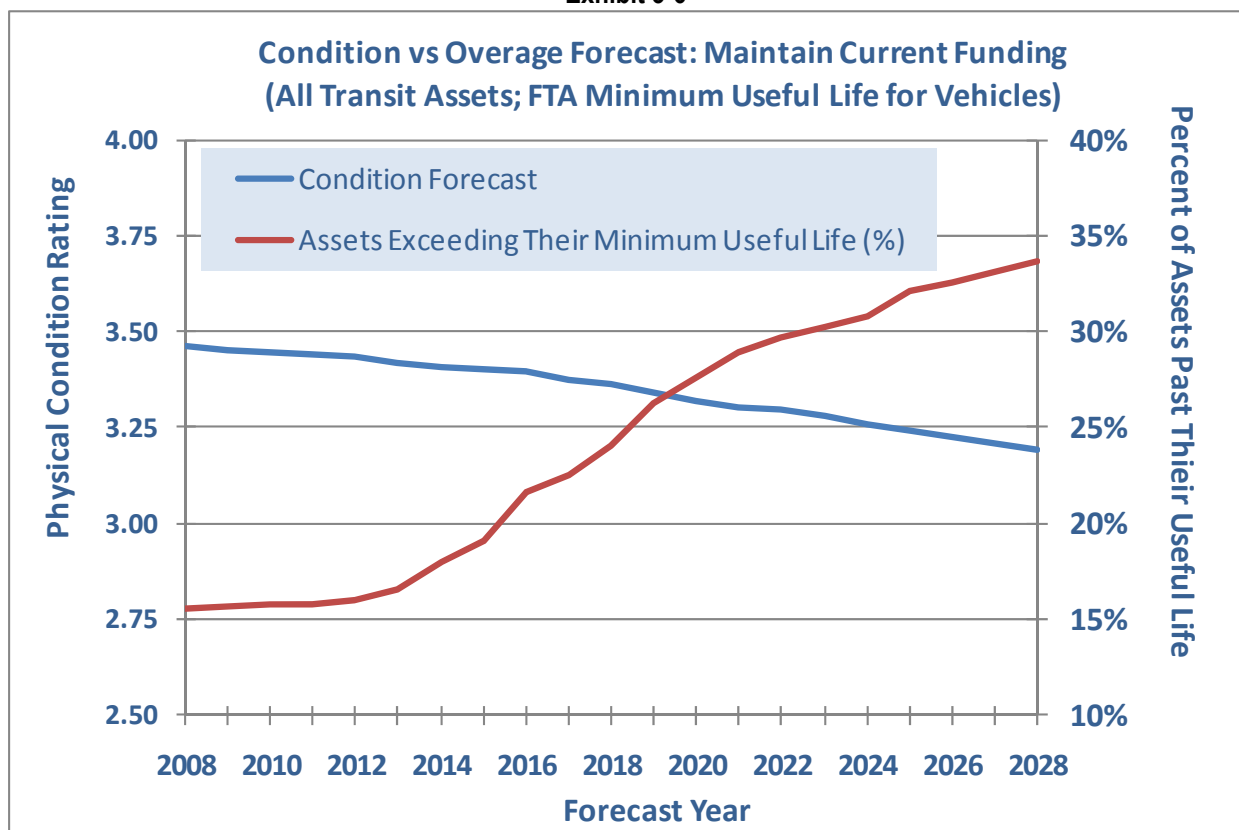
In 2006, the seven study agencies expended an estimated \$5.4 billion (\$5.73 billion in \$2008) to rehabilitate, replace, and improve their existing asset holdings, an amount significantly less than the \$8.4 billion (\$2008) this study estimates is required to attain SGR over the next twenty years (see Exhibit 3-5). This subsection considers the question, “what would happen to the overall physical condition of these transit systems over the next 20 years if funding were to remain fixed at current levels?” More generally this subsection also explores the potential long-term implications for the transit asset conditions of the seven study agencies if future funding remains *less* than that required to address both the SGR backlog and ongoing NR needs. Hence, in contrast to the *unconstrained* needs

estimates considered up to this point, this analysis considers the expected impacts of current *constrained* funding on long-term asset conditions. Specifically, this analysis considers the long-term condition impacts of:

- Maintaining the capital reinvestment rate at current levels
- Incremental changes to the rate of capital reinvestment

Maintain Current Reinvestment Rates: If current funding levels are maintained into the future, the forecasted condition rating and percent of assets still in service beyond their useful life is depicted in **Exhibit 3-6** for the seven study agencies' transit assets. TERM's estimates of both the resulting decline in overall asset conditions for the seven study agencies (left-axis) and the related increase in the proportion of assets exceeding their useful life (right-axis). The overall condition rating presented in Exhibit 3-6 represents a measure of the average condition of all transit assets maintained by the seven study agencies (weighted by replacement value).¹⁰ Assuming the seven study agencies maintain their current level of expenditures on rehabilitation and replacement over the next twenty years, TERM estimates that the overall condition of these agencies' existing assets will decline from their current value of 3.50 to roughly 3.19 by 2028, which represents a significant decline in overall asset conditions. To help place this decline in perspective, Exhibit 3-6 also presents the estimated proportion of transit assets that remain in service past their expected useful life. Should funding levels remain unchanged, this analysis estimates that the proportion of assets exceeding their useful life would increase from 16 percent to more than 30 percent by 2028.

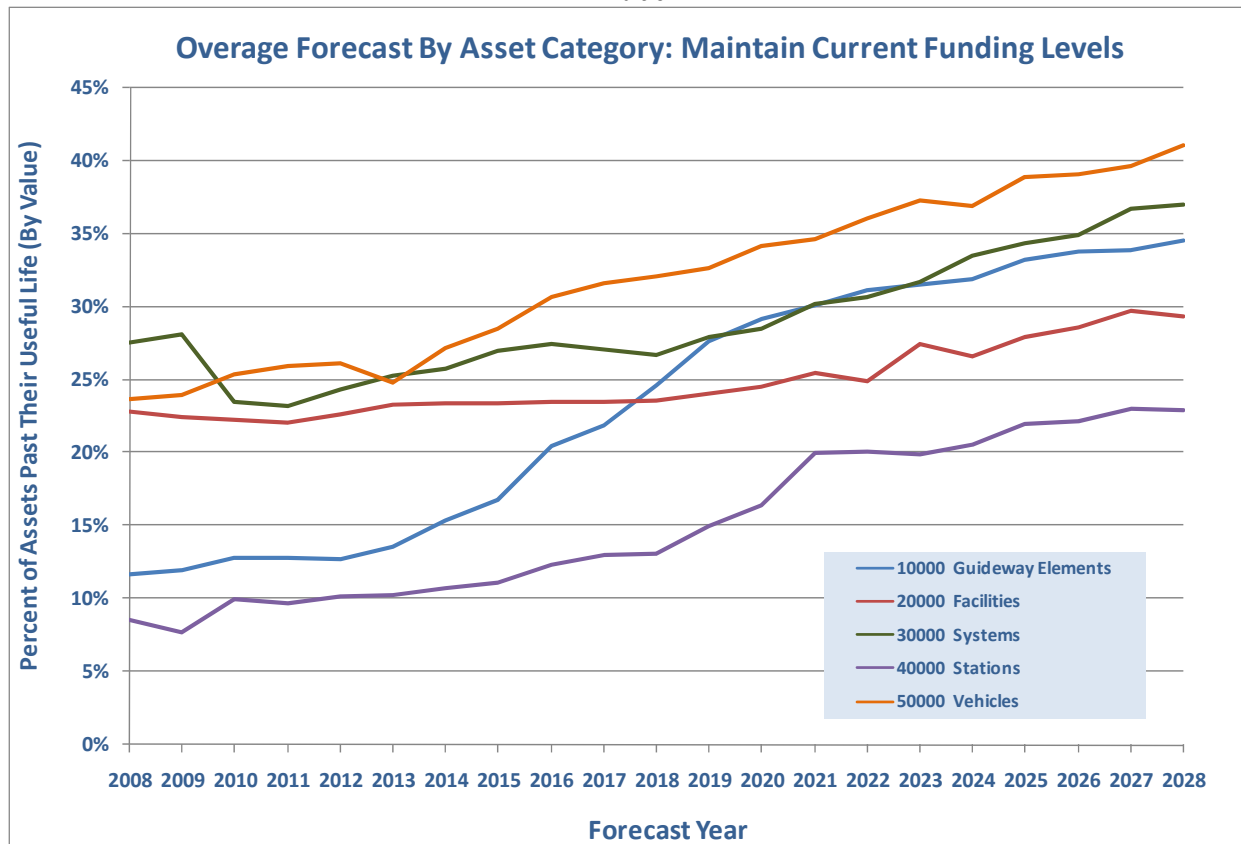
Exhibit 3-6



¹⁰ As described in Section 1, TERM rates asset conditions for individual assets on a numeric scale ranging from 5 (excellent), 4 (good), 3 (adequate), 2 (marginal) through 1 (poor). Given the condition ratings for individual assets, it is then possible to calculate average condition values for groups of assets including all assets for a given mode type, for a given agency or even for groups of agencies (as in **Exhibit 3-6**). These averages are always weighted by asset replacement value to provide a more accurate measure of aggregate asset conditions. See Exhibit 1-3 for a description of TERM's condition rating system.

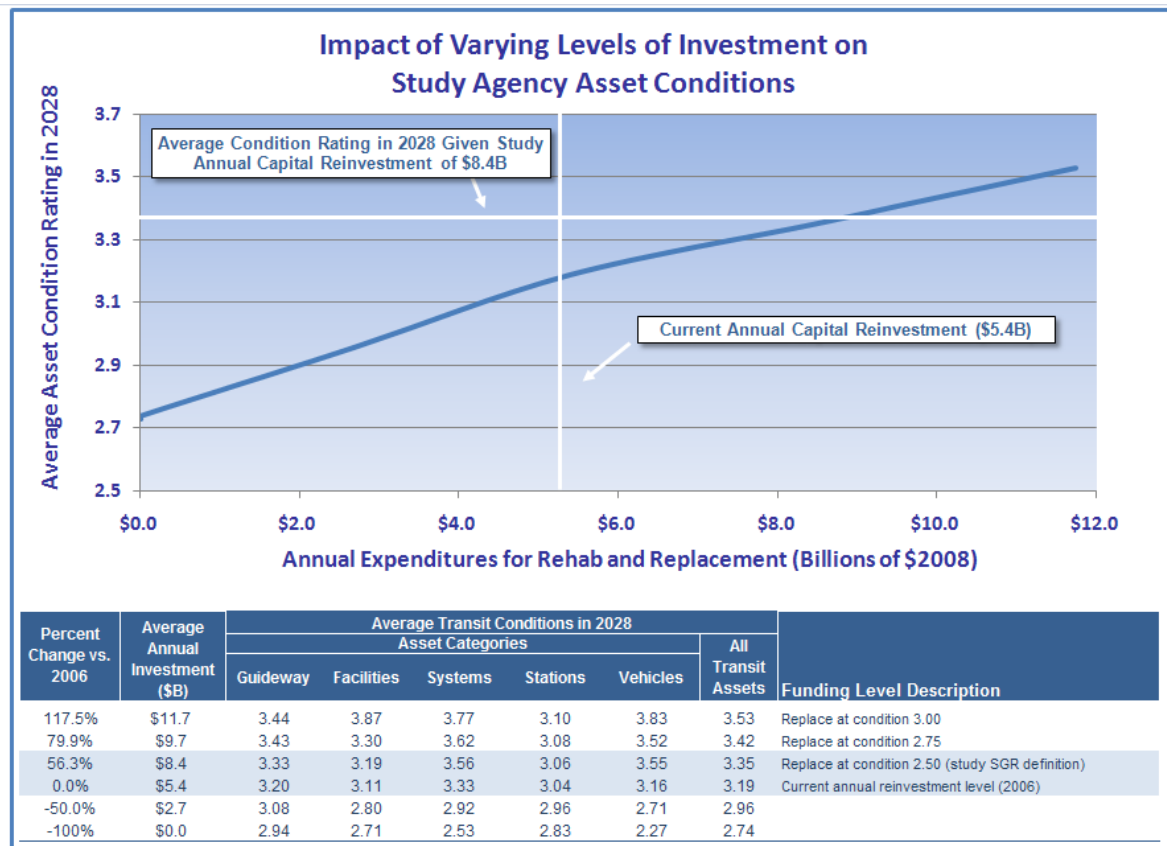
Exhibit 3-7 reproduces the estimate of the proportion of assets expected to remain in service past their expected useful life should funding levels remain unchanged over the next twenty years, this time segmented by asset type. This projection, which assumes that assets in lowest condition receive the highest priority for replacement (given constrained funding), suggests that the proportion of assets expected to remain in service past their useful life will increase for all asset types over the twenty years should funding remain at today's levels. Moreover, even if these transit operators choose to maintain or improve asset conditions for *some* asset types, it is clear from this analysis that they could not feasibly do so for *all* asset types simultaneously.

Exhibit 3-7



Impact of Varying Levels of Investment on Asset Conditions: The analysis above suggests that annual average investment on the order of \$8.4 billion is required for the study agencies to attain SGR over the next twenty years while continuation of the current annual reinvestment level of roughly \$5.4 billion is projected to result in a decline in overall asset conditions. What then is the impact on overall conditions of other levels of investment on the study agencies' asset conditions? **Exhibit 3-8** considers this question over annual investment levels ranging from zero investment dollars to roughly \$13.5 billion. Specifically, Exhibit 3-8 presents the estimated average condition of the study agencies' assets (by asset category and for all asset types combined) in the year 2028 assuming differing levels of annual investment on rehabilitation and replacement. This includes the estimated \$8.4 billion required to attain a state of good repair in twenty years assuming asset replacement at condition 2.50. Similarly, the \$11.7 billion annual investment amount represents the investment level required to reach SGR by 2028 assuming replacement at condition 3.00. Exhibit 3-8 suggests that continued reinvestment at the current rate of roughly \$5.4 billion annually would result in asset conditions well below that achieved by the estimated \$8.4 billion annual investment required to eliminate the existing backlog and address normal replacement needs.

Exhibit 3-8



In summary, this study estimates that annual expenditures from all sources, including Federal, State, local, and directly generated revenues, on the order of \$8.4 billion through 2028 are required for the seven study agencies to attain and maintain a state of good repair. Normal replacement expenditures of roughly \$5.9 billion annually would be required thereafter to maintain this state (see Exhibit 3-5). The current annual reinvestment rate of roughly \$5.4 billion is therefore insufficient to maintain current asset conditions and hence, in the absence of increased capital reinvestment expenditures, the size of the SGR investment backlog is expected to increase.

SECTION 4.0 - GRANT FORMULA MODIFICATIONS TO SUPPORT SGR

This chapter considers potential changes to the existing Federal capital funding programs to help rail transit operators better address their capital reinvestment needs. The chapter first considers potential changes to the existing Section 5309 Fixed Guideway Modernization program that would provide a better match between the allocation of funds and the recipients' reinvestment needs. As discussed below, this funding source currently tends to favor rail systems with newer assets and/or with a large number of directional route miles. The chapter provides background on the existing Fixed Guideway Modernization funding program and then considers potential changes designed to provide a better balance between the allocation of investment dollars and the capital reinvestment needs of program recipients. The chapter then concludes with a discussion of a potential new and temporary funding source designed to eliminate the existing SGR backlog over a period of two to three authorization cycles.

4.1 Fixed Guideway Modernization Program: Background

The Fixed Guideway Modernization program provides capital assistance for the modernization of existing fixed guideway systems, defined in the Federal Register as transit services that use exclusive or controlled rights-of-way or rails, entirely or in part. Given this definition, the program includes heavy rail, commuter rail, light rail, monorail, trolleybus, aerial tramway, inclined plane, cable car, automated guideway, ferryboats, the portion of motor bus service operated on exclusive or controlled rights-of-way, and high-occupancy vehicle (HOV) lanes.

For an urbanized area to receive Fixed Guideway Modernization funds, it needs to meet three criteria:

- Population of the urbanized area must be at least 200,000
- Fixed guideway system(s) must be in service operation for at least seven years, and
- At least one directional route mile of fixed guideway reported to NTD in the year of the apportionment

Current Apportionment Formula: Section 5309 Fixed Guideway Modernization funds are currently allocated to eligible urbanized areas by a fairly complex statutory formula that was last modified under the Transportation Equity Act for the 21st Century (TEA-21). This formula is comprised of seven individual tiers with varying committed funding levels. For each tier, funding is split between two different area groups. Area Group 1 includes eleven legislatively specified areas (often referred to as the "old rail cities"): Baltimore, Boston, Chicago / Northwest Indiana, Cleveland, New Orleans, New York, Northeast New Jersey, Philadelphia / Southern New Jersey, Pittsburgh, San Francisco and Southwest Connecticut. Area Group 2 is comprised of all remaining eligible urbanized areas. Funding for each tier and area group is then apportioned based on directional route mile and vehicle revenue mile information provided to the NTD, with 40% of the funding apportioned based on directional route miles and 60% based on vehicle revenue miles. The main driving factors for funding allocations in each tier are summarized in **Exhibit 4-1** below. Detailed descriptions of the seven individual funding tiers are provided in **Exhibit 4-2**.

Exhibit 4-1: Formula Funding Factors by Tier

Funding Tier	Committed Funding Level	% Funding Allocated to Legislatively Specified Areas	NTD Reporting Year for Formula Factors	% Funding Apportioned by:	
				Directional Route Miles	Vehicle Revenue Miles
Tier 1	√	100%	1995	40%	60%
Tier 2	√	50%	1995	40%	60%
Tier 3	√	78.28%	1995	40%	60%
Tier 4	√		1995	40%	60%
Tier 5	√	65%	Latest Available	40%	60%
Tier 6	√	60%	Latest Available	40%	60%
Tier 7		50%	Latest Available	40%	60%

Exhibit 4-2 Fixed Guideway Modernization Funding Tiers

Tier 1: \$497,700,000 in funds is committed to this tier. This funding is available only to the eleven legislatively specified areas and is apportioned based on amounts specified in law - \$8,372,000 to Baltimore, \$38,948,000 to Boston, \$78,169,000 to Chicago / Northwest Indiana, \$9,509,500 to Cleveland, \$1,730,588 to New Orleans, \$176,034,461 to New York, \$50,604,653 to Northeast New Jersey, \$58,924,764 to Philadelphia / Southern New Jersey, \$13,662,463 to Pittsburgh, \$33,989,571 to San Francisco and \$27,755,500 to Southwest Connecticut.

Tier 2: The next \$70,000,000 is divided equally between the two area groups; \$35,000,000 is available in committed funding to the legislatively specified areas and \$35,000,000 to the remaining eligible urbanized areas with fixed guideway systems in operation for at least seven years. For each area group, available funds are then apportioned based on the directional route mile and vehicle revenue mile information provided to the NTD for the 1995 reporting year.

Tier 3: For this tier, 78.28% of the \$5,700,000 in committed funds is allocated to the legislatively specified areas and is split among Pittsburgh (61.76%), Cleveland (10.73%) and New Orleans (5.79%). The remaining 21.72% is allocated to Area Group 2 and is apportioned based on the formula factors provided to the NTD for the 1995 reporting year.

Tier 4: \$186,600,000 in funds is committed to this tier. This funding is apportioned among all eligible urbanized areas in both Area Groups 1 and 2 based on the formula factors provided to the NTD for the 1995 reporting year.

Note: Funding for Tiers 2, 3 and 4 is apportioned among the eligible urbanized areas based on formula factors that were used to apportion funds for the Fixed Guideway Modernization program in FY1997 i.e. formula factors that were provided to the NTD for the 1995 reporting year. This means that urbanized areas that were eligible for funding in 1995 continue to receive the same annual funding allocations from these tiers irrespective of their latest counts for directional route miles and vehicle revenue miles. At the same time, currently-eligible urbanized areas that were not eligible for Fixed Guideway Modernization funds in 1995 do not receive any funding from these three tiers.

Tier 5: For this tier, 65% of the committed \$70,000,000 is allocated to the legislatively specified areas. Unlike the previous tier allocations, funding in this tier is apportioned based on the latest available directional route mile and vehicle revenue mile information reported to the NTD for fixed guideway segments which have been in revenue service for at least seven years in the year of the apportionment.

Tier 6: \$50,000,000 in funds is committed to this tier. This funding is split between the legislatively specified areas and the remaining eligible urbanized areas in a ratio of 3 to 2. Similar to Tier 5, funding is then apportioned based on the latest available formula factors reported to the NTD for fixed guideway segments which have been in revenue service for at least seven years in the year of the apportionment.

Tier 7: Any funds remaining under the Consolidated Appropriations Act are placed in this tier. These funds are allocated equally between the legislatively specified areas and the remaining eligible urbanized areas based on the latest available formula factors reported to the NTD for fixed guideway segments which have been in revenue service for at least seven years in the year of the apportionment. For the 2008 fiscal year, funding available in this tier totaled \$673,849,779.

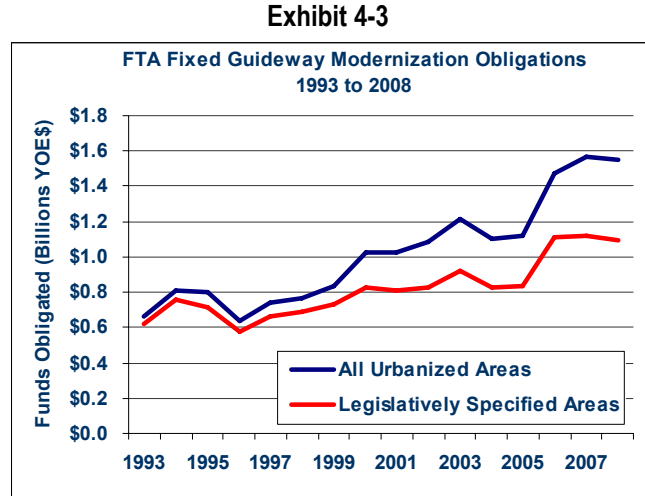
4.2 Fixed Guideway Modernization Program: Funding Trends

Participation in the Fixed Guideway Modernization program has been steadily increasing over time. This is the result of an increasing number of busway and HOV lane mile investments as well as new light rail systems which are now eligible for Fixed Guideway Modernization funds (i.e., systems that have reached the seven year mark for revenue service). This rising participation, however, has decreased the level of Fixed Guideway Modernization funding allocated to the legislatively specified areas, which correspond to the urbanized areas with the oldest rail assets and hence the highest recapitalization needs (note that all but one of the seven study agencies is included in a legislatively specified area).

Exhibit 4-3 illustrates this trend by showing that the share of Fixed Guideway Modernization funds flowing to these legislatively specified areas has declined from over 90% in 1993 to near 70% in 2008.

4.3 Funding Allocations vs. Estimated Needs

A key objective in reviewing the current Fixed Guideway Modernization program was to assess the extent to which the current allocation of Fixed Guideway funds corresponds to the relative funding needs of the recipient agencies by mode. This assessment was completed by comparing the funding allocations for FY 2008 with each recipient’s estimated capital reinvestment needs (based on national level results from a TERM run covering the needs of the entire U.S. transit industry and not just the seven study agencies).



The results of this comparison are summarized in **Exhibit 4-4** below. Specifically, this table shows the percentage of estimated capital reinvestment needs covered by Fixed Guideway Modernization funds, segmented both by mode and area group. The analysis shows that the current FY 2008 Fixed Guideway Modernization funding covers only 15 percent of the total 20-year average annual reinvestment needs of U.S. rail systems. This analysis also suggests:

Exhibit 4-4
Comparison of Recipient Needs with FY2008 Allocation of Fixed Guide Modernization Funds

Mode	Total FY08 Funding	Average Annual Reinvestment Needs	% of Needs Addressed
Legislatively Specified Areas			
Heavy Rail	\$ 457,879,174	\$ 5,437,716,040	8%
Commuter Rail	\$ 533,137,288	\$ 2,431,909,777	22%
Light Rail	\$ 41,443,240	\$ 291,348,162	14%
Total	\$ 1,032,459,703	\$ 8,160,973,980	13%
Other Urbanized Areas			
Heavy Rail	\$ 145,273,217	\$ 685,338,308	21%
Commuter Rail	\$ 106,529,787	\$ 154,322,913	69%
Light Rail	\$ 65,912,901	\$ 204,558,862	32%
Total	\$ 317,715,904	\$ 1,044,220,083	30%
All Urbanized Areas			
Heavy Rail	\$ 603,152,391	\$ 6,123,054,348	10%
Commuter Rail	\$ 639,667,075	\$ 2,586,232,690	25%
Light Rail	\$ 107,356,141	\$ 495,907,024	22%
Total	\$ 1,350,175,607	\$ 9,205,194,063	15%

- Lower Percentage Contribution to the “Old Rail Cities”: The capital reinvestment needs of rail systems in the legislatively specified areas (on a per directional route mile or per vehicle revenue mile basis) are significantly higher than those in the other urbanized areas. However, Fixed Guideway Modernization funds cover a significantly lower proportion of these needs in the legislatively specified areas than in the other urbanized areas (13 percent versus 30 percent).

- **Higher Percentage Contribution to Commuter Rail:** Fixed Guideway Modernization funds cover a significantly higher proportion of the capital reinvestment needs of commuter rail systems as compared to other rail modes (25 percent for commuter rail versus 10 percent and 22 percent for heavy and light rail respectively). Commuter rail has likely benefited from the Fixed Guideway Modernization's allocation of funds based on directional route miles, since (1) most commuter rail systems have a high number of directional route miles, and (2) commuter rail's capital replacement needs per directional route mile are lower than those for either heavy or light rail, particularly for those operators that operate over another carrier's right-of-way. Conversely, the percentage of needs addressed by this funding source is lowest for heavy rail systems (perhaps due to their higher capital reinvestment needs on a per directional route mile or per vehicle revenue mile basis).

4.4 Alternative Formula Funding Scenarios

This section evaluates potential adjustments to the current Fixed Guideway Modernization apportionment structure and presents a set of alternative funding scenarios aimed at providing an improved balance between the program funding allocations and the reinvestment needs of the recipient agencies.

The analysis shown in Exhibit 4-4 estimated that, on average, 15 percent of the nation's 20-year average annual rail capital reinvestment needs are covered by the FY 2008 Fixed Guideway Modernization funds. *The general intention behind these alternative funding formulas is to effectively redistribute funds from modes and urbanized area types where more than 15 percent of capital needs are being addressed to those where less than 15 percent of capital needs are being met.* In other words, the alternatives proposed here tend to shift funds towards rail systems which are older, larger and more heavily utilized – and hence tend to have higher capital reinvestment needs.

It should be noted that:

- The FY 2008 rail capital reinvestment needs used in this analysis are estimated by TERM from a run covering the needs of the entire U.S. rail transit industry (not just the needs of the seven study agencies)
- Even though funds allocated to an urbanized area can be used on any fixed guideway segment in that area, this analysis assumes that funds are allocated to a particular mode based on its respective formula factors. That is, an intermodal agency can receive Fixed Guideway Funds because of its commuter rail system, but can then apply these funds to its heavy rail network
- The analysis focuses solely on the three rail modes (heavy rail, commuter rail and light rail). Hence, the current funding allocations to the remaining modes eligible for Fixed Guideway Modernization funds – including busway/HOV lanes, automated guideway, inclined planes, and monorail – remains unchanged, and are not considered by this analysis

A) Scenarios Based on Current Fixed Guideway Modernization Program Structure

This section considers three scenarios, each representing a different adjustment to the current Fixed Guideway Modernization program apportionment structure. As such, these scenarios follow the existing seven-tier system for allocating funds among the different urbanized areas (see Exhibit 4-2). However, each scenario modifies a different aspect of the funding allocation shares. **Exhibits 4-5** and **4-6** below summarize the changes in allocation assumptions from the current structure for each scenario. Scenario 1 adjusts the share of funds apportioned by directional route miles; Scenario 2 adjusts the share of funds allocated to the legislatively specified areas; and

Scenario 3 adjusts both of these variables. Once again, the objective of these adjustments is to attain a better balance between the funding allocation and estimated reinvestment needs.

Exhibit 4-5: Formula Funding Scenarios

	Current Apportionment Structure is Maintained	Change in % Funding Apportioned by Directional Route Miles	Change in % Funding Allocated to Legislatively Specified Areas
Scenario 1	√	√	
Scenario 2	√		√
Scenario 3	√	√	√

Exhibit 4-6: Formula Funding Scenarios

Funding Tier	Scenario 1	Scenario 2	Scenario 3	
	% Funding Apportioned by Directional Route Miles	% Funding Allocated to Legislatively Specified Areas	% Funding Apportioned by Directional Route Miles	% Funding Allocated to Legislatively Specified Areas
Tier 1	0%	100.00%	0%	100.00%
Tier 2	0%	50.00%	0%	50.00%
Tier 3	0%	78.28%	0%	78.28%
Tier 4	0%		0%	
Tier 5	0%	65.00%	0%	100.00%
Tier 6	0%	60.00%	0%	60.00%
Tier 7	0%	85.00%	0%	80.00%

Scenario 1: In the current program apportionment structure, funds are apportioned based on formula factors as reported to the NTD. Specifically, 40 percent of funds are apportioned by directional route miles and 60 percent by vehicle revenue miles. However, as illustrated above (Exhibit 4-4), this existing apportionment structure results in federal funds covering a higher proportion of needs for commuter rail systems than those for heavy and light rail systems. The main formula factor driving this higher allocation of funds to commuter rail is directional route miles (commuter rail accounts for about 74 percent of directional route miles for all three rail modes).

Scenario 1 attempts to improve the balance in reinvestment needs coverage among modes by eliminating route-miles as a basis for allocation and then apportioning funds in all tiers based solely (i.e., 100%) on vehicle revenue miles. This change recognizes that rail transit reinvestment costs tend to be more highly correlated with system utilization than with network size. The funding allocation results for this scenario are presented in **Exhibit 4-7** along with the estimated percent of capital needs covered. Overall, this re-weighting of the apportionment factors yields a more balanced distribution of funds between modes *within* each urbanized area type, but the formula still covers a significantly lower proportion of the legislatively specified areas' needs.

Scenario 2: The current Fixed Guideway Modernization program apportionment structure meets only an estimated 13 percent of the capital reinvestment needs for the legislatively specified areas, but 30 percent of needs for all other urbanized areas. Moreover, total rail reinvestment needs for the legislatively specified areas are estimated to be roughly eight times higher than that of the remaining urbanized areas (as most of the nation's older, larger and more-heavily utilized rail systems are located in the legislatively specified areas). In contrast, the level of modernization funding currently allocated to these areas is only three times that allocated to the remaining eligible urbanized areas.

Scenario 2 attempts to better balance the allocation of funding to needs between the two groups of urbanized areas, primarily by increasing the level of funding allocated to the legislatively specified areas in Tier 7 from 50% to 85%. The resulting funding allocation is summarized below in **Exhibit 4-8**. After these changes, the total funding allocated to the legislatively specified areas is now close to eight times that allocated to the remaining urbanized areas,

providing a better match with the magnitude of reinvestment needs between urbanized area groups.¹¹ Note that these changes do not address the imbalance among rail modes, as considered in Scenario 1, since 40% of the funds are still apportioned based on directional route miles in this scenario.

**Exhibit 4-7
Comparison of Recipient Needs with Fixed Guideway Modernization Funds: Scenario 1**

Mode	Total FY08 Funding	Average Annual Reinvestment Needs	% of Needs Addressed
Legislatively Specified Areas			
Heavy Rail	\$ 626,344,405	\$ 5,437,716,040	12%
Commuter Rail	\$ 375,403,777	\$ 2,431,909,777	15%
Light Rail	\$ 35,031,530	\$ 291,348,162	12%
Total	\$ 1,036,779,712	\$ 8,160,973,980	13%
Other Urbanized Areas			
Heavy Rail	\$ 205,483,731	\$ 685,338,308	30%
Commuter Rail	\$ 43,250,257	\$ 154,322,913	28%
Light Rail	\$ 64,661,907	\$ 204,558,862	32%
Total	\$ 313,395,895	\$ 1,044,220,083	30%
All Urbanized Areas			
Heavy Rail	\$ 831,828,136	\$ 6,123,054,348	14%
Commuter Rail	\$ 418,654,033	\$ 2,586,232,690	16%
Light Rail	\$ 99,693,437	\$ 495,907,024	20%
Total	\$ 1,350,175,607	\$ 9,205,194,063	15%

**Exhibit 4-8
Comparison of Recipient Needs with Fixed Guideway Modernization Funds: Scenario 2**

Mode	Total FY08 Funding	Average Annual Reinvestment Needs	% of Needs Addressed
Legislatively Specified Areas			
Heavy Rail	\$ 560,009,789	\$ 5,437,716,040	10%
Commuter Rail	\$ 646,981,559	\$ 2,431,909,777	27%
Light Rail	\$ 48,999,976	\$ 291,348,162	17%
Total	\$ 1,255,991,323	\$ 8,160,973,980	15%
Other Urbanized Areas			
Heavy Rail	\$ 70,268,001	\$ 685,338,308	10%
Commuter Rail	\$ 50,635,188	\$ 154,322,913	33%
Light Rail	\$ 31,721,685	\$ 204,558,862	16%
Total	\$ 152,624,875	\$ 1,044,220,083	15%
All Urbanized Areas			
Heavy Rail	\$ 630,277,790	\$ 6,123,054,348	10%
Commuter Rail	\$ 697,616,747	\$ 2,586,232,690	27%
Light Rail	\$ 80,721,661	\$ 495,907,024	16%
Total	\$ 1,408,616,198	\$ 9,205,194,063	15%

Scenario 3: This last scenario under the current Fixed Guideway Modernization program apportionment structure combines the changes from Scenarios 1 and 2 by simultaneously modifying both the allocation factors to the legislatively specified areas and the apportionment factors based on the directional route miles. The result is an improved balance of funds to capital needs both between urbanized area groups *and* among rail modes.

¹¹ This level of funding to the legislatively specified areas can only be achieved if funding for Tier 7 continues at the same rate. If not, then the percentage of funding allocated to these areas might need to be increased in other tiers as well.

Specifically, under scenario 3, the legislatively specified areas receive an additional 35 percent of committed funds in Tier 5 and an additional 30 percent of funds in Tier 7 (see Exhibit 4-6). Funding for all tiers is also apportioned based solely on the vehicle revenue miles reported to the NTD. The estimated results of these changes are summarized below in **Exhibit 4-9**. As shown, this scenario achieves a relatively uniform match between capital reinvestment needs and the allocation of Fixed Guideway Modernization funds.

Exhibit 4-9
Comparison of Recipient Needs with Fixed Guideway Modernization Funds: Scenario 3

Mode	Total FY08 Funding	Average Annual Reinvestment Needs	% of Needs Addressed
Legislatively Specified Areas			
Heavy Rail	\$ 764,924,895	\$ 5,437,716,040	14%
Commuter Rail	\$ 446,592,327	\$ 2,431,909,777	18%
Light Rail	\$ 40,081,647	\$ 291,348,162	14%
Total	\$ 1,251,598,870	\$ 8,160,973,980	15%
Other Urbanized Areas			
Heavy Rail	\$ 102,827,964	\$ 685,338,308	15%
Commuter Rail	\$ 20,575,831	\$ 154,322,913	13%
Light Rail	\$ 31,335,728	\$ 204,558,862	15%
Total	\$ 154,739,523	\$ 1,044,220,083	15%
All Urbanized Areas			
Heavy Rail	\$ 867,752,859	\$ 6,123,054,348	14%
Commuter Rail	\$ 467,168,158	\$ 2,586,232,690	18%
Light Rail	\$ 71,417,375	\$ 495,907,024	14%
Total	\$ 1,406,338,393	\$ 9,205,194,063	15%

A key benefit of each of these three scenarios is their reliance on the existing seven tier and (currently) two factor apportionment structure (in contrast to potential solutions requiring development of an entirely new structure; see below). A potential drawback of scenarios 2 and 3, however, is the need to rely on analytical estimates (such as those produced by TERM) to determine the best allocation of funds between the legislatively specified areas and all other urbanized areas.

B) Other Apportionment Structures Alternatives

This section considers potential alternative approaches to redesigning Fixed Guideway Modernization program. Unlike the preceding scenarios, which were based on the existing seven tier structure, these alternatives consider entirely new structures which are again intended to improve the balance between funding allocation and reinvestment needs.

Apportionment Structures Based on External Needs Estimates: Another potential approach to allocating Fixed Guideway Funds would be to abandon the existing apportionment structure altogether, and distribute funds based on an independent needs estimate, such as those produced by TERM. Scenarios 2 and 3 above utilized TERM's needs estimates directly in the apportionment formulas to help allocate funding between the two existing urbanized area types. This analysis raises the possibility of using external needs estimates to create an optimal allocation of funds between both urbanized area types and then by mode types within each urban area type. Using needs estimates as a basis for funding distribution would ensure that each urban-area/mode-type combination would have an equal proportion of its needs (e.g., 15 percent) covered by the Fixed Guideway Modernization Funding source.

Even though this type of apportionment structure can more accurately match funds to capital needs in theory, errors in the needs estimation process could result in inaccurate or unfair funding allocations. This approach would

increase scrutiny of the needs estimates, which would need to be revised frequently to reflect ongoing changes in relative reinvestment needs between urbanized areas and mode type.

Modification or Expansion of the Urbanized Area Group Types: The existing mix of tiers and urbanized area types was developed in the 1970's and was designed, in part, to ensure that "old rail cities" obtained a higher level of funding in recognition of their higher needs. Thirty years later, a number of the Nation's "newer" rail systems are now entering "middle-age" and hence face significant reinvestment needs. In some cases these needs are comparable to those in the urbanized areas recognized in the legislatively specified area group. Given these considerations, the definition of the legislatively specified areas should be reviewed and potentially expanded to include additional urbanized areas whose needs now justify inclusion in this group.

Alternatively, Congress could consider implementation of an entirely new, multiple tier structure that reflects the differing reinvestment needs of rail transit investments of differing ages. For example, a three tier structure could reflect the differing needs of "new", "middle age" and "old" rail systems. A key challenge in implementing this type of structure would be to accurately assess which tier each rail system belongs in, the relative capital needs of each tier and when to transition a rail system (or components of that system) from one tier to the next. To ensure accuracy, these tier designations would also need to be defined by rail system (or portions thereof) rather than by urbanized area.

Other Apportionment Formula Variables: The current apportionment formula considers only two variables – directional route miles and vehicle revenue miles. As discussed above (see Exhibits 4-8 and 4-9), apportioning funds based solely on vehicle revenue miles would yield a better balance between the allocation of funds and capital needs (as compared to the current mix of vehicle revenue miles and direction route miles). This raises the question of whether there are other, better variables that can be combined with vehicle revenue miles to develop a funding formula that better balances the allocation of funds with needs.

Exhibit 4-10 addresses this question by first considering the statistical correlation between vehicle revenue miles (VRM) and other variables known to be highly correlated with reinvestment needs – including the number of track miles by vertical alignment type and passenger miles (quantities currently reported to NTD). In principle, variables that are *highly* correlated with reinvestment needs but *poorly* or only marginally correlated with VRM may represent potential candidates to add to a funding formula along with VRM (as these variables have "information" on investment needs that VRM does not). In contrast, if VRM is itself highly correlated with these other variables, then VRM and the highly correlated variable might "contain similar information" on reinvestment needs, and hence there is little to be gained by including both variables in the same formula.

Exhibit 4-10
Correlations between Potential Formula Funding Variables

Potential Funding Factors	Vehicle Revenue Miles	At Grade Track Miles	Elevated Track Miles	Subway Track Miles	Passenger Miles
Vehicle Revenue Miles (VRM)	1.000				
At Grade Track Miles	0.039	1.000			
Elevated Track Miles	0.878	0.019	1.000		
Subway Track Miles	0.962	-0.006	0.814	1.000	
Passenger Miles	0.925	0.349	0.823	0.910	1.000

Review of Table 4-10 suggests that VRM is highly correlated with the number of track miles that are "not at-grade" (i.e., are elevated or subway) as well as with passenger miles. Hence, these variables likely capture similar information on capital reinvestment needs as compared to VRM. Moreover, with the exception of at-grade track miles, each of these variables (VRM, elevated track miles, subway track miles and passenger miles) are all highly

correlated with each other and hence all carry roughly similar information on needs.¹² At a certain level these results should not be unexpected as capital reinvestment needs are highest for the Nation's oldest rail transit operators, which also tend to be the systems with the highest VRM, a large number of miles of elevated and subway track, and high annual passenger miles. Based on this and other statistical analyses it appears that there is no benefit to developing funding formulas for rail capital reinvestment needs that rely on multiple variables. Moreover, VRM performs as well as any of the alternatives considered here.

4.5 Permitted Uses of Fixed Guideway Funds

Finally, the financial plans for expansion projects seeking Federal Section 5309 New Starts funding sometimes include Section 5309 Fixed Guideway Modernization as a project funding source. Given the intended use of these funds and the magnitude of the existing backlog of transit reinvestment needs, it is suggested that FTA prohibit the use of Fixed Guideway Modernization funds as a funding source for any New Starts project. Specifically, grantees for New Starts projects would not be able to include Fixed Guideway Modernization funds in their Full Funding Grant Agreements (FFGAs) with FTA. FTA analysis suggests that roughly 2 percent to 3 percent of Fixed Guideway Modernization funds are applied to essentially non-modernization projects each year.

4.6 Temporary SGR Investment Fund

The analysis in Chapter 3 estimated that the investment backlog for the seven study agencies to be roughly \$50 billion (\$2008), and that existing funding levels are not sufficient to address this need. Hence, a second approach to addressing the SGR needs of the seven study agencies (beyond modifications to the allocation of the existing Fixed Guideway Modernization fund as described above) would be to develop a temporary funding program designed to eliminate the SGR backlog over an extended time period. In practice this temporary program could cover two or three six-year reauthorization periods (given the size of the existing backlog, a single reauthorization does not provide sufficient time to address the problem). In concept, the existing Fixed Guideway Modernization fund could remain in place during this period providing a funding source for normal replacement needs. The temporary program would then focus entirely on addressing the existing reinvestment backlog. **Exhibit 4-11** below reproduces the rightmost columns of Exhibit 3-9 which presents the level of annual funding (in \$2008) required to eliminate this backlog for the seven study agencies over the 6-, 12- and 20-year time periods.

Exhibit 4-11
Annual Funding Levels for a Temporary SGR Fund: Study Agencies Only (Billions of \$2008)

Mode	Annual Investment to Attain SGR over (in addition to normal replacement):		
	6 Years	12 Years	20 Years
Rail	\$7.8	\$3.9	\$2.3
Non-Rail	\$0.5	\$0.3	\$0.2
Total	\$8.3	\$4.2	\$2.5

¹² This result has been confirmed by a detailed regression analysis where combinations of these variables were used to predict capital reinvestment needs. In all cases, the individual variables (in single variable models) performed well in predicting reinvestment needs but little was gained in terms of explanatory power when these variables were used in combination.

SECTION 5.0 - ASSET MANAGEMENT PRACTICES OF STUDY AGENCIES

Over the past decade, transportation agencies from a variety of modes – including highways, maritime, aviation and transit – have initiated a broad range of “asset management” programs. A primary objective and fundamental value of these programs is to provide agencies with a more informed understanding of the condition of their transportation assets, their long-term capital investment needs (including preservation, expansion, and safety), and the costs, benefits and tradeoffs of all investment options. Armed with this understanding – and supported by good quality and reliable data – agency decision-makers can make more informed choices to efficiently use scarce resources.

To help address their own reinvestment challenges, many of the seven transit agencies included in this study have instituted, wholly or in part, an “asset management” program. Note however, that these programs vary widely in both breadth and maturity; while some agencies are doing a significant amount, others are only beginning to explore this option. This section outlines the key components of a comprehensive asset management program and then describes how the seven agencies studied here have implemented these processes. A key objective is to reflect on the current use of asset management processes within the transit industry, and to highlight some current best practices.

5.1 What is Transportation Asset Management?

The term “asset management” has become widespread in discussions of how best to address the needs of aging transportation infrastructure. Somewhat problematically, the term has also taken on broadly different meanings for different user groups. Hence, prior to assessing the asset management practices of the seven study agencies, it will be helpful to first answer the question: What is asset management?

The American Association of State Highway Transportation Officials (AASHTO) and the Federal Highway Administration (FHWA) define Transportation Asset Management (TAM) as follows:

“Transportation Asset Management is a strategic and systematic process of operating, maintaining, improving and expanding physical assets effectively throughout their lifecycle. It focuses on business and engineering practices for resource allocation and utilization, with the objective of better decision-making based upon quality information and well-defined objectives.”

Based on this definition, asset management is:

- *Strategic* and not *tactical* (i.e., it has a long-term focus)
- Seeks to *balance the competing needs* of operations, maintenance, reinvestment and system expansion; it is not focused on maintenance or reinvestment alone
- An *organization-wide endeavor*: It seeks to integrate planning, engineering, funding and IT perspectives
- Seeks to make *informed* and *prioritized* decisions regarding the use of *scarce resources* based on *reliable data* in support of *clear organizational objectives*

To contrast this definition with more “traditional” practices, practitioners note that asset management seeks to allocate resources based on merit (i.e., to the highest investment return) and not based on a simple or “worst first” prioritization. While many agencies have implicitly invested based on merit, asset management is designed to make these processes explicit, well-defined, and consistent with the agency’s policy objectives.

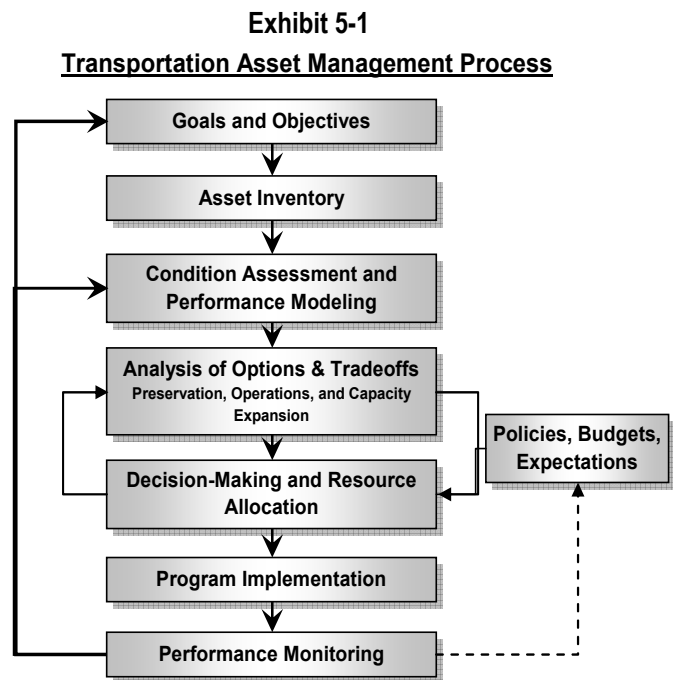
Finally, this definition of asset management implies that attaining and maintaining a state of good repair necessarily involves tradeoffs with other agency investment objectives, including operations, capital expansion and safety. Moreover, the state of good repair objective must also consider tradeoffs between individual asset types (e.g., track work vs. maintenance facilities). A key goal of asset management is to make informed investment decisions when allocating resources between investment options.

5.2 Components of Asset Management

A comprehensive asset management program consists of a mix of agency objectives, data sources, measurement and evaluation processes, and decision support tools. A typical representation of these components and their interaction is provided in **Exhibit 5-1**. Of these components, the following are most relevant to the objective of attaining and maintaining a state of good repair:

- Asset Inventories
- Asset Condition Assessments
- Decision Support Tools/Processes
- Investment Prioritization Processes

Together, these four components represent the core of the full transportation asset management process outlined on the right in Exhibit 5-1. The remaining subsections describe each of these asset management components and then documents the current practices of the seven study agencies in each of these areas.



5.3 Asset Inventories

A current and comprehensive asset inventory is the foundation of a good asset management program, and seven of the seven study agencies have developed inventories for capital planning purposes.

What is an Asset Inventory? A capital planning asset inventory is a current and comprehensive listing of all major assets used in the delivery of transit services. For each asset, these inventories typically document most, if not all, of the following asset attributes:

- Asset type
- Location (rail line, garage, division, other)
- Condition
- Date built / acquired
- Rehabilitation history
- Replacement cost (total and/or unit cost), including project cost multipliers
- Quantity
- Expected remaining life

This information is typically maintained in an electronic format (in a database or more frequently in spreadsheets) and can be used as input to decision support models and other capital needs evaluation processes.

Fixed Asset Ledgers vs. Asset Inventories: Importantly, most of the study agencies keep asset inventories intended for *capital planning* purposes, which are separate and distinct from the *fixed asset ledgers* that virtually all transit agencies maintain for accounting purposes. These data sources differ in critical ways that make an accounting ledger inappropriate for capital planning (**Exhibit 5-2**). Asset inventories developed for capital planning purposes are structured into groups of assets with similar functions and useful lives. In contrast, line items in fixed asset ledgers are typically grouped based on purchase contracts, with assets of varying useful lives grouped into a single record. Asset inventories focus on engineering or expected remaining service life to plan rehabilitation and replacements, while accounting ledgers focus on assessing asset depreciation based on accounting schedules. While these two data sources appear to contain similar kinds of information, they are usually organized in very different and incompatible ways.

Exhibit 5-2
Differences between Fixed Asset Ledgers and Asset Inventories

Characteristics	Fixed Asset Ledger	Capital Asset Inventory
Purpose	Support financial statement presentation	Support goals and objectives for capital reinvestment
Basis for Analysis	Acquisition Cost	Replacement Cost
Records aggregated by:	Date purchased	Asset type, useful life, and date purchased
Basis for Useful Life	Industry-wide estimates	On-site estimates for specific assets
Appropriate for Estimating Long-Term SGR Needs?	No	Yes

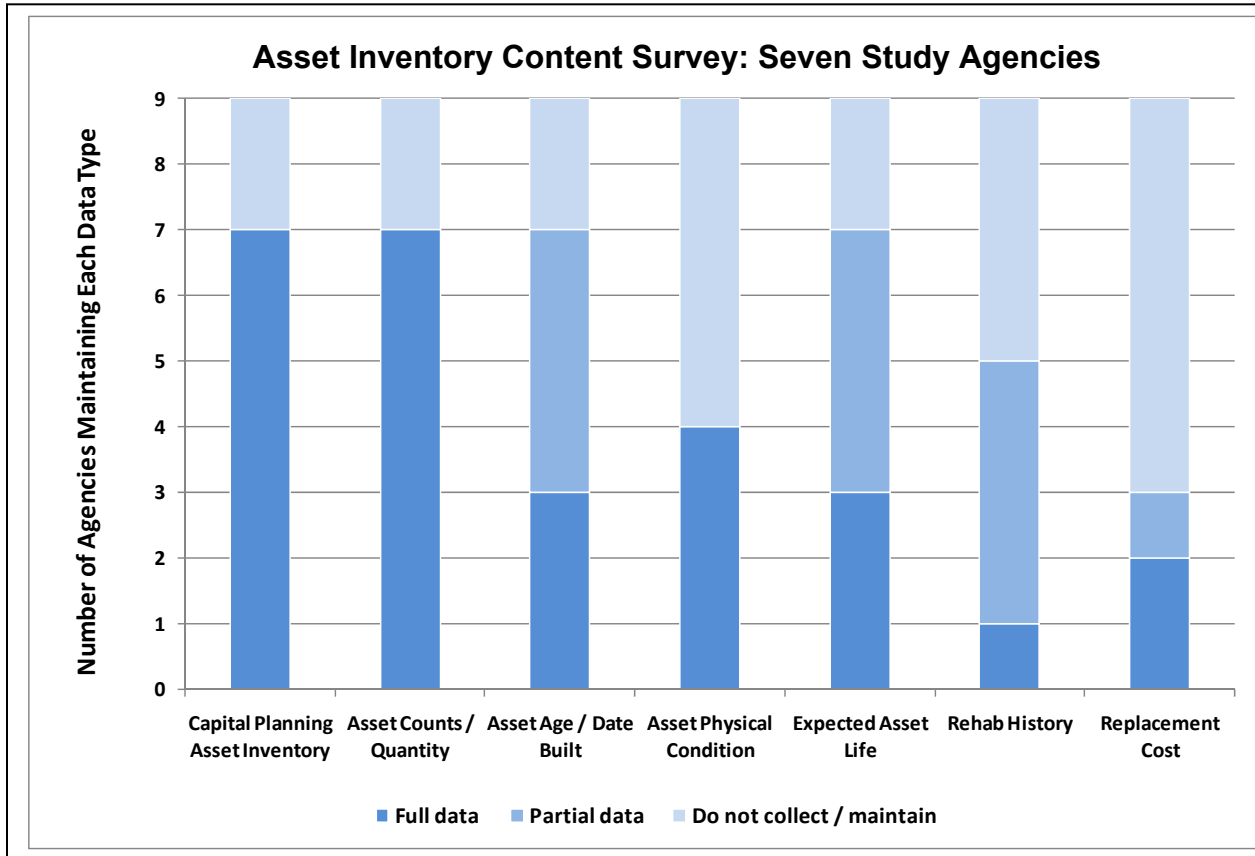
Current Practices at the Study Agencies: An overview of the current capital planning asset inventories of the seven study agencies (including the contents of those inventories) is provided below in **Exhibit 5-3**. Of the seven study agencies, seven have developed and/or are refining comprehensive asset inventories for capital planning purposes. In one instance, an agency's asset inventory was developed not by the agency itself, but by the Metropolitan Planning Organization (MPO) that allocates funding to that agency. Two of the seven agencies do not currently maintain asset inventories for capital planning purposes but are beginning to explore their development.

However, as Exhibit 5-3 shows, while seven of the seven study agencies have developed and/or are refining comprehensive asset inventories, the structure of these inventories varies widely. For example, all of the existing inventories document quantities of assets by type and date built or acquired for most of these assets (making it possible to calculate the current asset age). However, only three agencies document this information for all asset types. This finding is not entirely surprising since maintaining this information is very labor-intensive for certain asset types, but the absence of age or condition data results in an incomplete understanding of current reinvestment needs.

Similarly, only four of the seven asset inventories contain current information on asset conditions or expected remaining life, and only one of the seven contains reasonably comprehensive documentation of past asset rehabilitation activities. Finally, it is surprising that only two of the seven asset inventories include replacement cost data for the individual asset records (although most of these agencies maintain this data in other data sources). As

with rehabilitation data, replacement cost data is critical to understanding and estimating future reinvestment needs. Including this information in the inventory itself can greatly facilitate needs analysis.

Exhibit 5-3



Capital Planning Asset Inventories: Study Agencies

A good example of relatively comprehensive asset inventory records is provided in **Exhibit 5-4** (note that some location information such as street names, rail line and division data were omitted from this exhibit).

Exhibit 5-4
Sample Agency Asset Inventory Listing: Elevators

Location		History				Equipment & Capacity						Condition
Escl. No.	Sta. No.	Date Installed	Date Last Replaced	Date Rehab'd	Useful Life (Yrs)	Model	Manufacturer	Vertical Rise (ft)	Width (in)	Fire Equip	ADA Req	
101	306	1/1/1980	12/21/2001	n/a	30	PS-S1200	Fujitec	29	32	Yes	Yes	1
102	306	1/1/1980	1/1/2002	n/a	30	PS-S1200	Fujitec	34	32	Yes	Yes	1
122	424	7/1/1996	--	--	30	RT-HDM4	O & K	17	40	Yes	Yes	1
123	424	12/6/1996	--	--	30	RT-HDM4	O & K	14	40	Yes	Yes	1
203	465	5/1/1948	10/4/1999	n/a	30	RT-HDM4	O & K	50	36	Yes	Yes	1
204	465	2/1/1949	10/4/1999	n/a	30	RT-HDM4	O & K	50	36	Yes	Yes	1
207	465	6/1/1965	8/28/2000	n/a	30	RT-HDM4	O & K	32	48	Yes	Yes	1
208	465	4/1/1966	8/28/2000	n/a	30	RT-HDM4	O & K	20	48	Yes	Yes	1
209	465	4/1/1966	2/15/2002	n/a	30	RT-HDM4	O & K	31	48	Yes	Yes	1
210	465	6/1/1965	2/15/2002	n/a	30	RT-HDM4	O & K	20	48	Yes	Yes	1

Assessments of transit capital needs at the national level (such as the U.S. DOT's biennial Condition and Performance Report to Congress) necessarily rely on the limited asset inventory data collected by the nation's transit operators. Since few transit agencies have developed such inventories and since existing inventories are far from standardized (in terms of the level of detail maintained and the types of data recorded for each asset), estimates of national-level needs are subject to a degree of uncertainty. That uncertainty would be reduced if FTA were to provide Federal technical assistance to the industry to develop good quality asset inventory data, and if FTA were to require grantees to report on the age and condition of major transit asset types.

5.4 Asset Condition Assessments

Several U.S. rail transit agencies conduct either ongoing or periodic assessments of the physical condition of their entire stock of assets. The objective of these assessments is to develop or maintain a comprehensive understanding of the current condition of all major capital asset types, to analyze recapitalization needs and to prioritize capital projects. Given the information that these condition assessments provide, they clearly represent a valuable input to any comprehensive asset management program.

What is a Condition Assessment? In current industry practice, transit condition assessments usually consist of a series of on-site inspections, every three to ten years, where engineers rate the physical condition of all individual transit assets using some kind of standard metric. This data is typically collected and organized in a consistent way to create a "snapshot" of all assets on a comparable basis – data that is effective for capital reinvestment planning. Many transit agencies have adopted a universal rating system (say, an integer scale of 1 through 5) to capture the conditions of the diverse range of asset types needed to deliver transit services. Most rail transit agencies only perform detailed condition assessment on an occasional basis, due in part to their cost and complexity.

Maintenance Management Systems vs. Condition Assessments: It is important to distinguish the type of comprehensive asset condition assessment described above from the use of maintenance management systems to monitor the ongoing, day-to-day maintenance conducted by agency engineers. Engineering and maintenance staff at all U.S. rail transit agencies regularly inspect their agency's transit assets to help schedule maintenance activities. However, because these activities are designed to support the needs of an individual department, the information they produce is rarely an input to an agency-wide assessment of overall capital needs and conditions.

Current Practices at the Study Agencies: Three of the seven study agencies have committed to conducting comprehensive asset condition assessments on an ongoing basis every three to five years (NYCT, MNR and LIRR). For some asset types (e.g., track), asset conditions are continually assessed, with a “new” assessment initiated as soon as the “previous” assessment is completed.

In addition to the three New York agencies, the Chicago Transit Authority and the Massachusetts Bay Transportation Authority have completed major condition assessments. The CTA has completed two assessments since the mid-1990s, both of which were conducted by teams of consultant staff who covered virtually all fixed assets and assessed asset conditions to a relatively fine level of detail. The MBTA finished a 20-year systemwide needs assessment in 1999. These assessments have been used to assess and prioritize needs, and have been influential in helping “make the case” for more reinvestment in existing infrastructure and additional funding.

Agency capital planning staff use this condition data to help identify outstanding needs and to prioritize capital funds between asset types. Capital planning staff also use these condition data as an independent “check” or “validation” of the requests for capital funds they receive from agency engineering staff. Injecting this condition data into the capital planning process has reduced inter-departmental competition for capital funds, since the data clearly demonstrates which asset types have the most urgent reinvestment needs.

5.5 Use of Decision Support Tools and Processes

What is a Decision Support Tool? Decision support tools are analytical processes and/or models that estimate capital reinvestment needs over an extended time horizon, and that help prioritize investments or assess the impact of alternate funding scenarios (e.g., how long will it take to attain a state of good repair under different funding levels?). A key value of these tools is their ability to generate an objective, quantitative analysis of agency needs across an extended time horizon. Decision support tools are not a substitute for traditional engineering needs assessments by engineering staff; instead, engineering analyses should be a key input to the decision support tool as a complementary process. While decision support tools are not yet widely used by U.S. transit operators, a small number of transit operators or their local or regional funding agencies have developed such tools with successful results and some have used these tools to justify increased funding requests from local and state agencies.

Development of a comprehensive decision support tool is highly dependent on the availability of a current and comprehensive inventory of an agency’s major transit assets - a key input to the needs assessment modeling process.

Current Practices at the Study Agencies: The MBTA is the only agency of the seven in this study that has developed a comprehensive decision support tool. The MBTA’s “SGR Database” tool allows the agency to assess its unconstrained reinvestment needs, but also to realistically simulate the results of a budget constraint. Under limited budgets, the tool prioritizes SGR activities based on three factors: the degree to which the asset has exceeded its useful life (i.e., age), the asset’s relative importance to core operations and the number of riders affected by the asset. The model captures the very real dynamic facing transit capital planners: if an asset is not replaced in a given

Exhibit 5-5 Examples of Transit Decision Support Tools



year, it becomes an even higher priority in the next year. This decision support tool can show which specific projects should be prioritized for capital funds, and can determine the total time required to attain a complete state of good repair under alternative funding levels.

While none of the other study agencies currently maintains a decision support tool comparable to the MBTA's, many of the study agencies do conduct similar types of analyses on a more piece-meal basis. In particular, those agencies that maintain detailed asset inventories use this data to conduct needs analyses on an asset type by asset type basis.

Transit lags other sectors of the transportation industry in the development of comprehensive decision support tools for asset management, comprehensive asset inventories, and investment prioritization methods. Given the significant level of Federal capital funds devoted to transit capital expansion and reinvestment each year, FTA may be justified in encouraging and assisting U.S. transit operators to develop effective asset management practices. At the same time, given the wide diversity of agency types and local conditions, it might not be appropriate for the Federal government to proscribe specific asset management solutions.

5.6 Investment Prioritization

Each of the seven study transit operators makes decisions about how to allocate scarce capital dollars in different ways. While all of the agencies actively consider the expected impacts of differing investments, only two have developed a clear set of prioritization objectives and a well-defined prioritization process.

What are Investment Prioritization Processes? In a good asset management program, a well-defined and objective prioritization process is required to ensure that scarce capital dollars go to investments that best attain or support the agency's overall goals and objectives (e.g., maximize service reliability, safety and/or quality of service). This approach seeks to replace the more traditional process where staff from different departments or asset classes within the agency (e.g., facilities, maintenance of way, vehicles, or structures) develop their own needs assessments and compete for a limited pot of funding in a potentially subjective manner. In practice, good prioritization processes can consist of point-based ranking systems, structured internal review processes with senior management, or combinations of similar approaches – all with the objective of a well-defined and objective prioritization process to directly support overall organizational objectives.

Current Practices at the Study Agencies: The majority of the seven study agencies tend to rely on prioritization processes that are both informal (i.e., the process is not well defined) and implicit (the agencies' investment goals and objectives are not explicitly stated or defined). Under these circumstances, *reinvestment* dollars tend to be allocated through the following types of processes:

- **“Mission Critical” Assets First:** Most study agencies tend to favor reinvestment in “mission critical” asset types like vehicle fleets whereas “less critical” assets such as maintenance facilities and station amenities tend to receive lower prioritization.
- **Safety First:** Each of the seven agencies places a high priority on passenger safety and hence safety-related investments.
- **Multi-Factor Prioritization:** One of the seven agencies prioritizes reinvestment activities using five factors: Safety/Health Environment, State of Good Repair, Cost/Benefit, Operational Impacts, and Legal Commitments. Each of these factors corresponds to criteria spelled out in the agency's enabling legislation.
- **Coordinated Investments to Ensure Installation Efficiency:** In many instances, rail transit operators can greatly reduce either installation cost or disruption to service by simultaneously rehabilitating and replacing

multiple asset types located on the same track segment. This approach sometimes requires the early replacement of assets that have not yet reached the end of their useful life, but this may be well warranted given the economies of scale of a jointly coordinated replacement program.

- Historical Funding Levels: A number of study agencies do not actively prioritize investments across asset types, but rather continue to maintain historical funding allocations between agency departments and allow each department (e.g., track and structures) to prioritize investments within its own domain. The level of investment for each department may be relatively stable over time, with the implicit understanding that these levels are commensurate with needs.
- “Steady State” Investment Prioritization: One of the seven agencies develops a rough allocation of funding between assets based on their relative long-term needs if they were in a state of good repair and sufficient funding were available to maintain SGR into the future. This agency uses these “steady state” funding proportions as an approximate guide to allocate current available funds

Prioritizing Reinvestment vs. Other Needs: Finally, none of the seven study agencies identified a clear prioritization process for allocating (or reallocating) funds between reinvestment and *other* investment types such as core capacity improvements, New Starts expansions or technology improvements. Instead, prioritization tends to be a continuation of historical funding allocations to each investment type and is, in part, driven by the funding use restrictions imposed by the Federal funding system (e.g., the relative availability of New Starts versus Fixed Guideway Modernization funds). However, the budding asset management practices at these agencies are shifting attention to the magnitude of their reinvestment needs and the consequences of not addressing those needs. Armed with better information, some agencies have been able to begin to emphasize reinvestment over other capital needs.

5.7 Future Opportunities

As noted earlier, transit has generally lagged the rest of the transportation sector, most notably highways, in the development and implementation of asset management practices. In part, this is due to the variety of asset types used to deliver transit services. However, because the nation’s rail transit operators face significant reinvestment requirements and because the majority of Federal transit funds go to reinvestment activities, sound asset management practices supported by the FTA offer the potential to more effectively allocate limited capital funds.

Given these circumstances, FTA is now taking the first steps in focusing attention on transit infrastructure renewal, and can play a role in facilitating the development and implementation of asset management practices in a number of ways:

- Technical Guidance: The Federal Transit Administration frequently provides the nation’s transit operators with technical guidance and support, and could lend similar help to agencies through studies, reports, and training sessions to develop core asset management practices: defining SGR, creating asset inventories, and employing decision support tools in a more data-driven approach to investment prioritization.
- Working Groups: FTA currently conducts biannual “roundtables” with industry engineering professionals to address common issues impacting the design and construction of New Starts projects, and is considering a similar roundtable program to address state of good repair issues. These roundtables would help ensure that FTA’s strategies for attaining state of good repair accurately reflect real-world reinvestment realities.
- Grants Incentives: As a key funding partner for all of the nation’s urban transit operators, FTA could encourage the development and use of asset management practices through well-considered grants

incentives (e.g., additional level of funding to those agencies that adopt a core set of asset management practices).

- “TERM-Light”: FTA may make a simplified version of its national-level Transit Economic Requirements Model (TERM) available to local agencies. This would provide agencies with a ready-made decision support tool designed to help planners evaluate long-term transit recapitalization needs, and assess how different funding levels would impact the future condition and performance of their transit infrastructure.
- National Transit Asset Inventory: FTA is considering expanding the current National Transit Database (NTD) reporting requirements to include data on local agency asset inventory holdings and conditions. Good quality data such as this is a prerequisite to effective, long-term transit capital reinvestment analysis at the national or local level.

SECTION 6.0 - OPTIONS

Based on the analyses presented in the preceding sections, the Rail Modernization Study developed four key options that Congress and FTA may want to consider:

- Modifications to the existing Fixed Guideway Modernization fund formula;
- Implementation of a temporary funding source designed to eliminate the existing SGR backlog;
- Development of an asset management technical assistance suitable for U.S. transit operators; and,
- Development of a national transit capital asset reporting system

Each of these options is discussed below.

Fixed Guideway Funding Formula Modifications: The study determined that the current apportionment formula used to allocate Section 5309 Fixed Guideway Modernization funds tend to favor younger rail systems as well as commuter rail systems. Specifically, this formula tends to meet a higher proportion of the reinvestment needs of younger and commuter rail systems as compared to other systems. Congress should consider revisions to the Section 5309 Fixed Guideway Modernization apportionment structure. These changes should strive for a more even match between funding allocation and the capital reinvestment needs of program recipients based on differences in mode, alignment characteristics, and, to the extent possible, system age. The objective of these revisions should be to cover a roughly equal proportion of capital needs for all grantee types (i.e., with needs being higher for larger and older systems). These adjustments would not necessarily expand the size of the program, but would adjust the funding allocation to distribute funds where they are needed most. This approach would presumably preserve the local match requirements and continue the historical proportion of funding provided by state and local sources.

Temporary SGR Investment Fund: The study estimated the current SGR backlog for the seven study agencies to be roughly \$50.0 billion (\$2008). This estimate represents the level of investment required to replace all assets that are not in a state of good repair (as defined by the study) plus the cost to complete all major rehabilitation projects that are past due. The seven study agencies and the rail transit industry as a whole would benefit from the development of a temporary funding program designed to eliminate the existing SGR backlog. In practice, this temporary program could cover two or three six-year reauthorization periods (given the size of the existing backlog and the industry's capacity to accommodate additional construction on such a large scale, a single reauthorization period does not provide sufficient time to address the problem). In concept, the existing Fixed Guideway Modernization program should remain in place during this period as an independent funding source to cover the rail transit's normal replacement needs. The temporary program would then be focused entirely on reducing and eliminating the existing reinvestment backlog. For example, a temporary SGR investment program extending over a period of 12-years (two authorization cycles) would require an annual investment of approximately \$4.2 billion over the life of the program to address the investment backlog of the seven study agencies. This annual requirement drops to \$2.5 billion annually if needs are addressed over a 20-year time horizon. This approach would not necessarily have the same local match requirements as existing programs and thus all, or a larger proportion of funding might come from Federal sources. Apportionment of these funds could follow the same needs-based principles as those laid out for the modifying the Fixed Guideway Modernization apportionment formula as discussed above.

Technical Support for Asset Management: While each of the study agencies are making progress in the development and application of transit asset management programs, the study's findings tend to confirm the general observation that transit lags other sectors of the transportation industry (most notably highways) in this area. FTA should develop technical assistance programs, similar to those offered to State highway departments by the Federal Highway Administration (FHWA) to help the nation's operators develop comprehensive and effective asset management programs. Initial areas of focus should include the development and use of asset inventories (for

capital planning purposes), condition assessment monitoring systems, decision support tools, and multi-factor investment prioritization methods. The objective should be to provide technical support in the development and use of these tools and techniques but not to advocate specific solutions.

Capital Asset Reporting: This Rail Modernization Study has benefited from the availability of good quality asset inventory data for the seven study agencies. These data were provided by each of these agencies at the request of FTA. FTA's ability to repeat this analysis, either for the seven study agencies or for a broader group of operators, would greatly benefit from and be facilitated by a National Transit Capital Asset Reporting System that ensured (1) a regular asset reporting and (2) a consistent structure and level of reporting across all urban transit agencies. The availability of this data would support better-quality national needs assessments and transit asset condition monitoring than is currently possible. The National Transit Database (NTD) represents the most logical reporting mechanism for this data. Enactment of this reporting requirement would also encourage agencies to develop and maintain their own asset inventory and condition monitoring systems (potentially supported by the asset management technical support recommendation identified above).



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