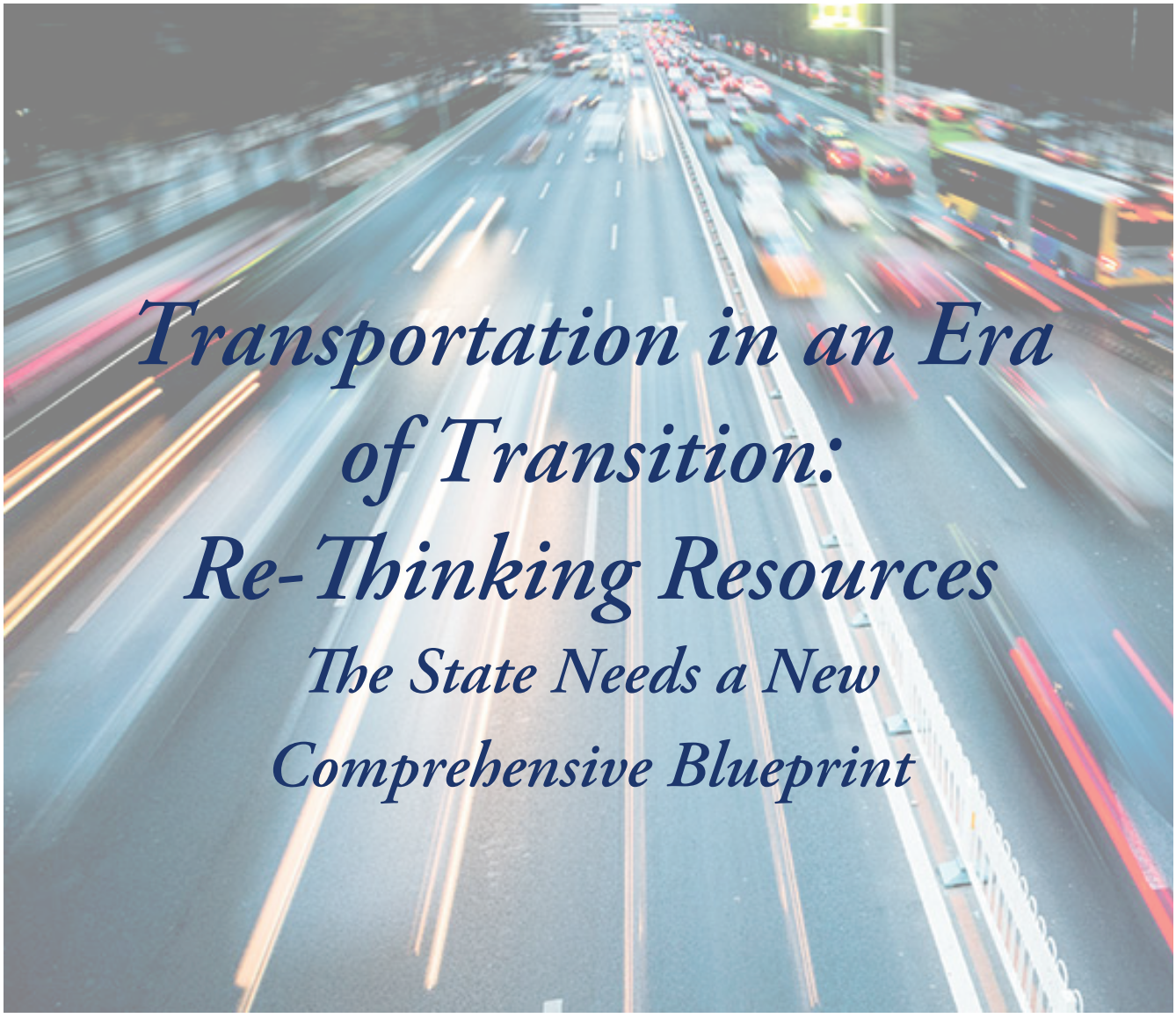

Transportation in an Era of Transition: Re-Thinking Resources

The State Needs a New Comprehensive Blueprint

SEPTEMBER 2017

MTF

About MTF

Founded in 1932, the Massachusetts Taxpayers Foundation is a non-partisan, non-profit research organization that serves as the independent source of information for the Commonwealth's decision-makers.

Our mission is to provide accurate, unbiased research with balanced, thoughtful recommendations that strengthen the state's finances and economy in order to foster the long-term well being of the Commonwealth.

TRANSPORTATION IN AN ERA OF TRANSITION: RE-THINKING RESOURCES

THE STATE NEEDS A NEW COMPREHENSIVE BLUEPRINT

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INTRODUCTION

A decade ago, the Transportation Finance Commission (TFC), an entity created by the legislature to develop a comprehensive, multi-modal long-range transportation finance plan for the Commonwealth of Massachusetts, issued two seminal reports that have shaped all subsequent transportation policy. Broadly speaking, lawmakers and the TFC accepted the premise that the problems confronting the state's transportation system were largely due to an imbalance between available resources and expenses at transit agencies, and the TFC's recommendations focused principally on additional revenues to close the projected shortfall.

In this report, the Foundation examines the current challenges to the state's transportation system and concludes that they are broader and more intractable than imagined by the TFC, and cannot be resolved by additional funds alone. The data presented show that ten years after the two reports were released, asset conditions of state and local roads and bridges remain problematic despite capital spending amounting to billions of dollars more than what the TFC projected would be available.

That the challenges plaguing the state's transportation system remain despite substantially more resources devoted to capital investments is partly a result of the underestimation of needs a decade ago – an issue now addressed by improved asset management systems and standards. But it also reflects a new understanding of the complexity of the problems confronting MassDOT and the MBTA. These problems are exacerbated by the state's fiscal constraints, as well as other emerging realities with huge long-term implications – most notably the inevitable and irreversible impacts from climate change, and technological advancements in mobility unforeseen ten years ago.

In light of the many changes occurring in the transportation realm, the Foundation strongly urges the Commonwealth to reconsider and reshape its planning process for the years ahead. The TFC narrative that directed policy for a decade and drove vital changes to fix the state's transportation system is no longer valid because the future challenges the state must confront are intrinsically different than those of a decade ago. This reality requires a new blueprint to address the many issues that have emerged since, or were not contemplated when, the TFC released its reports a decade ago.

THE TRANSPORTATION FINANCE COMMITTEE (TFC) REPORTS

In March 2007 the Transportation Finance Commission (TFC) released its seminal report, *Transportation Finance in Massachusetts: An Unsustainable System,* a groundbreaking analysis of the state's transportation system, its immense fiscal challenges and the huge infusion of capital spending required to repair and maintain it.

The TFC's second report, *Volume 2: Building a Sustainable Transportation Financing System*, released in September 2007, recommended a series of reforms to improve the way transportation agencies conduct business and provided a list of reforms, cost efficiencies, and revenue sources to close a funding gap estimated at estimated $15 billion to $19 billion.

These reports represented the first comprehensive benchmark of the state's transportation infrastructure with policy prescriptions to address the financial shortfall. The TFC's findings influenced virtually every transportation policy discussion and legislative action over the past decade.

The TFC's first report concluded that the state's transportation system was in "deep financial trouble because we have not faced up to the reality of how much it costs to preserve the system."[1]

The second report recommended how to close the aforementioned resource gap in order to fix the state's existing transportation system. The proposals included higher gas taxes, indexing the gas tax to inflation, and a long-term switch to a vehicle miles traveled (VMT) tax as cars become more fuel efficient. The report added a list of reform initiatives to generate greater efficiencies and savings to help close the enormous funding gap.

The message to lawmakers was clear – the state has the power to fix these problems through sound policy choices and the will to raise sufficient and sustainable revenues.

[1] *Transportation Finance in Massachusetts: An Unsustainable System,* TFC, March 2007, p. 3.

TRANSPORTATION IN AN ERA OF TRANSITION – KEY FINDINGS

Persisting Challenges

1. The state outspent revenue projections by $4.3 billion but asset conditions of roads and bridges remain problematic.

Over the ten-year period covering 2007 to 2016, MassDOT more than doubled annual capital spending on transportation from $1 billion to over $2 billion. In the process, the state expended $4.3 billion more to fix state and local roads, bridges, and the Turnpike than the TFC projected would be available ($15.8 billion spent vs. $11.5 billion projected). The state has committed another $2.2 billion in its current five-year capital investment plan (CIP) that, if expended, would bring the total to $6.5 billion in additional resources available for the 15-year period.

The bulk of this additional investment was financed by an increase in the state bond cap which is projected to add approximately $4 billion in spending through 2021 and borrowing against future federal funding and existing gas tax revenue to pay for the $3 billion Accelerated Bridge Program (ABP).

Despite these additional resources, asset conditions are still a problem for several reasons. One major cause stems from the inaccurate and/or incomplete data that the TFC relied upon in making its projections. The state's asset management systems did not yet have in place the data and methods to accurately forecast the conditions of its full portfolio over time. Further, the lack of specific targets to define 'good' condition vitiated the reliability of projections of infrastructure investment needs.

MassDOT has recently improved its asset management systems by incorporating tools that were unavailable in 2007 which provide better data on infrastructure needs. This should lead to more accurate cost projections for future investments. The MBTA has also upgraded its state of good repair database following several years of inattention.

2. Failure to control operating costs broke the T and diverted billions of state dollars from potential capital investments to unchecked expenses.

The TFC warned that the MBTA faced a likely budget shortfall of between $4 billion and $8 billion due to its inability to control operating costs. It recommended several ways for the MBTA to align operating expenses with revenues. Among these were a reduction in fringe benefit cost growth, restoration of MBTA management rights, and amendment of the Pacheco law to allow the authority to seek competitive bids for services.

Lawmakers implemented many of the TFC's recommendations. To reduce fringe benefit cost growth, lawmakers transferred MBTA employees and retirees to the state's Group Insurance Commission, but the process took several years to complete. Pension eligibility requirements were changed for new hires, producing no savings for the agency within the 20-year time horizon of the TFC's report. Legislators did not restore management rights or amend the Pacheco law[2], leaving the MBTA without vital tools to control costs. As a consequence, expenses grew twice as fast as revenues, creating an even larger gap than the TFC predicted.

Unable to wring sufficient savings from operations, the MBTA reduced capital spending and postponed principal payments on its debt that pushed hundreds of millions in debt obligations to the future. When these measures fell short, the state provided $2.1 billion in aid for operating budgets for fiscal years 2010 through 2018. This action perpetuated a problem that Forward Funding was supposed to resolve and diverted resources that otherwise could have gone to capital investments.

The MBTA's failure to limit the growth in operating expenses has detrimentally impacted all aspects of the system. The consequences have been costly and unmistakable. Reduced capital spending over an extended period caused a further degradation of the MBTA's infrastructure which will ultimately force the state to spend billions more than what the MBTA projected was needed to bring the system up to a state of good repair.

[2] Lawmakers suspended the Pacheco Law at the MBTA for three years starting in July, 2015.

3. The state, not the MBTA, now faces capital constraints that impede its ability to significantly increase investments.

The TFC raised concerns about the MBTA's "crushing debt burden." A decade later, the debt picture has reversed with the state facing constraints. Lawmakers issued bonds backed by the full faith and credit of the Commonwealth that increased the state's outstanding debt (principal) by $6.6 billion to $25 billion without raising sufficient revenues to cover the additional debt service costs. Meanwhile, MBTA debt service costs have fallen from 27 percent of total expenses in FY 2007 to 22 percent in FY 2017 as the total budget has grown from $1.3 billion to $2 billion in that period.

While the MBTA has the capacity to borrow more, the state is nearing its statutory debt limit. The debt limit and slow revenue growth impede the state's ability to ramp up capital investments for transportation infrastructure, particularly when other capital needs are extensive. Compounding the problem, the state has begun the repayment of $1 billion in federal funds borrowed, further reducing available resources for future capital investments.

The state's fiscal challenges are not limited to its capital budget. Slowed tax revenue growth for the past two years has strained the state's operating budget, constraining additional state assistance to the MBTA. This places a greater urgency on the Fiscal and Management Control Board (FMCB) and MBTA management to limit the growth of operating costs to no more than the projected 2 percent annual revenue growth so that the agency can balance its budget and preserve funds for capital investment.

Similarly, the state is not in a fiscal position to significantly increase the number of personnel at the Highway Division without substantial tradeoffs for other policy priorities. Finding new methods to escalate capital throughput without substantial increases in operating costs has become imperative to ensure progress on capital investment projects.

Emerging Challenges

The aforementioned challenges, while serious, are not new. In fact, they have been the focus of numerous reports and reform packages. Two major external influences are complicating this picture, and the state cannot afford to ignore them. Climate change and advancements in technology are both recent developments, which will have significant short and long-term impacts on infrastructure costs and transportation services.

4. Climate change adds costs – now

Climate change has emerged as one of the most pressing problems as both a long-term trend and a short-term shock. The state must contend with the impact of more frequent and more severe heat waves, storm surges, floods, heavy rainfall events, sea rises, and their impact on roads, rails, power, signals, tunnels, culverts and more.[3] Current capital plans are not developed and reviewed within this context, and projected expenditures do not reflect the priorities or costs associated with necessary climate change adaptations.

Going forward, project selection and capital planning must incorporate the implications and costs of maintaining transportation services in an era of rapidly changing climate conditions, or risk exposing our transportation systems to potentially catastrophic damage or investing in obsolete assets.

This is not an issue that can be ignored or postponed. Climate change impacts are already manifesting and corresponding costs are rising as several components of the state's transportation system regularly confront excessive flooding and inadequate storm water management. And the problems will worsen at a rate faster than state and municipal governments can prepare or keep pace.

5. Technology is changing transportation; tax revenues at risk

The ways in which people use motor vehicles, and the nature of the automobile itself, are evolving at stunning speed. Car and ride sharing services that were non-existent a few years ago are now commonplace, affecting patterns of use and

[3] Governor Baker signed Executive Order No. 569, *Establishing an Integrated Climate Change Strategy for the Commonwealth* to Reduce Carbon Emissions, Protect Residents and Municipalities, and Build a More Resilient Commonwealth, on September 16, 2016.

ownership. Electric vehicles (EVs) will begin to supplant gas-fueled vehicles, and automated vehicles (AVs) are expected to be introduced to the public within the next five to ten years. None of these changes were anticipated or accounted for in the TFC's recommendations or the state's previous CIPs, but they must become an integral part of the capital planning process moving forward. The case for doing so grows more compelling each day.

Changes in transportation services and technologies will almost certainly impact public transportation service delivery and future infrastructure needs. They will also disrupt state finances. Massachusetts tax revenues from the sale of motor vehicles ($850 million in FY 2017) and Registry and inspection fees ($570 million) will be at risk as automakers adjust to declining sales and transition to mobility services and subscription fees. Revenues from the tax on gasoline purchases, which reached $770 million in FY 2017, will be at risk as EVs and hybrids replace gas powered vehicles. Although the timelines are unknown, these are inevitable trends that must be considered as capital plans are made and revenue streams to pay for them are identified.

A New Blueprint

6. Re-thinking resources – what's next

The TFC's narrative that a substantial increase in resources would solve the state's transportation challenges, long supported by the Foundation, has proven to be incomplete. The fact that the state spent nearly $16 billion on state roads and bridges over the past decade, $4.3 billion more than the TFC projected would be available, yet asset condition problems persist, clearly demonstrates that more money is not sufficient to address the problem. Beyond resources, challenges likely include an incomplete inventory of assets and their conditions, inconsistent project management and/or inefficient spending, and a lack of metrics to monitor progress.

The inevitable impacts of climate change and technology advancements greatly increase the complexity of fixing the state's transportation system. Climate change adds to the costs of preserving and maintaining infrastructure while advances in transportation technology put current practices, priorities, and revenues at risk. How soon the state will feel these impacts is unknown.

What is clear is that the state lacks the requisite information to make profoundly difficult choices. Questions such as which projects to fund and when, and how revenue sources should be allocated must be included as part of a long-term sustainable transportation finance plan to address our transportation needs. Unfortunately, the state has not yet adopted such a plan.

The state should first assess the reliability of existing transportation revenues over the long term. Ride sharing and EVs put $2.2 billion of revenues from the gas tax, motor vehicles sales tax, and Registry and inspection fees at risk. Two ballot questions in 2018 – one that would raise the tax rate on income in excess of $1 million and one that would reduce the sales tax rate from 6.25 percent to either 5.0 percent or 4.5 percent – if passed, would cause a major restructuring of state finances that will directly affect transportation resources. Recent federal budget proposals would reduce funds for the MassDOT Highway Division and the MBTA. In other words, current transportation revenues are uncertain and could unravel.

In this era of transition, it is time for a new independent review of the state's transportation financing to redefine capital needs and how best to meet them. As the successor to the TFC's report and recommendations, this long-range plan must account for revenue risks, recommend models to scale capital throughput without unnecessarily increasing staffing levels, select appropriate targets for transportation asset conditions, and devise a method to review and prioritize all large-scale projects while accounting for changes in climate and technology. While the scope of the work is a tall order for any single commission, the state must undertake such a robust planning process. Failure to do so will lead to an inadequate transportation system and a weaker economy in the Commonwealth.

WHAT'S CHANGED SINCE THE TRANSPORTATION FINANCE COMMISSION (TFC) REPORT WAS ISSUED IN 2007?

The TFC's ominous warnings concerning the inadequacy of the state's transportation funding resources spurred lawmakers to address transportation finances and take other actions to fix the state's transportation infrastructure, but in ways that differed significantly from the clear and detailed recommendations in the TFC's two reports. Over the ensuing decade three major transportation bills passed the legislature. The first law restructured transportation agencies and included many of the TFC's recommended reforms, the second increased transportation resources, and the third accelerated the repair of structurally deficient bridges. This section provides a summary of those reforms.

Reforms, Restructuring and the Creation of MassDOT

Lawmakers adopted most of the TFC's reform recommendations in Chapter 25 of the Acts of 2009, *An Act Modernizing the Transportation Systems of the Commonwealth,* a series of reforms intended to better coordinate transportation policy and planning which created the Massachusetts Department of Transportation (MassDOT). The goal of this massive overhaul was to establish a single, unified, and accountable transportation organization designed to streamline operations and reduce costs.

This law directed the Secretary of Transportation to serve as the CEO of MassDOT overseeing four divisions – the Registry of Motor Vehicles, Highway Division, Rail and Transit Division and Aeronautics. The law also sought better coordination between MassDOT and the MBTA by combining several services including legal, real estate, procurement, and information technology, a move that also reduced operating expenses.

The legislation eliminated the independent Turnpike Authority, transferring its Big Dig debt obligations to MassDOT and Turnpike employees into the MassDOT Highway Division.

Although the MBTA remained an independent authority, the legislation changed its governing structure by having the MassDOT board also serve as the MBTA board to better align transportation policies. In addition, the legislation sought to control escalating health insurance costs at the MBTA by moving all employees and retirees into the state's Group Insurance Commission (GIC), saving an estimated $30 million annually in operating expenses. The legislation also changed the MBTA's '23 and out' pension system for all employees hired after 2012. The new policy required 25 years of service and 55 years of age before an employee would be eligible to collect a pension.

Lawmakers did not address TFC recommendations to reinstate management rights and amend the Pacheco Law. Without these two important tools for reducing labor costs, insufficient progress was made on cost control.

In response to the TFC's suggestion that the responsibility of road maintenance be consolidated, all Department of Conservation and Recreation (DCR) bridges and eight roads were transferred to MassDOT Highway Division. The Tobin Bridge and its $30 million in annual toll revenues were transferred from MassPort to the Metropolitan Highway System (MHS).

Lawmakers also created two dedicated transportation funds. The Commonwealth Transportation Fund (CTF), reconstituted from the Highway Trust Fund, receives gas tax and registry fees to pay debt service costs and contract assistance. The CTF is a budgeted fund subject to annual appropriation. The Massachusetts Transportation Trust Fund (MTTF) receives all other transportation revenues including tolls and department revenues. The MTTF is used to pay for MassDOT operations and special obligation debt assumed by the state from the Turnpike. MTTF funds are not subject to annual appropriations.

Revenues and Resources

To help close the enormous gap between available resources and needs, the TFC urged lawmakers to rely on dedicated transportation revenues. The Commission recommended an 11.5 cents hike in the gas tax indexed to inflation, and a five-cent vehicle-miles traveled (VMT) program for drivers on Massachusetts interstate roads. These actions would yield an estimated $16 billion in new, recurring funds over 20 years.

Lawmakers failed to enact the TFC's long-term finance plan, but did raise revenues by raising the gas tax three cents, indexing gas taxes to inflation (repealed by referendum in the 2014 election), re-purposing 2.5 cents of gas tax revenues that was used for underground storage tank cleanup, and dedicating motor vehicle sales tax revenues to transportation.

The state raised significantly more resources by financing capital investments. It raised the bond cap and financed approximately $3 billion by borrowing from future transportation funds to pay for an accelerated bridge repair program. Although these sources added hundreds of millions to support operating budgets and billions in capital spending above what the TFC projected, they have left the state with significantly higher debt obligations and limited future financial flexibility.

- Operating Sources

The 2009 transportation legislation was intended to address both reforms and revenues, but plans for additional funds were quickly overtaken by a $2.6 billion revenue loss in the FY 2009 state budget due to the fiscal crisis. In response, the legislature increased the sales tax rate to 6.25 percent from 5.0 percent and set aside funds from the sales tax for the Turnpike Authority and the MBTA to address immediate fiscal challenges.

In 2010, facing a costly default on interest rate swap agreements, the Turnpike Authority needed an immediate infusion of funds. Lawmakers responded by dedicating $100 million from new sales tax revenues to the Turnpike. This action prevented a default that would have required a sizable toll hike on the Metropolitan Highway System (MHS) to resolve.

Failure of the MBTA to make sufficient progress on closing its operating budget gap required the legislature to commit an additional $160 million to the MBTA in FY 2010. The $160 million was subsequently modified to a pre-budget transfer in FY 2015, guaranteeing a higher level of state support of the T's operating budget.

Despite a sizable fare hike (23 percent) two years later in 2012, the T's structural budget gap escalated once again. The state stepped in, providing $115 million to balance the T's 2014 budget. The $115 million appropriation increased to $122 million in FY 2015, and to $187 million in FY 2016. In FY 2018, the $187 million in state aid was split between general funds to support the MBTA's operating budget ($127 million) and state capital funds for infrastructure investments ($60 million).

In 2013, the legislature made another attempt to address the transportation funding situation by enacting Chapter 46 of the Acts of 2013, *An Act Relative to Transportation Finance*. Lawmakers increased the vehicle inspection fee to $35 from $29 with proceeds deposited into the Motor Vehicle Inspection Trust Fund (MVITF). The law directed MassDOT to self-fund a greater percentage of its operating budget, increasing its contribution of own-source revenues from 47 percent in FY 2014 to 51 percent in FY 2017 and FY 2018; and gave the agency the right to sweep excess MVITF funds without legislative appropriation to close budget gaps. MassDOT transferred approximately $40 million annually from the MVITF to support operating expenses in FY 2015 through FY 2018.

The 2013 legislation also required MassDOT to develop a plan to move all personnel and operating expenses from the capital budget to the operating budget. MassDOT personnel were transferred off the capital budget effective July 1, 2014 (FY 2015).[4]

Finally, the 2013 transportation finance legislation committed $580 million in state appropriations from the General Fund to the Commonwealth Transportation Fund to cover future transportation needs for the period from FY 2016 through FY 2020 as follows:

- $75 million in FY 2015;
- $96 million in FY 2016;
- $40 million in FY 2017;
- $40 million in FY 2018;
- $120 million in FY 2019; and
- $210 million in FY 2020.

[4] The FY 2018 budget moves approximately $30 million in MassDOT Highway Division wage and fringe benefit costs to the capital budget for federally-eligible capital projects.

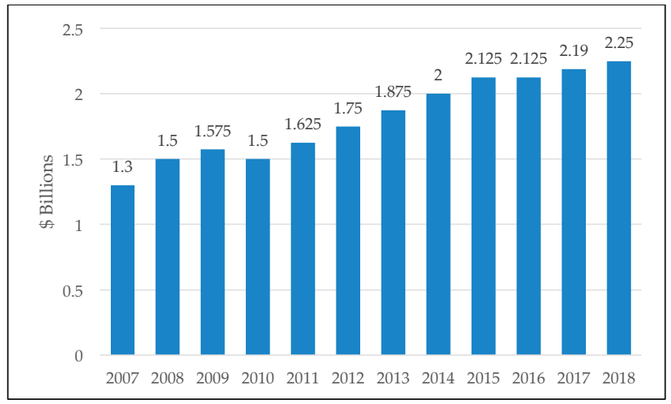
- Capital Sources

In addition to bailing out the Turnpike and MBTA, and pledging General Fund revenues to the CTF for future needs, the state committed billions of dollars in additional capital spending from a variety of sources since 2007. These include increases in the state bond cap, one-time funds from the federal government, financing the Accelerated Bridge Program, a small increase in the gas tax, and extending toll collections on the Western Turnpike (WT).

Lawmakers decided that the state could afford to borrow more each year to repair and maintain its infrastructure, and agreed, starting in 2007, to increase the state's $1.3 billion bond cap to do so. Each year the state conducts a debt affordability analysis to determine the level of borrowing it can afford based on a debt service costs ratio below eight percent of budgeted revenues. The bond cap was raised in nine of the past eleven years. It now stands at $2.26 billion in FY 2018, nearly $1 billion more than in 2007 (Chart 1).

In 2007, the state appropriated $665 million to transportation, representing 50 percent of the $1.3 billion bond cap. By 2016, the amount of funds for transportation had grown to $815 million, but as a percentage of bond cap funds it fell to less than 40 percent.

Chart 1 – Massachusetts State Bond Cap[5]



Taking other sources into account, total capital spending on transportation more than doubled from approximately $1 billion in 2007 to over $2 billion in 2016. Those additional sources come from federal matching funds, one-time federal funds during the recession to increase infrastructure investments, the Accelerated Bridge Program, the Rail Enhancement Program, and the extension of Western Turnpike tolls.

To help mitigate the impact of the 2008 recession, the federal government passed the American Recovery and Reinvestment Act (ARRA). One component of the ARRA bailout was designed to increase spending on transportation infrastructure to put people back to work quickly. Massachusetts received approximately $600 million in federal funds for 'shovel ready' projects ($320 million to the Highway Division and $280 million to the MBTA).

Following the deadly collapse of the I-35W Bridge in Minneapolis, Massachusetts lawmakers crafted the Accelerated Bridge Program (ABP) to fix the growing number of structurally deficient (SD) bridges. Lawmakers chose not to raise new funds for the program, preferring to finance the $2.9 billion investment by borrowing from future spending through the sale of $1 billion in grant anticipation notes (GANs) backed by federal funds, and $1.9 billion in gas tax revenue bonds.

While that program has successfully reduced the number of SD bridges, it comes at a high cost and the impact on available resources going forward is severe. The state began its ten-year repayment of the $1 billion in Grant Anticipation Notes (GANs) in 2017, and another $3 billion in debt service costs will be paid through 2047.

[5] *Commonwealth of Massachusetts Fiscal Year 2017-2021 Five-Year Capital Investment Plan,* p. 11.

The 2013 transportation finance bill fell well short of the $800 million annual objective, but the 3-cent hike in the gas tax, the re-purposing of 2.5 cents of gas tax revenues to transportation uses from the underground storage fund clean-up, and the transferring of sales tax revenues from the sale of motor vehicles to the CTF supported an additional $2.5 billion in capital spending through the Rail Enhancement Program.

In 2013 the state agreed to once again collect tolls on exits 1 – 6 on the Western Turnpike and in 2016 MassDOT extended tolls after full payment of the bonds after determining that WT is not in a state of good repair. Although the tolls were not increased as the TFC anticipated, these changes will generate approximately $150 million more in toll revenues annually than the TFC forecast.

In summary, lawmakers used a wide assortment of sources to gin up operating aid for the MBTA and capital investments in the state's roads, bridges, and public transit system.

HOW DOES ADDITIONAL FUNDING COMPARE WITH THE TFC'S ESTIMATES?

The TFC's first report projected available revenues for capital spending and operations over the 20-year period from 2007 – 2026. These projections relied on data supplied by the Executive Office of Transportation and the MBTA, and were modeled to incorporate a wide array of assumptions including future federal funds, toll revenues, fare increases, gas prices, wage and fringe benefit growth rates, inflation, transportation cost standards for repairs, and many other factors. Their analysis was comprehensive, rigorous, and compelling.

In this report the Foundation analyzes available resources by comparing TFC data covering the first 15 years of its analyses – FY 2007 – FY 2021 – with 15 years of MassDOT Highway Division and MBTA data comprised of ten years of actual capital spending (FY 2007 – FY 2016) and five years of available resources for roads, bridges and the MBTA from the FY 2017 – FY 2021 Capital Investment Plan (as updated by the FY 2018 – FY 2022 CIP). What follows is a breakdown of actual spending per category as compared to the TFC projections.

State Roads

MassDOT owns approximately 9,600 lane miles of roadway which represents 13 percent of the 72,000 lane miles in Massachusetts and nearly 60 percent of annual vehicular miles. One-third of the 9,600 lane miles, approximately 3,300, are interstate highway roads that account for over 30 percent of all vehicular miles traveled.[6]

As shown in Table 1 (detailed breakout in Appendix A), the state spent $2.4 billion more on state road repairs and maintenance from FY 2007 – FY 2016 than the TFC projected. Available resources for the FY 2017 – FY 2021 five-year period are approximately $600 million more than TFC estimates, bringing the total to $3 billion more than the TFC projected.

Table 1 – Available Revenues: Highway Division Road Program

Road Program Funding Resources	2007-2011	2012-2016	10-yr Spend	2017-2021	15-yr Total
TFC Estimate	1,573	2,168	3,741	3,135	6,876
Update	2,539	3,600	6,139	3,724	9,863
Difference	**966**	**1,432**	**2,398**	**589**	**2,987**

Bridges

There are approximately 5,000 bridges in the state of which 3,483 are owned by MassDOT. Municipalities are responsible for approximately 1,400 bridges and the MBTA owns 77.

Following passage of the $2.9 billion Accelerated Bridge Program, investment in Highway Division bridges spiked during the 2012 – 2016 period with the state spending $1.1 billion more on these bridges than the TFC anticipated. After 15 years, the state will have committed nearly $1.5 billion more for its bridge program than was estimated in 2007 (Table 2 details in Appendix B).

Table 2 – Available Revenues: MassDOT Highway Division Bridge Program

Bridge Program Funding Resources	2007-2011	2012-2016	10-yr. Spend	2017-2021	15-yr Total
TFC Estimate	1,187	1,433	2,621	1,662	4,283
Update	1,146	2,609	3,755	2,013	5,768
Difference	**-42**	**1,176**	**1,134**	**352**	**1,486**

[6] *Report of the Performance and Asset Management Advisory Council: Progress by MassDOT Highway Division on Integrated Asset Management,* January 15, 2016, pp. 10-11.

Local Roads (Chapter 90)

Municipalities own more than 56,000 lane miles of roadway accounting for nearly 80 percent of the 72,000 total in the state. State spending from FY 2007 – FY 2016 exceeded projections by almost $400 million and will come close to $700 million more than the TFC estimated over 15 years (Table 3 and Appendix C).

Table 3 – Available Revenues: Municipal Road Program

Municipal Road Program Funding Resources	2007-2011	2012-2016	10-yr. Spend	2017-2021	15-yr Total
TFC Estimate	576	656	1,232	761	1,993
Update	616	999	1,614	1,139	2,753
Difference	**40**	**342**	**382**	**378**	**760**

Metropolitan Highway System (MHS)

Available resources for the MHS are $430 million above expectations because the state increased state contract assistance by $100 million annually in 2010 rather than raising tolls in order to prevent a default on swap agreements which would have triggered a $260 million termination payment to UBS (Table 4).

Table 4– Available Revenues: Metropolitan Highway System

Metropolitan Highway System Funding Resources	2007-2011	2012-2016	10-yr. Spend	2017-2021	15-yr Total
TFC Estimate	1,061	1,295	2,356	1,578	3,934
Update	1,129	1,606	2,735	1,628	4,363
Toll and other Revenues	962	1,106	2,068	1,069	3,137
Contract Assistance	167	500	667	500	1,167
Difference	**68**	**311**	**379**	**51**	**429**

Western Turnpike

Available resources for the Western Turnpike are $875 million above expectations for the 15-year period. The TFC anticipated that toll collections would expire in early FY 2017 when the Western Turnpike bonds were paid off; however,[7] in 2016 MassDOT judged that the road was not in a state of good repair, thereby allowing the state to continue toll collections as permitted in the 2009 transportation reform legislation[8] (Table 5).

Table 5– Available Revenues: Western Turnpike

Western Turnpike Funding Resources	2007-2011	2012-2016	10-yr. Spend	2017-2021	15-yr Total
TFC Estimate	744	771	1,514	0	1,514
Update	744	814	1,557	830	2,388
Difference	**0**	**43**	**43**	**830**	**874**

[7] M.G.L. Chapter 6C, Section 13

[8] Chapter 25 of the Acts of 2009, Section 173

Summary

Through 2021 the state plans to spend $6.5 billion more on roads and bridges than the TFC estimated in 2007. Capital spending on state and local roads, bridges, and available resources for the MHS and Western Turnpike were $4.3 billion more than was predicted by the TFC for years FY 2007 – FY 2016. The state expects to expend $2.2 billion more for years FY 2017 – FY 2021 (Table 6).

Table 6 – Available Resources: Roads, Bridges, and the Turnpike

Summary - Sources in Excess of TFC Estimates	2007-2011	2012-2016	10-yr. Spend	2017-2021	15-yr Total
Road Program	966	1,432	2,398	589	2,987
Bridge Program	-42	1,176	1,134	352	1,486
Municipal Road Program	40	342	382	378	760
MHS	68	311	379	51	429
Western Turnpike	0	43	43	830	874
Total	**1,032**	**3,304**	**4,336**	**2,200**	**6,536**

MBTA

The TFC took a different approach with the MBTA, focusing on its operating budget in great detail. To evaluate the MBTA's potential financial risks, the TFC reviewed four scenarios, then settled on two as most likely to occur. Both were then used to estimate the budget gap. In one calculation, the TFC assumed that the MBTA would invest $470 million per year on its infrastructure – indexed to inflation over 20 years – with the corresponding debt service costs included in the operating budget. The $470 million capital spending option was included in the 'best revenue-worse costs' option. In the second scenario, the TFC expected that the MBTA would spend $570 million on capital investments to eliminate the SGR backlog – again indexed to inflation – with corresponding higher debt service costs as part of the 'worse revenue-best costs' model (Figure 1).

Figure 1

MBTA Funding Assumption Scenarios

Scenarios	Assumptions: Revenue	Assumptions: Cost
Best Revenue-Worse Costs	Revenues are assumed to increase at a higher rate (e.g., higher fare increases and higher sales tax revenue)	Costs are assumed to increase at a higher rate (e.g., higher inflation and higher wages)
Worse Revenue-Best Costs	Revenues are assumed to be lower (e.g., lower fare increases and lower sales tax growth)	Costs are assumed to increase at a slower rate (e.g., lower inflation and lower wage increases)

The TFC predicted that in the 'best revenue/worse cost' scenario the MBTA faced an operating budget shortfall of $4.2 billion, which would double to $8.4 billion in the 'worse revenue/best cost' scenario over the 20-year period (Figure 2).

Figure 2 – MBTA Gap Scenarios

Revenue/Cost Scenario	Surplus (Deficit) SGR Spending: $470 Million	$570 Million
Best Revenue/Worse Cost	($4.2)	($5.8)
Worse Revenue/Best Cost	($6.6)	($8.4)
Worse Revenue/Worse Cost	($11.4)	($13.1)
Best Revenue/Best Cost	$0.6	($1.1)

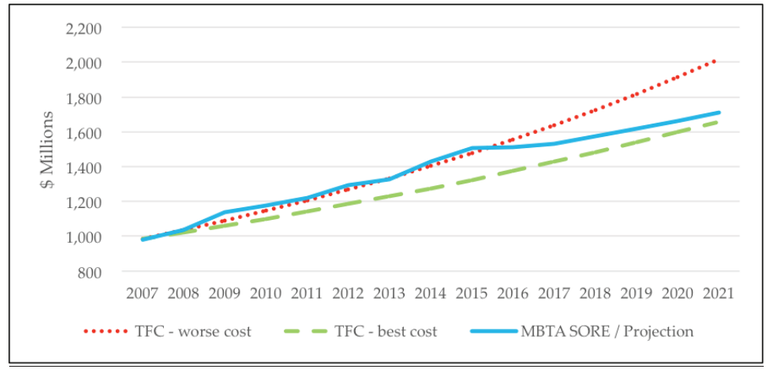
Note: "Most likely" scenarios shaded in light blue.

- Operating Expenses

The MBTA operating budget includes wage and fringe benefits, materials, supplies, and services, and outsourced contracts for commuter rail, The RIDE, and water shuttles, but excludes debt service costs from operating expenses. The TFC's 'best cost' option projected that operating expenses would grow 3.8 percent each year and the 'worse cost' scenario envisioned a 5.2 percent rate of growth.

According to MBTA's statement of revenues and expenses (SORE), operating expenses grew at a slightly faster pace than the TFC's 'worse cost' projection for FY 2007 through FY 2015 – the period before the FMCB assumed control (Figure 4 and Table 7).

Figure 4 – MBTA Operating Expense Comparison



The TFC's 4 percent wage growth projection proved accurate. Their estimate of 8 percent growth in fringe benefits was overstated largely because the 2009 reform legislation incorporated the TFC recommendation to move MBTA employees and retirees into the Group Insurance Commission's health care coverage, saving tens of millions annually (Table 7).

Table 7 – MBTA Annual Operating Cost Increase Breakdowns

2007 - 2015	TFC	MBTA SORE
Wages	4.0%	4.0%
Fringe	8.0%	3.4%
Other Operating	5.0%	7.7%
Total	**5.2%**	**5.4%**

Other operating expenses, however, grew at a considerably faster rate – 7.7 percent versus the TFC's estimate of 5.0 percent – because commuter rail service costs increased 7 percent annually while The Ride's costs averaged 10 percent growth.

Reining in MBTA operating costs was, and is, the most critical challenge confronting the long-term stability of the organization. Since MBTA revenues are constrained at an approximately 2 percent annual growth, the only way to balance the budget is to keep operating costs in line with revenues or seek more state funds. Unfortunately, the state is grappling with anemic revenue growth itself – less than 2 percent for the past two fiscal years – and large structural budget gaps make bailing out the MBTA increasingly unlikely.

The FMCB and new leadership at the MBTA understand these fiscal realities and have relentlessly sought greater efficiencies in the way the MBTA delivers services. The three-year suspension of the Pacheco law provided the authority

with leverage to negotiate better business practices while improving overall performance and the initial results have been impressive.

As shown in Table 8, operating costs have dropped from a 5.45 percent average annual growth for FY 2007 – FY 2015 to a projected 2.1 percent. It is impossible to overstate the importance of this accomplishment. Aligning operating costs with revenues is essential to fixing the T's infrastructure.

Table 8 – Change in MBTA Operating Cost Post FMCB

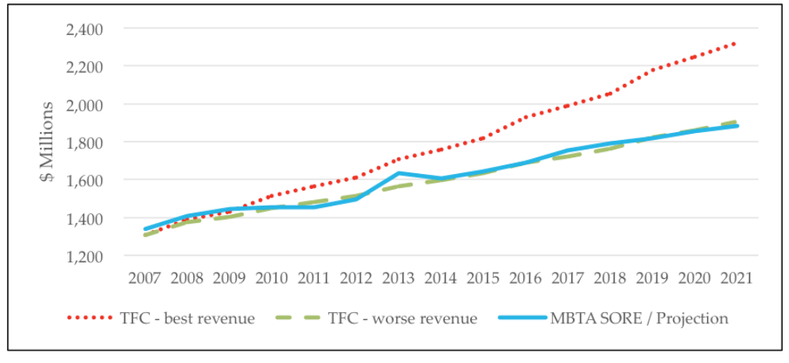
	Best Cost	Worse Cost	Actual / Projected
FY 07 - FY 15	3.85%	5.12%	5.45%
FY 16 - FY 21	3.85%	5.34%	2.11%

- Revenue Growth

Comparing the TFC's revenue projections with MBTA actual revenues requires a brief explanation of what was assumed in the calculations. The TFC's 'worse revenue' scenario expected dedicated sales tax revenues to increase 3 percent annually, local assessments to increase 2.5 percent, and fares to grow by 10 percent every three years following a 25 percent fare hike in 2007. Cumulatively, MBTA 'worse revenues' would grow at an average of 2.8 percent per year.

Instead, dedicated sales tax revenues increased by just 1.5 percent annually, half the TFC's projection, and local assessments grew at 1.8 percent per year. If not for a 25 percent fare hike in 2012, MBTA revenues would have been significantly weaker than the TFC's 'worse case'.

Figure 5 – MBTA Revenue Comparison



As the Foundation has noted in several reports and presentations, MBTA revenue growth has been lower than anticipated. Due to slower growth in state sales tax revenues, MBTA dedicated sales tax revenues growth has been capped at the lower of inflation or 3 percent for many years. Local access revenues provided by municipalities serviced by the MBTA are limited by the lower of inflation or 2.5 percent, and lawmakers recently limited fare hikes to a maximum increase of 7 percent once every 24 months. The cumulative impact of these on future MBTA revenues is an expected growth rate of just 2.2 percent annually (Table 9).

Table 9 – MBTA Own Source Revenue Growth

	Best Rev.	Worse Rev.	Actual / Projected
FY 07 - FY 16	4.13%	2.88%	2.97%
FY 17 - FY 21	4.13%	2.59%	2.19%

With operating costs growing faster than the TFC's 'worse cost' option and revenues trending with the 'worse revenue' scenario, the MBTA confronted recurring fiscal crises. After having limited debt service costs and moving some personnel and other administrative expenses to the capital budget, the agency was running out of options to close the gap. The possibility of raising fares and/or making service cuts was poorly received by riders, advocates, and lawmakers, further limiting the MBTA's possible solutions.

That forced the state to increase contract aid by over $2 billion over nine years, beginning with a $160 million in assistance in FY 2010 that was subsequently changed to a pre-budget transfer in FY 2015. The state added $115 million to balance the MBTA's FY 2014 operating budget that grew to $122 million in FY 2015 and $187 million in FY 2016 (Table 10).

Table 10 – State Assistance to MBTA Operating Budget

Fiscal Year	Add'l Sales Tax Revenues	State Contract Assistance	Total
2010	160		160
2011	160		160
2012	160		160
2013	160		160
2014	160	115	275
2015	160	122	282
2016	160	156	316
2017	160	156	316
2018	160	127	287
Additional State Assistance			**2,116**

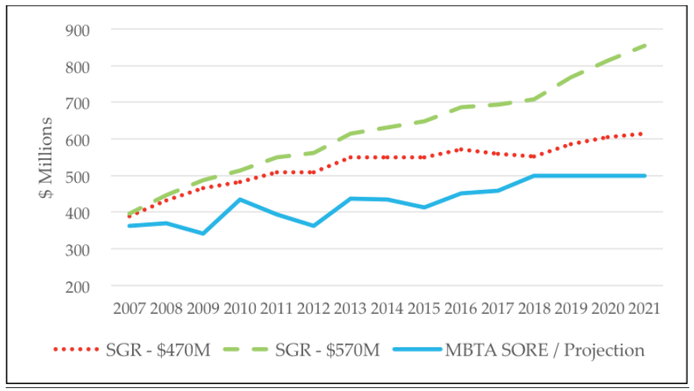
One additional note of caution – the $187 million in state contract assistance is not guaranteed as the Commonwealth confronts its own fiscal constraints. Already, ongoing budget challenges forced the state to substitute $31 million in capital support for operating funds in both FY 2016 and FY 2017, and in FY 2018 the state swapped out $60 million of the $187 million for capital uses only.

- Debt Service

Unable to wring more savings from operating expenses over the FY 2007 – FY 2015 period, the MBTA turned to gimmicks to reduce debt service costs. Most notable among them were the reduction in capital spending on infrastructure, the postponing of principal payments by issuing new debt to pay down existing debt and securitizing parking revenues to shift hundreds of millions in payments to the future.

The TFC projected MBTA debt service costs by assuming $470-$570 annual spending on capital assets. As shown in Figure 6, actual MBTA debt service costs were substantially lower than the TFC estimates.

Figure 6 – MBTA Debt Service Cost Comparison



Assuming $470 million in annual capital investments – the minimal amount the T committed to spending each year to prevent its infrastructure from deteriorating – the T spent a cumulative $1 billion less in debt service costs than the TFC estimated for FY 2007 – FY 2016 (Table 10).

The consequences of these actions have been costly and unmistakable. Reduced capital spending over a prolonged period – well below the TFC's recommended $570 million (adjusted for inflation) – has degraded MBTA's infrastructure, undermining its ability to deliver transit services and extending the time needed to repair the system. Further, the current costs to address the MBTA asset needs are in excess of $1 billion annually and rising – a target the MBTA has not met.

IN WHAT CONDITION IS THE STATE'S INFRASTRUCTURE?

In assessing the current condition of the state's transportation infrastructure, the Foundation relies on recent MassDOT and MBTA asset reports rather than on the projected needs analyses from the TFC's 2007 reports. Both MassDOT and the MBTA have collected more comprehensive data on their assets in recent years that provide more accurate assessments of capital spending and pending investments needs.

Interstate Pavement Conditions

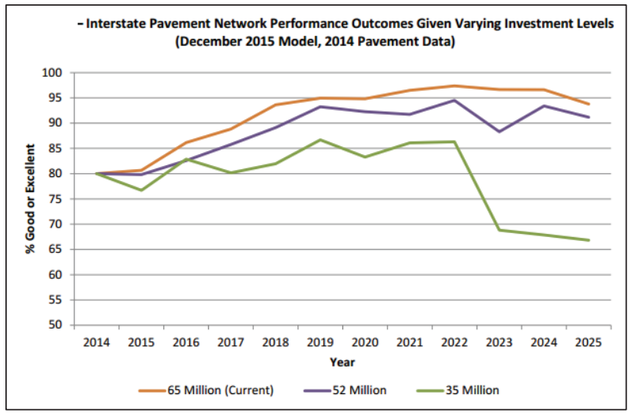
The MassDOT Highway Division inspects the roadways under its control through a data collection system employing a specially equipped motor vehicle. The inspection measures the roughness of the pavement and classifies the condition of the roadways using a Pavement Serviceability Index (PSI) that then divides roads into four categories from poor to excellent (Figure 7).

Figure 7 – Highway Division Road Classification System

Condition	PSI Range	
	Interstate	Non-Interstate
Excellent	3.5-5.0	3.5-5.0
Good	3.0-3.5	2.8-3.5
Fair	2.5-3.0	2.3-2.8
Poor	0.0-2.5	0.0-2.3

According to MassDOT's most recent report, 82 percent of interstate roads were in good or excellent condition in FY 2015.[9] If the state were to continue to spend $65 million per year, roads in good or excellent condition would increase to 96 percent. After evaluating these data, the state decided to alter the most recent five-year CIP proposal to reduce capital spending on interstate roads to approximately $56 million per year while increasing investments in non-interstate roads. The $56 million is expected to keep 90 percent of interstate roadways in good or excellent condition (Figure 8).

Figure 8 – Scenario Spending Analysis on Intestate Pavement[10]

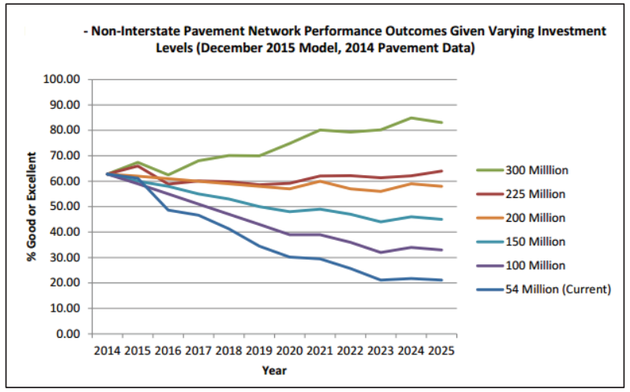


[9] *MassDOT Tracker: Annual Performance Report*, November 2016, p. 10.
[10] Report of the Performance and Asset Management Advisory Council: *Progress by MassDOT Highway Division on Integrated Asset Management*, January 15, 2016, p. 19.

Non-Interstate Pavement Conditions

MassDOT estimates that 49 percent of non-interstate roads are in good or excellent condition. If the state were to continue to spend at its current rate of $54 million per year, the condition of roads would erode further, causing only 30 percent to be in good or excellent condition over the next five years (Figure 9). The most recent five-year CIP proposes to increase capital spending on resurfacing of non-interstate roads to approximately $110 million per year to prevent this deterioration from happening. This increased annual investment is projected to bring 60 percent of non-interstate roads up to good or excellent condition.[11]

Figure 9 - Scenario Spending Analysis on Non-Intestate Pavement



Bridge Conditions

MassDOT is responsible for inspecting and reporting on the condition of approximately 5,000 bridges. It does this by visually inspecting each bridge every two years as required by National Bridge Inspection Standards. Following FHWA guidelines, MassDOT must determine whether a bridge is structurally deficient (SD).

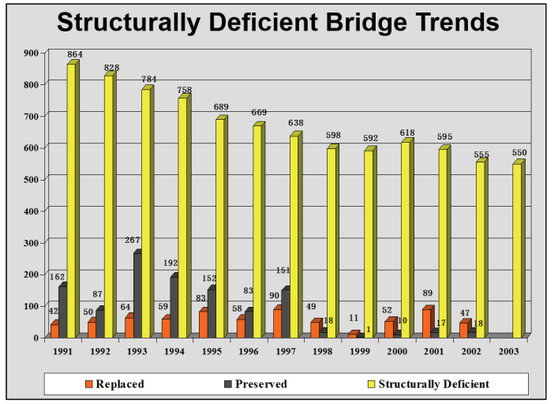
To qualify as SD, a bridge must exhibit a measurable deterioration in its deck, substructure, or superstructure, and while the designation does not mean that the bridge is unsafe, it does indicate that immediate repairs are needed to avoid user restrictions. Bridges are regularly added to the list following inspection and removed once repairs are made.

For example, in 1991 the state reported that 864 bridges were SD, 162 bridges had been preserved and another 42 replaced. By 2003, the number of SD bridges was reduced by one-third to 550 (Figure 10). [12]

[11] *MassDOT Tracker: Annual Performance Report*, November 2016, p. 10.

[12] *Massachusetts Bridges 2007 – A Condition Update*, p. 30.

Figure 10 – 2007 Bridge Condition Report

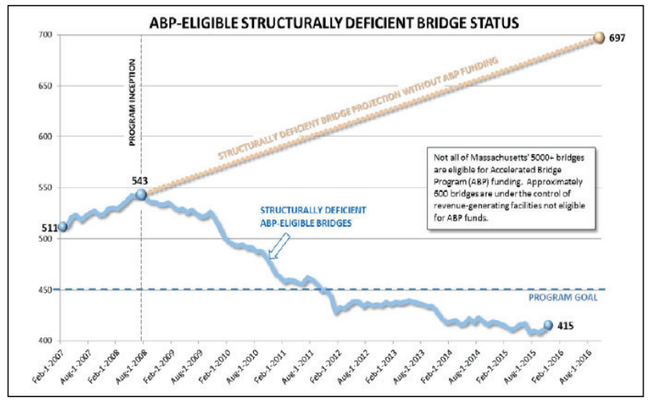


In the 2007 bridge report, the state estimated that it would take $200 million a year to reach its goal of reducing the number of SD bridges by 20 percent to 440 bridges. This figure excluded bridge projects in excess of $20 million. At the time of this review, the state was spending only $100 million a year on SD bridges, half the recommended amount. The state projected that spending only $100 million would cause the number of SD bridges to increase by 30 percent to 720 in five years.

Extended over a 20-year period, this analysis suggests a $2 billion shortfall in repairing and replacing SD bridges. When the cost of 11 bridge projects in excess of $20 million are included– estimated at nearly $700 million – these total costs are consistent with the TFC's projected bridge program gap of $2.4 billion.[13]

Spurred by the fatal bridge collapse in Minneapolis, lawmakers passed the $2.9 billion Accelerated Bridge Program to address the shortfall in funding for SD bridges. As shown in Figure 11, the ABP averted a projected a growth in the number of SD bridges to 700 by 2016 and reduced the number to approximately 400.[14]

Figure 11 – Accelerated Bridge Program's Impact on SD Bridges

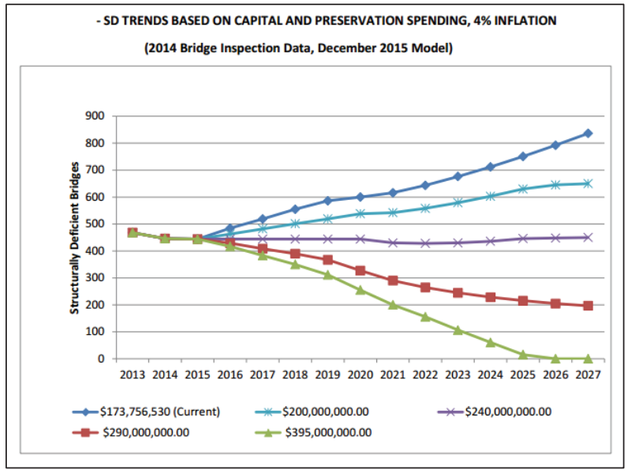


[13] Ibid. p. 43.

[14] Report of the Performance and Asset Management Advisory Council: *Progress by MassDOT Highway Division on Integrated Asset Management*, January 15, 2016, p. 26.

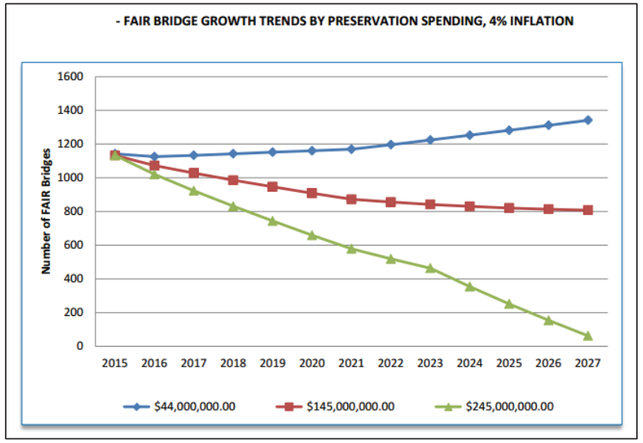
With the Accelerated Bridge Program concluding, MassDOT recently analyzed various spending scenarios and their projected impact on the number of SD bridges (Figure 12).[15] The MassDOT estimates that spending $240 million a year would preserve the current number of SD bridges at approximately 450 while spending $290 million per year would reduce the number by one-third to 300 by 2021.

Figure 12 - Scenario Spending Analysis on SD Bridges



To prevent the number of bridges listed in fair condition from increasing, MassDOT estimates annual capital investment of approximately $90 million would be necessary, or double the current spend rate of $44 million per year (Figure 13).

Figure 13 - Scenario Spending Analysis on Bridges in Fair Condition



[15] Report of the Performance and Asset Management Advisory Council: *Progress by MassDOT Highway Division on Integrated Asset Management*, January 15, 2016, p. 27.

MassDOT's FY 2017 – FY 2021 CIP proposed to spend $400 million per year on bridge maintenance and repairs. This figure is in line with the $380 million estimate to achieve a 30 percent reduction in the number of SD bridges while preventing the number of bridges listed in fair condition from growing.

However, funding needs may differ from these projections once MassDOT completes its predictive modeling using the Federal Highway Administration's methodology which incorporates the size of the bridge span into the bridge performance calculation. This measure reports the ratio of square feet of deck area on structurally deficient bridges to the total square footage of deck area on all bridges, which should yield a more precise estimate of spending needs.

Figure 14

MassDOT SD Deck Area and Backlog

	SD Deck Area (ft²)	Backlog
NHS	5,031,835	$3,181,499,197
Total	5,931,857	$3,750,559,842

By this measure, the state has nearly 6 million square feet of deck on SD bridges, representing 15 percent of all bridge deck area, which exceeds the FHWA's 10 percent threshold. MassDOT estimates that at an average cost of repairs of $632 per square foot, the state faces a $3.75 billion backlog in bridge repairs (Figure 14).[16]

How the new measure using the square footage of deck area translates into annual spending needs is critical to the state's capital plan and demonstrates the importance of improved metrics to achieve desired outcomes.

Metropolitan Highway System (MHS)

MHS derives revenues from tolls, rental and leasing income, state contract assistance and a small amount of investment income. These revenues pay for operating expenses and debt service costs left from the Big Dig with remaining funds available for pay-go capital investments or deposited into the MHS reserve account.

As shown in Figure 15, the MHS needs approximately $400 million in capital investments per year of which $220 million is tied to state of good repair projects.[17]

Figure 15 – Metropolitan Highway System Capital Spending Needs

Cost Category	2016	2017	2018	2019	2020	5 Year Total
1. Modernization	$ 57.99	$ 71.13	$ 12.71	$ 2.30	$ 8.93	$ 153.06
2. Capacity	$ 9.85	$ 4.38	$ 98.19	$ 101.62	$ 105.18	$ 319.22
3. State of Good Repair	$ 224.34	$ 243.34	$ 264.89	$ 198.19	$ 167.86	$ 1,098.62
4. CRC	$ 116.44	$ 72.81	$ 74.56	$ 70.10	$ 58.20	$ 392.10
MHS Total Cost	$408.62	$391.67	$450.34	$372.21	$340.16	$ 1,963.00

Over the FY 2013 through FY 2016 period, MassDOT spent an average of just $100 million annually on paygo construction and maintenance – less than one-half of what is needed for state of good repair projects (Table 11). MassDOT's most recent CIP indicates that it will reduce that amount to approximately $85 million in paygo capital annually for years 2017 – 2021.

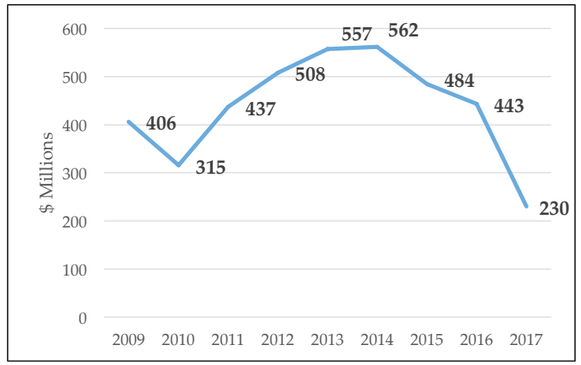
[16] *Progress Report of the Performance and Asset Management Council*, September 2016, p. A-2.
[17] *2015 Triennial Inspection, Metropolitan Highway System*, p. 53.

Table 11 – MHS Operating Revenue and Expenses ($ millions)[18]

MHS	2013	2014	2015	2016	2017	Average
Revenues	334	351	349	351	334	344
Op. Expenses	109	132	118	124	133	123
Debt Service	129	131	152	152	152	143
Paygo Capital	55	70	154	128	130	**107**
Net	41	17	(75)	(53)	(81)	(30)

MassDOT's capital investments in 2015 through 2017, including transitional costs for all-electronic tolling, required withdrawals from MHS reserves, reducing the balance from $562 million in 2015 to an estimated $230 million in 2017 (Figure 16).

Figure 16 – MHS Yearend Reserve Balance



Western Turnpike (WT)

The WT derives revenues from tolls and rental and leasing income. These revenues pay for operating expenses and debt service costs (outstanding WT bonds were paid off in 2017). Remaining funds are available for paygo capital investments or deposited into the WT reserve account.

As shown in Figure 17, MassDOT should spend approximately $150 million annually on state of good repair projects to prevent the WT from deteriorating any further.[19]

Figure 17 – Western Turnpike Capital Spending Needs

Cost Category	2016	2017	2018	2019	2020	5 Year Total
1. Modernization	$ 44.32	$ 27.83	$ 8.38	$ 8.67	$ 8.88	$ 98.07
2. Capacity	$ -	$ -	$ -	$ -	$ -	$ -
3. State of Good Repair	$ 138.81	$ 145.48	$ 157.58	$ 155.91	$ 164.64	$762.42
Western Turnpike Total Cost	$183.13	$173.30	$165.95	$164.58	$173.52	$860.48

MassDOT was spending substantially less than that – averaging $40 million annually in paygo investments for years 2013 through 2016 to maintain the WT (Table 12) which is over $100 million less than the amount estimated by the TFC for SGR projects. MassDOT expects to increase spending to approximately $95 million a year for years 2017 through 2021 which is still less than projected needs.

[18] MassDOT Revenue and Expense Reports

[19] *2015 Triennial Inspection, Western Turnpike*, p. 44.

Table 12 - WT Operating Revenue and Expenses ($ millions)[20]

WT	2013	2014	2015	2016	2017	Average
Revenues	148	166	173	194	170	170
Op. Expenses	84	96	103	97	116	99
Debt Service	21	20	19	18	17	19
Paygo Capital	28	29	35	75	125	**58**
Net	15	20	16	4	(88)	(7)

Summary

Despite additional resources, asset conditions across the state's transportation system remain in subpar condition, and the reasons for this are many and varied. A primary reason is that the TFC wanted to avoid overstating the size of the gap and in its own words described its estimate as "very conservative". However, even if the TFC employed a more aggressive approach, the underlying data from asset management systems could not accurately estimate the resource needs of the state's infrastructure because there were no agreed upon targets for assets being in 'good' condition.

Inaccurate project cost estimates added to the problem. For example, six high-cost bridges (five of which were included in the TFC report) cost approximately $650 million more to repair than the Highway Division projected (Table 13).

Table 13– Comparison of Highway Division Estimates of Certain High Cost Bridges

MassHighway and DCR High Cost Bridges	TFC	Current
Fore River (Quincy/Weymouth)	160	230
Whittier - I-95 (Amesbury/Newburyport)	132	305
Longfellow (Boston)	200	275
Woods Memorial (Medford / Everett)	34	76
Kenneth A. Burns - Rte 9 (Shrewsbury / Worcester)	50	105
Rte. 79 - Braga Bridge (Fall River)	-	230
Total	**576**	**1,221**

MBTA - A DISASTROUS DECADE

In 2006 the MBTA presented an update of its 1999 State-of-Good-Repair (SGR) study stating that its backlog was $2.7 billion.[21] The T estimated that spending $470 million annually on its infrastructure would prevent the SGR backlog from growing and that if the amount were increased to $620 million, the backlog would be eliminated over 20 years.

By 2009, the MBTA increased its estimate of the SGR backlog to $3 billion and adjusted its requisite spending accordingly. The $470 million needed to prevent the current backlog from growing soared to $694 million.[22] The $694 million figure was reaffirmed in a 2013 MBTA asset management presentation.[23]

The TFC's gap analysis included capital spending levels of $470 million and $570 million annually in its two most likely scenarios. $470 million in annual spending would prevent the SGR backlog from growing further and an additional $100 million annual investment would eliminate the backlog over 25 years. This projection replaced the T's $620 million estimate over 20 years.

The MBTA's continued struggle to balance its operating budget, combined with a lack of transparency, led to disastrous results discovered in the wake of the winter of 2015:

[20] MassDOT Revenue and Expense Reports

[21] *MBTA State of Good Repair Report, Key Infrastructure and Capital Spending Issues*, 2006 Edition.

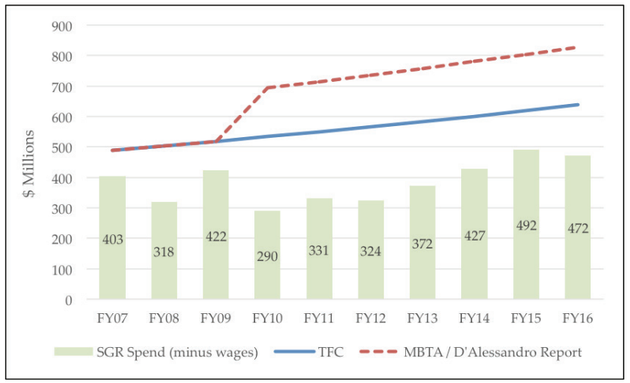
[22] MBTA Review, November 1, 2009, D'Alessandro et. al. p. 23.

[23] MBTA, *Asset Management at the MBTA: Past, Present, and Future*, Robert Guptil, Manager of Systems Integration, p. 4.

- The T did not adjust capital spending to its own estimate of $694 million annually.
- The T has not included inflation adjustments in its cost forecasts (the TFC adjusted capital spending by 3-4 percent annually).
- Although the T committed to a minimum of $470 million in SGR projects, it spent far less in years 2007 through 2014.
- The T did not publish its SGR backlog between 2009 and 2015.

As shown in Figure 18, the TFC's 'best revenue/worse costs' scenario projected minimum capital spending of $470 million growing at 4 percent (represented by the blue or solid line). An adjustment of the annual spending needs to $694 million in 2010, following the MBTA's revised estimate of the funds needed to preserve MBTA assets from further deterioration, is represented by the red (dotted) line. The bar chart reflects the actual MBTA capital spending on SGR minus costs for wages.[24]

Figure 18 – MBTA Capital Spending on State-of-Good Repair Projects



Over the first 10 years (FY 2007 – FY 2016), the MBTA spent considerably less than what the TFC projected the T would need to spend to prevent the SGR backlog from growing. Based on the MBTA's original estimate, it spent $1.75 billion less than the TFC recommended. Using the updated estimate of $694 million as the amount needed to preserve asset conditions, the T invested $3 billion less than what was necessary, thereby allowing substantial deterioration to its infrastructure (Table 14).

Table 14 – MBTA Capital Spending to Maintain Existing SGR Backlog

	TFC - 470	Actual	MBTA / D'Alessandro Report	Actual
FY07	489	-86	489	-86
FY08	503	-185	503	-185
FY09	519	-96	519	-96
FY10	534	-244	694	-404
FY11	550	-219	715	-384
FY12	567	-242	736	-412
FY13	584	-211	758	-386
FY14	601	-174	781	-354
FY15	619	-127	805	-312
FY16	638	-166	829	-357
	5,604	**-1,750**	**6,829**	**-2,975**

[24] CMS capital spending data for years FY 2007 – FY 2016 supplied by the MBTA.

STATE FISCAL CHALLENGES CONSTRAIN BORROWING CAPACITY

In reviewing the challenges confronting the state's transportation system, the TFC report cited two significant constraints: (1) the MBTA's "crushing debt burden" and (2) insufficient budget and staff at the Highway Division to "adequately oversee and maintain the system." To manage these challenges, the TFC proposed new dedicated transportation revenues from a hike in the gas tax (11.5 cents) indexed to inflation, augmented by a 5-cent vehicle mile traveled fee on state interstate roads. These recurrent revenue streams were estimated to yield $16 billion over 20 years.

The state opted to forego the TFC's long-term finance plan and instead relied on a modest increase in revenues and substantial increases in bonded debt to support critical capital investments. Ten years later, this practice has flipped the debt picture with the state's borrowing capacity now constrained. The reliance on state bonds to finance MassDOT and MBTA expenditures pushed the state's outstanding debt (principal) to $25 billion in 2016, up $6.6 billion or 35 percent from 2006.

While the MBTA has the capacity to borrow more, the state is rapidly reaching its statutory debt limit leaving little flexibility to ramp up capital investments for infrastructure at a time when the state's capital needs are extensive. Moreover, the state began a ten-year repayment of the $1 billion in Grant Anticipation Notes (GANs) in 2017, along with another $2.9 billion in debt service costs paid through 2046, thereby further reducing the amount of available capital for years.

In essence, the challenges plaguing the state's transportation system remain despite substantially more resources devoted to capital investments – a clear indication of the complexity of the structural problems and the need for a multi-faceted approach to tackling them, starting with a clear-cut definition of the state's transportation capital needs.

TRANSPORTATION PLANNING IN AN ERA OF MASS DISRUPTION

Further complicating the state's transportation challenges are external factors over which the state has little control but which are fundamentally altering transportation systems. In a period of scarce resources, the state cannot afford to develop long-term investment plans without factoring in the inevitable and irreversible effects of changes to the climate and technology advances in mobility. These are not problems that can be ignored or postponed.

When the TFC released its reports in 2007, Al Gore won the Nobel Prize for his work *An Inconvenient Truth*, global warming had just been assessed as 'unequivocal' by the Intergovernmental Panel on Climate Change[25], weather stories did not lead the nightly news, Facebook had an estimated 20 million members, Uber and Lyft did not exist, Nokia dominated mobile phones with a market cap of $250 billion, and Apple had just released the first iPhone.

Today, extreme weather is the norm – heat waves, ice melts, rising sea levels, extreme storms, and record precipitation are changing the global landscape. And technology is changing at record speed. Facebook has increased membership a hundredfold to 2 billion. It took Uber 6 years to reach 1 billion rides – and six months to reach the second billion. Microsoft bought Nokia for $8 billion in 2013. And Apple's iPhone – an all-in-one device combining email, music, phone, camera, and internet access with millions of apps – put smartphones in people's hands and changed everything. These rapid technological advancements are making once-dominant products, companies, and whole industries suddenly obsolete.

Whatever the timing, climate change and technologic advancements present inescapable transformations to the state's transportation system placing new – and expensive – demands on the state's infrastructure.

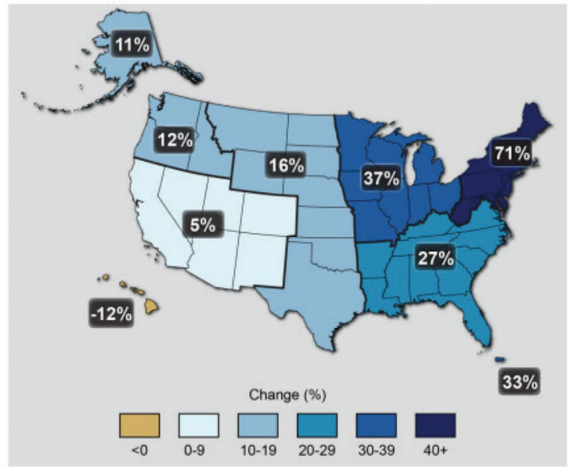
Climate

Among the most pressing problems that has grown in urgency over the past decade is climate change. Both the long-term trends and short-term shocks of our changing weather patterns are driving up infrastructure costs as the state contends with the impact of heat waves, ice storms, coastal storm surges, sea level rise, and extreme precipitation on roads, rails, power, signals, tunnels, culverts and more. Interruptions to Massachusetts' transportation systems from extreme weather can prevent citizens from reaching school, work, family members or even life-saving medical care.

As shown in Figure 19, the Northeast has experienced the greatest U.S. increase in heavy precipitation events over the past five decades and the trend is quickening.[26] The number of days with precipitation exceeding two inches is expected to increase from 37 to 46 percent in the Northeast by mid-century.[27] Massachusetts' existing storm water and transportation infrastructure is not designed to withstand these higher volumes. Investments in storm water retention and repair of flood-damaged roads, culverts and other transportation infrastructure will be required to prevent harm to people and property.

[25] See http://www.ipcc.ch for the updated Fifth Assessment Report.
[26] *U.S. GLOBAL CHANGE RESEARCH PROGRAM CLIMATE SCIENCE SPECIAL REPORT* (CSSR), Fifth-Order Draft (subject to final copyedit), June 28, 2017, pgs. 301 and 314.
[27] *2013: Regional Climate Trends and Scenarios for the National Climate Assessment: Part 3. Climate of the Northeast,* U.S. National Oceanic and Atmospheric Administration, Kunkel, K. E., L.E. Stevens, L. Sun, E. Janssen, D. Wuebbles, J. Rennells, A. DeGaetano, J.G. Dobson

Figure 19 – Observed Changes in Very Heavy Precipitation Events – 1958 to 2012[28]



Massachusetts and the other New England states are expected to experience the impacts of climate change earlier than other regions. New research shows that average temperatures in the Northeast could rise by 2 degrees Celsius by 2030, two decades earlier than the global mean surface temperature reaches that figure.[29]

Boston and neighboring communities are expected to experience a 25 percent higher rise in sea level than other areas around the world[30] A rise of up to 7 feet is projected by the end of the century that would flood 30 percent of Boston twice daily at high tide. Hotter temperatures, substantial increases in precipitation and more extremes storms are hastening the impacts of storm surges and flooding across Boston, the state and the Northeast.[31]

The impact on transportation infrastructure could be severe and occur faster than state and municipal governments can prepare or keep pace. For example, high temperatures expand and soften pavement leading to rutting, potholes and the need for more frequent and costly repairs. High temperatures also cause rail tracks to expand and buckle making train travel hazardous.

Heavy rains can wash out culverts threatening the integrity of roads, tunnels, and bridges. As we witnessed with Hurricanes Harvey and Irma, damage to the transportation infrastructure from these storms will surely run to many billions of dollars. Sea level rise and storm surges may inundate subway tunnels as experienced by New York City during Hurricane Sandy (salt water is especially hard on electrical systems).

These kinds of damages and expensive repairs require that capital investments into rail lines and subway infrastructure be rebuilt, raised, moved or even replaced with more flexible and resilient alternatives to prevent future disruptions. Current capital plans and projected expenditures do not include climate change adaptation costs. Such costs are best controlled by incorporating resilience into initial project design.

[28] *2014: Climate Change Impacts in the United States: The Third National Climate Assessment*, Jerry M Melillo, Teresa (T.C) Richmond, and Gary W. Yohn, Eds., U.S. Global Change Research Program, p. 9.
[29] *Consequences of Global Warming of 1.5 °C and 2 °C for Regional Temperature and Precipitation Changes in the Contiguous United States*, University of Massachusetts, Ambarish V. Karmalkar, Raymond S. Bradley, January 11, 2017.
[30] *Antarctic model raises prospect of unstoppable ice collapse*, Nature, Jeff Tollefson, March 30, 2016.
[31] *U.S. GLOBAL CHANGE RESEARCH PROGRAM CLIMATE SCIENCE SPECIAL REPORT* (CSSR), Fifth-Order Draft (subject to final copyedit), June 28, 2017, p. 513.

Technology

Companies around the world are investing tens of billions of dollars in a dash to disrupt the automotive industry. Led by automotive behemoths GM, Ford, Toyota, Daimler AG, Volkswagen/Audi, Nissan/Renault, Tesla, and others, in collaboration or competition with technology giants Amazon, Apple, Alphabet (Google), Samsung, and Intel, electric vehicles (EVs) will soon begin replacing gas-fueled vehicles, and fully automated vehicles (AVs) are likely to be introduced to the public within the next decade. Together with innovative new transportation companies such as Lyft, and Uber and hundreds more, ride sharing services are now global and the delivery of transportation services is being transformed.

It may feel like a vision that never quite transpires but change is already upon us. Mary Barra, CEO of General Motors, is among those who believe the petrol-fueled car is the past:

> "We are moving from an industry that, for 100 years, has relied on vehicles that are stand-alone, mechanically controlled and petroleum-fueled to ones that will soon be interconnected, electronically controlled and fueled by a range of energy sources. I believe the auto industry will change more in the next five to 10 years than it has in the last 50, and this gives us the opportunity to make cars more capable, more sustainable and more exciting than ever before."[32]

The speed at which others in the industry have reached this conclusion is stunning. In a 2015 survey of auto executives just 12 percent responded 'yes' to the question 'would there be a major business model disruption in the automotive industry'. Two years later that 12 percent soared to 83 percent who answered in the affirmative.[33] Further, 59 percent of surveyed executives agreed that half of today's car owners do not want to own an automobile in 2025.[34]

- Car / ride sharing apps and car ownership – what's happening

Car manufacturers used to want to sell as many vehicles as possible until they discovered the growing trend of millennials to forego driver's licenses[35] and forsake car ownership[36] for ride and car sharing services. As these services expand their reach,

> "It may become more like the airline business where we see jets that have been in service for 50 years," says Chris Ballinger, CFO and head of mobility services at the Toyota Research Institute. "Now I don't think a car will be in service for 50 years but I'm saying it may move in that direction…with tens of millions of miles and decades of service."[37]

In response to this shift, Ford, GM and many others are moving into the mobility business. GM introduced a ride sharing company Maven, Ford bought and launched Chariot a ride sharing service in San Francisco and New York. BMW's pick up and drop off service, ReachNow, recently expanded to Brooklyn, Cadillac introduced a subscription service where customers pay a monthly fee to swap models whenever they want, and Lexus / Toyota invested in Getaround – a car sharing service that lets owners rent their cars and apply the payments to their lease to offset the cost of ownership.

[32] Mary Barra, Chief Executive Officer and Chairperson of the General Motors Company, Address to the World Economic Forum, Davos, January 21, 2016.

[33] KMPG's *Global Automotive Executive Survey 2017*, p. 24.

[34] Ibid. p. 25.

[35] *Recent Decreases in the Proportion of Persons with a Driver's License across all Age Groups*, The University of Michigan, Transportation Research Institute, Michael Sivak and Brandon Schoettle, January 2016.

[36] Posted with *The Graying of American Debt*, Liberty Street Economics, by Meta Brown, Donghoon Lee, Joelle Scally, Katherine Strair, and Wilbert van der Klaauw, Federal Reserve Bank of New York, 2016.

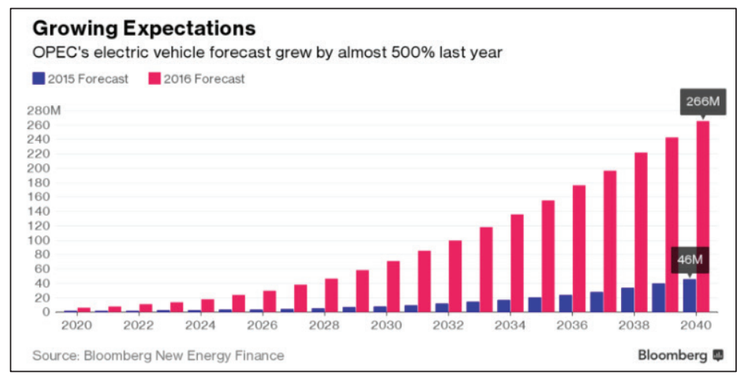
[37] *The End of Car Ownership*, Tim Higgins, The Wall Street Journal, June 20, 2017.

This transition stems in part from growing evidence and new research[38] that ride sharing apps reduce car ownership but also because auto manufacturers have concluded that ride sharing services provide higher profit margins and better sustainable revenues than selling cars to individuals – an acknowledgement that upends their business model for the past 100 years.

- Electronic Vehicles (EV) – a question of when

Oil producers are revising their forecasts of the adoption of EVs due to the quickening pace of technology. In 2016 the Organization of Petroleum Exporting Countries (OPEC) changed its estimate of EV global sales to 266 million vehicles in 2040, up from 46 million (Figure 20). *That is a 500 percent increase in their forecast from just 12 months earlier*.

Figure 20 – OPEC's Electric Vehicle Forecast – 2015 / 2016[39]



The market for electric vehicles is growing so quickly that Chinese-owned Volvo recently announced that it will stop manufacturing traditional gas powered cars by 2019 and build only hybrids and electric vehicles. This move will make China where over 40 percent of global EVs were manufactured in 2016, even more of a global leader in producing EVs. Reducing emissions in China and other countries following the Paris climate accord is a driving force behind a wave of state actions to pursue EVs.

The Netherlands and Norway banned the sale of gas powered cars beginning in 2025. India wants every car sold to be powered by electricity by 2030. Germany voted to ban the sale of vehicles with internal combustion engines by 2030. France and the UK announced plans to ban all gas and diesel cars by 2040. Austria, China, Denmark, Ireland, Japan, Portugal, Korea, and Spain have all set target dates for electric vehicles.

The Boston Consulting Group (BCG) conservatively estimates that 25 percent of miles driven in the United States – 800 to 900 billion miles – "could be traveled by shared electric vehicles by 2030."[40] BCG acknowledges that adoption could come faster if new innovations and price models further reduce costs for consumers.

The transition to EVs relies on several important technologic advancements including a longer range between charges and fast and convenient re-charging options. The industry is moving rapidly to solve both issues and, as OPEC prognosticators show, the transition time to EVs shrinks as rapidly as the technology advances.

[38] *Measuring the Impact of an Unanticipated Suspension of Ride-Sourcing in Austin, Texas*, Robert Hampshire, University of Michigan, Chris Simek, Texas A&M University et al, May 31, 2017.

[39] *Big Oil Just Woke Up to Threat of Rising Electric Car Demand*, Bloomberg Technology, Jess Shankleman, July 14, 2017.

[40] *By 2030, 25% of Miles Driven in US Could Be In Shared Self-Driving Electric Vehicles*, BCG Press Release, April 10, 2017.

- Autonomous Vehicles (AV) and Mass Transit - the potential

While most of the AV focus is on individual cars and personal transport, the next generation of self-driving shuttles and buses is already being piloted. Although the technology challenges are similar, the transition to autonomous shuttles and buses will likely occur sooner because these vehicles are directed towards local routes and last- mile connections to existing public transit.

Shared, autonomous shuttles and minivans may also compete with public transportation by offering near door-to-door service at lower costs than public buses. Public transit agencies that continue to operate traditional fixed route service with large inefficient, petrol-fueled buses will be forced to compete for riders. Or as José Viegas, secretary general of the International Transport Forum, recently concluded:

> "Traditional buses, with fixed routes, provide worse service than direct, smaller services. Yes, you need heavy transport in some cases. But traditional buses on fixed routes, we tested them, and none of them were strong enough to beat this new system."[41]

As these technologies emerge, the possibilities for transit services become apparent. The MBTA's The RIDE is already piloting a program with Uber and Lyft. Bus rapid transit (BRT) provides one example of further possibilities. Connected vehicle-to-vehicle BRT could eliminate its largest drawback – capacity. BRT operators could place a driver/monitor in the first vehicle (if necessary) and then scale to meet demand by linking as many buses as necessary travelling inches apart in a train-like configuration at top speeds. This could deliver comparable service on heavily trafficked corridors at substantially lower costs than rail.

- AVs and public infrastructure – the future

AV technologies will also greatly enhance transportation capacity. They create an internal map of the vehicle's surroundings based on an array of lasers, radar, sonar, cameras and sensors to determine road conditions, such as traffic lights, stop signs or how to identify and navigate road construction sites. Software processes these data inputs, plots a path and signals the vehicle to accelerate, brake, and steer.

For greater safety and enhanced performance, AVs could use vehicle-to-infrastructure (V2I) communications – a system of hardware, software, and wireless communications that transfers data between vehicles and the infrastructure. Simply put, AVs would perform better if they could talk to signs, signals, and roads. To adapt AVs into the transportation system, communities will have to work with industry to upgrade a variety of infrastructure components including:

- road and bridge sensor networks,
- digital road signs,
- upgraded and maintained lane markings,
- smart charging options for EVs,
- intelligent traffic signals,
- data storage and processing capacity,
- broadband network to capture and transmit data to traveling vehicles.

Emerging Technologies and Demographic Trends Put Revenue at Risk

In addition to higher capital costs to address these emerging trends, the state must contend with the impact they will have on current revenue sources and the likely diminution to them over time. In FY 2017, the state collected $2.2 billion from three transportation sources: (1) taxes on the sale of motor vehicles ($850 million), (2) gas tax revenues ($770 million), and (3) Registry and inspection fees ($570 million). These funds are largely dedicated to paying interest and principal costs of state transportation debt.

These revenue sources are tied to a 20th-century automotive model of household ownership and frequent replacement of gasoline-powered vehicles; they will be at risk should people purchase fewer cars and drive more fuel-efficient vehicles.

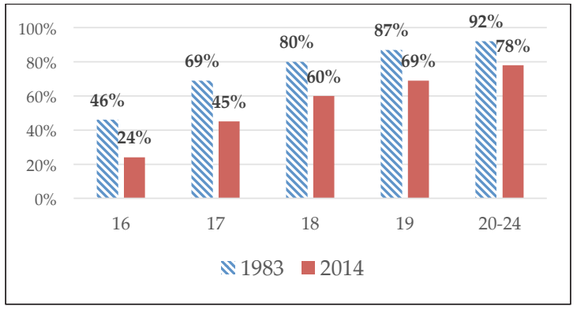
[41] *Bye-Bye, Buses: Autonomous Shuttles May Soon Upend Public Transportation*, Car and Driver, Pete Bigelow, October 3, 2016.

Trends regarding driver's licenses and auto originations per capita indicate that people are foregoing auto ownership in favor of alternative transportation services.

A recent report found that the number of people under the age of 24 who have obtained a driver's license has dropped substantially since 1983 (Figure 21).[42] Reasons offered by those choosing to forgo a license included the expense of "owning and maintaining a vehicle" (32 percent), and "the ability to get transportation from others" (31 percent).

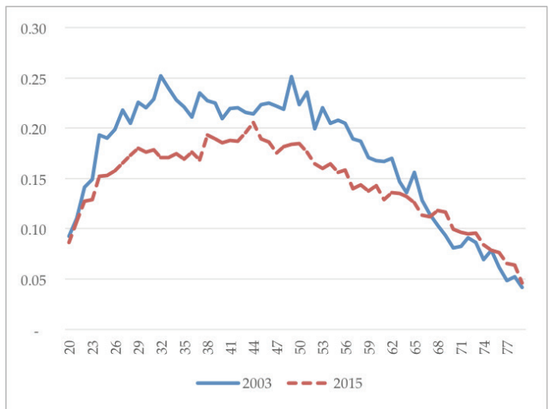
While this decline can be partially explained by fewer jobs for this age group, the rapid adoption of ride and car sharing services can also be explained by their lower costs and greater convenience in transportation trips– especially so in cities where high insurance and parking expenses add to the cost of owning a vehicle.

Figure 21 – Percentage of Persons Age 16 – 24 with a Driver's License



These changing economic conditions and shifts from purchasing cars to ride and car sharing services will also have a deleterious impact on motor vehicle sales tax revenues even if the economic recovery continues as fewer young people are purchasing cars than a dozen years ago (Figure 22).

Figure 22 - Per Capita Auto Originations by Age[43]

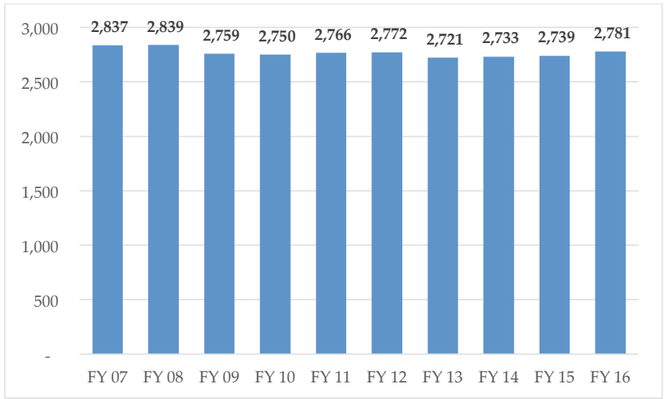


[42] *Recent Decreases in the Proportion of Persons with a Driver's License across all Age Groups*, The University of Michigan, Transportation Research Institute, Michael Sivak and Brandon Schoettle, January 2016.

[43] Posted with *The Graying of American Debt*, Liberty Street Economics, by Meta Brown, Donghoon Lee, Joelle Scally, Katherine Strair, and Wilbert van der Klaauw, Federal Reserve Bank of New York, 2016.

The TFC anticipated a move away from fossil fuel vehicles that would make the gas tax obsolete – a widely-held assumption that may still prove correct but that is not borne out by current data. In fact, recent information shows that the opposite has happened – the number of gallons of gasoline consumed increased each of the past four years and was greater in 2016 than every year since 2008 (Figure 23).[44] This may be attributed to the current popularity of light trucks (pickups, SUVs, minivans).

Figure 23 – Gallons of Gasoline Consumed in Massachusetts (in millions)



The TFC's prediction of diminishing gas tax revenues will eventually happen given the recent acceleration of EV vehicle adoption, albeit on a delayed time table. Today, virtually every car manufacturer is developing either an all-electric vehicle (EV) or a hybrid car because they are more efficient and durable. On the regulatory side, several nations have banned the sales of internal combustion engine vehicles in the next 10 – 20 years to reduce emissions.

The TFC expressed concern about federal funds due to declines in the federal highway trust fund balance and a stagnant federal gas tax. Although Congress recently passed the first long-term transportation bill in 10 years, doubts about the health of the Federal Highway Trust Fund continue. Congress relied on $70 billion of one-time solutions to fund the FAST Act and the trust fund is on a path to run out of sufficient funds to support the current level of federal investment after 2020. Further, the administration has shown a willingness to reduce federal support for transportation programs that could result in lower aid to states in the near term.

The move to hybrids and EVs is as irreversible as climate change – but the speed of adoption is still unknown. The outcome, though, means an inevitable reduction in gallons of gasoline sold and a corresponding decline in gas tax revenues.

[44] *The Commonwealth of Massachusetts Annual Financial Information, Commonwealth Transportation Fund Revenue Bonds*, March 21, 2017, p. 2.

CONCLUSIONS: RE-THINKIKING RESOURCES

The TFC was charged with developing a "comprehensive, multimodal, long-range, transportation finance plan" to improve the state's transportation infrastructure "through potential cost savings, efficiencies, and additional revenues." To close the gap, the TFC proposed new revenues that would generate approximately $16 billion over 20 years. Its work was guided by the principle that:

> *Transportation should be paid for primarily by users. Unlike other public goods such as police and fire protection, transportation is a utility, and it is reasonable for users to pay for the use and benefit they derive from the system.*[45]

Lawmakers addressed many of the TFC's recommendations to reduce costs and improve efficiencies, but neglected to pass a long-term sustainable revenue package. Instead, the state took an incremental step by passing the 2013 transportation finance bill and relied on stopgap financing to make up the difference. This strategy provided needed additional resources for capital investment but added billions of dollars to the state's debt load and hamstrung the state's ability to make increased future infrastructure investments.

State tax revenue growth has slowed dramatically, increasing by just 1.8 percent on average in the past two years. The combination of tight capital and operating budgets means the state lacks the capacity to ramp up capital spending or increase staffing at MassDOT and the MBTA to escalate capital throughput.

Fortunately, MassDOT and the MBTA have made substantial improvements to their asset management systems. By incorporating performance tools that are designed to predict long-term asset conditions based on different levels of investments, the state is better equipped to generate more accurate cost estimates and adjust them for changing fiscal conditions. The state has better data and metrics to measure returns on capital spending than in the past.

These changing financial conditions in themselves warrant a revision to the transportation blueprint for the next decade. But fundamental changes to transportation delivery prompted by technological advances and climate change compel the state to broaden its focus beyond just preserving transportation infrastructure with limited resources to fundamentally rethinking its transportation plan.

On the finance and management side, the state must consider the implications of these ongoing changes for revenues as well as expenditures. The state should assess the reliability of existing transportation revenues over the long-term. Ride sharing and EVs put $2.2 billion of revenues from the gas tax, motor vehicles sales tax, and Registry and inspection fees at risk. Two ballot questions in 2018 – one that would raise the tax rate on income in excess of $1 million and one that would reduce the sales tax rate from 6.25 percent to either 5.0 percent of 4.5 percent, if passed, would cause a major restructuring of state finances that will impact transportation resources. Recent federal budget proposals could reduce funds for the MassDOT Highway Division and the MBTA. In other words, current transportation revenues are uncertain and could unravel quickly.

The state should also set clearly defined asset condition targets in its revised transportation plan. Should the state aim for 60 percent of its non-interstate pavement conditions to be in good or excellent condition? 80 percent? 100 percent? Is a 90 percent target for structurally sound bridges acceptable? Establishing realistic targets in the context of broader choices and tradeoffs will dictate how much must be spent to preserve the transportation system.

Beyond this reconsideration of finance and management issues for existing systems, transportation leaders must also establish, implement and adhere to an evaluation process for large-scale projects, expansions and pilots that includes a cost-benefit analysis, climate change adaptation cost assessment, alternative mobility options, preventative maintenance costs, and a financing plan that covers capital and operating costs over the life of the project. Projects should be prioritized and started pending sufficient resources – both managerial bandwidth and funding.

[45] *Building a Sustainable Transportation Financing System*, Transportation Finance Commission, September 2007, p. 27.

In summary, given the many uncertainties before us, the state needs an independent review to better define its transportation capital needs and a comprehensive plan to pay for them. Such a study should include an agreement on asset condition targets; establish priorities for funding for resiliency, safety, capacity, and expansions; and develop a methodical and rigorous evaluation process to differentiate between transportation needs versus 'wants' that factors in the impacts of climate and technology.

The finance plan must account for a multitude of revenue risks while examining all available public and private funding and financing options to meet the state's transportation infrastructure needs.

APPENDIX

Appendix A – CAPITAL SPENDING ON STATE ROADS: 2007 - 2016

Capital Spending on Roads	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	10 yr. Total
TFC Estimate	313.6	322.8	276.1								913
(61210417) NON-FEDERAL ROADWAY PROJECTS				15.7	15.7	45.5	67.9	25.3	19.2	9.6	199
(61210716) NON-INTERSTATE FEDERAL AID - HIGHWAYS				159.7	92.8	30.3	15.5	11.0	10.4	0.4	320
(61210717) NON-FEDERALLY ASSISTED CONSTRUCTION & ADVERTISEMENT				161.0	104.3	45.0	21.9	17.4	12.2	11.1	373
(61210815) FEDERALLY ASSISTED CONSTRUCTION (FA) - INTERSTATE				42.6	65.8	30.8	9.2	0.2	0.0	0.0	149
(61210816) FEDERALLY ASSISTED CONSTRUCTION (FA) - NON INTERSTATE				217.4	321.2	495.8	388.0	295.8	138.5	31.9	1,889
(61210817) NON-FEDERALLY ASSISTED (NFA) CONSTRUCTION				0.0	107.9	37.1	16.1	7.7	3.1	1.5	173
(61210826) HIGHWAY PROJECTS - ARRA				88.3	159.0	65.2	7.2	0.7	0.0	0.0	320
(61211215) FEDERAL AID - INTERSTATE HIGHWAY SYSTEM				0.0	0.0	0.0	29.6	63.1	63.0	29.7	185
(61211216) FEDERAL AID - NON-INTERSTATE HIGHWAY SYSTEM				0.0	0.0	0.0	0.1	82.3	209.7	134.5	427
(61211314) FEDERAL AID HIGHWAY				0.0	0.0	0.0	0.0	0.5	119.5	410.0	530
(61211317) NON-FEDERAL AID HIGHWAY				0.0	0.0	0.0	0.0	2.2	216.8	310.7	530
Other				39.0	36.7	37.9	13.4	3.9	1.0	0.5	132
Total	**314**	**323**	**276**	**724**	**903**	**788**	**569**	**510**	**793**	**940**	**6,139**

Appendix B – CAPITAL SPENDING ON BRIDGES: 2007 - 2016

Capital Spending on Bridges	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	10 yr. Total
TFC Estimate	204.0	211.9	274.2								690
(61210800) ACCELERATED BRIDGE PROGRAM - MHD				135.0	290.1	287.0	340.6	477.3	398.9	347.9	2,277
(61210847) STATEWIDE ROAD AND BRIDGE PROGRAM - NFA				0.0	10.1	147.1	172.7	102.3	28.2	32.4	493
(61211217) NON-FEDERAL AID - ROADWAY AND BRIDGE PROJECTS				0.0	0.0	0.0	0.2	191.3	66.4	12.2	270
Other				14.0	6.5	3.6	1.1	0.2	0.1	0.0	26
Total	**204**	**212**	**274**	**149**	**307**	**438**	**515**	**771**	**494**	**392**	**3,755**

APPENDIX C – CAPITAL SPENDING ON MUNICIPAL ROADS: 2007 - 2016

Municipal Roads Capital Spending	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	10 yr. Total
TFC Estimate	96.0	120.0	120.0								336
(61220498) CHAPTER 90 PROGRAM				17.0	14.8	38.2	19.2	6.3	2.7	1.1	99
(61220867) CHAPTER 90 - MUNICIPAL ROADS AND BRIDGES				42.5	18.4	12.2	10.7	3.5	1.3	0.7	89
(61220868) CHAPTER 90 TOWN & COUNTY WAYS				45.9	122.0	68.5	30.8	13.7	5.2	2.2	288
(61221190) MUNICIPAL WAYS CONSTRUCTION AND RECONSTRUCTION				0.0	0.0	81.0	53.5	37.5	13.8	3.9	190
(61221223) CHAPTER 90 MUNICIPAL ROAD PROJECTS				0.0	0.0	0.0	61.1	63.2	36.4	16.6	177
(61221224) CHAPTER 90 - LOCAL ROAD AID				0.0	0.0	0.0	0.0	0.0	81.6	92.9	175
(61221323) CH90 MUNICIPAL ROAD PROJECTS				0.0	0.0	0.0	0.0	64.8	69.9	28.3	163
(61221524) MUNICIPAL WAYS CONSTRUCTION AND RECONSTRUCTION				0.0	0.0	0.0	0.0	0.0	0.0	77.8	78
Other				4.8	14.5	0.0	0.0	0.0	0.0	0.2	19
Total	**96**	**120**	**120**	**110**	**170**	**200**	**175**	**189**	**211**	**224**	**1,614**

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