The Economic Cost of Failing to Modernize Public Transportation

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Acknowledgements

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Failure to invest in public transportation infrastructure modernization, also referred to as *State of Good Repair (SGR),* over the next six years results in a loss of $340 billion in cumulative business sales from 2017-2023. This translates to a loss of $180 billion in cumulative gross national product (GNP) and a loss of $109 billion in household income. Job loss due to this lack of investment in the upkeep and maintenance of America's aging infrastructure results in the nation losing 162,000 jobs. These loses are a product of decreases in efficiency and productivity from public transit delays and disruptions. The economy benefits when operators can devote resources toward expanding and modernizing service in response to emerging growth instead of investing resources into merely managing and maintaining facilities and equipment that are past their useful service life.

Boston's 2015 inclement weather suggests that a regional economy can risk upwards of $40 million of losses in terms of both revenue and recovery if unanticipated events strike a major transit system in less than a good State of Good Repair. Along with the net gains or losses at stake to the U.S. economy, the condition of public transit infrastructure has regional and local implications. As cities throughout America compete to retain key occupations and businesses, the condition and quality of public transit infrastructure plays a growing role in what makes a thriving regional economy. The total SGR backlog was estimated to be at $89.9 billion in 2015, and is continuing to grow. Six case studies provide detailed examples of how different agencies are dealing with SGR issues:

San Francisco Municipal Transportation Agency (SFMTA), San Francisco, CA

In San Francisco, both the municipal transit agency (SFMTA) and the regional Bay Area Rapid Transit (BART) are operating with ridership significantly exceeding capacity. Both agencies have struggled to apply available resources to fill gaps in SGR and prevent increases in user costs as infrastructure ages. Business leaders are counting on a public transit system that can adapt to follow emerging market trends, develop workplaces, and be a reliable mobility option for residents. SFMTA estimates a $2.41 billion backlog in SGR investment needs.

Southeastern Pennsylvania Transportation Authority (SEPTA), Philadelphia, PA

In the Philadelphia region, the Southeastern Pennsylvania Transportation Authority (SEPTA) has developed a proficiency for identifying the condition of its assets and has allocated resources on an ongoing basis to optimize the user experience by minimizing delays and system failures. As SEPTA's tracking of SGR needs, backlog and connections to the user experience becomes more comprehensive, the agency can articulate the case for increased SGR investment. SEPTA can also demonstrate how limitations in the SGR relate to the agency's ability to respond to growing market and business demands. SEPTA estimated a $5 billion backlog in SGR investment needs in 2014.

Massachusetts Bay Transportation Authority (MBTA), Boston, MA

Boston's Massachusetts Bay Transportation Authority (MBTA) and its experience of catastrophic system failures in the wake of extreme snow events in 2015 is among the nation's most instructive examples of the risk associated with allowing SGR to decline. It is also demonstrative of the paradigm shift that can occur when the business and policymaking communities become aware of what is at stake in preserving public transit assets. The 2015 experience was a turning point in MBTA's SGR investment model—from a business process focused on "putting out fires"—to a process focused on resilience, competitiveness, and strategic intelligence. The paradigm shift came at a significant cost to the Boston region's businesses and residents in the form of lost wages, productivity and efficiency. Furthermore, it is still unclear whether and how MBTA will arrive at the revenue needed to achieve its 15-year objective of resolving its SGR backlog, much less the more aggressive 10-year objective advocated by the business community. Perhaps the most significant question raised by the Boston experience is whether other legacy systems—or the entire U.S.—will be able to benefit from Boston's 2015 experience to make strategic SGR investments over time within the context of the Moving Ahead for Progress in the 21st Century Act (MAP-21) and Fixing America's Surface Transportation (FAST) Act asset management regime. MBTA estimates a $7.3 billion backlog in SGR investment needs, without including components of the commuter rail system.

Metropolitan Atlanta Rapid Transit Authority (MARTA), Atlanta, GA

The Metropolitan Atlanta Rapid Transit Authority (MARTA) has one of the most highly developed asset management systems in America, and is increasingly leveraging its understanding of its SGR needs to support a shift in how the business community views public transit. MARTA's proactive approach to its SGR enables the agency to clearly show how investments made in the system will enhance the region's ability to offer more, and better

service over time at less cost. MARTA estimates a $2.2 billion backlog in SGR investment needs.

Washington Metropolitan Area Transit Authority (WMATA), Washington, DC

The Washington Metropolitan Area Transit Authority (WMATA) is one of the largest public transit systems in the United States. It invests heavily to ensure SGR is adequate to safely provide its services. A long history of underinvestment, however, leaves WMATA with a backlog of approximately $6.6 billion with approximately 16.7 percent of the agency's assets (by value) considered to be in the SGR backlog. WMATA estimates an annual investment of $1.8 billion is needed over the next 10 years to achieve a good state of repair. A dedicated funding source to achieve this level is currently being worked out by the three respective jurisdictions. The importance of WMATA's stations (and their condition) in economic development is highlighted by the fact that 54 percent of jobs in the region are within one-half mile of a Metrorail station and land value near Metrorail generates $3.1 billion per year in property tax revenues to WMATA's funding partners.[1]

Chicago Transit Authority (CTA), Chicago, IL

The Chicago Transit Authority (CTA) has assets of more than 1,400 rail cars operating more than 288 miles of track and 1,800 buses serving more than 1,300 miles of routes. CTA has a SGR backlog of approximately $12.5 billion, meaning that reinvestment comprises the vast majority of CTA's outlays. For CTA, the concept of "State of Good Repair" goes beyond simply preserving existing assets, as CTA recognizes that replacing an old asset involves an appropriate level of modernization to current-year equipment standards, whether for buses, railcars, rails or stations. For this reason, there is a degree of modernization built into CTA's SGR projects. CTA has some of the nation's best documented instances of real-estate values enhanced by modernization and enhancement of station areas, with improved locations such as the Morgan and Cermak-McCormick Place stations alone generating more than $2.5 billion in private land investment from 2015-2017.

1 *https://www.wmata.com/initiatives/case-for-transit/upload/WMATA-Making-the-Case-for-Transit-Final-Tech-Report.pdf*

1. Background and Introduction

For over a century, many of America's largest and most established public transit systems have operated with facilities and infrastructure that are decades old. As year-over-year investments in the replacement, rehabilitation and modernization of vehicles, tracks, equipment, stations and other assets fell short of identified needs, the primary mission of many public transit agencies became operating services in just adequate, or often marginal to poor condition. Success came to be understood in terms of preventing failure, ensuring reliability and finding ways to keep service running without interruptions affecting users. While public transit agencies learned to be extremely successful at operating under these conditions, it became increasingly difficult to benchmark the degree to which antiquated equipment or unmet needs to keep the SGR of capital assets was affecting efficiency, agility or expansion capacity for America's public transit systems. The issue of public transportation modernization is also referred technically to as *State of Good Repair (SGR)*. The concept of "good," "excellent" or "exceptional" transit facilities and equipment became largely out of reach, with the costs or implications of being less than "good" or "excellent" unknown and often not even considered.

As the 21st century knowledge economy has evolved with greater focus on quality of life, sustainable transportation and the millennial workforce, the quality of public transit has become a vital aspect of local and regional economic competitiveness. Unlike in the past century, public transit is increasingly seen less as a staple to simply ensure mobility for segments of the workforce, but rather as a neighborhood and urban amenity necessary for places to compete for workers, conventions and other economic activities. The federal transportation laws, MAP-21 and the FAST Act, have provided a structure for public transit agencies to track and report the current state of their transit assets. However, the growing success of agencies with asset management seems to only highlight the degree to which the needed investment to arrive at

even fully adequate, much less competitive infrastructure, is beyond available streams of funding.

This study builds on both growing bodies of literature on state of good repair (SGR) and disinvestment generally and specifically related to public transit. Public transit studies can be divided into those that assess the current condition of assets nationally or for specific systems; those that provide evaluation and guidance on how to pursue SGR; and those that examine the consequences of failing to maintain SGR.

Outside the realm of transit assets, the National Cooperative Highway Research Program (NCHRP) in 2015 issued *Synthesis Report 480 – Economic and Development Implications of Transportation Disinvestment*, which identifies the main state of practice regarding disinvestment decision-making processes for highway and bridge infrastructure. For brevity, this report does not include an extensive reexamination of the literature related to those asset classes. The report also examines asset management and disinvestment literature from the perspective of private business, especially manufacturing firms, and others making long-term investments. Best practices may also be available from other public sector authorities such as the military (Grussing et al. 2006). *Synthesis Report 480* discusses progress made by state departments of transportation (DOTs) in learning from one another and related organizations, and suggests the need for a similar review of state of practice among public transit agencies across the U.S.

1.1 What Assets are Below A SGR?

The Federal Highway Administration (FHWA) and Federal Transit Administration (FTA) have jointly published the *Status of the Nation's Bridges, Highways, and Transit: Conditions and Performance Report to Congress* in 1999, 2002, 2004, 2006, 2009, 2010, 2013, and 2015. This national report series provides a high-level overview of conditions-based FTA surveys and inspections of asset conditions; a brief review of public transit performance; and estimates of investment needs nationwide based on FTA's Transit Economic Requirements Model (TERM) model. Although inventories of public transit assets are collected for the National Transit Database (NTD), only bus vehicles must be reported with age information and no asset categories require condition reporting as of the beginning of 2017.

The 2015 Conditions and Performance Report finds that for rail, a poor condition is found in more than 35 percent of the nation's fixed guideway elements (dedicated right of way), nearly 40 percent of stations, over 24 percent of maintenance facilities, 17 percent of communication systems and 2.1 percent of vehicles. For bus, a poor condition is found in approximately 6 percent of fixed guideway elements, 12 percent of stations, 7 percent of facilities, 17 percent of communication systems and 10 percent of vehicles.

In 2008, FTA began to increase the federal focus on SGR and the depth of analysis beyond the Conditions and Performance Reports. This effort began with the 2008 SGR Summit, which covered a wide variety of SGR-related topics with 14 agencies and DOTs (AECOM and FTA 2008, FTA 2008). This meeting helped set the FTA's research agenda for the coming years. In most of the following years, FTA has hosted a SGR Roundtable, recently renamed the Transit Asset Management (TAM) Roundtable.

Following the summit, the FTA issued two condition reports. The first was the *Rail Modernization Study* (2009), which covered the nation's seven largest

rail public transit operators in depth (the Chicago Transit Authority (CTA), Boston's Massachusetts Bay Transportation Authority (MBTA), New York's Metropolitan Transportation Authority (MTA), New Jersey Transit (NJT), Bay Area Rapid Transit (BART), Southeastern Pennsylvania Transportation Authority (SEPTA) and Washington Metropolitan Area Transit Authority (WMATA)). FTA found that more than $50 billion in SGR backlog existed at these agencies alone. The *National SGR Assessment* found a national SGR backlog (for all systems, inclusive of the $50 billion for the seven largest operators) of $77.7 billion with $14.4 billion annually necessary to prevent the backlog from growing any higher. As investments have fallen short of this level, by the time of publication of the 2015 Condition and Performance Report, total backlog estimates had already grown to $89.9 billion (FHWA and FTA 2015) and were continuing to grow.

The *Rail Modernization Study* (FTA 2009) found that although the largest seven rail systems maintained asset inventories, three had condition monitoring systems in place, two used rigorous prioritization methods, and only one conducted what-if analysis using decision support tools. MTA was one agency that had integrated inventory and condition assessment information with its 5- and 20-year capital planning processes (Boylan 2009). At the time of the *National SGR Study* (FTA 2010a), of 16 additional agencies surveyed, none had inventory, condition monitoring, decision support, or prioritization systems in place. *TCRP Synthesis 92: Transit Asset Condition Reporting* also found that public transit asset management systems used by the 50 largest agencies were relatively "elementary and limited," although already more widespread than when FTA was surveying agencies for the *National SGR Study* (McCollom and Berrang 2011).

There is evidence of progress at many agencies toward more robust SGR assessment systems. By the next year's SGR Roundtable, additional agencies were sharing their progress on asset inventories and condition assessment, incorporating SGR into decision-making processes. In addition to the seven largest rail agencies, since 2009 best practices and progress on agency initiatives have been presented by Chapel Hill Transit, Dallas Area Rapid Transit, Southern California's Foothill Transit, Houston's Metropolitan Transit Authority of Harris County, Seattle's King County Transit, Long Beach Transit, Long Island Railroad, Metropolitan Atlanta Rapid Transit Authority (MARTA), Niagara Frontier Transit Authority, Denver's RTD, San Francisco Municipal Transportation Agency, St. Louis Metro, Utah Transit Authority, and Virginia's Department of Rail and Public Transportation.

These agencies' presentations show that the capacity to track asset conditions and needs has expanded significantly, at least among leading agencies. The tools and procedures developed by these agencies will continue to be disseminated to other agencies. However, as identified by McCollom and Berrang (2011), even when agencies have frequently updated information, asset management systems often lack the information necessary to prioritize between investments and provide funding justifications to policymakers and the public.

1.2 Why Pursue Public Transit SGR?

The second line of SGR research discussed here is especially important as few agencies have successfully incorporated performance outcomes of failure to achieve SGR in their asset management systems and planning processes. Although most public transit agency staff intimately understand the importance of maintaining asset condition, it is important to

communicate the operational impacts of capital infrastructure SGR to stakeholders. The Government Accountability Office (GAO) in 2013 reported that establishing relationships between SGR investments and performance effects through additional research would help agencies make prioritization decisions and justify funding. It also included case studies of how BART, Detroit's SMART, MARTA, and WMATA have been developing these relationships for different asset classes.

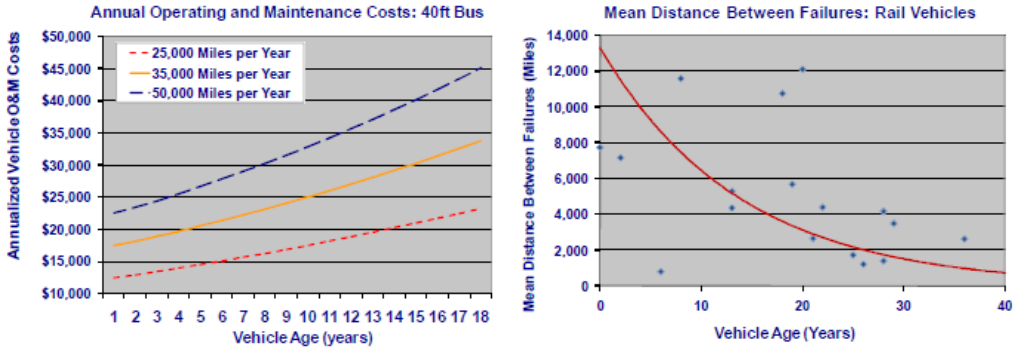
Understanding and communicating why SGR is important requires connecting both (1) asset condition to asset performance and (2) asset performance to performance measures that stakeholders value. Mean distance between failures (MDBF) is a valuable measure within the agency, but stakeholders understand delay, reliability and maintenance cost impacts. Research has made some progress in advancing both connections. This section mostly covers their application in one-time studies and reports, whereas the next section discusses their use in tools, plans and business processes.

Performance outcomes of failing to maintain SGR was one of the topics of FTA's initial SGR Summit (FTA 2008). Performance is an aspect of the Conditions and Performance Reports and some aspects of performance are current NTD submission requirements. As **Figure 1** shows, there is a clear relationship between age (which itself is correlated with condition) and performance measures like maintenance cost and MDBF. This is not necessarily a new revelation, as shown in relationships between vehicle and guideway age and failure rates for MTA's New York City Transit and SFMTA, as well as documenting the improvement in performance following investment (Kuiper 1985).

In reviewing the FTA's minimum retirement standards for public transit buses and vans, (Laver et al 2007) confirmed the correlation between age and failure rates and discussed a measure of customer travel impacts. This study, which recommended no major changes in minimum age requirements, is an example of FTA's ongoing research efforts to provide useful standards and improve the technical foundation for tools such as the Transit Economic Requirements Model (TERM). Safety concerns have also been associated with backlog growth, with the specific example of a CTA derailment attributed partially to poor infrastructure condition (Flanigon 2010).

Separate from assessing the relationship between condition and failure, studies have examined how delay and reliability changes from failures may affect travelers.

Figure 1. Relationship between Asset Age and Performance or Cost (FTA 2008, p. 15)



Paterson and Vautin (2015) conducted a study in the San Francisco Bay Area that used a regional travel demand model to examine the benefit-cost impacts of SGR-related delay. Unreliability and delay caused by poor asset condition not only raise travel time costs but also cause travelers to seek other modal options. Studies in Chicago have empirically shown how routes with track under slow orders due to poor conditions have lost ridership because travel speed and reliability had deteriorated (Judge 2005; Bernal et al 2016).

Several studies of the SEPTA system assess economic impact on the community as well as benefit-cost relationships for SGR projects (ELGP and Econsult 2007; ELGP and Econsult 2013; Voith et al 2014; Zale and Knueppel 2014). These studies, along with Paterson and Vautin (2015), tie public transit ridership decreases to deteriorating asset condition back to roadway travel. Costs for drivers include congestion and parking costs, which can result in job losses, decreases in property values, and lost state and local tax revenue. The 2007 study considers a 20 percent service decrease while the 2013 and later studies consider over a 40 percent decrease in service and a much greater decrease in geographic coverage. As Zale and Knueppel discuss, this modeling was essential in SEPTA's successful effort to gain additional funding support from policymakers. Ontiveros and Econsult (2015) have also presented a case example in the Philadelphia region of how equity and Title VI concerns can be connected to the SGR discussion.

1.3 Achieving Transit SGR

One of the keys to successfully achieving SGR will be to connect the improvements in asset inventories and condition assessment with the findings of studies on user costs and regional impacts for decision making processes. NY MTA's current enterprise asset management system includes tracking of impacts in numberless standard benefit categories including customer satisfaction, system revenue, and environmental performance (Steward 2014). The London Underground provides a leading example of how user impacts can be a valuable performance measure of SGR efforts (FTA 2010b). Future versions of TERM, and the national Conditions and Performance reports produced using it, are expected to incorporate measures of user cost due to performance impacts of SGR (Cohen 2012).

Continued refinement of TERM serves as a basis for standard asset deterioration curves and condition rating standards. Additionally, FTA's release of TERM-Lite better allows individual agencies to take advantage of FTA research to conduct scenario analysis of funding options (Gates and Laver 2011; Giorgis and Laver 2014). As an example, TERM-Lite was used for Paterson and Vautin's 2015 Bay Area scenario analysis. While TERM was designed internally to be used by FTA for all the nation's public transit infrastructure at once, TERM-Lite greatly simplifies the information required for one agency to forecast backlog and funding needs.

Besides facilitating peer exchange of best practices through venues such as the SGR/TAM Roundtables, FTA (2010b) has also published 11 case studies of public transit asset management and collected best practice documents. Giuffre et al (2009) discusses one of the cases (VA DRPT) in more depth as well as other best practices and available tools. Other efforts have focused on collecting SGR practices from Europe, which included looking at different funding strategies there (TCRP 2011).

These efforts to collect practices and case studies preceded FTA's release of an Asset Management Guide in 2012. This guide establishes FTA's recommended best practice framework and business model. It discusses both development of an asset management plan and specific components of asset management practices such as asset inventory, condition assessment, performance analysis and modeling, risk management, and lifecycle cost management components. Finally, the guide shows how organizations can move from their current state of practice towards best practice (Rose et al 2012). APTA has also released several best practices documents for creating an asset management program, defining an asset management framework, and conducting asset inventories and condition assessments (ATPA 2013a; APTA 2013b; APTA 2013c).

Two significant national reports have been issued through the TCRP program, providing decision-making frameworks and tools for SGR situations. *TCRP Report 157 – SGR: Prioritizing the Rehabilitation and Replacement of Existing Capital Assets and Evaluating the Implications for Transit* specifically focuses on prioritization processes and provides four different analytic tools, which make them valuable to agencies working with different types of available data or analytic perspectives (Spy Pond et al 2012). A portion of the report also advances the state of practice (discussed previously) for linking SGR investments and impacts on agency operations and customer experience. *TCRP Report 172 – Guidance for Developing an Asset Management Plan* (Spy Pond et al 2014) further refines the Transit Asset Prioritization Tool (the four spreadsheet models developed for Report 157) and discusses how it can be used to develop scenario analysis and finalize an asset management plan. Several tutorials on the tool are included.

Within the literature, the *Asset Management Guide*, *TCRP Report 157*, and *TCRP Report 172* currently define best practices for policy, business process, management, planning, and analytic frameworks in public transit asset management and SGR programs. Many agencies and researchers are currently applying these methods and guidance or building on them further.

1.4 Ongoing National Research

Several efforts are already underway to advance the state of practice at the national level. *TCRP Project E-11 – The Relationship between Transit Asset condition and Service Quality* seeks to provide additional quantitative support for why SGR is important. *The Transit Capacity and Quality of Service Manual* identifies many factors affecting service quality, but this research should provide a much stronger quantitative relationship between asset condition and customer experience (TCRP 2014). This finding can then be incorporated into future versions of tools such as the Transit Asset Prioritization Tool to support investment decision making.

TRCP Project E-12 – Guidance for Calculating the Return on Investment in Transit SGR will provide additional insight into how agencies can evaluate the return on investment (ROI) for SGR projects. This study may help agencies adapt current methods used for system expansion and improvement for use in SGR project evaluation, or recommend new methods focused on SGR impacts. These resources will help better communicate the value of SGR projects and weigh their importance against other project types in prioritization processes.

Methodology

This report bases its six primary case studies on a two-pronged approach that includes both qualitative and quantitative methods. For the qualitative portion, the authors interviewed representatives from local and regional transit agencies, metropolitan planning organizations (MPO's) and economic development organizations. These interviews were supplemented by a review of open-source literature to ascertain:

- How transit agencies are defining, measuring and benchmarking their SGR needs and conditions
- Major sources of economic cost that SGR deficiencies pass on to system users
- Constraints that SGR deficiencies play in system planning and responsiveness to business needs
- Specific ways that transit SGR strengths and weaknesses affect the local and regional economic development process

Specific sources of interviews are kept confidential to ensure candor and objectivity in business and economic perspectives, however wherever possible outside secondary reports and sources are cited throughout the report.

The knowledge gained from interviews with on-the-ground practitioners and economic development organizations is presented within the larger context of the SGR issue and its economic implications. SGR investment needs and gaps are presented within the context of secondary sources such as the AASHTO bottom line report and the USDOT Conditions and Performance report. The wider implications of these needs are derived from an earlier analysis of unmet transportation preservation needs quantifying costs according to the FTA Transportation Economic Requirements Model (TERM) and representing impacts as found in the University of Maryland's LIFT global trade model. The costs of transit SGR deficiencies are translated into changes in the U.S. industry composition and associated long-term effects in employment, earnings, GNP and business output.

Overall dependence of individual regional economies on transit services are based on an integration of US Census Public Use Micro-Data Sample (PUMS) data together with ridership statistics from the cited transit agencies and ratio's derived from Moody's Analytics.

2. Transit SGR as an Economic Issue

2.1 From Functionally Adequate to Competitive

In 2014, when State Farm Insurance chose to locate 8,000 jobs in Atlanta (including 3,000 new jobs) in a campus served by the Dunwoody MARTA station, both entities acknowledged that the presence of public transit was integral to the quality of the business environment and for the workers they sought to attract and retain. Well-documented growth in business activity and the re-location of knowledge workers has also been seen in areas like the Denver Technology Center, South Lake Union in Seattle and the Warehouse District and Target Center in Minneapolis. More recently, when Amazon issued a request from cities to host its second headquarters, the company listed access to public transit as one of its ideal site location requirements.

These examples illustrate how public transit is a competitive component—one that distinguishes a solid business environment vying for skilled labor from less competitive areas that risk falling behind in today's knowledge economy. In effect, it is increasingly the case that the *quality* of public transit as a *desirable amenity* is the key to a competitive business environment–in contrast to past decades when the mere presence of public transit may have been understood as a necessary element for workforce commuting. Economic developers and real estate brokers interviewed in Atlanta, San Francisco, Chicago, Boston and Philadelphia indicated that today's economy is very different from 20 years ago when public transit was seen as neutral or potentially even negative for firms seeking business locations. The same brokers and recruiters today observe that it is not uncommon for site selection consultants and managers to actually ride public transit when visiting prospective communities to assess not only the existence of but also the

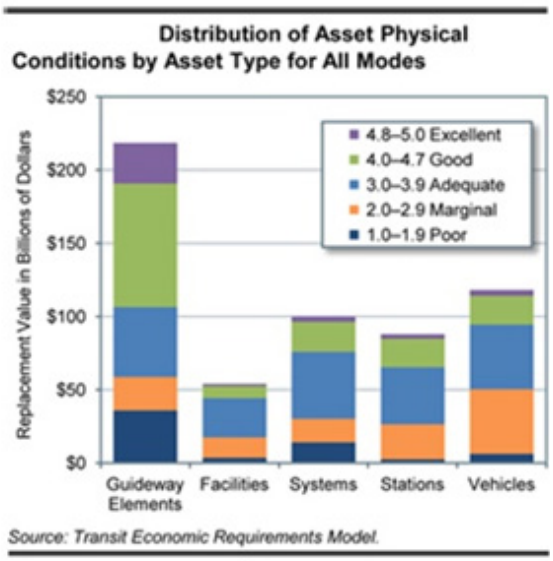
Figure 2: MARTA Station near State Farm Site (Source: Atlanta Constitution)

quality of the public transit experience. The condition, appearance, and caliber of vehicles, tracks, stations and other infrastructure factors into where American business is conducted and why.

America's ability to compete with countries around the world depends on the productivity of its cities and metropolitan regions and, in turn, the success of regional public transit systems. In Asia, a continent containing some of the most successful public transit systems in the world, cities face the same challenges as those in the U.S. These include aging assets and high customer expectations in the face of increasing ridership. Hong Kong, Singapore, and Tokyo prioritize SGR, placing it at the center of their business. Hong Kong's MTR public transit system adopts a "prescriptive maintenance" approach that "assumes that all potential failure modes have been considered and maintenance plans address them such that unscheduled failures do not occur." SMRT in Singapore addresses SGR issues in its marketing by emphasizing that maintenance efforts may inconvenience customers but SMRT asks for patience and feedback. In Tokyo, the JR East high-speed and commuter rail systems utilize a well-staffed production line to maintain and clean cars, demonstrating a cost-efficient way to make preventative repairs and manage SGR.

America's public transit systems are experiencing a growing realization of both the cost and importance of investing in the ongoing condition and performance of its buses, tracks, stations and other infrastructure. Beginning with the Moving Ahead for Progress in the 21st Century Act in 2012 and then the 2015 Fixing America's Surface Transportation Act, public transit systems have been required to take stock of the SGR of their existing infrastructure. As agencies are more transparent, it has become increasingly clear that many of America's assets are operating in marginal to fair condition, with relatively few reaching "Good" or "Very Good" standards.

Figure 3: State of Good Repair for Public Transit Assets in U.S. (Source: AASHTO 2015 Bottom Line Report)



In 2013, according to the USDOT Conditions and Performance Report, approximately 13 percent of U.S. public transit assets were considered past their useful life, defined as lower marginal or poor condition (2.5 or less on a scale of 1-5). However, as shown in **Figure 3**, for most asset classes, well less than half of assets are in good or excellent condition. Furthermore, the latest federal statistics do not reflect new needs coming into focus as more public transit systems apply the FTA's five-point scale for the first time and report findings. According to the FTA's 2013 report to Congress on the Progress on SGR Pilot Progress, only 23 percent of U.S. public transit agencies were using the consistent scale shown in **Figure 3**.

The FTA standard clearly is oriented toward recognizing needs at the minimum tolerable condition at which public transit systems can function consistently. However, the growing gap between the emerging economic role of the competitive "amenity" value of public transit and the merely "functional" condition raises questions about the unrealized potential from significantly enhancing the quality and condition of America's infrastructure.

Vital economic questions associated with the public transit SGR include:

(1) How does the poor, fair or marginal condition of most of America's infrastructure affect what public transit operators are able to offer for communities seeking to grow economically?

(2) What risks does a local, regional or national economy face when the public transit SGR struggles to remain fair or marginal at best?

(3) What are the bottom line costs and financial opportunities associated with decisions relating to changing the SGR in America's public transit assets?

2.2 Transit Conditions and Economic Competitiveness

When it comes to the competitiveness of U.S. cities, it is no longer just the existence or availability of public transit service that makes the difference, but rather its quality and amenity value. In interviews with developers, business recruiters and public transit operators in major cities throughout America, the SGR for systems consistently is a "make or break" factor in key economic development opportunities. There are three respects in which the public transit SGR is most cited as a key determinant of a community's economic vitality. These include:

1) Transit Quality as a Feature of High Impact Events

Cities and regions spend billions of dollars to attract sporting franchises, conventions, collegiate athletic events, airline hubs and other highly visible events to brand their communities as world class cities. These projects demonstrate amenities to retain citizens and workers and project a high community quality of life. For example, the MetLife Stadium in East Rutherford, New Jersey (home to both the New York Giants and New York Jets) was constructed at a public cost of $1.6 billion in 2010, and is served by NJ Transit via the Meadowlands Rail System. The stadium authority routinely checks in with NJ Transit regarding operations, equipment and services in advance of major sporting events to ensure the reliability and quality of transportation for attendees. MARTA in Atlanta has indicated similar correspondence with regard to Atlanta Falcons games. Furthermore, when Salt Lake City, Utah began its campaign to host the 2002 Winter Olympics, the city invested heavily in its TRAX rail transit system, the quality of which is generally associated with the attraction of the Olympics to this day, which was shown to have generated $100 million in GDP, $4.8 billion in business sales and $1.5 billion in earnings for the state's economy (most of which would represent net gain in economic activity to the United States, if Salt Lake had not been selected and the Olympics had located elsewhere).

Figure 4: NJ Transit Serving Meadowlands Stadium

In 2016, public transit was a major factor leading to the Republican National Committee choosing Cleveland, Ohio as the site for its national convention, bringing $188 million in wage income to Cleveland and northeastern Ohio. In New Orleans, the Loyola streetcar line was expanded just in time for Super Bowl XLVII, which was held on February 3, 2013, in the city's Mercedes-Benz Superdome. Since then, the line has generated $2.7 billion in new infrastructure, retail, and commercial development. According to the New Orleans Regional Transit Authority, the TIGER-funded project was designed to "promote and support economic development in the area by allowing improved connectivity between convention, tourism, entertainment, energy, and health care and biosciences facilities."

As cities spend billions of dollars on stadiums, convention centers and recruiting efforts to offer amenities to draw sports franchises and convention business, public transit is almost universally seen as part of the "bundle" of amenities associated with this business attraction investment. In this type of competitive environment, just as antiquated, dilapidated or "marginally fair" convention center facades, stadium seats or sky-boxes are a liability for regional economic competitiveness, "marginally fair" or merely functional public transit stations, vehicles and amenities–while operationally sufficient–can make the difference between hosting a hundred-million dollar or even billion-dollar event, or missing out on such opportunities. The role of public transit as a competitive amenity, judged by its quality and modernization (and not merely by its adequate functionality), represents a significant paradigm shift in assessing transit investment needs and priorities.

2) Public Transit Quality as a Neighborhood Amenity for the Workforce

APTA's 2016 report, *Public Transportation's Role in the Knowledge Economy*, documents many examples of how firms are located in cities and regions that can retain a highly skilled workforce through the availability of high-quality public transit. The report emphasizes the role of public transit in influencing not only the mode choice of workers, but also city and neighborhood options and the associated choices of major employers in industries such as bio-technology, information technology, pharmaceuticals, finance and other high value sectors to expand or remain in any given local economy.

Figure 5 pictures a typical Google employee shuttle of the type used to transport workers in Silicon Valley. It represents how knowledge economy firms are recognizing the value of high-quality transportation, which they may provide themselves if it does not already adequately exist.

The findings of APTA's 2016 study are borne out by other research, such as the 2015 Community & Transportation Preferences Study by Portland State University and the National Association of Realtors,

Figure 5: Google Employee Shuttle
(Source: Cody Pickens/Fortune.com)

which found that 64 percent of respondents preferred to live in neighborhoods served by public transit, with millennials reporting recent use at a rate of 40 percent compared with only 28 percent of Generation X. Also, in 2017, *Area Development Magazine's 31st Annual Survey of Corporate Executives* found that 40 percent of firms making a relocation decision in that year cited transportation infrastructure considerations, and 20 percent cited labor availability as key factors driving the location decision. A groundbreaking 2014 study, *Characteristics of Premium Transit Services that Affect Mode Choice (TCRP 166), a comparative factor analysis from Salt Lake City, Utah, Charlotte, NC and Chicago, IL*, documented how qualitative factors such as cleanliness, crowding and comfort have an impact not only on mode choice but also if public transit is perceived as a viable amenity for use in a given place.

In effect, a growing body of national research demonstrates that with an increase in riders viewing public transit as a desired amenity (akin to parks, public art and other neighborhood or community features).

Figure 6: Bus Service in Downtown Birmingham to be Significantly Enhanced

3) Resilience of Public Transit

Non-rail public transit routes can be reconfigured to reflect new spatial patterns of development and be responsive to shifting neighborhood and market dynamics. Non-rail public transit routes and feeder services do not typically require extensive right of way acquisition or politically sensitive turn-backs of unused facilities to re-direct resources to meet geographic demands. The agility of public transit to respond to changes in land and consumer markets can be a significant strength for a community seeking affordable and competitive ways to offer the amenity of public transit while also supporting increasingly dense transportation markets. For example, in 2017, Birmingham, Alabama is benefiting from TIGER and other grant assistance for the placement of a significant new bus rapid transit (BRT) system to support higher densities and levels of development in its downtown, and other, emerging areas. In 2008, the Kansas City Transportation Authority undertook a comprehensive Transit Supportive Land Use Assessment that led to significant enhancements of business and neighborhood environments associated with evolving public transit modes throughout Kansas City.

Reconfiguring and re-deploying their public transit assets enables regions to be highly efficient and innovative in responding to new land markets and workforce preferences. However, when existing public transit assets are in only marginally fair or poor condition for their existing function, public transit providers have less flexibility in terms of expanding or changing how they use these assets. In this way, limits on the public transit SGR require agencies to devote significant internal resources to simply keeping assets in their current function, jeopardizing their agility in the face of changing economic demands. The specific types

of limitations that merely "functional" public transit conditions pose on internal agency operations is explored in Chapter 3.

2.3 Beyond the Bottom Line

These examples of the growing economic importance of the condition and quality of public transit infrastructure along with overall increasing demand as an amenity is borne out by long-standing data and research conducted over a decade. In 2015, APTA and the American Association of State Highway and Transportation Officials published the 2015 Bottom Line Report on the condition of U.S. public transportation, as well as future investment needs. **Figure 7** together with **Tables 2** and **3** below illustrate information from the 2015 Bottom Line Report regarding how, despite a 41 percent increase in public transit passenger miles (relative to only a 22 percent increase in highway miles), the current trend in investment has not led to any significant or sustainable improvement in the SGR among America's bus or rail assets since 2010.

Figure 7: Increase in Public Transit Passenger Miles (Source: APTA)

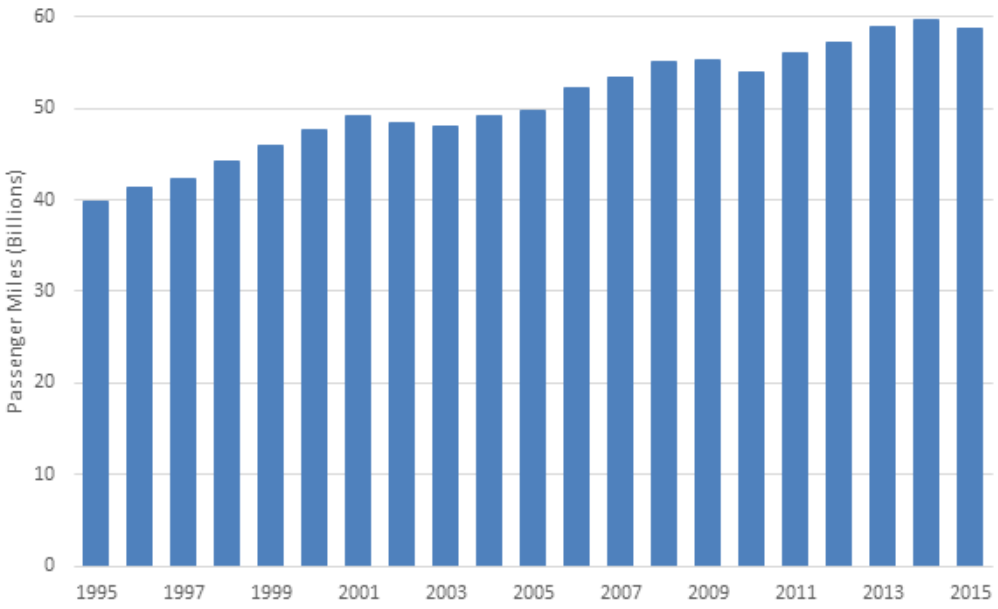


Table 2: Urban Bus Public Transit Conditions up to 2010

	2000	2002	2004	2006	2008	2010
Average Condition Rating	3.5	3.3	3.5	3.5	3.3	3.2
Total Buses and Vans						
Total Fleet Count	78,814	88,645	91,012	92,674	103,485	105,579
Weighted Average Age (Years)	6.5	6.2	6.0	6.0	6.1	6.1
Weighted Average Condition Rating	3.3	3.2	3.3	3.3	3.1	3.0
Below Condition 2.50 (Percent)	10.2%	11.8%	10.6%	10.4%	12.0%	10.5%

Source: National Transit Database (NTD). This is the most recent data available.

Table 3: Urban Rail Public Transit Conditions Up to 2010

Urban Rail Fleet Count, Age, and Condition, 2000–2010

	2000	2002	2004	2006	2008	2010
Total Rail						
Total Fleet Count	17,148	18,813	19,623	20,251	20,715	21,062
Weighted Average Age (Years)	21.7	20.4	19.5	19.3	20.1	18.9
Weighted Average Condition Rating	3.5	3.5	3.5	3.6	3.5	3.5
Below Condition 2.50 (Percent)	6.0%	4.6%	4.1%	3.6%	4.2%	3.6%

Source: Transit Economic Requirements Model and National Transit Database. This is the most recent data available.

When public transit conditions are maintained at only the marginal, and not the fair standard of 2.5 on the scale of 1-5, systems not only forego many of the amenity impacts described in Section 1.2; they also risk compromising the reliability and accessibility of places served by public transit. Service interruptions impose direct productivity costs on U.S. businesses in addition to the competitive, and other, losses incurred if infrastructure is unable to perform. For example, in January 2015, the Washington Metropolitan Area Transit Authority (WMATA) experienced a tunnel fire, which resulted in the death of one person. In March 2016, WMATA had another fire which caused more than a full day of lost service for the 700,000+ daily passengers dependent on the system. In October 2017, the New York City Independent Budget Office published a financial brief documenting that "the dollar value of the hours lost to [MTA subway] delays on a typical workday morning is about $1.2 million a day, or $307 million annually" and, "the average number of delays in a month has increased dramatically, from about 20,000 a month in 2012 to more than 67,450 in May 2017."

Figure 8 demonstrates how the long-standing trend in investing in public transit to sustain only the marginal SGR has not significantly increased the mean distance between service failures, with the distance actually declining in many years.

Compromises in the SGR for public transit vehicles affect the economy through:

(1) Lost productive time for workers accommodating failures of the type shown in Figure 8;

(2) Business costs incurred by firms making alterations when such failures occur;

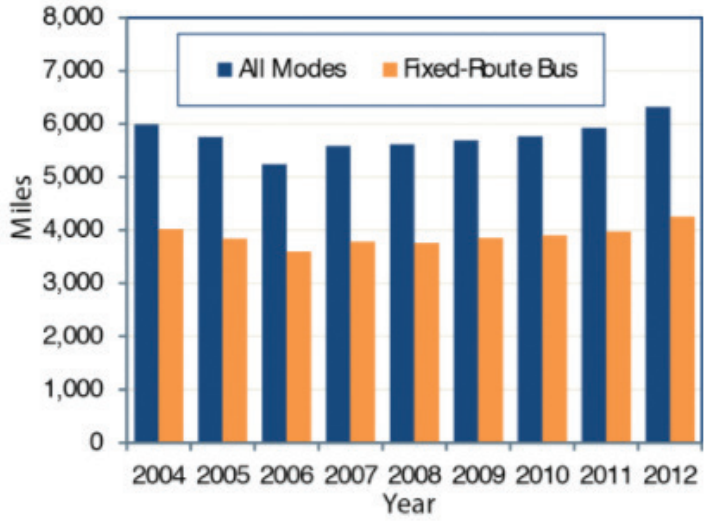
(3) Additional costs imposed when second-best solutions must be employed during a failure; and

(4) Reduced business economic activity, collaboration and economic growth occurring when U.S. cities and business districts are unable to sustain the type of activity attracted and retained by public transit (as described in Section 1.2).

What is at Stake: Jobs, GNP and Business Sales

Consistent with the above observations of how the USDOT's minimum standard for SGR as 2.5 or better on a 1-5 scale overlooks many of the investment needs of America's public transit fleets, the 2015 Bottom Line Report recommends a $46.9 billion (in 2012 dollars) annual investment for a six-year period to both (1) arrive at an appropriate SGR at which public transit systems can achieve the agility and quality needed to serve their potential competitive role in today's economy and (2)

Figure 8: Mean Distance Between Failures, Directly Operated Service, 2004-2012



Source: 2015 Status of the Nation's Highways, Bridges, and Transit: Conditions and Performance

expand to meet market growth. This is significantly more than the $19 billion associated with continuing at the marginal/fair standard which has persisted to date.

Given the projected trend in public transit funding of only $18.5 billion/year (in 2012 dollars), six years of annual investment at the $46.9 billion level would require an additional $170.4 billion of total public transit investment from 2017-2023. That spending would result in more than 162,000 permanent jobs, $180 billion in additional U.S. GNP and over $340 billion in additional business sales. (See methodology on page 11.)

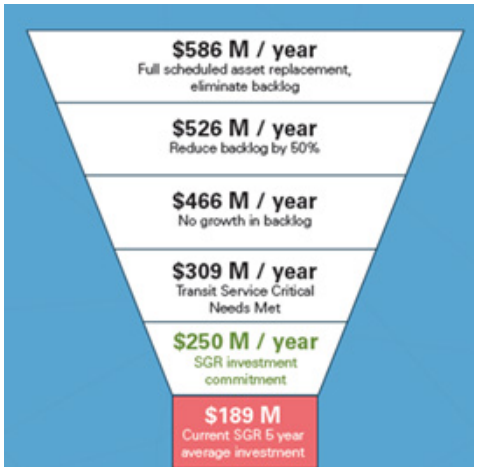
3. Unmet Needs of Public Transit Systems

Despite evidence that the condition and quality of America's public transit infrastructure is more crucial to the nation's economic performance than ever before, U.S. operations continue to struggle to maintain the status quo with marginal or barely adequate assets. To understand the investment needs to enable transit operations to achieve the level of quality, agility and competitiveness envisioned in the previous chapter, it is helpful to assess how public transit agencies cope with today's infrastructure. Understanding how agencies comprehend and respond to unmet investment needs affecting their SGR can lead to an appreciation of why investment is needed and what America's public transit organizations can achieve when appropriate investment is made available.

This chapter explores how the following six public transit agencies are both becoming aware of, and coping with, their current SGR, and both the risks and opportunities they face with respect to investment in existing infrastructure. Public transit agencies from throughout the U.S. were given an online survey and these representative legacy systems demonstrated issues of the types represented.

- San Francisco Municipal Transportation Agency (SFMTA)
- Southeastern Pennsylvania Transportation Authority (SEPTA)
- Massachusetts Bay Transportation Authority (MBTA)
- Metropolitan Atlanta Rapid Transit Authority (MARTA)
- Washington Metropolitan Area Transportation Authority (WMATA)
- Chicago Transit Authority (CTA)

Figure 9: Funding Scenarios for SFMTA



3.1 San Francisco Municipal Transit Agency

SFMTA is responsible for LRT, bus, cable car, historic trolley, as well as paratransit services, parking, street signals and taxi regulation in the city of San Francisco. The fixed route services are referred to as MUNI. Like many U.S. public transit operations, MUNI implements an asset management program consistent with the FAST Act requirements in collaboration with a separate Capital Budget Division within the agency and the planning division, which addresses MUNI's SGR needs within the context of its 20-year capital planning process. In addition to including SGR improvements within the context of MUNI's five-year Capital Improvement Program (CIP), the agency publishes an annual SGR report.

Investment needs and priorities for Transit SGR

SFMTA currently carries a backlog of $2.41 billion in SGR investment needs and a total asset replacement value of $13.6 billion in 2016. In 2010, SFMTA made a commitment to the FTA to spend $250 million annually on addressing its SGR needs. Spending averaged $189 million per year from 2011-2015 but has been rising in recent years. The 2017-2021 CIP contains $1.7 billion for SGR projects, including replacement of significant portions of the bus and LRV fleets. This much higher investment level will still result in a gradually increasing backlog according to current estimates. **Figure 9** shows the 20-year spending scenarios in SFMTA's 2016 SGR Report.

Both of SFMTA's electric trolley bus garages are beyond their useful life and susceptible to an earthquake. Complete replacement, combined with above ground joint development, has been proposed. These two facilities account for more than 40 percent of SFMTA's rubber tire fleet. At least two other garages—one streetcar and one diesel bus—are beyond useful life. However, according to the 2014 Fleet Plan and Addendum to the Facility Plan, these SGR projects will be delayed to prioritize fleet expansion, which requires a new garage.

Every two years, SFMTA develops an unconstrained 20-year capital needs plan addressing overall investment needs in each SFMTA program (as shown in **Figure 10**). In this process, existing facilities (such as structures, stations, parking and other non-vehicle, non-track elements) have often been among the most neglected assets in the system as they are not deemed "public

Figure 10: SFMTA Capital Programs Related to SGR

Investment needs categorized as asset classes and capital programs, prioritized into transit service critical and other State of Good Repair needs

	Asset Class	Capital Program
Transit Service Critical	Light Rail Vehicle Motor Coach Vehicle Overhead Catenary System Track Train Control & Comms Trolley Coach Vehicle Other Systems / Vehicles	Transit Fixed Guideway Fleet Communications / IT
Other SGR	Facilities Parking & Traffic Stations Other Systems / Vehicles	Facility Streets Security Traffic & Signals Parking Transit Optimization / Exp
Non-SGR		Central Subway Taxi

transit service critical." However, there is some fear that their deferred maintenance and renewal could eventually lead to unforeseen deficiencies or costs as some exceed 100 years of age. SFMTA has issued a Facilities Framework to address the issue.

The Challenge of Defining and Measuring SGR Effects in the SFMTA Context

While SFMTA is aware of its SGR backlog and that many of its facilities are not covered by its current investment resources, the agency is still working to understand how these issues affect the system's economic potential and the competitiveness of the Bay region. SFMTA has a formal definition of SGR which "refers to the condition in which an Agency's capital assets are able to operate at a full level of performance." This means they can meet service demands in a safe and efficient manner. To address SGR needs, MUNI has maintenance teams that respond to emergent short-term challenges in getting service running to meet demands (responding in "real time" to potential and emerging service needs associated with infrastructure conditions). MUNI has enjoyed some marginal increases in funding for preventative maintenance, which makes this effort somewhat easier and more economical, but not at a level that frees up resources to fundamentally change the scope of MUNI's overall operation.

The FAST Act FTA asset management regulation has provided leverage to explicitly address SGR issues when setting priorities, enabling the agency to look beyond the current process of "putting out fires" and look forward at SGR needs over the long-term. While there are a host of potential SGR measures available in FTA's guidance and five-point system, most of SMFTA internal tracking is age-based. The agency uses a database of approximately 3,750 assets and their ages within the context of "TERM-lite" [the Transit Economic Requirements Model (TERM) similar to the one cited in Chapter 2, made available at the local public transit agency level] to quantify its SGR backlog on an ongoing basis.

To ensure that even older assets, or those in marginal or adequate condition can perform with minimal service interruptions, SFMTA has specific asset condition standards and an inspection schedule generally based on the age of the asset. Effectively, the older the asset mix, the more preventative maintenance and inspection frequency is required, adding to the share of agency resources committed to maintaining the status quo. Across the system as a whole, the on-time performance of SFMTA service is the key metric used to retrospectively evaluate how effective the preventative maintenance has been.

MUNI is aware that the SGR status of its assets affects what the agency can do in ways that are subtler than affecting on-time performance, and is currently developing new methods and capabilities to demonstrate the effects of asset conditions on operating and emergency maintenance costs. However, the tools and frameworks for these measures are not yet in place. The agency anticipates a new enterprise asset management system will enable at least some progress in this regard.

Because MUNI absorbs the costs of its older and marginal or adequate (as opposed to "good") public transit assets through its internal inspection and preventative maintenance regimes, it has been difficult for the agency to quantify or envision how its current costs or user performance outcomes might be different if the agency experienced a "good" or "very good" SGR among all of its assets. This lack of a clear understanding of the incremental costs of unmet SGR needs has made

it difficult to address SGR as a programmatic investment issue within the context of long-range multi-modal planning (both in terms of the benefits of SGR funding and the potential expanded scope and reach of what MUNI can do given better and easier-to-operate equipment).

Business Perspective on SFMTA's SGR Needs and Implications

The business community in the San Francisco Bay area has a strong interest in the ongoing performance of MUNI, BART and other systems in the Bay Area, as approximately 21 percent of the region's workforce uses public transit daily and earnings amount to $17.3 billion per year (according to U.S. Census data combined with SFMTA and BART ridership statistics). Moreover, public transit plays a disproportionate role in the region's most competitive industries, with 24 percent of the region's transit commuters supporting the highly competitive science and technology industries; 17 percent supporting the region's education and health care industries; 14 percent supporting entertainment and related services; and 10 percent supporting the finance, insurance and real estate sectors. The business community sees the importance of public transit as extending beyond simply managing today's assets to preparing for future economic activity.

Because San Francisco's urban geography is contained by natural barriers, economic developers in the Bay Area view public transit SGR as a more critical issue for SFMTA than the actual extent of service. For this reason, in November 2016 there was widespread support within the business community for a funding initiative that would have specifically addressed the condition of public transit infrastructure in San Francisco. While this initiative did not pass, a larger regional public transit preservation funding initiative for the Bay Area Rapid Transit (BART) called Measure RR was successful. Measure RR, which will raise $3.5 billion for BART trackway, station, and earthquake retrofitting improvements, passed in part because of its promise to improve system reliability and create a more prosperous region.[1]

The resurgence of the Bay Area economy after the last recession has led to record ridership on both BART and CALTRAIN, which when combined with the absence of available parking in business districts throughout the Bay Area, led the business community to see a considerable vulnerability associated with the risk of system failure. This perceived vulnerability was instrumental in business needs driving much of the support for the BART preservation initiative.

In interviews, local economic developers also cited the secure preservation of both MUNI and BART infrastructure as essential to sustaining the development capacity of San Francisco proper. The city today houses 100,000 more people than it did only 10 years ago, with new housing developments with less than one car of parking capacity per housing unit (60 percent of San Francisco's workforce commutes daily by public transit or rideshare). Business recruiters and land brokers have been quick to point out that while the quality of life in San Francisco is a draw for the target workforce, the world class amenities of downtown are quickly eroded if they are paired with unreliable public transit access to and from affordable neighborhoods.

Lessons Learned

San Francisco and the larger Bay Area demonstrate that public transit SGR, including the condition and performance of infrastructure, is becoming of greater

1 *Bay Area Rapid Transit.* https://www.bart.gov/news/articles/2016/news20161109.

interest to the business community. As agencies like SFMTA and BART contemplate their current cost structures and the risk to their performances from different SGR conditions, there is a growing opportunity for increased benchmarking and dialogue with the business community on the role of public transit in the region's economy. Groups like the San Francisco Planning and Urban Research (SPUR) think tank, the San Francisco Chamber of Commerce and the Silicon Valley Leadership Group are well-positioned to take advantage of the growing awareness of public transit SGR resulting from the FAST Act's asset management compliance. These groups can also identify new and competitive standards and strategies to leverage public transit conditions to enhance economic competitiveness for the Bay Area.

3.2 Southeastern Pennsylvania Transit Authority

The Southeastern Pennsylvania Transit Authority (SEPTA) is responsible for services throughout Bucks, Chester, Delaware, Montgomery, and Philadelphia counties including regional rail, trolley lines, high-speed lines, buses and special connectors. The regional rail system provides a direct connection to Philadelphia International Airport.

Investment Needs & Priorities for Transit SGR

SEPTA is currently in the process of assessing its SGR backlog in light of current public transit asset management planning. The agency has been able to decrease its backlog somewhat since SEPTA reported $5 billion in 2014. In 2013, SEPTA was spending about $200 million per year and had a rapidly growing backlog. Roughly $330 million was necessary to maintain current backlog levels and $652 million was estimated to be enough to eliminate the backlog within 20 years. SEPTA negotiated a funding increase with Pennsylvania to provide about $500 million to begin addressing assets in the worst condition.

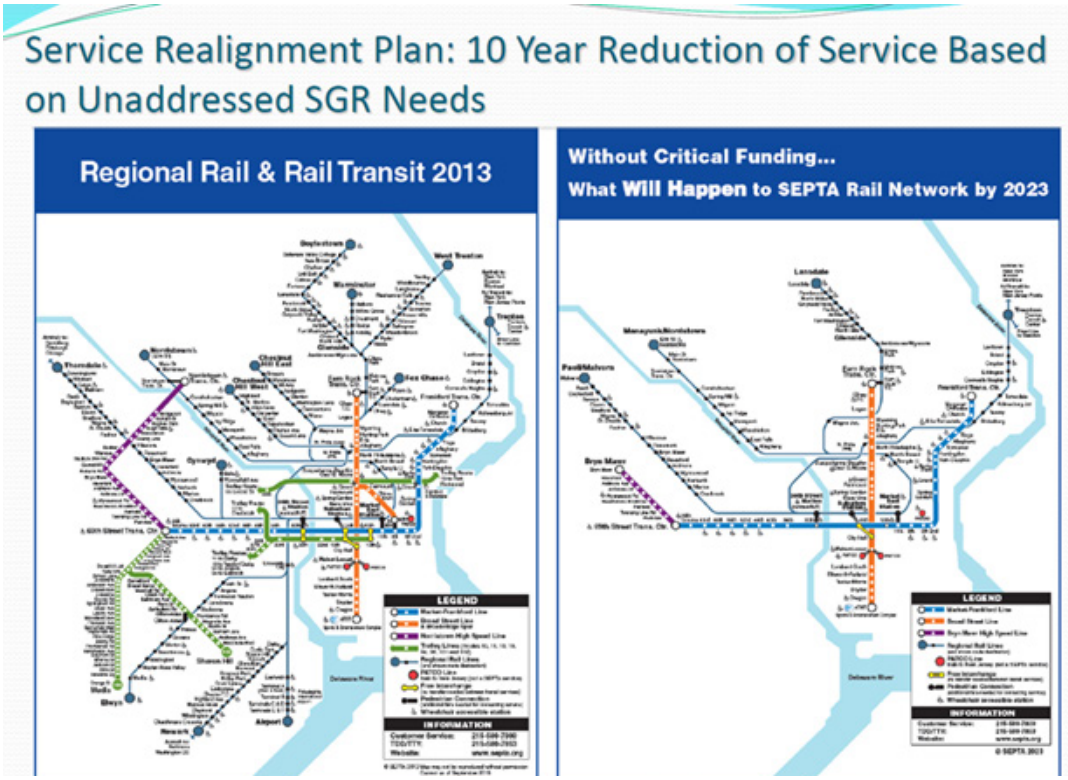
For SEPTA, making the case for SGR funding required getting beyond simply discussing the size of the backlog to showing both the public and lawmakers how the SGR backlog might ultimately result in service cuts. When advocating for SGR funding, SEPTA used photos of some of the infrastructure in very poor condition to show people what SGR backlog actually meant. **Figure 11** shows how SEPTA demonstrated the case for funding by showing how unmet SGR needs could affect SEPTA's offerings in the long-term.

The Challenge of Defining and Measuring the Effects of SGR for SEPTA

SEPTA defines maintaining and managing the SGR of its assets as core to the agency's mission. Instead of system expansion, during the last few decades SEPTA chose to focus capital resources on inspections, maintenance and capital renewal. The capital program also involves addressing core capacity and climate adaptation, and creating innovative partnerships to secure funding for new projects. Like most public transit agencies faced with operating aged infrastructure, a key to SEPTA's success is preventative maintenance and applying significant resources at the right times to avoid failures affecting the user experience.

While SEPTA is extremely proficient at devoting efforts and resources to make the system work, the age and SGR needs remain the dominant factor driving the agency's priorities and performance. Deferring SGR projects adds to inspection costs since SEPTA increases the frequency for assets in poor condition. In general, there can be higher lifecycle costs if assets are not replaced at the optimal times.

Figure 11: SEPTA Analysis showing potential long-term service implications of SGR shortfalls



SEPTA has begun to utilize a decision-making tool to identify SGR needs based on asset age, condition, and performance. It has a rigorous condition inspection program, with some assets being inspected daily and others weekly or monthly. After identifying needs, solutions are prioritized based on cost effectiveness and operational impact. SEPTA utilizes performance-based tracking based on failure analyses, for example, related to signal failure.

The internal programming process is not asset based. SEPTA does not say that "vehicles are going to get 30 percent of funding." Rather the agency looks at the system as an "organism." SEPTA works hard to synchronize multiple projects within the corridor for completion at one time. An example of this is completing work on track and power while installing positive train control on a corridor. Vehicles will be a major part of the program for a couple years since they accounted for more than 40 percent of the $5 billion backlog in 2014.

Ideally, SEPTA would be able to allocate all funding toward assets in the worst condition, but in reality, needs are slotted in where they fit with scheduled construction. This allows for economies of mobilization and is superior from the customer's perspective because it minimizes service disruptions. However, if an asset is in truly poor condition, it will be addressed immediately without considering project schedules and tradeoffs.

SEPTA understands a successful management and investment strategy to be ensuring the customer experience is minimally affected or unaffected by the age and status of the infrastructure. On the regional rail system, where ridership has increased by 50 percent over the last 15 years, SEPTA has spent a significant amount of money on OCS replacement, signal

upgrades, and station improvements. This demonstrates how successful SEPTA has been at supporting a growing public transit market without significant new infrastructure, in part through its SGR management.

Finally, SEPTA receives input that it considers related to SGR from riders. Social media has increased feedback. SEPTA also conducts a customer satisfaction survey once or twice a year, and has focus groups for young riders, riders with disabilities, and the general rider population. These groups meet monthly and provide testimony before SEPTA's board. The most important issues for constituents are vehicle, station and pavement conditions.

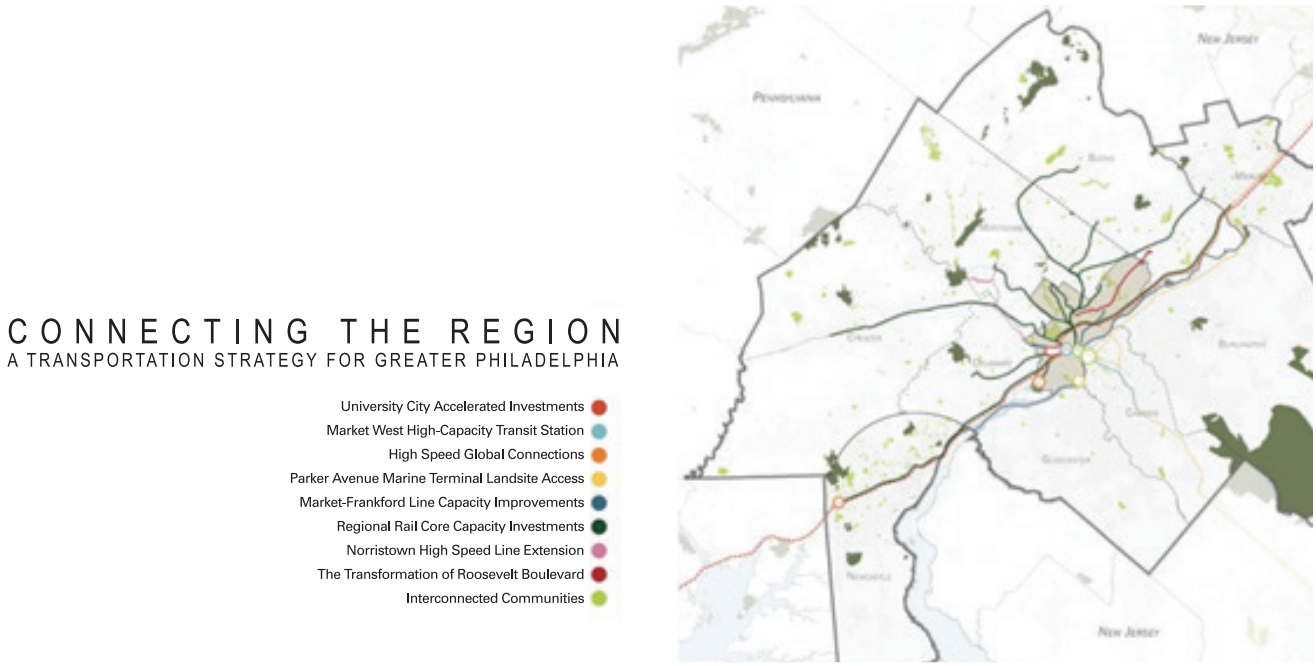
Business Perspectives on SEPTA's SGR Needs and Implications

The Philadelphia region's business community is highly dependent on the state of good repair, as public transit carries 14 percent of the region's workforce. Transit commuting accounts for more than $8 billion per year in earnings (according to U.S. Census data combined with SEPTA ridership statistics). Moreover, public transit plays a disproportionate role in some of the Philadelphia region's most competitive industries, with 31 percent of transit commuters supporting the region's education and healthcare sectors, and 15 percent participating in the Philadelphia region's professional, technical and scientific firms.

While SEPTA is highly effective at leveraging its available funding to maintain performance standards with its given level of SGR, the southeastern Pennsylvania business community envisions an even wider role for public transit in the economy. The CEO Council for Growth is a group of business, higher education, and civic leaders who commit their time and efforts to enhancing economic growth and prosperity in the 11-county region across northern Delaware, southern New Jersey and southeastern Pennsylvania. The council is an initiative of the Chamber of Commerce for Greater Philadelphia influencing regional and national policy through advocacy. It has put forward a transportation growth strategy, "Connecting the Region." The aim of the strategy has been to identify the most transformative transportation investments—each achievable within a 10-year period—that will best attract investment and enable growth throughout the region. While improving system efficiency (access and reliability are the main objectives of the strategy), business advocacy has also focused on the need for upgrading technology, expanding, and re-configuring service to be more responsive to shifting markets. **Figure 12** shows areas where the council envisions enhanced, new or expanded transportation corridors serving the region.

The business priority most directly related to SGR is the improvement of SEPTA's regional rail system capacity with a focus on strengthening connections, improving frequency and reliability, and enhancing access throughout the region. This envisioned investment in "core services" would entail procurement of bi-level electrical multiple units, expansion of the Wayne Maintenance Facility, and other expansions. However, much of the business focus is on expanding and re-configuring the region's public transit system to address growing markets. Extending trolley service to the airport; additional capacity for SEPTA's Market-Frankford line (MFL)—including new rail cars and a rail extension; enhancement of the 30th Street SEPTA headhouse and passageway and the intercity bus terminal; the addition of a new SEPTA MFL station between the existing 15th Street and 30th Street stations; and the expansion of SEPTA's Norristown High Speed Line (NHSL) to the

Figure 12: Areas where the CEO Council Envisions Expanded or Enhanced Services (Source: CEO Council for Growth)



King of Prussia business district are all public transit priorities.

However, as has been documented, even with the recently enhanced SGR funding, the age and condition of SEPTA's existing infrastructure and the size of SEPTA's SGR back-log requires that the agency focus on existing services rather than on new opportunities and services envisioned by the business community.

Lessons Learned

SEPTA demonstrates how even with limited systems and data for directly tracing the costs of SGR deficiencies to existing users, a public transit agency can make an effective case for SGR funding by connecting the costs of aging and marginally sufficient infrastructure with the long-term sustainability of public transit service. Furthermore, as SEPTA's tracking of SGR needs, backlog and connections to the user experience become more comprehensive, the agency is in a position to continue to articulate the case for SGR investment. Failings in an agency's SGR will limit its ability to respond to growing market and business demands through modernization and expansion.

3.3 Massachusetts Bay Transportation Authority

The MBTA, often called the "T," is responsible for operating public transportation services in Greater Boston, Massachusetts. It became a division of the Massachusetts Department of Transportation (MassDOT) in 2009. The MBTA and SEPTA are the only public transit agencies that operate all modes available in the U.S.: light rail (MBTA's Ashmont–Mattapan High Speed and Green Lines); heavy rail (the Blue, Orange, and Red Lines); regional rail (the Commuter Rail); electric trolleybus (the Silver Line); and paratransit bus (MBTA Bus).[2]

2 "Media Guide" *(PDF). SEPTA. 2012. Retrieved 2012-12-21.*

Investment Needs and Priorities for Public Transit SGR

According to MBTA's April 2017 Strategic Plan, The MBTA has nearly $25 billion of physical assets including vehicles, bridges, track, tunnels, stations, signals and power systems, elevators and escalators, and communication equipment. In 2015, nearly one-third of these assets were not in a SGR, as scored according to age and percent of useful life remaining, condition, and performance. The backlog, defined as the amount of investment required to move all assets into SGR, was estimated at $7.3 billion, an amount that was unquestionably understated since it did not include some components of the commuter rail system, and other key assets. These estimates are on track to be updated with the full implementation of the Asset Management Information System by December 2020. There is a direct correlation between asset condition and service reliability, maintenance costs, day-to-day operational challenges, and customer experience. While capital funding was not adequate to address the SGR backlog, the funding that was available was not entirely utilized. Of the $5.1 billion of capital spending planned between 2011-2015, only $2.7 billion was actually spent. The highest priority for MBTA infrastructure is building the capacity for capital delivery.

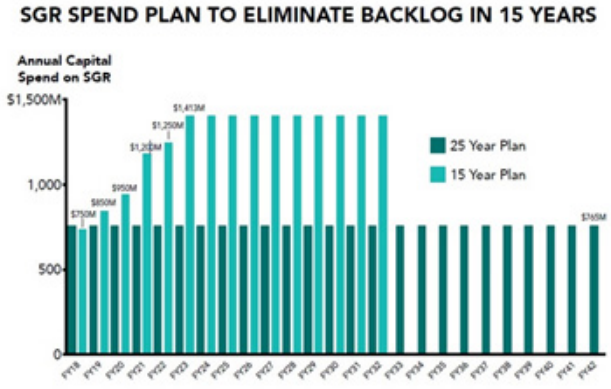
In its strategic plan, MBTA proposes to increase funding to clear the agency's SGR backlog in 15 years instead of 25 years by ramping up SGR funding to more than $1.4 billion annually by fiscal year 2023, as shown in **Figure 13**. The strategic plan is a result of a two-year effort beginning in 2015 in the wake of service interruptions largely attributable to long-standing SGR challenges exacerbated by the extreme inclement winter weather conditions.

Challenges of Defining and Measuring Public Transit SGR

While many public transit operations use age as a proxy for SGR, MBTA owns some of the oldest infrastructure in the nation, with most assets well past their useful life based on age measures alone. SGR is especially an issue for structures and buildings, even more so than vehicles, which are more visible and often addressed sooner. Very significant portions of MBTA's buildings (stations, maintenance facilities, and storage yards/garages), power plants, signal systems, and right of way need to be addressed by the SGR program. Unlike many public transit operations, the Boston community has long expected MBTA to be continually expanding or reconfiguring its service in response to changing socio-economic and market demands. As mentioned in previous chapters, SGR repair is an important prerequisite to being able to fulfill any of those needs.

SGR at its core is about reliability – so that service is running on schedule, when riders need it, and all infrastructure is available to meet those needs. The 2015 winter service failures provided MBTA with a highly visible example for measuring and demonstrating the

Figure 13: MBTA Proposal to Resolve Backlog in 15 Years (Source MBTA 2017 Strategic Plan)



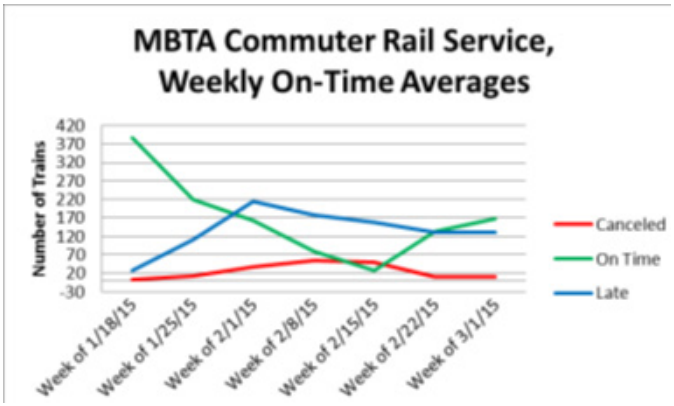
Note: Dollar figures shown above are 2015 dollars and uninflated (future update will include inflation). SGR backlog assumption based on 2015 assessment of $7.3B SGR backlog.

risks associated with underinvestment in public transit SGR. A succession of extreme winter weather events in 2015 led to a near collapse in MBTA's ability to perform on-time or to recover its performance in any predictable period of time, raising public awareness about the cost of deficiencies and the risks imposed by MBTA's pre-existing SGR. **Figure 14** demonstrates MBTA's on-time performance through the winter incidents in 2015. Similar effects occurred on MBTA's bus, barge, shuttle and subway services. The weather events significantly affected MBTA public transit equipment, resulting in the following impacts[3]:

- On the subway, snow and ice covered the third rail, resulting in power loss to trains.
- Heavy rail and commuter rail switches failed after being covered by snow; switch heaters could not keep up with snowfall.
- Vehicle doors became frozen shut by ice.
- Ice and snow covered commuter rail train brakes, delaying regular inspections.
- Fine snow dust became stuck inside commuter rail traction motors, causing failures.
- Packed ice and snow along commuter rail brake rigging, underframes, and electrical connections made it difficult to connect trains and caused service failures.
- Roadway salt caused commuter rail grade crossings to fail, resulting in delays.

In addition to the $40 million of direct costs the MBTA incurred due to lost revenue from service failures and recovery costs during the 2015 events, there were also consequences for the entire metropolitan Boston economy. A survey of local employers from Boston's "A Better City" group found that 96 percent of responding businesses had directly experienced MBTA subway service disruptions, 92 percent had experienced poor roadway conditions, 88 percent had directly experienced disruptions in commuter rail service and 85 percent experienced disruptions in MBTA bus service.[4] Additionally, 88 percent of businesses responding indicated impediments getting employees to work as the most significant concern associated with the failures.

Figure 14: MBTA Commuter Rail Performance Through 2015 Winter Events (Source: A Better City "2015 Severe Winter Weather Impacts – Attachment A")



These challenges led to SGR becoming MBTA's top priority. After having a complete failure of infrastructure, the region was motivated to recognize that SGR deficiencies needed to be fixed ahead of any other priorities. The system failures enabled Boston's public transit community to communicate the importance of SGR investment in providing service to the region. MBTA used the 2015 failures as an opportunity to bring in outside agencies and SGR leaders to discuss how others have dealt with the risks and challenges faced by MBTA. MBTA has continued to work with peer agencies to share lessons learned and communicate the improvements they have been making. Since 2015,

3 *Attachment A: 2015 Severe Winter Weather Pattern Impacts - Supplemental Information. March 27, 2015. Massachusetts Emergency Management Agency.*

4 *A Better City "The Impact of this Winter's Weather on ABC Members." March 2015.*

the agency has invested more than $101 million in capital improvement projects that will make the system stronger when severe weather occurs again. Projects included upgrading track and signals, acquiring snow-fighting equipment, and adding propane heaters and covers to existing infrastructure.[5]

These events came just as federal transportation law was providing impetus and guidance regarding the effective management of public transit assets in the long-term. In addition to requirements raised by the 2015 experience, MBTA's Asset Management Program is inspired by FTA's Transit Asset Management final ruling that came out of the MAP-21 rulemaking process. The program uses risk-based methodologies that are a completely different way of thinking about how an agency delivers its services. The goal of operating under an asset management paradigm is to maintain assets to a level where they can perform optimally. One MBTA manager has commented that "95 percent of the work needed for good asset management is understanding risks, while only 5 percent is about strategic investment decisions," emphasizing the importance of appropriate data and intelligence on asset conditions to manage and improve SGR in the long-term.

MBTA's approach to SGR today is understanding (1) what MBTA has in terms of assets; (2) where the assets are located; and (3) what condition the assets are in. MBTA has placed heavy emphasis on condition measurements, mostly discounting age-based methodologies as not viable for their set of assets. Like most agencies, MBTA utilizes visual inspections but is working very hard to move to a functional monitoring paradigm. With functional monitoring, MBTA hopes to mathematically derive the probability of failure for different assets. This is relatively straightforward for trains and buses, for which performance data for specific assets is available. It is a much more complicated issue to develop decay and failure formulas for assets like right of way and buildings.

MBTA has come to realize that SGR is related to customer experience, not just due to the example provided by the 2015 winter storm failures, but in terms of passenger reliability moving forward. Even in the face of this experience, MBTA staff cite the importance of quantifying and keeping the SGR status, investment need and its implications in front of decision makers, as it is the type of need that often only presents itself in crisis situations when options for recovery are limited. MBTA hopes that other agencies can learn from its experience and use the FAST Act public transit asset management paradigm to track, report and raise awareness of SGR needs and their impact before other cities experience what Boston did.

Business Perspectives on MBTA SGR Needs & Impacts

The business community in the Boston region has a strong interest in the ongoing performance of the MBTA as effectively 21 percent of the region's workforce uses public transit on a daily basis earning over $12.2 billion per year (according to US Census data combined with MBTA ridership statistics for the areas directly served by MBTA). Moreover, public transit plays a disproportionate role in the region's industries accounting for the area's competitiveness, with 27 percent of transit commuters supporting the region's highly competitive education and health care industry; 20 percent supporting scientific, managerial or technology firms; 14 percent in entertainment and related services; and 12 percent in finance, real estate and insurance. Hence, the fact that MBTA is able to operate on a daily basis as it exists today

5 *Progressive Railroading*. http://www.progressiverailroading.com/passenger_rail/news/MBTA-outlines-101-million-in-winter-resiliency-efforts--53216.

is critical to the ongoing vitality of the regional economy. The business community sees the importance of public transit as extending beyond simply managing today's assets to the potential of future growth and economic activity.

As described in the previous section, Boston area businesses reported extensive difficulty with workforce accessibility during the 2015 failures, and the business community took a prominent role in the development of the 2017 strategic plan, with groups like A Better City and the Boston Chamber of Commerce participating directly in the input and review of the plan. While in other regions business interests have often focused on SGR primarily as a pre-requisite to expanded or enhanced service in new areas, the Boston business community places a strong emphasis on SGR issues such as on-time performance, reliability and infrastructure quality as having a direct impact on the business environment.

In reviewing the MBTA strategic plan, Boston Chamber of Commerce CEO James Rooney observed that in the first quarter of 2017 seven of the MBTA's 14 commuter lines were late 20 percent or more of the time during peak service. As indicated above, the MBTA strategic plan proposes acceleration of clearing the SGR backlog from 25 to 15 years, however the Boston Chamber CEO proposed a goal of speeding the backlog removal to as little as 10 years with a more aggressive funding schedule. He also advocated for the modernization of software and attracting more managerial and technical expertise so that MBTA can be a global leading organization.

For these reasons, business groups in Boston have strongly articulated the desire for a stable and committed source of both SGR and expansion funding in the long term. There is widespread business support for increasing MBTA's ability to generate own-source revenue through advertising, parking and real-estate development, but also significant appetite for discussions about other dedicated sources of revenue to make the 10-year resolution of MBTA's SGR backlog a reality.

Lessons Learned

The MBTA provides an instructive example of the risks that long-standing, legacy public transit agencies take when operating with aged assets in marginal or merely adequate condition. In interviews, MBTA staff and business stakeholders alike view the 2015 experience as a turning point in MBTA's SGR investment paradigm from a business process focused on "putting out fires" and simply enabling antiquated public transit assets to function, to a process focused on resilience and strategic intelligence on the quality of public transit assets and their economic impact. This resulted in a significant cost to the Boston region's businesses and residents in the form of lost wages, productivity and efficiency in 2015. Furthermore, it is still unclear whether and how MBTA will arrive at the needed revenue to achieve its 15-year objective of resolving its SGR backlog, much less the more aggressive 10-year objective advocated from within the business community. Perhaps the most significant question raised by the Boston experience is whether other legacy systems—or the U.S. as a whole—will be able to benefit from Boston's experience to make strategic SGR investments over time within the context of the MAP-21 and FAST Act asset management regime.

3.4 Metropolitan Atlanta Rapid Transit Authority

MARTA's assets include heavy rail rapid transit and bus transit routes operating in Georgia's Fulton, Clayton and DeKalb counties. MARTA serves both Atlanta and its

suburbs of Alpharetta, Avondale Estates, Brookhaven, Chamblee, Clarkston, College Park, Decatur, Doraville, Dunwoody, East Point, Ellenwood, Fairburn, Forest Park, Hapeville, Jonesboro, Lake City, Lovejoy, Lithonia, Morrow, Palmetto, Riverdale, Roswell, Sandy Springs, Stone Mountain, and Union City. MARTA also directly serves Atlanta's Hartsfield-Jackson International Airport.

Investment Needs and Priorities for Public Transit SGR

MARTA views itself as one of America's leading public transit organizations with respect to quantifying, measuring and strategically managing its assets. MARTA not only seeks to be pro-active enough to anticipate long-term SGR needs and invest accordingly, but also to manage the impacts that asset age and condition has on its ability to perform and respond to change over time. MARTA's current backlog varies as projects occur, but in recent years consistently has been close to $2.2 billion in needs for the entire agency. MARTA's management tracks its asset preservation backlog on an ongoing basis not only in terms of the cost to prospectively bring all assets into a desired SGR, but also in terms of the costs it imposes on MARTA's long-term sustainability. A vital SGR question cited by management as integral to MARTA's understanding of its backlog is whether MARTA "can break-even and perform while carrying its current backlog."

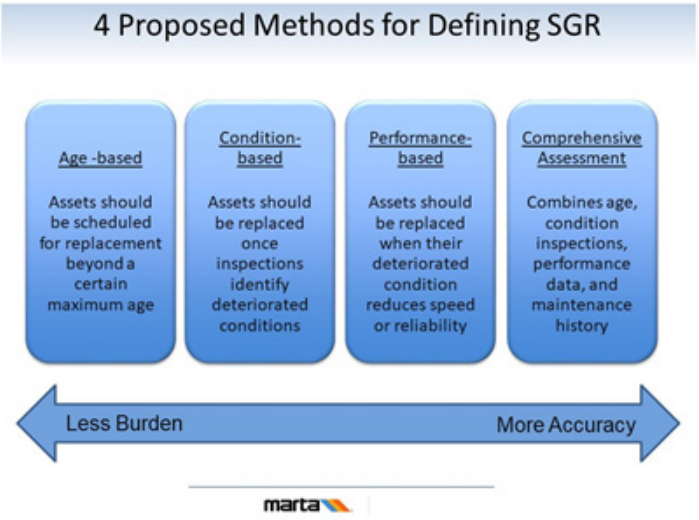
By tracking its asset conditions and the relationship of its capital outlays and overall SGR over time, MARTA has learned about the significant lag time from making capital investments and enjoying any of the efficiency or other results from SGR investments. For example, it takes six years from the time of investment commitment to get new rail cars online. Consequently, MARTA acknowledges that it must make its investments in rail cars years before the cars currently in operation may need replacement. MARTA has learned that tracking its backlog is not only a way of understanding how much investment is needed to achieve a given SGR, but of understanding when the investment must occur to minimize the cost and risk of failing to meet a target.

While carrying its approximately $2.2 billion backlog, MARTA spends approximately $3.1 billion over a 10-year period on its capital program. An asset is considered to have entered the backlog when it has been identified as an investment need based on MARTA's investment criteria. Unlike some other agencies, MARTA defines its backlog not solely in terms of existing assets due or past due for replacement or upgrade, but also to include capital assets needed to support planned future expansion. In this way MARTA does not distinguish the SGR issue from the issues of agility, modernization or responsiveness to emerging markets as described earlier in this report, but rather tracks one cohesive backlog for all investment types (preservation, modernization and expansion).

MARTA has a longer track record than most public transit agencies of its size in the use of models to look at investment levels. The agency understands both preservation/SGR and modernization or expansion needs in relation to funding capacity with prioritized investments, with the value of investments "above the line" (defined as within the current funding capacity) equal to the value of investments "below the line." Before committing (or borrowing) funding for any new, modernized or expanded service, MARTA must be ready to fully execute the intended service when the asset becomes available. For example, if it takes 50 weeks to build a bus and 6-8 months to procure one, MARTA must make significant efforts to commit funds for buses within about one-and-a-half years before they will be needed.

When it comes to prioritizing public transit assets for investment, replacement or rehabilitation, MARTA typically invests first in the oldest assets or the assets shown to be in the lowest condition on FTA's five-point scale described at the outset of this report. Scores on the five-point scale are assigned based on inspections which assess the remaining useful life of each asset in MARTA's inventory. As MARTA becomes aware of SGR issues that may be affecting the speed or reliability of the system, its policy is to initiate inspection, maintenance and testing so as to have no measurable adverse impact on user experience.

Figure 15: Types of Performance Indicators Used by MARTA



Challenges of Defining and Measuring the Effects of MARTA's SGR

MARTA defines the SGR for its assets in terms of Age, Condition, Performance and Priority, all of which are based on the five-point system offered by FTA. Conceptually, these indicators are intended to capture the ability of equipment to serve its intended function. Therefore, a SGR investment can mean preventive maintenance, rehabilitation or replacement with respect to MARTA's defined service need for that particular asset. **Figure 15** shows the range of types of performance indicators MARTA uses to track public transit SGR. On time performance, miles between failures and customer complaints are practical measures related to SGR experience that MARTA tracks and publicly reports on a regular basis.

MARTA has used an enterprise asset management system since the early 1990s to track its asset conditions. The system allows for subject matter experts and independent verifiers to inspect each asset and assign it a rating. However, with more than 50,000 assets in the system this proved difficult to maintain. When MAP-21 and the FAST Act introduced specific asset reporting requirements, MARTA took the opportunity to review and update these records, finding and resolving missing indicators with respect to at least one measure on approximately 80 percent of the records.

MARTA has been able to exceed federal requirements in defining and measuring its SGR, and focuses primarily on (1) enterprise management to clearly demonstrate asset conditions, needs and progress; (2) the strategic bundling of different types of asset needs into "projects"; and (3) delivering projects in a timely manner.

Business Perspectives on MARTA's SGR

Atlanta's regional business community is still realizing the importance of public transit SGR in enabling the region's economy to both grow and expand. While public transit carries 4 percent of the Atlanta region's workforce, transit-supported commuting accounts for over $2 billion per year in earnings (according to U.S. Census data combined with MARTA ridership statistics). Moreover, public transit plays a disproportionate role in some of the Atlanta region's most competitive industries,

with 24 percent of metro Atlanta's transit commuters supporting the region's entertainment and services industry (including the convention and visitor activity described in earlier chapters); 17 percent supporting the region's health care and educational establishments; and 14 percent supporting professional, technical and scientific firms.

In the Metro-Atlanta Chamber of Commerce 2017-2018 policy agenda, almost all of the transportation priorities relate to the ongoing sustainability and growing role of public transit in the economy. They explicitly address the funding gap in existing public transit assets and call for a long-term dedicated funding source not only for the preservation of but also the expansion of public transportation services. This represents an ongoing paradigm shift for Atlanta's business community from past decades when public transit was viewed skeptically or negatively to a time of growing consensus that neighborhoods served by transit may be a key to retaining the region's knowledge workers and attracting the firms dependent on such workers. APTA's 2016 report, *Public Transportation's Role in the Knowledge Economy*, includes a case study on how this plays out in Atlanta's health care and bio-technology sectors. When State Farm Insurance (cited in Chapter 2) was considering sites in Atlanta, the site selection team specifically requested offices be "as close as possible" to the MARTA station to facilitate the interconnected walkway for employees. Interviews with real estate brokers and business recruiters active in the Atlanta region indicate this is not an unusual request: public transit-oriented neighborhoods and workplaces, as well as business sites requiring less parking, are an increasingly hot commodity among businesses coming to Atlanta.

Furthermore, because Atlanta is heavily dependent on convention and business visitors, Atlanta's regional economic development organizations are sensitive to the quality of MARTA's infrastructure and performance. MARTA reports that it is standard practice for businesses to call in advance of a major event or trade show to emphasize the importance of service during exceptionally high-value events. For example, several firms and business organizations contact MARTA to ensure everything will be running sufficiently during the Annual ApparelsMart in September. MARTA is also in regular communication with the Atlanta Falcons, the Atlanta Braves and major universities regarding the reliability, capacity and readiness of MARTA as major sporting events approach. Both sports franchises and major conventions approach MARTA to embed information about MARTA's on-time performance, frequency and operations to craft event-specific apps for participant use.

Lessons Learned

The MARTA experience is very instructive as it demonstrates that early and ongoing attention to the quality and condition of public transit assets can enhance a region's economic competitiveness and make a favorable impression on major business and economic players. Furthermore, MARTA's pro-active approach to its SGR enables the agency to clearly show not only the needs for investment in SGR at the regional level, but also how investments made in the system will enhance the region's ability to offer more and better public transit over time at less cost. As a result, the business and economic development community increasingly embrace public transit as a strategic advantage.

3.5 Washington Metropolitan Area Transit Authority

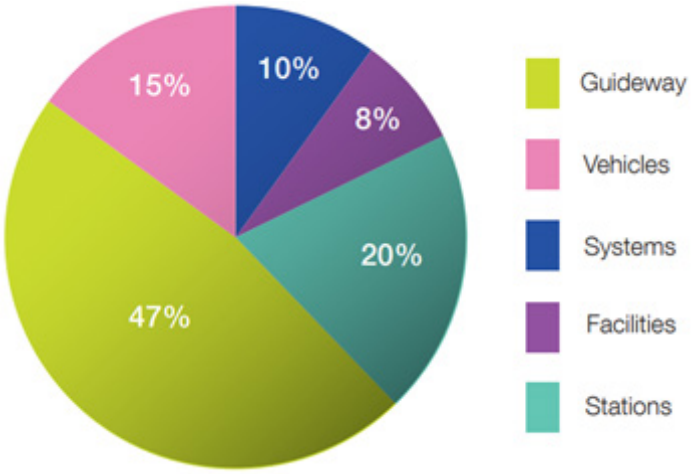
WMATA's transit assets include approximately 233 miles of revenue track, 1,242 rail cars, 1,589 buses, 675 paratransit vehicles, and 91 rail stations.[6] In total, the agency operates and maintains $39.4 billion in physical assets spread across several asset types (**Figure 16**).[7] Metro bus and rail systems serve a 1,500-square-mile area spanning the District of Columbia; Arlington, Fairfax, and Loudoun counties in Virginia; and Montgomery and Prince George's counties in Maryland. Metro provides a direct connection to Ronald Reagan Washington National Airport via rail, and Dulles International Airport via bus.

Investment Needs and Priorities for Public Transit SGR

In order to deliver safe, reliable and efficient transit services, Metro needs to maintain its assets in SGR, which is a state that must be continually maintained with ongoing work. However, chronic capital underinvestment led to decades of deferred maintenance. The SGR backlog at WMATA is currently estimated at $6.6 billion, representing about 16.7 percent of the value of its assets—a level that is higher than the agency would prefer to maintain. Vehicle replacement and rehabilitation accounts for the largest portion of SGR needs by asset type, followed by electrification of the rail system, IT and network system improvements, and trackwork.[8]

To address deferred maintenance needs and achieve a state of good repair, WMATA will require an annual investment of $1.8 billion over the next 10 years. The assets in this backlog require immediate reinvestment

Figure 16: Summary of Existing Value by Asset Type



Source: Washington Metropolitan Area Transit Authority, 10-Year Capital Needs Inventory and Prioritization, CY 2017 - 2026 Needs, page i-1.

as they are past their useful lives or require rehabilitation or replacement due to compliance issues. Deferred capital needs that are regulatory and/or compliance-related include replacing rail cars, ventilation system improvements, installing a new radio system and cellular infrastructure, and replacing track circuits and power cabling. Additional deferred investment needs include replacing power cable insulators and worn track and tunnel components, and upgrading the train signaling system.[9] Making these investments will improve service quality by reducing disruptions, enhancing safety, and providing on-time service. Once WMATA addresses its backlog of deferred investments, the current estimate of normal replacement/reinvestment needs to maintain a SGR is approximately $1.1 billion annually .

Unlike most other transit agencies, WMATA lacks a bondable dedicated funding source, meaning the agency

6 *WMATA, 10-Year Capital Needs Inventory and Prioritization, CY 2017 - 2026 Needs, Washington, D.C.: WMATA Office of Planning, November 2016,* https://www.wmata.com/initiatives/plans/upload/CNI-full-report-and-appendices.pdf.

7 *Interview with Washington Metropolitan Area Transit Authority staff, January 5, 2018.*

8 *WMATA, 10-Year Capital Needs Inventory and Prioritization, CY 2017 - 2026 Needs, page 3-35..*

9 *WMATA, 10-Year Capital Needs Inventory and Prioritization, CY 2017 - 2026 Needs, page i-2, i-4.*

is reliant on unpredictable state and local funding that is subject to an annual appropriations process. This makes it difficult to rely on future SGR investments, although such investments are WMATA's priority. Bondable dedicated funding would enable Metro to better plan large-scale projects, reduce time and resources spent on negotiating and financing, and increase its capital deployment ratio. The current general manager of WMATA has requested an additional $500 million annually for capital improvements to be borne out by the three respective jurisdictions (D.C., Virginia, Maryland).

Transit leaders have been "sounding the alarm " about WMATA's infrastructure investment needs for more than 30 years in attempts to secure adequate funding for system capital reinvestment. Unfortunately, these alarms have gone unheeded for decades, and today the system has reached a point where deferred maintenance has resulted in chronic system failures and emergency conditions. In response to these conditions, WMATA's general manager shut down the entire system for 29 hours in March 2016 to conduct safety checks. And then in 2017, WMATA launched SafeTrack, a comprehensive and holistic emergency effort to address immediate safety and reliability issues on Metrorail and the most aggressive track rehabilitation program in WMATA's history.[10] Over a one-year period, the agency accelerated track rehabilitation work through a series of "Safety Surges" in which it widened headways, cut service hours, and closed portions of the system for one to two weeks. SafeTrack focused on 93 miles of track outside of the system's core, representing approximately 40 percent of the system.

According to WMATA, these issues came to a head as a result of decades of underinvestment, with lawmakers prioritizing capital expansion over necessary capital reinvestment and maintenance. In addition, as WMATA's funding partners prioritized expanding hours of service, the system became less able to leverage sufficient maintenance windows to conduct critical preventive maintenance work. Consequently, the agency is trying to make an economic argument for sustainable dedicated investments that will support efforts to invest in and maintain SGR, and the agency has implemented reductions in service hours to provide the time necessary to conduct maintenance and repair work.

WMATA and other regional agencies closely track Metro's performance and the impact SGR investments have on customer experience. In its annual Metro Performance report, the agency monitors several Key Performance Indicators (including on-time performance, bus and rail fleet reliability, rail infrastructure availability and speed restrictions, elevator and escalator availability, customer satisfaction, and numerous safety and security measures[11]), its progress toward meeting strategic goals, and paths to improved performance.

In January 2017, the National Capital Region Transportation Planning Board (TPB) released a preliminary analysis of transportation impacts of the SafeTrack program, an accelerated SGR initiative.[12] The memo assessed four types of impacts: traffic congestion, transit usage, traffic counts, and bike impacts. TPB

10 *WMATA, "SafeTrack,"* https://www.wmata.com/service/SafeTrack.cfm, *accessed February 7, 2018.*

11 *WMATA, Metro Vital Signs January-December 2016 Annual Report, February 2017,* https://www.wmata.com/about/records/scorecard/upload/Vital-Signs_Report_2016-Q4_030117.pdf.

12 *Eric Randall to TPB Technical Committee, Overview of Preliminary Analysis of Transportation Impacts of WMATA SafeTrack Program, memorandum, January 27, 2017,* https://www.mwcog.org/assets/1/28/02032017_-_Item_12_-_Transportation_Impacts_of_WMATAs_SafeTrack_Program.pdf.

found that traffic impacts were minimal at the regional level, with most impacts occurring during the morning peak period. Vehicle traffic counts did increase around some surge locations, however. Daily Metrorail boardings decreased by 2.6 percent during the 10 SafeTrack maintenance "surges" TPB analyzed, and an average of 5 percent of Metrorail riders switched to Metrobus. Overall, about "32 percent of regular Metrorail travelers decided to not make a trip during each surge." TPB also found that trips by bikes increased during SafeTrack surges, both on Capital Bikeshare and in two counting locations.

Challenges of Defining and Measuring Transit SGR

WMATA defines its SGR needs as "the replacement, rehabilitation, or annual capital maintenance of existing capital assets necessary for system preservation."[13] Assets with deferred maintenance needs are beyond their useful life, require replacement to satisfy compliance requirements, or are in poor condition. WMATA is developing a new, multi-step process to proactively identify investment needs.

After completing an asset inventory and conditions assessment, WMATA used FTA's Capital Needs Analysis Tool called TERM Lite to quantify the capital investment needs of the authority using a risk-based prioritization framework. TERM (Transportation Economic Requirements Model) Lite[14] helps transit agencies assess their SGR backlog; the level of annual investment needed to reach SGR; the impact of variations in funding on future asset conditions and reinvestment needs; and overall investment priorities. TERM Lite forecasts SGR needs "based on each individual asset's age, useful life, replacement cost, and life-cycle policy regarding the timing and cost of rehabilitations or application of ACM [annual capital maintenance]."[15]

WMATA also conducted a supplementary call for new investment needs (CFN) to identify investments that would not have been found by examining existing asset inventories or service conditions. Both of these efforts – which have been evaluated by outside consultants and deems to be of superior quality in terms of approach and analysis – will ultimately feed into the agency's Capital Improvement Program (CIP).

In 2016, Metro developed a new Capital Needs Inventory (CNI) process that involves changes to how the agency estimates and prioritizes its capital needs. Goals for the new CNI include the following, among others[16]:

- Construct an objective, data-driven, and risk-based approach to estimate Metro's major rehabilitation and capital asset replacement/acquisition needs (**Figure 17**)
- Build a prioritization methodology aligned with Metro's strategic goals and grounded in asset inventory and conditions assessments
- Ensure that safety, service delivery, ridership, and asset conditions will drive investment prioritization in a quantifiable and data-driven manner

Business Perspectives on WMATA's SGR

The Washington, DC region's business community is actively concerned with the issue of the public transit SGR

13 *WMATA, 10-Year Capital Needs Inventory and Prioritization, CY 2017 - 2026 Needs, page i-2.*

14 *WMATA, 10-Year Capital Needs Inventory and Prioritization, CY 2017 - 2026 Needs, page 1-12.*

15 *WMATA, 10-Year Capital Needs Inventory and Prioritization, CY 2017 - 2026 Needs, page 3-29.*

16 *WMATA, 10-Year Capital Needs Inventory and Prioritization, CY 2017 - 2026 Needs, page 1-11.*

Figure 17: Risk-Based Weighting of Criteria

Source: Washington Metropolitan Area Transit Authority, 10-Year Capital Needs Inventory and Prioritization, CY 2017 - 2026 Needs, page 1-11.

as both an asset and a potential vulnerability. Transit-supported commuting accounts for over $16 billion per year in earnings (according to U.S. Census data combined with WMATA ridership statistics). Moreover, public transit plays a disproportionate role in some of the Washington, DC Region's most competitive industries, with 23 percent of transit commuters participating in the metro region's professional, technical and scientific firms; and 19 percent supporting the region's core base of government and public administration (including the federal government). WMATA has well documented how its station locations relate to the overall development climate in the region. WMATA's research shows that 54 percent of jobs in the region are within ½ mile of a Metrorail station. Furthermore, $235 billion of the region's real estate value is within a ½ mile of the Metrorail Network. Property values near Metrorail stations are found to be 7-9 percent higher than those not near stations, and land value near Metrorail generates $3.1 billion per year in property tax revenues to WMATA's funding partners.[17]

Greater Washington's business community recognizes that the Metro transit system is one of the region's competitive advantages and "strongest calling cards."[18] The D.C. region is one of the most congested in the country, and Metro plays a key role in transporting people and attracting employees. There is a concern among business leaders, however, that D.C. is losing its competitive advantage with the degradation of transit service from lack of investment, and that transit could become a "negative mark" on the region. In one interviewee's words, "If we don't care for [transit], it stops being a strength."

The recently launched MetroNow coalition is comprised of leaders in greater Washington's business, nonprofit, and advocacy communities. According to the organization's website, these leaders "have come together to ensure that action is taken to put Metro—the backbone of greater Washington's transportation infrastructure—on a safe, smart, and sustainable path forward…"[19] This coalition tracks and advocates for transit-supportive legislation at the local, state, and federal levels. Its 2018 priority is to advocate for long-term, dedicated funding solutions that are gaining traction in D.C., Maryland, Virginia, and the U.S. Congress. In June 2017, the coalition sent a letter in

17 *https://www.wmata.com/initiatives/case-for-transit/upload/WMATA-Making-the-Case-for-Transit-Final-Tech-Report.pdf*

18 *Interview with, Federal City Council, February 8, 2018.*

19 *MetroNow Coalition, "About,"* https://metronow.com/about-us/*, accessed February 9, 2018.*

support of transit investment to government leaders that was co-signed by more than 20 organizations, over half of which were chambers of commerce.[20]

MetroNow tracks and reports SGR statistics related to unfunded capital needs, safety, and reliability. The website also highlights the benefits of maintaining existing transit services to the business community, including access to jobs, the cost of congestion, and the value of real estate around Metro stops. The real estate industry is well-represented among MetroNow's membership, with members including the DC Building Industry Association, ULI-Washington, and LISC.

The relocation of high-profile corporate headquarters to urban areas served by Metro provides additional evidence of the business community's support for investing in public transit. For example, in 2015, Marriott International announced that it would relocate from North Bethesda to downtown Bethesda, in part to be closer to Metro (and the Maryland Transit Administration Purple Line that is schedule to open in 2022).[21] In February 2017, Nestlé announced that it would relocate its U.S. headquarters from California to a new, 16-story office tower in Arlington, Virginia, adjacent to a Metro station, with the quality and sustainability of service quality at these locations integral to the location decision.[22]

3.6 Chicago Transit Authority

CTA's transit assets include more than 1,400 rail cars operating over 288 miles of track and over 1,800 buses serving 1,300 miles of fixed bus routes.[23] The agency's heavy rail system (the "L") and bus system together serve Chicago and 35 surrounding communities. These include Evanston, Forest Park, Oak Park, Rosemont, Skokie, and Wilmette, all of which are in Cook County. CTA's bus system primarily serves Cook County, with several destinations in DuPage County. CTA provides direct connections to Midway International Airport and O'Hare International Airport in Chicago.

Investment Needs and Priorities for Public Transit SGR

CTA devotes a "vast majority" of its annual spending to reaching and maintaining a state of good repair.[24] A study by the Regional Transportation Authority (RTA) identified and forecasted CTA's SGR backlog by using data on the age of CTA's assets and industry useful life standards. CTA has a current SGR backlog of $12.5 billion (in 2015 dollars) and expects to spend $3 billion on capital improvements over the next five years ($600 million annually), which is short of the $1 billion per year needed.[25]

The Federal Transit Administration provides CTA with roughly $300 million in capital funding annually through its formula funding program. CTA has historically relied

20 *Federal City Council et al. to The Honorable Muriel Bowser, The Honorable Larry Hogan, The Honorable Terry McAuliffe, and The Honorable Elaine Chao, letter, June 22, 2017,* http://www.federalcitycouncil.org/sites/default/files/Metro%20Reform%20Letter_Regional%20Business%20Support.pdf.

21 *Tracy Hadden Loh, "Marriott is moving its headquarters to downtown Bethesda so it can be in a denser place that's closer to transit," Greater Greater Washington, October 18, 2016,* https://ggwash.org/view/43188/marriott-is-moving-its-headquarters-to-downtown-bethesda-so-it-can-be-in-a-denser-place-thats-closer-to-transit.

22 *Dave Emke, "Nestlé Chooses Rosslyn, Not Reston, for New U.S. Headquarters," Reston Now, February 1, 2017,* https://www.restonnow.com/2017/02/01/nestle-chooses-rosslyn-not-reston-for-new-u-s-headquarters/.

23 *Regional Transportation Authority, Capital Asset Condition 2016, Year 5 Assessment, December 2016,* https://www.rtachicago.org/files/documents/businessandfinance/capitalassetconditionassessment/2016%20Capital%20Asset%20Condition%20Assessment%20Report.pdf.

24 *Interview with Chicago Transit Authority staff, December 21, 2017.*

25 *Regional Transportation Authority, Capital Asset Condition 2016, Year 5 Assessment, page 14.*

heavily on state grant funds, but the lack of a new Illinois capital program since 2009 means state sources are very limited in the current CTA Capital Improvement Program. CTA has also at various times secured funding from the federal CMAQ, MOD, TIFIA, and TIGER programs.

The Red and Purple Modernization Program (RPM) accounts for well over half of available funds in CTA's current capital program.[26] RPM will rebuild several miles of the L on the north side of Chicago, adding capacity and providing more frequent service. RPM is the largest capital improvement in CTA's history, and represents a $2.1 billion core capacity project that will reduce the agency's SGR backlog by an estimated $800 million by replacing assets that are beyond their useful life. RPM will be financed in part through a special Transit-Tax Increment Financing (TIF) district authorized through state legislation in June 2016.[27] CTA is also advancing the planning and design for an extension of the Red Line on the south side of Chicago.

For CTA, the concept of "state of good repair" goes beyond simply preserving existing assets, as CTA recognizes that replacing an old asset involves an appropriate level of modernization to current-year equipment standards, whether for buses, rail cars, rails or stations. For this reason there is a degree of modernization built into CTA's SGR projects. In general, there is "always a move toward a safer system" with CTA's SGR investments. The agency recognizes areas where there is a confluence between SGR and modernization, and makes investments that accomplish both goals, e.g., upgrading old signal systems on the L.

When making investment decisions, CTA prioritizes assets by focusing on the issues that have the biggest impact on the customer experience. The agency rigorously tracks unmet needs and consistently makes the case for ongoing and increasing investment to resolve its SGR backlog. CTA has a robust performance management system that provides daily and monthly reporting of detailed customer performance measures. This framework allows the agency to constantly focus on safety and reliability and "aggressively identify assets that are negatively affecting customers." The impact of slow zones (speed restrictions over sections of track to ensure safety) and in-service breakdowns of revenue vehicles are two key ongoing concerns to CTA.

CTA also actively considers how SGR investments in its heavy rail system expand access to jobs for its customers. As part of its Red Line South Reconstruction Project (RSR), the agency reconstructed a 10.2-mile stretch of the Red Line on the south side of Chicago in 2013 that resulted in shorter travel times and an improved customer experience.[28] CTA used a Geographic Information System (GIS) application to estimate the change in the number of jobs available to South Side residents resulting from the RSR. The number of jobs accessible within a 45-minute transit ride increased substantially in several South Side neighborhoods (**Figure 18**).

Challenges of Defining and Measuring Transit SGR

The aforementioned RTA study estimates capital needs for "total backlog, normal replacement, rehabilitation, and annual capital maintenance of assets."[29] RTA

26 *Chicago Transit Authority, "Red and Purple Modernization,"* http://www.transitchicago.com/rpmproject/, *accessed January 26, 2018.*

27 *Chicago Transit Authority, Chicago Department of Planning & Development, and SB Friedman Development Advisors, "Red and Purple Modernization Phase One Project Redevelopment Project Area Tax Increment Financing," public meeting on September 13, 2016,* http://www.transitchicago.com/assets/1/media_relations_documents/RPM_Transit_TIF_9-13_Public_Meeting_Preso_FINAL.pdf.

28 *Chicago Transit Authority, "Red Line South Reconstruction Project,"* http://www.transitchicago.com/redsouth/, *accessed January 26, 2018.*

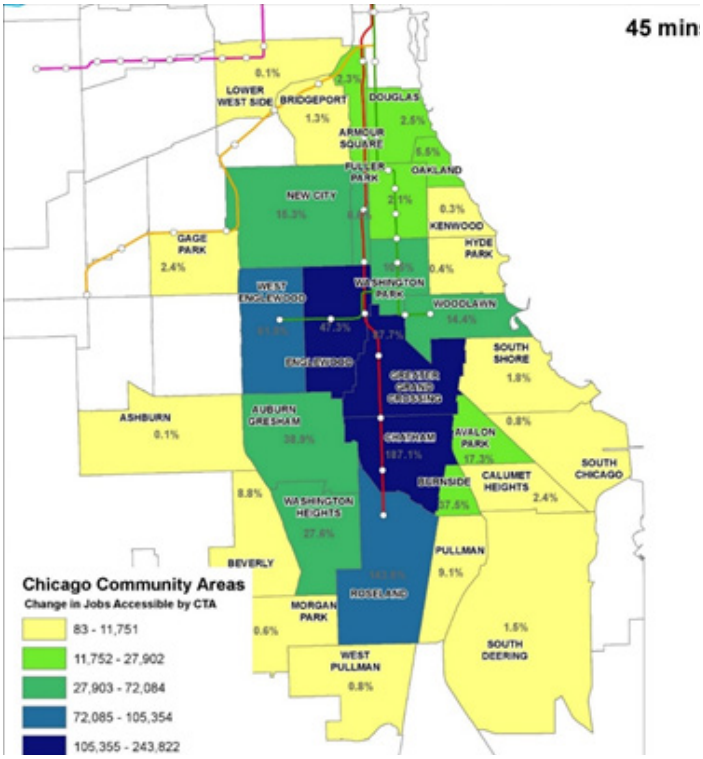
29 *Regional Transportation Authority, Capital Asset Condition 2016, Year 5 Assessment, page 12.*

considers each of these activities to be necessary for maintaining a state of good repair, and defines them as follows:

- *Backlog:* Investment to replace all assets that currently exceed their useful life (does not include deferred rehabilitation needs)
- *Normal Replacement:* Ongoing replacement of existing assets as they reach the end of their expected useful life. Normal replacement does not include deferred replacement needs, only those needs for assets that will reach the end of their useful life over the next 10-year period.
- *Rehabilitation:* Ongoing rehabilitation needs for existing assets. Rehabilitation does not include deferred rehabilitation needs, only those rehabilitation activities that will arise over the next 10-year period as required to maintain a state of good repair.
- *Annual Capital Maintenance (ACM):* Ongoing minor capital investments as required to maintain a state of good repair over the next 10-year period.

In addition to CTA's $12.5 billion SGR backlog, it has 10-year normal replacement needs totaling $5.7 billion, 10-year rehabilitation needs totaling $4.2 billion, and 10-year capital maintenance needs totaling $698 million.[30] This amounts to a total reinvestment need of $23.1 billion. Rail accounts for 82 percent of CTA's total reinvestment need and bus accounts for 18 percent, with a small amount shared between the two. Rail investment needs include track and structures, rolling stock, and stations. Bus investment needs include fleet rehab and replacement, as well as bus facilities.

Figure 18: Change in the Number of Jobs Accessible via CTA within 45 Minutes Resulting from the Red Line South Reconstruction (Source: CTA)



RTA calculates an SGR backlog ratio that represents the total backlog divided by the "normal reinvestment," or the annual level of investment needed to maintain SGR once attained. The ratio "provides a useful measure of the relative size or severity of the backlog." The normal reinvestment is a combination of normal replacement, rehabilitation, and annual capital maintenance costs. For CTA this amount is $10.6 billion from 2016-2025, or $1.06 billion annually. This means that CTA's SGR backlog ratio is approximately 11.8. According to RTA, "the SGR ratio can range anywhere from 10 to 20 [for older rail agencies]" and "can be on the order of 2 [for younger rail and bus agencies]."

30 *Regional Transportation Authority, Capital Asset Condition 2016, Year 5 Assessment, pages 14-17.*

Business Perspectives on CTA's SGR

The business community in the Chicago region has a strong interest in the ongoing performance of CTA as approximately 15 percent of the region's workforce uses public transit on a daily basis earning over $22.5 billion per year (according to US Census data combined with CTA ridership statistics for the areas directly served by CTA). Moreover, public transit plays a disproportionate role in the region's industries accounting for its competitiveness, with 32 percent of transit commuters supporting the region's highly competitive scientific, managerial and technology firms and 26 percent supporting Chicago's financial, real estate and insurance industries. The business community sees the importance of reliable public transit and is actively advocating for funding to secure CTA's performance in the long-term.

According to the World Trade Center Chicago (WTCC), the presence of transit is a significant factor for business attractiveness and retention; in the last 20 years, public transit has moved up the list of key factors for headquarter location decisions.[31] Access to airports is what WTCC often hears the business community emphasize, and CTA plays a significant role in that. For management, CTA's transit system is seen as more reliable than driving and less expensive than subsidizing parking for employees. And for employees, the ability to get around without a car is increasingly valued.

Many Chicago-area businesses "recognize and support" SGR as much as they do new investment, understanding that ongoing maintenance of transit assets is important and that even minor mechanical difficulties can cause delays. Businesses also view CTA station reconstruction projects as valuable investments, and several capacity expansion projects have stimulated significant real estate activity around CTA stations. Between 2004-2009, CTA reconstructed and modernized several Brown Line stations as part of its Brown Line Capacity Expansion Project. According to the agency, project impacts include the following[32] :

- Median home values near the Brown Line increased 55 percent from 2000 to 2014, which is 35 percent higher growth compared to the entire city and a growth rate 20 percent higher than homes located in the RPM corridor.
- From 2000-2014, 15 percent of all City of Chicago new construction building permits were issued near Brown Line stations, three times as many per square mile as the RPM corridor.

31 *Interview with World Trade Center Chicago staff, 25 January, 2018.*

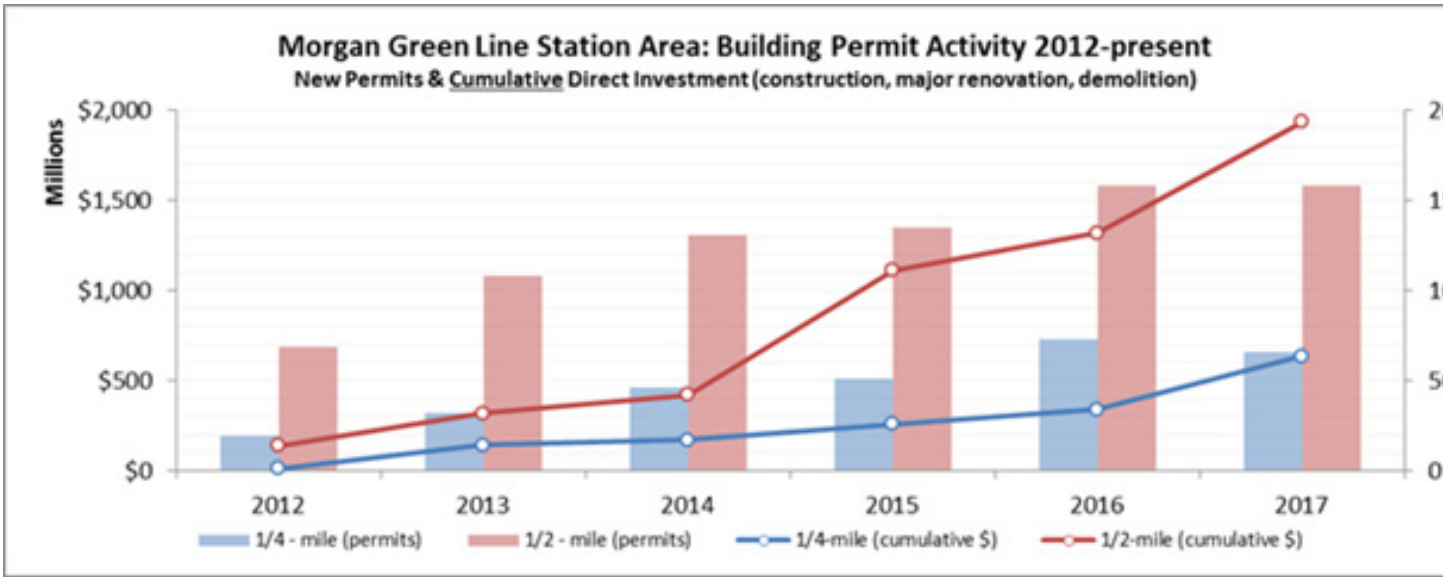
32 *Chicago Transit Authority*

Table 4: Building Permits Issued and Investment Made Surrounding the CTA Wilson Red and Purple Line Station, 2015-2017

Year	Half-mile		Quarter-mile	
	# of Permits Issued	Estimated Direct Costs/Investment	# of Permits Issued	Estimated Direct Costs/Investment
2015	35	$ 50,254,300	16	$ 33,190,300
2016	37	$ 7,374,803	13	$ 464,900
2017	27	$ 47,865,714	7	$ 11,537,132
TOTAL	**99**	**$ 105,494,817**	**36**	**$ 45,192,332**

Source: Chicago Transit Authority

Figure 19: Building Permits Issued and Investment Made Surrounding the CTA Morgan Station, 2012-2017



Source: Chicago Transit Authority

- Ridership on the Brown Line grew 45 percent following project completion.

CTA is currently reconstructing Wilson Station, which serves the Red Line and Purple Line on Chicago's north side.[33] Since 2015, there has been $105 million in real estate investment within a half-mile of the station and $45 million within a quarter-mile, suggesting that the business community is responding favorably to CTA's investment and the improved service that will result from it (**Table 4**).[34]

The completed Morgan and Cermak-McCormick Place Green Line stations have attracted even greater levels of investment. Since 2012, $1.9 billion has been invested within a half-mile of the Morgan Station (**Figure 19**). From 2015-2017, $638 million was invested within a half-mile of the Cermak-McCormick Place Station (**Table 5**).

Lessons Learned

CTA's experience demonstrates how investments in SGR can improve customer experience while stimulating private-sector investment. CTA has invested significantly in heavy rail station reconstructions, allowing the agency to maintain key assets while also attracting new real estate investment. At the same time, track reconstructions have shortened travel times and improved job accessibility for some of Chicago's most-underserved neighborhoods.

RTA's asset conditions assessment provides CTA with high-level information on its reinvestment needs, assisting the agency's long-term planning, while the performance management system allows them to quickly identify assets that negatively impact customers in the short-term. Investment in the expansion of asset management, which is currently underway at CTA, will continue to increase the quality of data available for use in programming and operating decisions.

33 *Chicago Transit Authority, "Wilson Station Reconstruction," http://www.transitchicago.com/wilson/, accessed January 26, 2018.*

34 *Chicago Transit Authority*

Table 5: Building Permits Issued and Investment Made Surrounding the CTA Cermak-McCormick Place Green Line Station, 2015-2017

Year	Half-mile		Quarter-mile	
	# of Permits Issued	Estimated Direct Costs/Investment	# of Permits Issued	Estimated Direct Costs/Investment
2015	59	$ 41,383,749	22	$ 7,562,006
2016	67	$ 566,430,232	32	$ 16,872,427
2017	64	$ 30,680,096	22	$ 6,515,002
TOTAL	**190**	**$ 638,494,077**	**76**	**$ 30,949,435**

Source: Chicago Transit Authority

4. Conclusions

This report demonstrates ways in which some of America's largest and oldest transit agencies are responding to the age and State of Good Repair in their capital assets and the resulting economic impact. The asset management and reporting requirements of MAP-21 and the FAST Act reveal that while public transit agencies do a remarkable job of protecting system users from failures and direct costs of inadequate infrastructure, the erosion of SGR imposes significant economic costs over the long-term. While public transit agencies devote a strong majority of their capital and other resources to preventing service failures or interruptions and ensuring the critical safety of passengers, business leaders recognize a need for more agile, expansive and competitive transit assets. Increasingly, not only the availability of public transit, but the quality and competitiveness of public transit infrastructure, is understood as critical to determining the location and extent of economic activity in American cities. These findings point to a need for a stronger alliance between public transit providers, developers and businesses in setting a higher standard of public transit conditions for American cities to exceed the adequate levels of national minimum standards. These partnerships can be of value in identifying both regional (including private funding) and federal funding. It is equally essential that public transit agencies educate business and economic development interests about how the emerging understanding of SGR needs relate to regional growth priorities, and how together they can shape state and federal policies accordingly.

These findings both re-enforce and extend the findings of APTA's previous work in the 2016 report, *Public Transportation's Role in the Knowledge Economy, Open for Business: The Business Case for Investment in Public Transportation*; 2015 APTA and AASHTO *Bottom Line Report*; 2014 update to *The Economic Impact of Public Transportation*; and the 2013 reports, *A New Partnership: Rail Transit* and *Convention Growth and The New Real Estate Mantra: Location Near Public Transportation*.

4.1 Exceeding Minimum Standards

Whether it is knowledge intensive businesses in San Francisco seeking to retain highly-trained workers or Atlanta seeking to draw in convention business, the *experience* of public transit is clearly a part of the value equation in America's cities. A review of SGR from both the public transit agency and business community perspective finds that the 2.5 SGR standard on the USDOT five-point scale (representing "marginal" but not "adequate" public transit capital conditions) is widely regarded as a "floor" or minimum tolerable SGR for public transit assets. Those that exceed these standards can see significant gains in the economic value of their system. Findings from throughout the U.S. economy suggest that businesses, developers and public transit agencies can be well served by raising the bar of system conditions by:

(1) Forming regional partnerships to determine the specific standards of condition and performance that will make particular public transit services *competitive* in today's economy;

(2) Collaborating in advocating for secured funding from national and state levels to ensure the minimum baseline of SGR funding is in place to *ensure coverage of the minimum tolerable SGR* so that additional resources can be made available to exceed standards and enhance services in ways that enhance regional competitiveness; and

(3) Exploring how public and private funding can be leveraged to achieve levels of public transit condition, performance and agility within the context of overall regional development investments in neighborhoods, downtowns and the amenities that characterize world-class business environments.

4.2 SGR as the Foundation for Expansion

In most systems profiled in the last chapter, agencies devoted most of their resources towards managing their current SGR to ensure smooth operation of existing services while the respective business communities focused on the needs for new and enhanced services. Exceptions were Boston and Washington, D.C. Metro, where the changing and expanding of service had been the norm until unmet SGR needs created crises that required immediate SGR investments. Taken together, the experiences of public transit systems and economic development interests show that it is essential for systems to secure a funding stream for their basic SGR needs and get to a level of SGR where resources can be free to consider strategic changes to the extent of services in the future. Some considerations include:

(1) Including metrics such as the SGR/Operation & Maintenance cost per trip or revenue mile as an indicator of system efficiency (and consideration of how this ratio changes with the SGR investment level);

(2) Defining and communicating a set of SGR standards that leave the public transit agency and its resources free to consider changes such as modernization or re-design of significant services in response to market pressures; and

(3) Education of the business and economic development communities about the minimum level of SGR investment needed as a prerequisite for achieving the benefits of expansion or modernization initiatives.

4.3 Learning from Experience and Protecting the Economy

Among the most significant observations in this study is the $40 million cost that MBTA's weather related problems imposed on Boston's regional economy and the role that the catastrophic events of 2015 had on creating a paradigm shift in the region with respect to public transit SGR. Equally striking is the ongoing annual occurrence of public transit system failure diffused throughout the U.S. which, if addressed, could generate over 162,000 jobs and over $180 billion in GNP over a six-year period. Moving forward, the fundamental question is whether cities will learn from the costs of todays' interruptions, the lessons of Boston, and the successes for areas that

have invested in quality public transit and, if so, what form that investment will take. The role of the public and private sectors faces new definitions and challenges. It will be the businesses, developers and elected leaders who ultimately determine whether and how public transit conditions in American cities will realize the economic potential of each community in the future.

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