2010

National State of Good Repair Assessment

Federal Transit Administration

June 2010

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TABLE OF CONTENTS

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EXECUTIVE SUMMARY

Overview

Following the April 2009 *Rail Modernization Study*, a report requested by Congress to assess the level of capital investment required to attain and maintain a state of good repair for the nation's seven largest public transportation rail systems, Transportation Secretary Ray LaHood tasked FTA with expanding the scope of the study to assess the level of investment required to bring *all* of our nation's public transportation (transit) systems into a state of good repair. The 2009 *Rail Modernization Study* had estimated the current SGR backlog for the seven rail operators to be $50 billion ($2008). The study also determined that $5.9 billion in annual reinvestment is required to avoid further expansion of that backlog.

While the seven agencies included in the 2009 *Rail Modernization Study* are responsible for a majority of the nation's transit assets (including most of the nation's oldest rail assets), the Study's findings – in particular the magnitude of the investment backlog – emphasize the need for a more comprehensive understanding of transit reinvestment needs. This 2010 *National State of Good Repair Assessment* evaluates the level of investment required to bring *all* U.S. transit assets – including the assets of all urbanized area and rural transit operators – to a state of good repair. The analysis presented here describes a current national SGR backlog of an estimated $77.7 billion ($2009). It also estimates that an annual average of $14.4 billion in normal replacement expenditures would be required to keep that backlog from getting larger.

Study Scope

The difference in scope between the Rail Modernization Study and this National SGR Assessment is that the former focused only on assets associated with the nation's seven largest rail operators. These agencies do not represent a significant share of the nation's non-rail ridership, non-rail assets (including bus, paratransit and vanpool) or total agency modes[1]. Even for rail transit they only include 51% of the nation's track miles and 74% of rail vehicles. Moreover, the Rail Modernization Study did not include the more than 1,300 agency-modes and over 20,000 vehicles owned and operated by the nation's rural transit operators (assets that *are* included in this National SGR Assessment). The scope of this National SGR Assessment includes, to the best of our knowledge, all transit assets in the United States.

Specifically, this expanded assessment considers the SGR reinvestment needs of the following:

Modes:
- Rail (heavy rail, light rail, commuter rail, automated guideway, and monorail)
- Bus and related (motor and trolley bus, demand response, and van pool)
- Joint assets (including administrative facilities and non-revenue support vehicles)

Agency Types:
- Urbanized operators (5307)
- Rural operators (5311)

Asset Types
- Guideway (track and structures)
- Facilities (admin buildings, maintenance buildings and yards)

[1] Note: "Agency-mode" represents the total number of agency-mode combinations as reported to the National Transit Database (NTD). For example, a local agency that operates each of heavy rail, motor bus and demand response is considered to operate a total of three (3) agency-modes.

- Systems (train control, traction power, communications, revenue collection)
- Stations, park and rides, and shelters
- Vehicles (revenue and non-revenue)

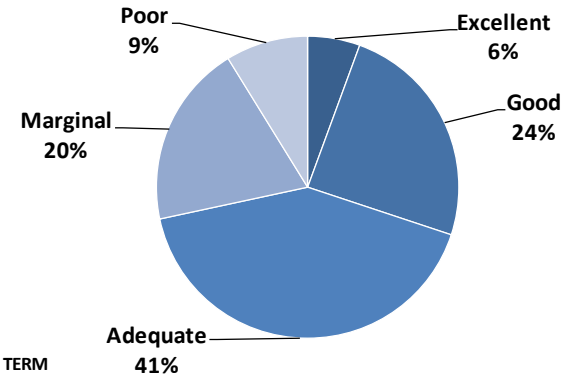
Current Asset Conditions

This study begins with a preliminary assessment of national transit reinvestment needs based solely on the physical condition of the existing stock of transit assets. A summary of this analysis, developed using FTA's Transit Economic Requirements Model (TERM) based on the asset data supplied by a large sample of urban transit agencies, is presented in **Exhibit ES-1**.

Roughly one-third of the nation's transit 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.

Exhibit ES-1

All Transit Assets



Source: TERM

Study Approach: TERM and State of Good Repair

The Transit Economic Requirements Model (TERM): As with the Rail Modernization Study, the National SGR Assessment estimates of the level of investment required to bring the nation's transit assets 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).

While the core of this study's reinvestment needs estimates are derived from TERM, the study's needs estimates have also been compared and contrasted with the unconstrained needs estimates of a sample of the nation's larger local transit agencies. Specifically, these local agency needs estimates were used as an independent check of the estimates produced by TERM and TERM's estimates have been adjusted as appropriate to better reflect the costs and asset life expectancies of the nation's transit operators. In addition, staff from many of the nation's larger agencies participated in these comparisons.

Asset Data Sample: TERM's analysis of SGR needs relies on the availability of asset inventory records for the full range of assets owned and operated for those agencies whose SGR needs are being assessed. For the Rail Modernization Study, each of the seven agencies included in the study provided a detailed listing of their current asset holdings (note: with the exception of revenue vehicles, there is, at present, no federal reporting requirement or process on local agency transit asset holdings). For this study, FTA augmented the asset data obtained for the Rail Modernization Study with asset data obtained from a sample of 36 additional rail and bus operators (the additional data were obtained primarily from the largest rail and bus agencies not included in the Rail Mod Study). Data for those agencies not included in the data requests for either this study or the Rail Mod study relied on existing asset inventory records previously provided to FTA for use in TERM[2].

[2] Much of this asset inventory data was obtained within the past five years and together with data form Rail Mod study and the new data obtained for this analysis cover the vast majority of the nation's transit assets. The asset holdings of those agencies that have never reported their asset holdings to FTA were estimated based on (1) these agencies existing fleet sizes and number of maintenance facilities (data reported

State of Good Repair (SGR): As with the Rail Modernization 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).[3] 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 National SGR Needs

The study's estimates of the current investment backlog for the nation's transit agencies and the level of investment required to address that backlog over various time periods is provided below in **Exhibit ES-2**. Assuming assets are permitted to remain in service beyond their expected useful life for a limited time (an assumption based on current agency practices), TERM estimates a current national SGR backlog of roughly $77.7 billion ($2009). Once this backlog has been addressed, an estimated annual average of $14.4 billion in normal replacement expenditures would be required to maintain that state of good repair. Alternatively, an annual investment of $18.3 billion is estimated as sufficient to attain SGR over a 20-year period while simultaneously addressing normal replacement needs (or $3.9 billion annually to address the backlog alone).

Exhibit ES-2
National SGR Backlog and Annual Normal Replacement Needs (Billions of $2009)

Mode	SGR Backlog	Average Annual Normal Replacement Needs	Annual Investment to Attain SGR over (including normal replacement): 6 Years	12 Years	20 Years	Annual Investment to Eliminate SGR Backlog over: 6 Years	12 Years	20 Years
Rail	$59.2	$8.2	$18.1	$13.2	$11.2	$9.9	$4.9	$3.0
Non-Rail	$18.4	$6.1	$9.2	$7.7	$7.1	$3.1	$1.5	$0.9
Total	**$77.7**	**$14.4**	**$27.3**	**$20.9**	**$18.3**	**$12.9**	**$6.5**	**$3.9**

Needs vs. Current Expenditures: The actual level of investment in the rehabilitation, replacement and improvement of the nation's existing transit assets was in the range of $12.0 to $13.0 billion in 2009[4]. This amount is below the $14.4 billion required to address normal replacement needs alone, suggesting the investment backlog for the nation's transit assets is increasing.

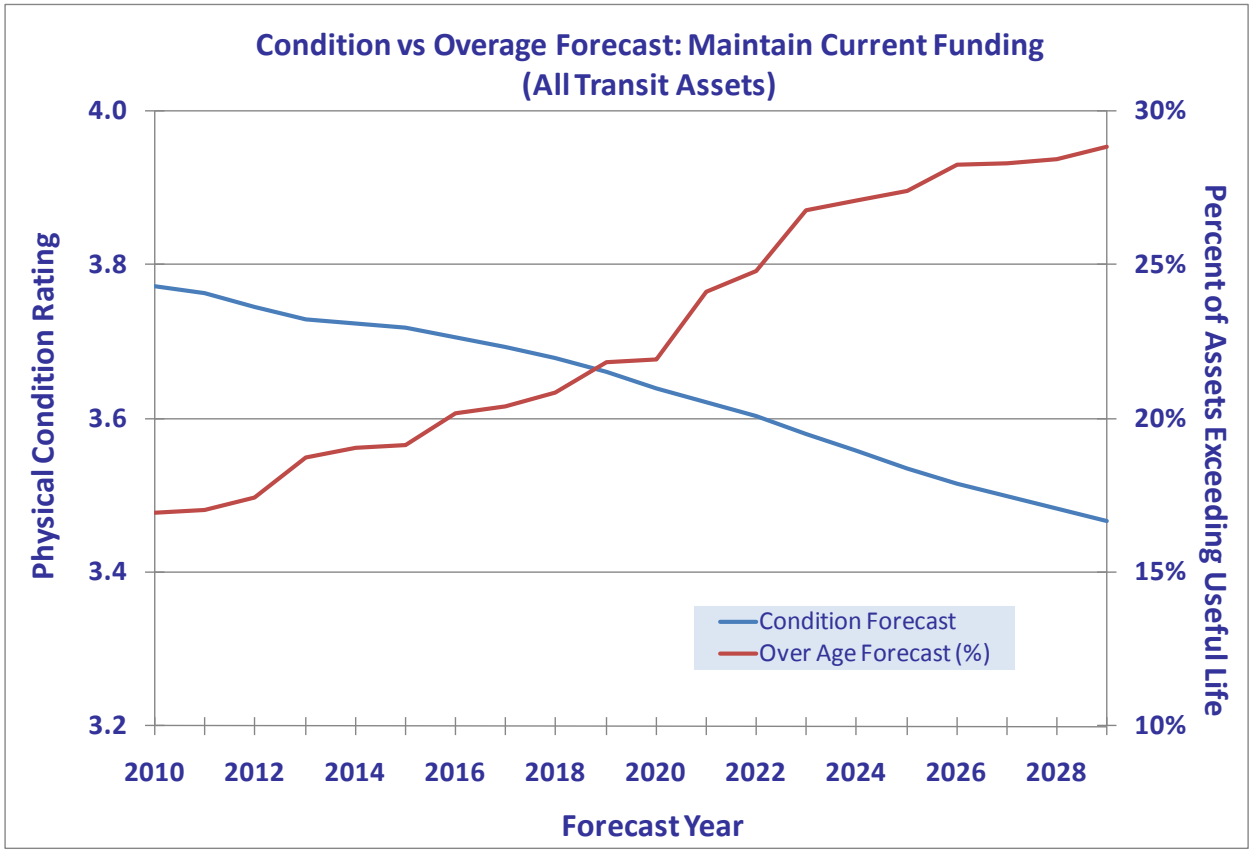
The potential consequences of maintaining the current rate of reinvestment rate are shown in **Exhibit ES-3**. This analysis suggests that continued reinvestment at current rates will result in further declines in the overall condition of the nation's transit assets (left-axis), and the proportion of assets exceeding their useful life (right-axis) will increase from the current 16 percent to more than 30 percent by 2029.

to NTD) and (2) the asset holdings, asset age distribution and asset replacement costs of comparable agencies that have reported their asset holdings to FTA.

[3] 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.

[4] Source: 2009 NTD and FTA estimates of capital expenditures on rehabilitation and replacement activities for both urban and non-urbanized transit operators.

Exhibit ES-3



Asset Management Practices of the Study Agencies

As with the Rail Modernization Study, the National SGR Assessment identified some of the current asset management practices of those agencies that were contacted either for data collection or for follow-up analysis and review of the study's preliminary needs projections. This aspect of the Study focused specifically on the methods and processes these agencies are currently using to document and assess the current condition and future replacement needs of their transit infrastructure. This analysis identified many significant differences with similar analysis completed for the Rail Mod Study:

- None of the Sampled Agencies Possess Fully Developed Capital Planning Asset Inventories: In contrast to the seven agencies included in the Rail Mod study (all of which have developed asset inventories specifically for capital planning purposes), only one of the agencies contacted for this National SGR Assessment has developed an asset inventory designed intentionally to support long-term capital planning processes. This finding suggests that while many of the nation's largest transit operators have made progress in developing such inventories and their related analytical tools, relatively few medium and smaller size agencies have completed development of such inventories.

- However, Some Agencies are Making Progress: While relatively few of these smaller agencies have completed development of such inventories, several of the agencies contacted for this study have taken their initial steps towards developing such inventories. Moreover, many that have not formally initiated such efforts, have recognized the need to do so, have discussed this issue within their organization and expressed interest in learning about how others are addressing this issue and how best to proceed.

- Differing Approaches to Inventory Development for this Study: Each of the sixteen agencies that responded to the data request for this study developed their asset inventory data submissions from one of three general types of sources. Most of these agencies obtained their asset records from the fixed asset ledgers – a data source that tends to be fairly comprehensive of total agency asset holding but which is not always well suited to assessing future capital needs. The second most useful source was prior engineering condition assessments or asset documentation maintained by individual departments within each agency (e.g., by staff responsible for specific asset types such as stations). Finally, a small number of the agencies contacted for this Study developed their capital planning asset inventories from their Computerized Maintenance Management Systems (CMMS).

As with the Rail Modernization Study, this National SGR Assessment also sought to document the transit asset management (TAM) practices of the agencies contacted for the study. This analysis focused on the same four key TAM practices considered in the Rail Mod final report. The completed scan revealed the following:

- Asset Inventory Development (capital planning): As discussed above, few agencies have completed development of capital asset inventories intended to support long-term capital needs analysis.

- Asset Condition Monitoring: At the present time, only three of the seven of the agencies included in the Rail Mod Study and three of the sixteen additional agencies contacted for this National Assessment have committed to conducting comprehensive asset condition assessments on an ongoing 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 23 agencies contacted for the Rail Mod and National SGR Assessment studies currently maintains a decision support tool permitting these types of analyses.

- Investment Prioritization: Approaches to prioritizing capital investments also vary widely. All agencies allocate 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. The observed approaches used to prioritize these differing needs include the following:

  – "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 23 agencies contacted for the Rail Mod and National SGR Assessment studies use an objective, multi-factor project scoring process to help rank and prioritize their investment needs.

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.

In April 2009, the Federal Transit Administration (FTA) completed an assessment of the level of investment required to bring the assets of the nation's seven largest rail transit agencies to a state of good repair (SGR). This assessment, published as the *Rail Modernization Study*, estimated the current SGR backlog for these seven rail operators to be roughly $50 billion. The study also determined that an additional $5.9 billion in annual reinvestment is required to avoid further expansion of that backlog.

While it is understood that the seven agencies included in the Rail Modernization Study are responsible for a majority of the nation's transit assets (including most of the nation's oldest rail assets), the Study's findings – in particular the magnitude of the investment backlog – have emphasized the need for a more comprehensive assessment of transit reinvestment needs. Towards that end this National State of Good Repair Assessment expands the scope of the earlier study to assess the level of investment required to bring all U.S. transit assets to a state of good repair.

1.2 Study Scope

The difference in scope between the Rail Modernization Study and this National SGR Assessment is outlined below in **Exhibit 1-1**. While the seven large rail operators included in the Rail Modernization Study account for a significant share of the nation's total ridership and rail assets, the nation's total stock of transit assets are operated by a much broader and more diverse group of transit operators, all of which are represented in this National SGR Assessment[5]. Moreover, note that comparison provided in Exhibit 1-1 does not include the more than 1,300 agency-modes and the over 20,000 buses and vans owned and operated by the nation's rural transit operators (assets also included in this National SGR Assessment).

Specifically, this expanded assessment considers the SGR reinvestment needs of the following:

Modes:
- Rail (heavy rail, light rail, commuter rail, automated guideway AGT, monorail)
- Bus and related (motor and trolley bus, demand response, and van pool)
- Joint assets (including administrative facilities and non-revenue support vehicles)

Agency Types:
- Urbanized operators (5307)
- Rural operators (5311)

Asset Types
- Guideway (track and structures)
- Facilities (admin buildings, maintenance buildings and yards)
- Systems (train control, traction power, communications, revenue collection)

[5] Note: "Agency-mode" represents the total number of agency-mode combinations as reported to the National Transit Database (NTD). For example, a local agency that operates each of heavy rail, motor bus and demand response is considered to operate a total of three (3) agency-modes.

- Stations, park and rides, and shelters
- Vehicles (revenue and non-revenue)

Exhibit 1-1
Scope Comparison of Rail Modernization and National SGR Assessment: Urbanized Operators*

Modes	Annual Boardings (Millions)	Track Miles	Passenger Stations	Fleet Vehicles	Maintenance Facilities	Agency Modes
RAIL MODERNIZATION STUDY						
Rail	3,006	6,049	1,726	14,629	109	14
Non-Rail	1,810	0	0	12,025	142	12
TOTAL	4,816	6,049	1,726	26,654	251	26
NATIONAL SGR ASSESSMENT						
Rail	3,849	11,796	3,095	19,826	211	73
Non-Rail	5,581	0	1,313	92,119	1,280	1,179
TOTAL	9,430	11,796	4,408	111,945	1,491	1,252
INCREASE IN COVERAGE						
Rail	843	5,747	1,369	5,197	102	59
Non-Rail	3,771	0	1,313	80,094	1,138	1,167
TOTAL	4,614	5,747	2,682	85,291	1,240	1,226
% INCLUDED IN RAIL MODERNIZATION STUDY						
Rail	78%	51%	56%	74%	52%	19%
Non-Rail	32%	na	0%	13%	11%	1%
TOTAL	51%	51%	39%	24%	17%	2%

*Excludes rural agencies which account for more than 1,300 agency-modes and over 20,000 vehicles

1.3 Study Approach: TERM and State of Good Repair

The Transit Economic Requirements Model (TERM): As with the Rail Modernization Study, the National SGR Assessment estimates of the level of investment required to bring the nation's transit assets 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).

While the core of this study's reinvestment needs estimates are derived from TERM, the study's needs estimates have also been compared and contrasted with the unconstrained needs estimates of a sample of the nation's larger local transit agencies. Specifically, these local agency needs estimates were used as an independent check of the estimates produced by TERM and TERM's estimates have been adjusted as appropriate to better reflect the costs and asset life expectancies of the nation's transit operators. In addition, staff from many of the nation's larger agencies participated in these comparisons.

State of Good Repair (SGR): As with the Rail Modernization 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).[6] Similarly, an entire transit system would be in a state of good repair if all of

[6] 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.

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.

1.3 Primary Data Collection

TERM's analysis of SGR needs relies on the availability of asset inventory records for the full range of assets owned and operated for those agencies whose SGR needs are being assessed by the model. For the Rail Modernization Study, each of the seven agencies included in that study provided a detailed listing of their current asset holdings (note: with the exception of revenue vehicles, there is, at present, no federal reporting requirement on local agency transit asset holdings). For this study, FTA augmented the asset data obtained for the Rail Modernization Study with asset data obtained from a sample of 36 additional rail and bus operators – including 16 agencies that responded to a direct data request for this study as well as data for an additional 20 agencies that were obtained as part of TERM's ongoing data update. These additional data were obtained primarily from the largest rail and bus agencies not included in the Rail Mod Study. Data for those agencies not included in the data requests for either this study or the Rail Mod study relied on existing asset inventory records previously provided to FTA for use in TERM[8].

The names and characteristics of the agencies for which data were requested specifically for this study and for the Rail Mod Study are identified in **Exhibit 1-2**[9].

Exhibit 1-2
Agencies Providing Asset Inventory Data to the Rail Modernization and National SGR Assessment Studies

Study Agency	Modes[7]
RAIL MODERNIZATION AGENCIES	
New York City Transit (MTA NYCT)	HR, MB, DR
MTA Long Island Railroad (MTA LIRR)	CR
Metro-North Railroad (MTA MNCR)	CR, MB, FB
Washington Metropolitan Area Transit Authority (WMATA)	HR, MB, DR
Massachusetts Bay Transportation Authority (MBTA)	CR,DR, HR, LR, MB, FB
Chicago Transit Authority (CTA)	HR, MB
Southeastern Pennsylvania Transportation Authority (SEPTA)	CR, DR, HR, LR, MB
San Francisco Bay Area Rapid Transit District (BART)	HR
New Jersey Transit Corporation (NJ TRANSIT)	CR, DR, LR, MB
AGENCIES ADDED FOR NATIONAL SGR ASSESSMENT	
Los Angeles MTA	DR, HR, LR, MB
San Diego Metropolitan Transportation System	DR, LR, MB
Metropolitan Atlanta Regional Transportation Authority (MARTA)	DR, HR, MB
Portland TriMet	DR, LR, MB
Denver Regional Transportation District	DR, LR, MB
Utah Transportation Authority	CR, DR, LR, MB
Houston Metro	DR, LR, MB
King County DOT (Seattle)	DR, LR, MB
Minneapolis Metro	CR, DR, LR, MB
MetroLink (SCRRA)	CR
St. Louis Metro	DR, LR, MB
Miami Dade Transit Authority	DR, HR, MB
Port Authority of Allegheny County (Pittsburgh)	DR, LR, MB
Port Authority TransHudson Corporation	FB, HR

[7] HR: Heavy Rail, LR: Light Rail, CR: Commuter Rail, MB: Motorbus, DR: Demand Response, FB: Ferry Boat

[8] Much of this asset inventory data was obtained within the past five years and together with data form Rail Mod study and the new data obtained for this analysis cover the vast majority of the nation's transit assets. The asset holdings of those agencies that have never reported their asset holdings to FTA were estimated based on (1) these agencies existing fleet sizes and number of maintenance facilities (data reported to NTD) and (2) the asset holdings, asset age distribution and asset replacement costs of comparable agencies that have reported their asset holdings to FTA.

[9] The New York Metropolitan Transportation Authority (MTA) submitted data to the Rail Modernization Study for three systems listed here. Two systems that submitted data for the National Assessment asked to remain anonymous.

1.4 Current Conditions

A key motivation for the Rail Modernization and National SGR Assessment studies is the concern that a significant proportion of the nation's transit assets are in need of capital reinvestment. Analysis of the nation's transit assets using FTA's Transit Economic Requirements Model (TERM) tends to support this position. 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**.

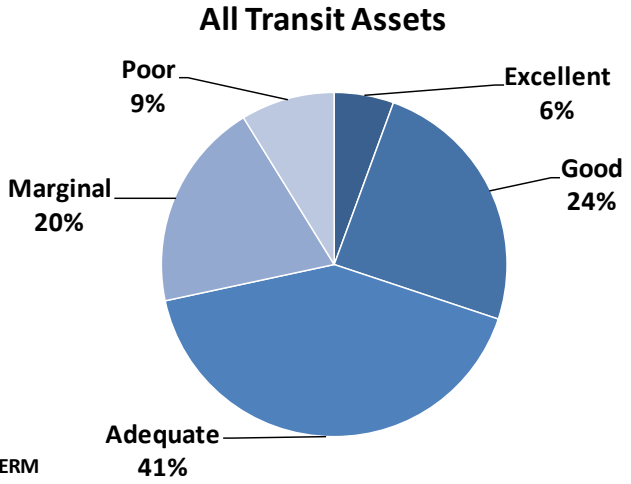
Exhibit 1-3
TERM Condition Rating Scale

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)

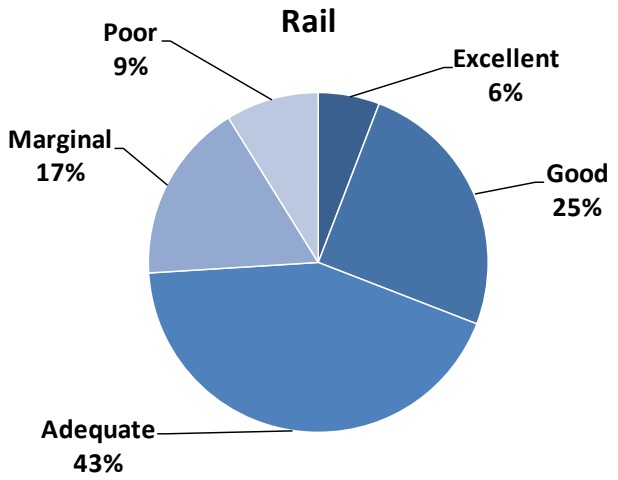
Exhibit 1-4 below presents TERM's assessment of the physical condition of the nation's transit assets, in total and for bus and rail modes. This analysis shows that between a quarter and a third of these assets are in marginal or poor condition, and that bus assets have the largest proportion in poor and marginal condition (41%).

Similarly, **Exhibit 1-5** presents the distribution of asset conditions for the nation's transit assets 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 national investment (replacement value in $2008) in each of the five asset categories. This exhibit suggests that guideway elements (almost entirely supporting rail modes) represent a large portion of the assets in marginal and poor condition, and also represent a large share of the national investment in transit infrastructure.

Exhibit 1-4
National Transit Conditions: In Total and Bus Vs Rail



Source: TERM



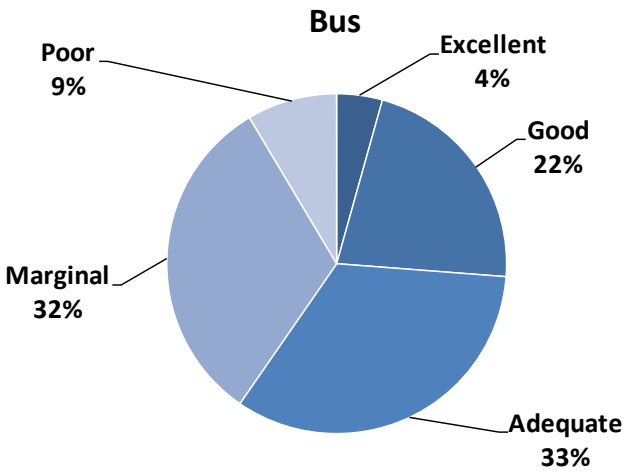
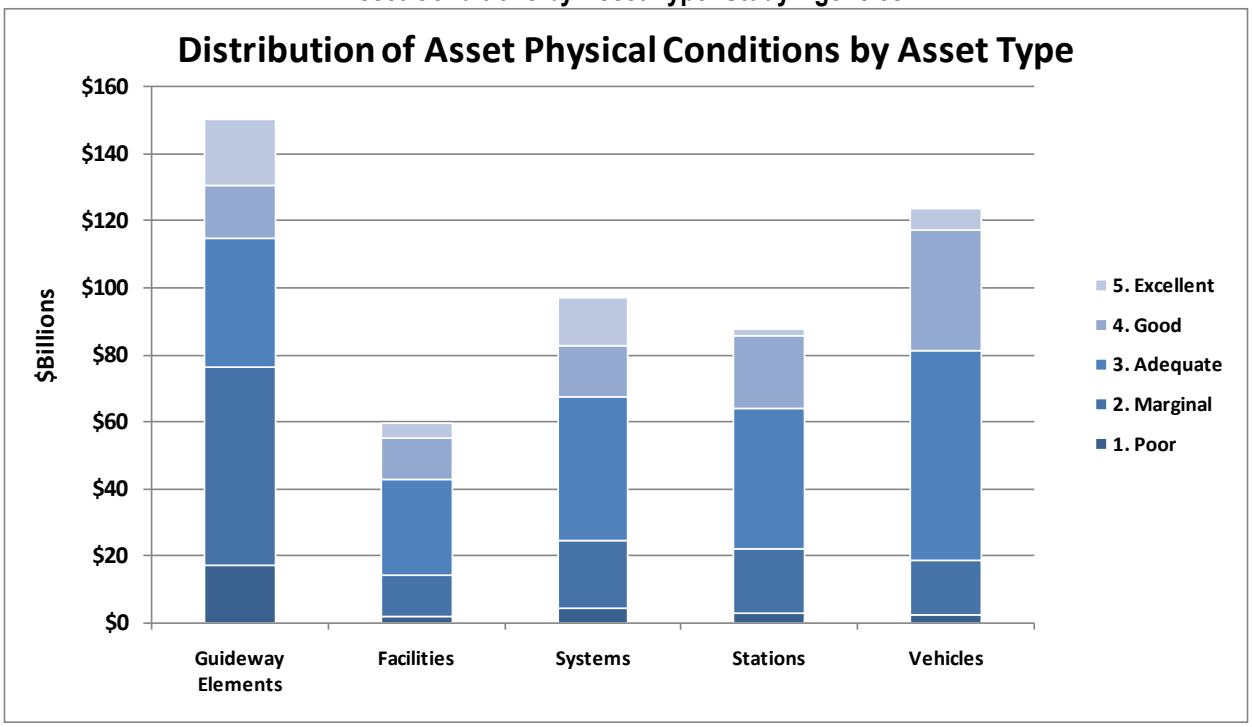


Exhibit 1-5
Asset Conditions by Asset Type: Study Agencies



1.5 Other SGR Initiatives

This National SGR Assessment represents one of a number of FTA's efforts to better understand and focus attention on transit infrastructure renewal. 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 it be measured?
- 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 outstanding SGR needs?
- How can and should the Federal government help achieve SGR?

Other FTA initiatives that address these challenges include the following:

- **SGR Roundtable:** From July 8 to 10, 2009, the Washington Metropolitan Area Transit Authority and the Federal Transit Administration co-hosted the First State of Good Repair (SGR) Roundtable with representatives from 30 transit agencies from around the United States. The SGR Roundtable provided a forum for transit properties to discuss and share best practices on addressing issues associated with SGR, transit asset management, and the relationship between capital asset condition and safety. FTA intends to hold additional SGR Roundtables in the future.
- **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. This workshop is documented in *Transit State of Good Repair Beginning the Dialogue* (October 2008, posted at www.fta.dot.gov/documents/SGR.pdf.)

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- **FTA SGR Working Group:** FTA has established an internal working group that meets regularly to consider SGR-related issues and potential initiatives.
- **FTA Discretionary Bus and Bus Facilities Program:** On May 4, 2010, FTA announced the availability of discretionary Section 5309 Bus and Bus Facilities grant funds in support of its ''State of Good Repair'' initiative. The State of Good Repair (SGR) Bus initiative will be funded with up to $775 million in unallocated Fiscal Year (FY) 2010 discretionary Bus and Bus Facilities Program funds. The SGR Bus initiative will make funds available to public transit providers to finance capital projects to replace, rehabilitate, and purchase buses and related equipment and to construct/ rehabilitate bus-related facilities

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 investment required to bring the Nation's rail transit assets to a state of good repair and presents the assumptions and analysis methods used to develop those estimates. This section also presents forecasts of future transit asset conditions assuming funding levels remain at current levels. Section 3 provides an overview of the asset management processes used by the agencies contacted for the Rail Modernization and National SGR Assessment Studies, with particular emphasis on the methods used to develop the asset inventories provided for these studies.

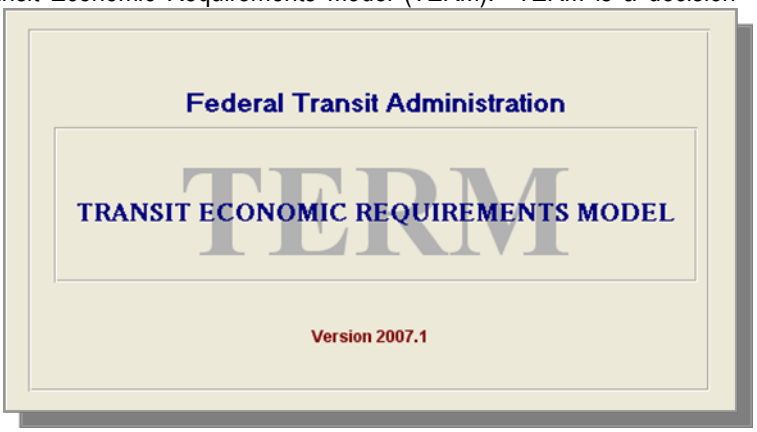
SECTION 2.0 - COST TO BRING TRANSIT TO A STATE OF GOOD REPAIR

This section considers the level of investment required to bring the capital assets of the nation's urban and rural transit agencies to a state of good repair. In addition, the section also describes the approach used to develop these estimates, including the underlying data sources, 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 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

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

The study estimates of the level of investment required to bring the nation's transit 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).



Since 1995 the TERM 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 compared to the unconstrained needs estimates of agencies that provided data for this study to ensure their reliability. The ongoing process of testing and review provides confidence in TERM's ability to reliably assess transit investment needs on a national scale.

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

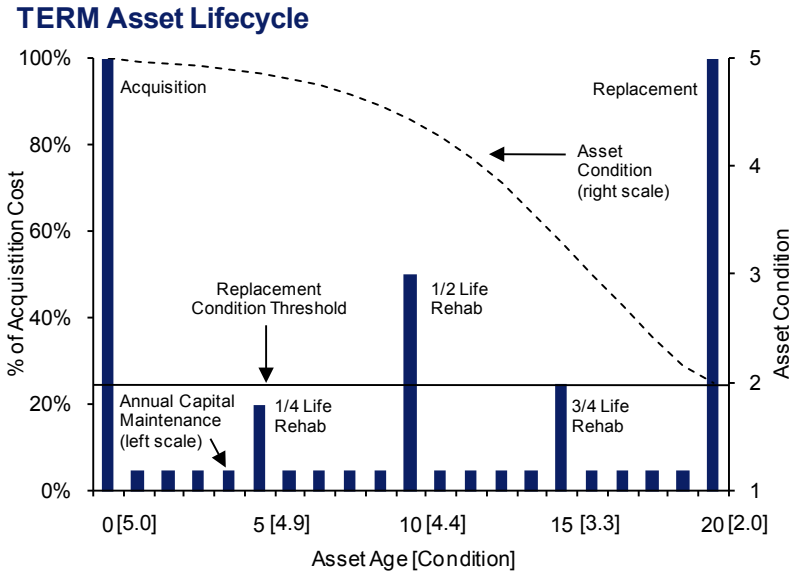
- **Constructability Constraints:** Some agencies construct financially-unconstrained needs estimates, but impose practical "constructability" constraints to reflect how the agency could realistically increase its capital program dramatically given available construction, labor, scheduling and program management considerations. This study's estimates are "purely" unconstrained.

- **Differing Time Horizons:** Finally, the nine 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 internal needs estimates of individual agencies would necessarily involve adding "apples to oranges" and would not yield an accurate assessment of the total SGR needs for these agencies or a good base for extrapolation.

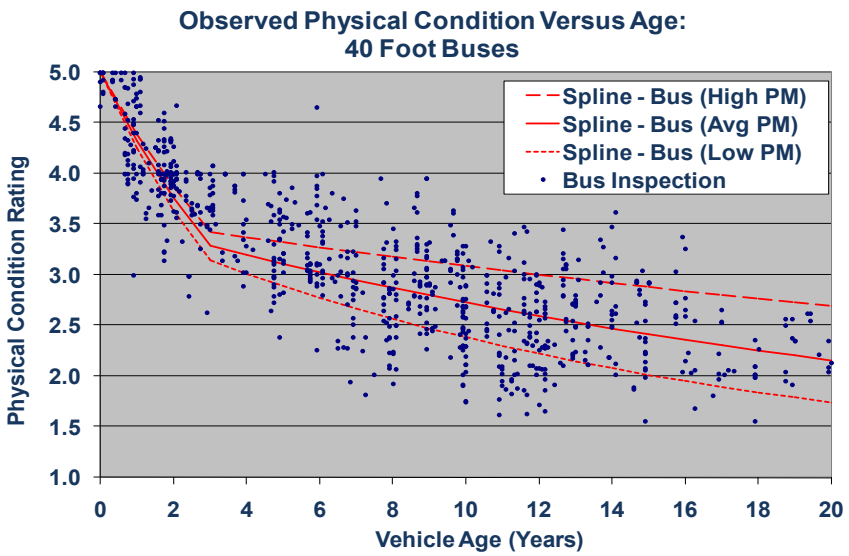
TERM's Rehabilitation and Replacement Module: Estimates of long-term capital replacement needs are generated by TERM's "Rehabilitation and Replacement Module". This module begins with an inventory of the total capital asset holdings at each agency and simulates the future replacement and rehabilitation 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 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 20 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 2-1**.

Exhibit 2-1



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 2-2** (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 2-2 (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.

Exhibit 2-2



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 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 can be expected to impact the physical conditions of transit assets.

Study Agency Input: While TERM's estimates form the core of this study's evaluation of transit capital reinvestment needs, the study also reviewed internal, financially-unconstrained estimates of capital reinvestment needs for many of the agencies that provided data for the study. 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.

2.2 Agency Asset Inventories

This study obtained and processed individual asset inventories for the 43[10] agencies which provided them for use in TERM, and hence reflects the most recent native data available for the nation's largest transit 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

[10] 7 Rail Mod agencies, 16 responses to data for this study, and 20 other new agency data submissions

requested, and these 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 the inventories provided by the study agencies is provided in **Exhibit 2-3**.

The quality of the asset inventories submitted by some of the study agencies was very good, mostly because those inventories have been developed expressly for agency capital planning purposes. 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 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.

Exhibit 2-3
Truncated Listing of Asset Types Recognized by TERM

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	-

2.3 Cost Assumptions and Issues

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

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
- 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 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 an 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 2009 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 – was unusually high in recent years (at least up to the start of the current economic recession). 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 again contribute to 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 use 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.

2.4 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.

2.5 Investment to Bring Transit Agencies to SGR

This subsection presents the study's estimates of the level of investment required to bring the nation's transit agencies to a state of good repair. This SGR needs analysis also distinguishes between two types of rehabilitation and replacement needs:

- **SGR Backlog:** This is the level of investment required for:
  - Immediate replacement of all assets whose condition falls below the minimum threshold of 2.50, or which currently exceed their useful life
  - 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, few agencies have 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 nation's existing transit assets to a state of good repair are presented in **Exhibits 2-4** and **2-5**. 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 national SGR backlog of roughly $77.7 billion ($2009). In other words, a "lump sum" investment of roughly $77.7 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 $14.4 billion would be required to maintain that state of good repair thereafter. As noted above, these SGR needs estimates do not include any capital needs relating to expansion and core capacity needs.

Exhibit 2-4

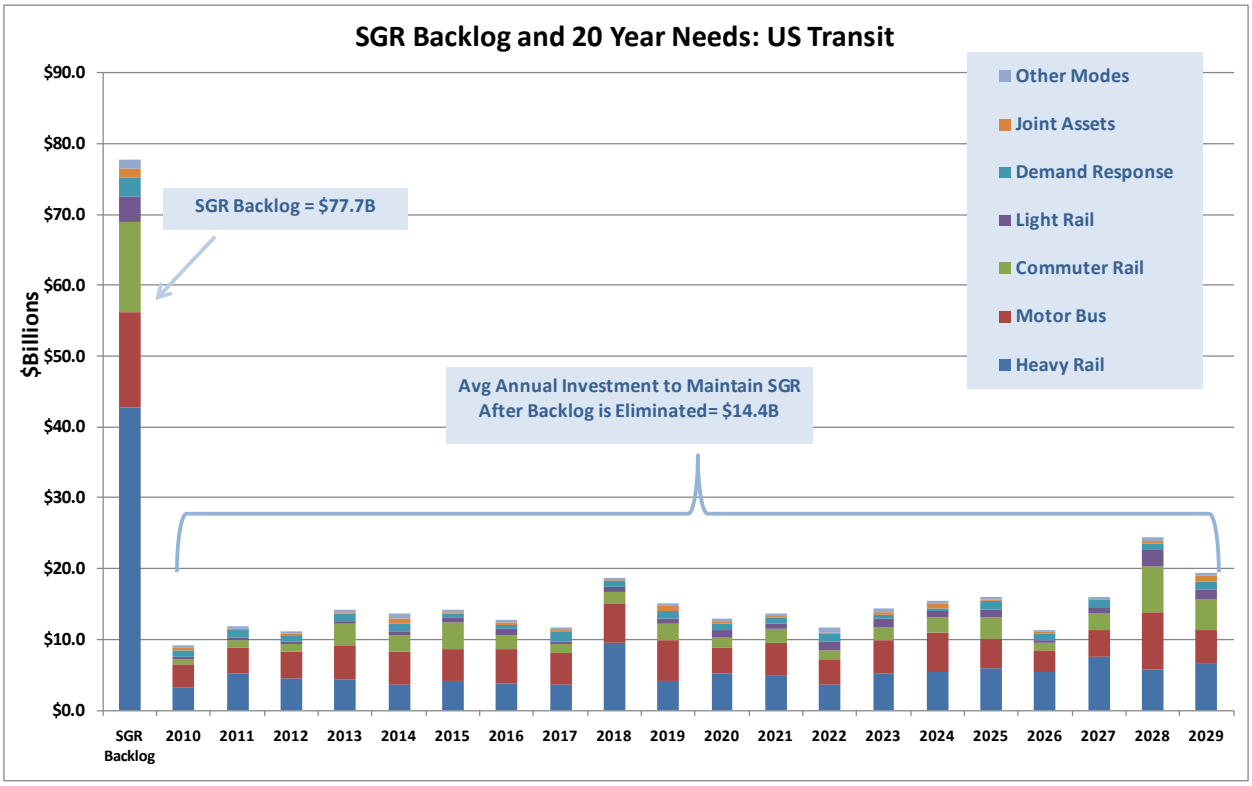
National SGR Needs (Billions of $2009): Replacement Condition = 2.50

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	$42.7	$5.1	$12.2	$8.7	$7.3	$7.1	$3.6	$2.1
Motor Bus	$13.5	$4.5	$6.8	$5.7	$5.2	$2.3	$1.1	$0.7
Commuter Rail	$12.6	$2.2	$4.4	$3.3	$2.9	$2.1	$1.1	$0.6
Light Rail	$3.6	$0.8	$1.4	$1.1	$1.0	$0.6	$0.3	$0.2
Demand Response	$2.8	$0.9	$1.4	$1.2	$1.1	$0.5	$0.2	$0.1
Joint Assets	$1.3	$0.3	$0.6	$0.5	$0.4	$0.2	$0.1	$0.1
Other Modes	$1.1	$0.4	$0.6	$0.5	$0.4	$0.2	$0.1	$0.1
Total	**$77.7**	**$14.4**	**$27.3**	**$20.9**	**$18.3**	**$12.9**	**$6.5**	**$3.9**

The current SGR backlog and NR needs (as presented in the leftmost columns of Exhibit 2-4 and in Exhibit 2-5) 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 2-4 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 SGR 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 $27.3 billion (including normal

replacement needs and assuming replacement of assets in condition 2.50 and lower), of which $12.9 billion annually would address the backlog alone. Similarly, the level of average annual investment is $20.9 billion to attain SGR over a 12-year time horizon ($6.5 billion in addition to NR) and $18.3 billion to attain SGR over a 20-year time horizon ($3.9 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 2008 was one the order of $12.0 billion to $13.0 billion for the transit industry as a whole.

Exhibit 2-5



Exhibits 2-4 and 2-5 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 bus and commuter rail. The investment needs for light rail are significantly lower, reflecting the relatively young age of light rail assets. The joint assets "mode" represents investments in assets that service multiple modes within multi-modal transit agencies, such as administrative facilities, non-revenue vehicles and some types of communications systems. Finally, the "other" modes include a range of modes that together represent a relatively small share of SGR investment needs and include ferries, van pool, ATG, monorail and inclined planes.

2.6 Constrained Funding Analysis

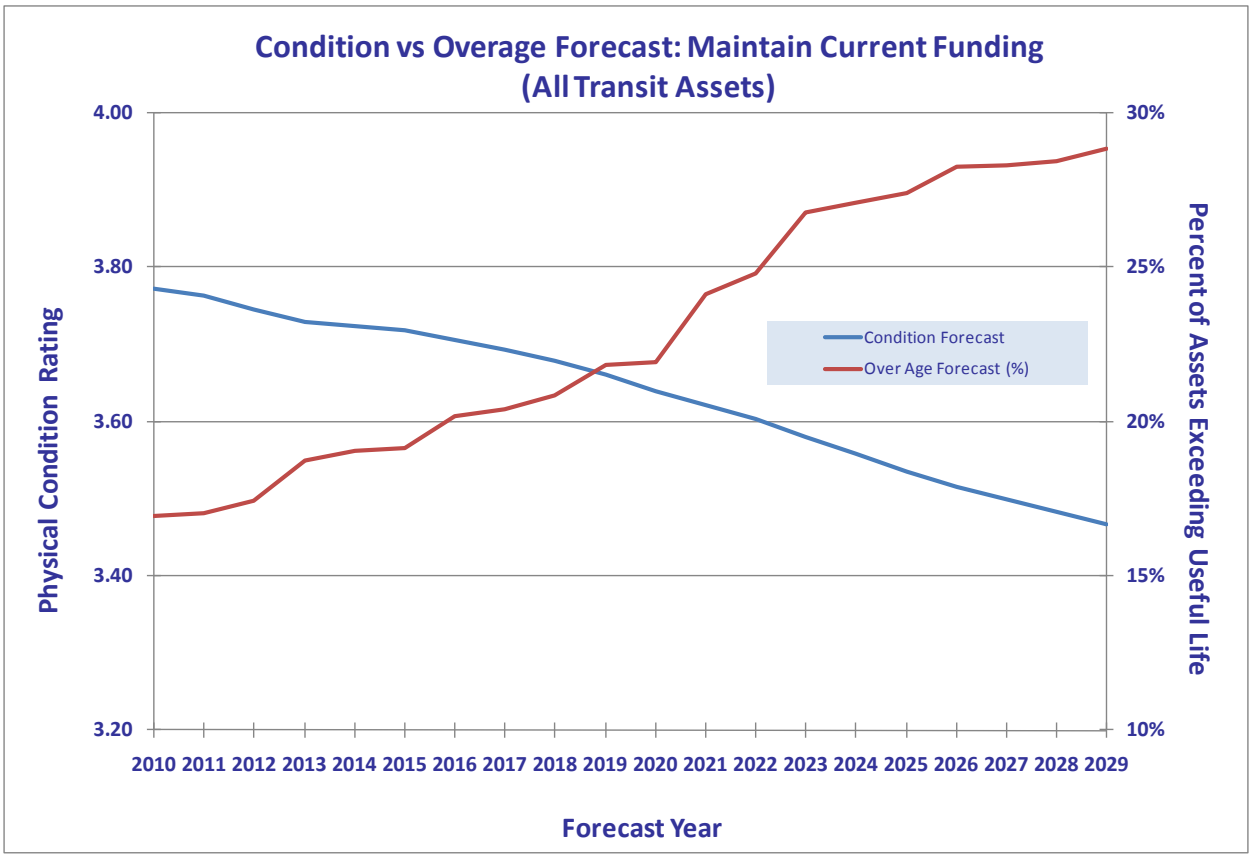
In 2006, the nation's urbanized and rural transit operators invested between $12.0 billion and $13.0 billion to rehabilitate, replace, and improve their existing asset holdings, less than the estimated $14.4 billion ($2009) required to address normal replacement needs alone (see Exhibit 2-4). This subsection 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 national transit asset conditions should future funding levels remain *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: To help address this question, **Exhibit 2-6** presents TERM's a forecast of both the resulting decline in overall transit asset conditions (left-axis) and the related increase in the proportion of assets exceeding their useful life (right-axis) over the next 20 years should funding remain at roughly current levels. The overall condition rating presented in Exhibit 2-6 represents a measure of the average condition of all transit assets weighted by replacement value.[11] Assuming local agencies maintain their current rate of reinvestment over the next 20 years, TERM estimates that the overall condition of the nation's transit assets will decline from their current value of 3.78 to roughly 3.44 by 2029, which represents a significant decline in overall asset conditions. To help place this decline in perspective, Exhibit 2-6 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 17 percent to close to 30 percent by 2029.

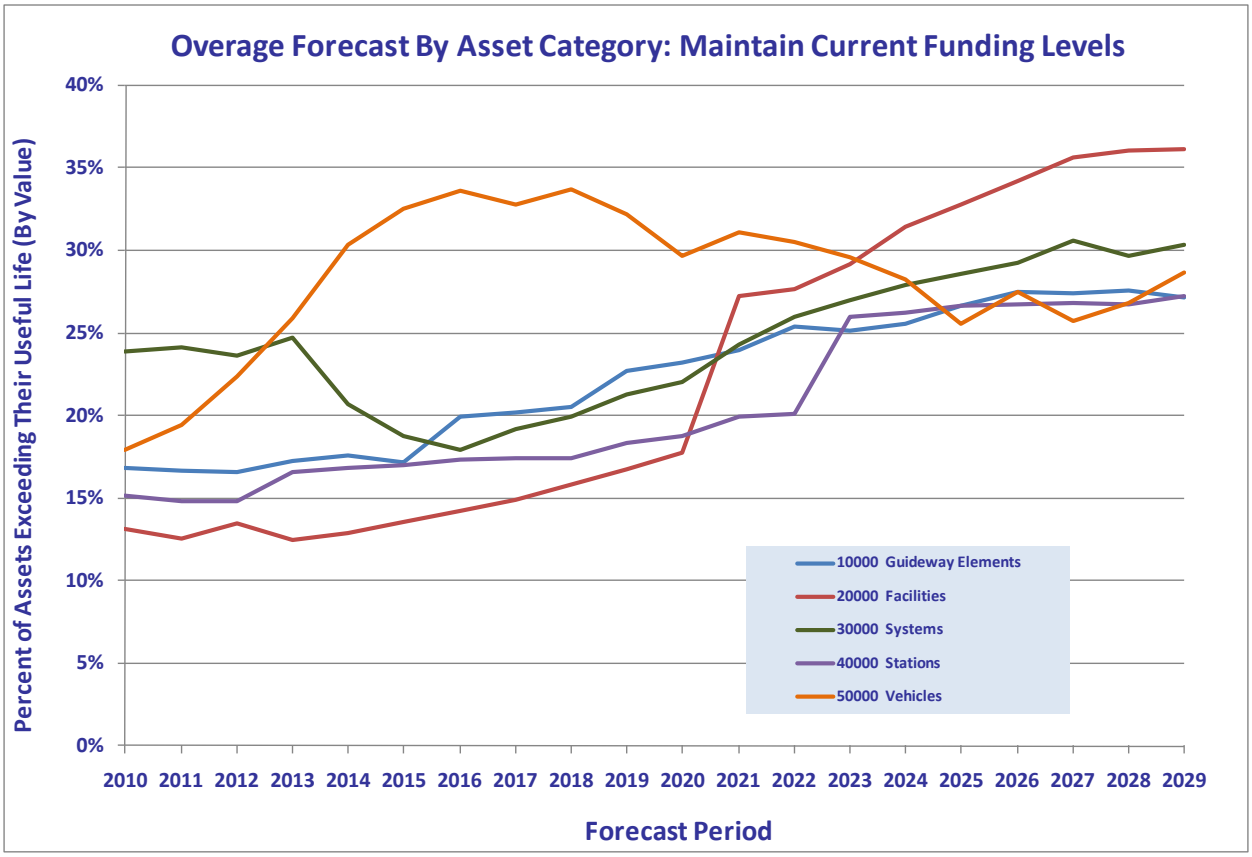
Exhibit 2-6



[11] 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 2-6**). 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.

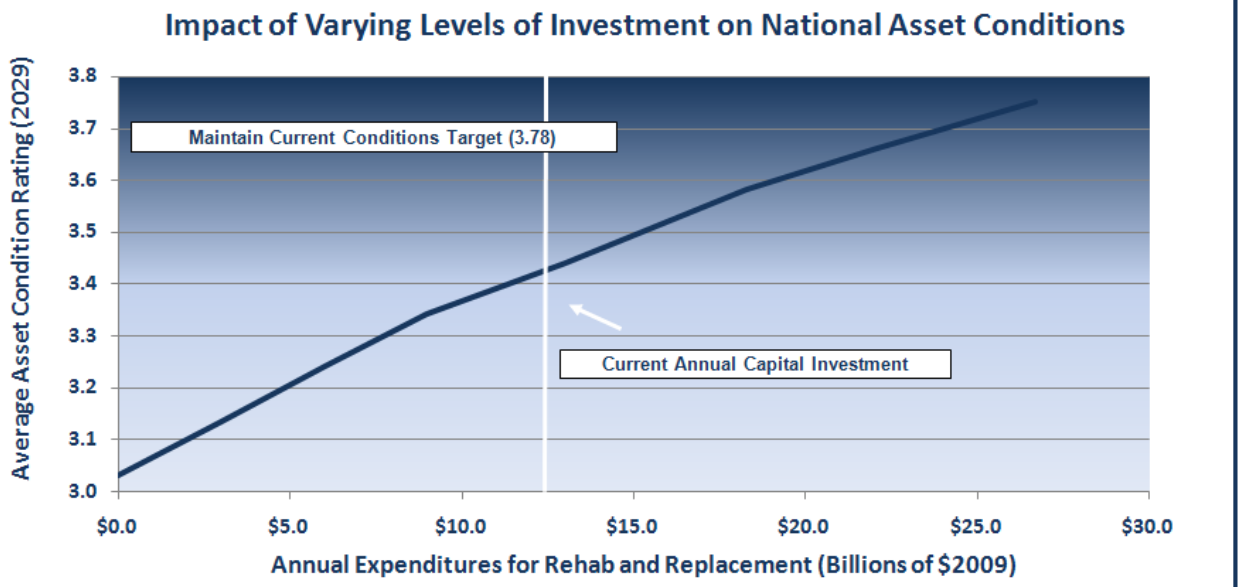
Exhibit 2-7 reproduces the estimate of the proportion of assets expected to remain in service past their expected useful life should funding levels remain unchanged over the next 20 years, now segmented by asset type. This projection, which assumes that assets in lowest condition receive the highest 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 next 20 years should funding remain at current levels. Moreover, even if 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 2-7



Impact of Varying Levels of Investment on Asset Conditions: The analysis above suggests that annual average investment on the order of $18.3 billion is required for the nation's urban and rural agencies to attain SGR over the next 20 years while continuation of current annual reinvestment rates is projected to result in a decline in overall asset conditions. What then is the relationship between asset conditions and the overall rate of reinvestment in general? **Exhibit 2-8** considers this question over annual investment levels ranging from zero investment dollars to more than $25.0 billion. Specifically, Exhibit 2-8 presents the estimated average condition of the nation's transit assets (by asset category and for all asset types combined) in the year 2029 assuming differing levels of annual investment on rehabilitation and replacement. This includes the estimated $18.3 billion required to attain a state of good repair in 20 years assuming asset replacement at condition 2.50. Similarly, the $26.7 billion annual investment amount represents the investment level required to reach SGR by 2029 assuming replacement at condition 3.00. Exhibit 2-8 suggests that continuation of the current reinvestment at current rate would result in asset conditions well below that achieved by the estimated $18.3 billion annual investment required to eliminate the existing backlog and address normal replacement needs.

Exhibit 2-8



Percent Change vs. Baseline	Average Annual Investment ($M)	Average Transit Conditions in 2029						Funding Level Description
		Asset Categories					All Transit Assets	
		Guideway	Facilities	Systems	Stations	Vehicles		
105.4%	$26.7	3.72	3.89	3.76	3.78	3.66	3.75	Replace at condition 3.00
70.0%	$22.1	3.69	3.53	3.64	3.76	3.50	3.66	Replace at condition 2.75
40.8%	$18.3	3.62	3.16	3.56	3.75	3.43	3.58	Replace at condition 2.5
0.0%	$13.0	3.54	2.74	3.45	3.73	3.25	3.44	Current Expenditures: $13B
-30.8%	9.00	3.46	2.72	3.28	3.72	2.87	3.34	Constrained to $9B
-53.8%	$6.0	3.37	2.70	3.11	3.71	2.48	3.24	Constrained to $6B
-76.9%	$3.0	3.24	2.65	2.85	3.68	2.37	3.14	Constrained to $3B
-100%	$0.0	3.11	2.59	2.59	3.65	2.25	3.03	Constrained to $0B

SECTION 3.0 – TRANSIT ASSET MANAGEMENT PRACTICES

In addition to assessing national level SGR investment needs, the National SGR Assessment also documented the asset management practices of the 23 agencies that provided "capital planning asset inventory" inventory data in support of both this study and the earlier Rail Modernization Study. This aspect of the study focused primarily on documenting the methods and internal data sources used to develop these asset inventory listings but also worked to document whether and how this information is being used by the agencies themselves for the purposes of long-term capital planning. The discussion below first describes what is meant by a "capital planning asset inventory" and then goes on to identify the data sources and methodologies used by the 23 agencies that provided asset inventory information for this study and the earlier Rail Modernization Study.

3.1 What is a Capital Planning 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 sometimes in spreadsheets) and can be used as input to decision support models and other capital needs evaluation processes.

Sources of Capital Planning Asset Inventory Data: At present, there is no industry standard or preferred method for obtaining and recording asset inventory data for capital planning purposes. Rather, there appear to be as many approaches to addressing this issue as there are agencies that have considered the problem. However, even with this broad array of approaches, there do appear to be three primary sources agencies have used to obtain this data (**Exhibit 3-1**):

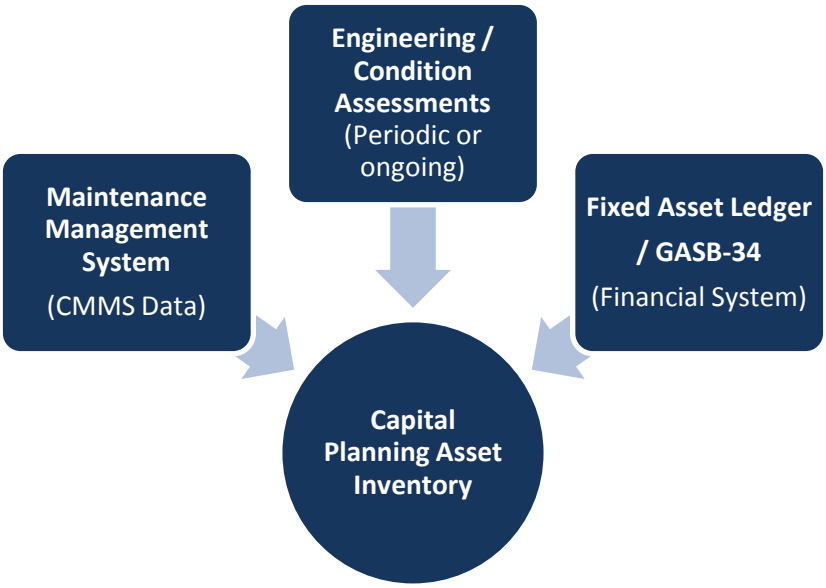
- Condition Assessments (ongoing or periodic)
- Fixed Asset Ledgers
- Computerized Maintenance Management Systems (CMMS)

The pros and cons of each of these sources are considered below. Note that while these three approaches have been used for initial inventory development, the completed inventory may be maintained as an independent data source.

Condition Assessments: A comprehensive condition assessment provides a transit property with a detailed listing of that agency's current asset holdings as well an engineering assessment of the current condition of each asset and potentially each asset's expected remaining useful life. In contrast to the other data sources considered here, condition assessment records are generally reported at level of detail that is appropriate for long-term capital planning (i.e., less detailed than provided by CMMS systems) and yet sufficiently disaggregated such that assets with significantly different life-cycle properties are segmented from one another (unlike fixed asset ledger data, which tends to be oriented to grouped contract expenditures and not individual assets). The disadvantage of condition

assessments is their expense (each asset must be identified and at least a representative sample must be inspected) and the need to repeat the condition assessment on a periodic basis. Note that most of the nine large rail agencies that provided data to the Rail Modernization Study obtained this information from data they already maintained in pre-existing asset condition (or related) asset listings.

Exhibit 3-1
Potential Sources of Data for Capital Planning Asset Inventory Development



Fixed Asset Ledgers: Fixed asset ledgers are accounting tools designed for financial reporting on capital assets (e.g., depreciated value). The value of these sources for development of a capital planning asset inventory is that they record all capital assets and frequently (though not always) are structured to group assets into logical, related categories (e.g., revenue and non-revenue vehicles, structures, etc.). This source is also designed to track both new asset purchases and eventual asset retirement. Beyond these strengths, this source also suffers from many deficiencies from the viewpoint of long-term capital planning (all of which could be addressed in principle). First, this source tends to record the cost of financial transactions (e.g., acquisition of a new rail segment) that frequently group multiple assets with differing life-cycle attributes into a single "asset" record (including assets with differing expected lives and differing timing and costs of rehabilitation and replacement events). In addition, this source also records many assets that do not require eventual "replacement" (e.g., land, capitalized soft-costs, and past refurbishment costs). Note, however, that each of these concerns could potentially be addressed if the asset records where appropriately tagged within the fixed asset ledger. While it is not clear that any U.S. transit agencies have structured their ledgers to address these issues, GASB 34 does allow transportation agencies to adopt this type of approach with the specific objective in mind. GASB 34, which also includes provisions that tie asset financial information to asset physical conditions (information not otherwise included in fixed asset ledgers), is discussed in detail below as a case study. Finally, a comparison summary of the differences between of fixed asset ledgers and a true capital planning asset inventory are presented in **Exhibit 3-2** below. Most the sixteen agencies that provided asset data for the National SGR Assessment obtained this data by running reports out of their fixed asset ledgers (none of these agencies obtained this information from a capital planning related asset inventory).

Exhibit 3-2
Differences between Fixed Asset Ledgers and Capital Asset Inventories

Characteristics	Fixed Asset Ledger	Capital Asset Inventory
Purpose	Calculating depreciation for accounting purposes	Capital planning and asset management
Typical Records	Purchase contracts, past projects	Pieces of equipment to be maintained and replaced
Records aggregated by:	Date purchased	Asset type, useful life, and date purchased
Basis for Useful Life	Accounting schedules	Engineering assessments
Appropriate for Estimating Long-Term SGR Needs?	No	Yes

CMMS: Finally, agencies can obtain data on their asset holdings from their computerized maintenance management systems (CMMS) or related systems. CMMS systems are designed to record past maintenance activities and current and future maintenance needs for agency asset holdings (e.g., fleet vehicles). As with asset ledgers, these systems offer the advantage that they are updated regularly (as agency staff schedule and perform maintenance activities). At the same time, CMMS systems suffer as a potential source of long-term capital planning asset inventory data as they are (1) rarely if ever record all agency asset holdings (frequently they only record fleet vehicle and maintenance facility assets) and (2) CMMS system usually record asset holdings at a very fine (i.e., disaggregated) level of detail. Only one of the agencies contacted for either the Rail Modernization or National SGR Assessment study data samples provided data obtained from a CMMS system. Moreover, two additional agencies that did submit data for these studies did attempt to develop asset listings from their CMMS systems but eventually dropped this approach for the reasons identified above (i.e., not comprehensive of all asset types and a high level of asset disaggregation for those assets that were documented in their CMMS).

Case Study – GASB Statement 34 and Transit Asset Management

Why is GASB-34 of Potential Interest to Transit Operators?
This report identifies a number of approaches transit agencies might consider using for the development of asset inventories suitable for analysis of long-term capital needs. This case study provides background on one of those options, "GASB Statement 34". Though primarily intended as a means of improved financial reporting for assets held by public agencies, the "modified" approach to GASB 34 calls for the development and maintenance of both (1) fixed asset accounting data based on life-cycle principals and (2) tracking and recording of asset physical conditions over time within this same fixed asset database (an activity requiring the coordination of both accounting and engineering staff activities). Together, the asset age, type and condition data contained in databases developed using the modified approach to GASB 34 thereby can provide good quality data critical for long-term capital needs analysis in a database that is both comprehensive of all asset types and actively maintained by both financial accounting and agency engineering staff.

GASB – 34 and State DOTs
As of 2003, all of the Nation's state transportation departments use GASB-34. Moreover, 22 of the 50 state DOT's employ some version of the "modified" approach to GASB-34 (see below for a description of the depreciation and modified approaches to GASB-34).

This case study:

- Describes the reasons for developing GASB-34 and its related value to transit agencies looking to develop asset inventories
- Identifies the agency departments typically involved in supporting GASB-34

- Compares briefly the Depreciated vs. modified approaches to GASB-34
- Provides a brief description of how one transit agency, Metrolink, is applying this approach

Who Developed GASB-34 and Why? The Governmental Accounting Standards Board (GASB) created a new framework for how state and local governments report their finances to the public in June of 1999. This new framework is referred to as GASB Statement 34, which provides much more useful and understandable information for long term planning purposes in addition to stewardship of short term funds for budgetary focuses. Under GASB Statement 34 guidelines, governments produce financial statements that show all the resources available to them for the provision of public services including infrastructure and other assets with long lives. In addition, by continually measuring the age and physical condition of capital assets on a life-cycle basis (in contrast to the use of traditional "straight line depreciation"), this approach better reflects the actual costs of providing government services (how much of the capital stock is "consumed" each year to provide service) as well as providing good quality data for long-term capital needs analysis.

GASB is a private, nonprofit body responsible for establishing and improving accounting and financial reporting standards for U.S. states, counties, cities, and other local governments, as well as any organizations under those governments' jurisdictions, such as transportation authorities, municipal utilities, state universities, etc. It is overseen by a nonprofit Financial Accounting Foundation.

GASB Statement 34 was developed over many years during which time GASB established nearly three dozen new standards of governmental accounting and financial reporting that form the foundation of the new requirements. To create the new guidelines the GASB worked closely with the members of the Governmental Accounting Standards Advisory Council, the National Governors' Association, the U.S. Conference of Mayors, the National Conference of State Legislatures, the National Association of State Auditors, Comptrollers and Treasurers, the Government Finance Officers Association, the Bond Market Association, the National Federation of Municipal Analysts, the Association of Financial Guaranty Insurers, the Governmental Research Association, the American Institute of Certified Public Accountants, the American Accounting Association, the American Public Power Association, and others.

Who is Responsible for GASB-34 Within an Organization? Completing the GASB Statement 34 guidelines are primarily the responsibility of the finance and/or accounting department within an organization. However, if the organization elects to use the GASB Statement 34 modified approach to reporting infrastructure (the approach of interest to agencies developing asset inventories), additional departments would also be responsible for providing information to fulfill the guidelines. Additional departments, such as the engineering, maintenance and repair, and strategic planning, would help provide required supplementary information that discloses the assessed physical condition of all the infrastructure assets, assessment methodology, acceptable condition levels, and necessary funding to reach or maintain assets at the acceptable condition levels.

Depreciated vs. Modified Approaches to GASB-34: GASB-34 helps governments (including transit agencies) better communicate to government managers, public and private investors, citizen and taxpayer organizations, and the public in general, the amount and quality of services using the public's resources. Financial statements using GASB Statement 34 guidelines provide more comprehensive information about the costs of public services by including infrastructure information that is of significantly higher quality and accuracy than is provided under more traditional accounting methods. Under these guidelines, governments must use full accrual accounting[12] to report basic financial statements and required supplementary information. There are two different methodologies for providing the required supplementary information.

Depreciated Approach: The first methodology spreads the purchase or construction price of long-lived assets over the years those assets are expected to be used, often in equal amounts and commonly referred to as "depreciation

[12] The full accrual accounting approach includes capital assets (such as facilities, systems, guideway elements, vehicles, etc.) and long-term liabilities (e.g. general obligation debt) in additional to the standard current assets (e.g. cash) and liabilities (e.g. accounts payable).

expenses". This method, which employs straight line depreciation, has more in common with traditional financial accounting methods as compared to the modified approach described below and does not provide the same high quality of asset inventory data as the modified approach. Transit agencies interested in adopting GASB-34 should consider the modified approach if the development of a good quality asset inventory and condition data is a primary reason for considering GASB-34.

Modified Approach: The other methodology, commonly referred to as the "modified approach", allows governments that can demonstrate that they maintain their infrastructure at a target condition level to report their expenses for maintaining and preserving infrastructure assets instead of depreciating them. From the viewpoint of the objective of attaining a state of good repair and the related development and use of asset inventories, the key point to note from the statement above is that agencies using the modified approach are *required* to establish asset condition maintenance targets and to actively measure their progress in attaining those targets. Hence, far more than just a "financial reporting" requirement, the modified approach to GASB-34 can be a central pillar of an agency's asset management program; including the ongoing measurement of current asset physical conditions and progress towards a desired asset condition target. Moreover, rather than just employing the skills of agency finance and accounting staff, the modified approach necessarily requires active coordination of asset management related processes between finance, engineering, maintenance, IT and upper management staff (state DOT's employing the modified approach report an increase in the level of communication and coordination between departments supporting GASB-34 activities).

Governments, such as transit agencies, reporting their infrastructure using the modified approach are required to meet certain conditions and to disclose publicly the evidence demonstrating their compliance with the following conditions:

- "The assessed physical condition of infrastructure assets (governments perform such assessments at least every three years, and disclose the results of at least the three most recent condition assessments)
- Descriptions of the criteria the government uses to measure and report asset condition
- The condition level at which the government intends to maintain the assets
- A comparison of the annual dollar amount estimated to be required to maintain and preserve the assets at the condition level established by the government with the actual expenses, for at least the last five years" [13]

This modified approach is very valuable to transit asset management for several reasons. First, it presents a method to develop and/or maintain an asset inventory that records the purchase and retirement of all capital assets. This asset inventory can be used for long-term capital reinvestment planning. Second, this approach requires ongoing condition measurements of transit assets that are completed at least every three years. Third, this transit asset information should help the agency better assess both how well it has done building and maintaining its assets, and helps with the agency's medium and long-term capital reinvestment planning. Last, this information assists transit management in better communicating to government managers, public and private investors, citizen and taxpayer organizations, and the public in general the level of transit asset investment, maintenance and condition preferred and/or required.

Who in Transit Has Used GASB-34? One example of a transit agency adopting the GASB Statement 34 modified approach is Metrolink. Metrolink provides commuter train service for Southern California. It was created in 1992 by the Southern California Regional Rail Authority (SCRRA), which consists of five county transportation planning agencies. Metrolink is a joint powers board organization that competes with the agencies on the joint powers board (such as Los Angeles County Metropolitan Transportation Authority) for the same capital funds. Metrolink successfully adopted the GASB Statement 34 modified approach to better communicate its case for a share in the

[13] Government Accounting Standings Board, unknown date; Overview - Governmental Accounting Standards Board Statement No. 34, Basic Financial Statements—and Management's Discussion and Analysis—for State and Local Governments; online, http://www.gasb.org/repmodel/oview34.pdf, accessed 28 December 2009.

region's capital funds for transit. In order to implement the modified approach, it needed to engage multiple departments within the organization. Departments that are major providers of the information required by the guidelines include finance and accounting, engineering and maintenance, and information technology. The joint effort from these multiple departments results in an annual financial statement that shows all the resources available to MetroLink for the provision of public services including guideway elements, facilities, systems, stations, and vehicles as well as better reflecting actual costs of providing commuter rail services by including condition assessments of their transit assets employed to support service delivery. Additionally, the condition measurement process allows Metrolink to better manage their transit assets.

This case study summarizes the GASB Statement 34 guidelines and argues why it might be of interest to transit asset management. GASB Statement 34's modified approach provides a means of developing and maintaining a capital planning asset inventory in addition to a condition measurement process. It joins these two processes within a financial statement that governments (including transit agencies) are required to provide on an annual basis. Additionally, it consolidates the financial and infrastructure information into a single document.

3.2 Current Practices at the Study Agencies:

As with the Rail Modernization Study, the National SGR Assessment identified some of the current asset management practices of those agencies that were contacted either for data collection or for follow-up analysis and review of the study's preliminary needs projections. This aspect of the Study focused specifically on the methods and processes these agencies are currently using to document and assess the current condition and future replacement needs of their transit infrastructure. This analysis identified many significant differences with a similar analysis completed for the Rail Mod Study:

- None of the Sampled Agencies Possess Fully Developed Capital Planning Asset Inventories: In contrast to the seven agencies included in the Rail Mod study (all of which have developed asset inventories specifically for capital planning purposes), only one of the agencies contacted for this National SGR Assessment has developed an asset inventory designed intentionally to support long-term capital planning processes. This finding suggests that while many of the nation's largest transit operators have made progress in developing such inventories and their related analytical tools, relatively few medium and smaller size agencies have completed development of such inventories.

- However, Some Agencies are Making Progress: While relatively few of these smaller agencies have completed development of such inventories, several of the agencies contacted for this study have taken their initial steps towards developing such inventories. Moreover, many that have not formally initiated such efforts, have recognized the need to do so, have discussed this issue within their organization and expressed interest in learning about how others are addressing this issue and how best to proceed.

- Differing Approaches to Inventory Development for this Study: Each of the sixteen agencies that responded to the data request for this study developed their asset inventory data submissions from one of three general types of sources (**Exhibit 3-1**). Most of these agencies obtained their asset records from the fixed asset ledgers – a data source that tends to be fairly comprehensive of total agency asset holding but which is not always well suited to assessing future capital needs. The second most useful source was prior engineering condition assessments or asset documentation maintained by individual departments within each agency (e.g., by staff responsible for specific asset types such as stations). Finally, a small number of the agencies contacted for this study developed their capital planning asset inventories from their Computerized Maintenance Management Systems (CMMS).

As with the Rail Modernization Study, this National SGR Assessment also sought to document the transit asset management (TAM) practices of the sixteen transit agencies contacted for the study. This analysis focused on the same four key TAM practices considered in the Rail Mod final report. The completed scan revealed the following:

- Asset Inventory Development (capital planning): As discussed above, few agencies have completed development of capital asset inventories intended to support long-term capital needs analysis.

- Asset Condition Monitoring: At the present time, only three of the seven of the agencies included in the Rail Mod Study and three of the sixteen additional agencies contacted for this National Assessment have committed to conducting comprehensive asset condition assessments on an ongoing 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 23 agencies contacted for the Rail Mod and National SGR Assessment studies currently maintains a decision support tool permitting these types of analyses.

- Investment Prioritization: Approaches to prioritizing capital investments also vary widely. All agencies allocate 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. The observed approaches used to prioritize these differing needs include the following:

  - "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 23 agencies contacted for the Rail Mod and National SGR Assessment studies use an objective, multi-factor project scoring process to help rank and prioritize their investment needs.

3.3 Future Opportunities

The Federal Highway Administration and the Federal Aviation Administration have active programs of technical assistance to improve asset management in their sectors of the transportation industry. FTA has determined that there is also a need for this in the transit industry but, due to the variety of asset types used to deliver transit services, has taken longer to implement a program to provide this kind of assistance. 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 just as they do in the highway and aviation sectors.

Given these circumstances, FTA is continuing to take 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. FTA is currently developing a one-day course in Transit Asset Management in conjunction with the National Transit Institute.

- 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.

- Asset Management Initiative: The FY 2010 DOT-HUD appropriations bill provides significant resources to FTA to encourage improved management of the condition and recapitalization of the Nation's transit infrastructure. Specifically:

  > *"Asset Management – The conference agreement includes $5,000,000 to develop **asset management plans**, **technical assistance**, **data collection** and a **pilot program** as proposed by the Senate. The House did not include similar language. The conferees expect the pilot program to include transit agencies that vary in size and direct FTA to report findings to the House and Senate Committees on appropriations within 18 months of enactment."*