# 2015 AASHTO Bottom Line Report

EXECUTIVE VERSION


# Transportation Bottom Line

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS

100 YEARS
AASHTO
1914–2014

# 2015 AASHTO Bottom Line Report
# Executive Version

# Transportation
# Bottom Line

# PREPARED FOR
# AASHTO

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The information contained in this report was prepared as part of NCHRP Project HR-20-24, Task 086,

National Cooperative Highway Research Program.

**<u>SPECIAL NOTE</u>:** This report **<u>IS NOT</u>** an official publication of the National Cooperative Highway Research Program, Transportation Research Board, National Research Council, or The National Academies.

## AT A GLANCE

An annual investment of $120 billion for highways and bridges between 2015 and 2020 is necessary to improve the condition and performance of the system, given a rate of travel growth of 1.0 percent per year in vehicle miles of travel, which has been AASHTO's sustainability goal, and which represents the likely impacts of both population growth and economic recovery.

If travel growth is at 1.4 percent per year, which carries forward the rate employed in the 2009 Bottom Line and is consistent with the long term trend from 1995 to 2010, and has been indicated in recent months, then needed investment to improve the highway and bridge system will be $144 billion per year.

In 2010, the most recent year for which full data has been compiled by the Federal Highway Administration, highway capital investment from sources other than the American Recovery and Reinvestment Act, totaled $88.3 billion per year, but future funding levels are now highly uncertain.

An annual investment of $43 billion for public transportation is necessary to improve system performance and condition, given an expected 2.4 percent annual growth in transit passenger miles of travel.

If transit ridership growth rises to 3.5 percent, the level that would double transit passenger miles of travel in 20 years, investment in public transportation capital would have to increase to $56  billion per year.

In 2011, transit capital investment from all levels of government totaled $17.1 billion, according to APTA.

The model based investment estimates do not include all needs.  Highway operations investments, safety and security, and environmental mitigation costs for highways and transit capital projects may add over $10 billion per year to annual investment costs, although these are not compiled for all systems and agencies. Importantly, long term highway reconstruction costs may also not be fully captured.

The highway and bridge backlog required to restore the system to the level of condition and performance required to meet today's demand is $740 billion: of that amount the highway system rehabilitation backlog accounts for $392 billion; the highway system capacity expansion backlog accounts for $237 billion; and the bridge rehabilitation backlog accounts for $112 billion.

The highway system rehabilitation value of $392 billion plus bridges at $112 billion, is roughly comparable in concept to the transit state of good repair (SGR) backlog approach, which has a value of $77.7 billion. The FTA has not calculated a transit system capacity expansion backlog.

Recent research "A Failure To Act" sponsored by the American Society of Civil Engineers on the economic impacts of investing to improve conditions and performance of highways and public transportation indicated that the average US household will benefit by a cumulative $157,000 extra income between 2012 and 2040 compared to current levels of highway and transit investment, which is more than three times current median household income.

An economic analysis for APTA of the transit investments in the 2009 Bottom Line report showed that the marginal return from investing additional dollars in transit capital was 3.7 times the incremental cost of those investments.

FHWA's condition and performance report for 2010 showed that by the end of the 20 year analysis period, the annual user cost savings from higher levels of highway investment were 2.6 to 3.8 times as great as the annual added investment over current levels.

Between 1991 and 2011, both highway vehicle miles of travel and transit passenger miles of travel increased at a long term average annual rate of 1.6 percent.

Highway travel declined during the recession and its aftermath, and has slowly resumed growth since 2011, reaching an annual increase of only 0.6 percent in 2013 and transit travel grew only 1.1 percent in 2013, reflecting the slow beginning of the economic recovery from the great recession.

Highway travel is expected to reach 3 trillion miles of travel again in 2014 not seen since 2008.

In 2011, the freight transported in America was 17.6 billion tons, with 64 percent by truck, and freight ton miles are expected to grow 72 percent from 2015 to 2040.

In 2013, transit passengers totaled 10.7 billion, the highest level since 1956.

International tourism, an intense user of our transportation system, generated $181 billion for the US in 2013.

Transportation industries employ more than 11.7 million persons.

Since 1950, the population of the United States more than doubled but the road system grew only from 3.3 million miles to 4.1 million miles.

The number of motor vehicles in the United States has quadrupled from around 65 million at the start of the Interstate in 1956 to 254 million in 2012.

The overall population of the US is anticipated to grow by 37 million from 2010 to 2025, but the over 65 population is expected to grow by 25 million, the under 18 population by 4 million, and the working age population of 18 to 64 by only 8 million.

Structurally deficient bridges have declined by 43% from 1994 to 2013, but 63,500 SD bridges remain.

Highway fatalities have decreased from 41,000 in 2007 to an estimate of below 33,000 in 2013.

## ACKNOWLEDGEMENTS

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This report is the product of cooperative research sponsored jointly by the National Cooperative Highway Research Program (NCHRP) and the Transit Cooperative Research Program (TCRP).

AASHTO and APTA provided both input information and source data, and AASHTO and APTA staff have provided advice on what changes since the 2009 Bottom Line Report warrant attention for this update.

Alan E. Pisarski and Arlee T. Reno, independent researchers, have served as the research team for this report and were also the primary team members for the 2009 Bottom Line Report.

Ross Crichton, leader of the USDOT's team for the 2013 Condition and Performance Report, and many of his DOT colleagues have provided valuable inputs and advice on data sources and analysis.

This effort was guided by the panel for NCHRP Project 20-24(86), with NCHRP staff support from Dr. Andrew Lemer and Ms. Sheila Moore. The panel provided guidance on all aspects of the project and advice and assistance on sources and methods.

## DISCLAIMER

**NCHRP Project 20-24(86), FY 2013**

*Critical Assessment for Future Surface Transportation Needs Analyses (Refresh the Policy Capacity of the Bottom Line/C&P)*

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## FOREWORD

2015 will be a critical year for the future of America and for the surface transportation program. Congress and the Administration will be called upon to craft legislation that will put in place the surface transportation programs that will be essential to the nation's economic recovery and quality of life. The challenges of funding are arrayed against the overwhelming case that enhanced investment is absolutely critical to the future of the nation.

Many issues must be addressed including but not limited to the following:

Investing in highway and transit infrastructure not only to sustain a recovery but also to support long term economic success for all Americans.

Sustaining the solvency of the Federal Highway Trust Fund.

Maintaining rural and urban access and connectivity

Addressing transportation impacts on global climate change and climate change impacts on transportation.

Reconstruction needs of an aging transportation system.

Reducing congestion on highways and crowding on major transit lines.

Increasing the capacity and safety of transportation systems.

Maintaining international competitiveness.

This comprehensive assessment of highway, bridge, and transit investment needs provides a definitive base of information for decisions about levels of necessary investment. It is based on the forecasting models and data systems used by the US Federal Highway Administration and the US Federal Transit Administration, and on the results of FHWA analyses, supplemented by additional research. The result is the most comprehensive analysis of the nation's transportation investment needs which is now possible.

## TABLE OF CONTENTS

# KEY FINDINGS

During the present period of recession and long recovery there has been an opportunity for governments to "catch up" with road system and transit investment requirements as demand growth has been limited and construction and rehabilitation costs were low. This, unfortunately, has not been realized as federal, state and local government resources were sharply limited during the same recession. As a result the backlog of national investment needs for both rehabilitation and other condition improvements, and response to historical capacity deficits remain substantial.

## Highway and Bridge Requirements

Three primary highway and bridge investment scenarios were developed and evaluated, along with their sub-scenario variations. These employ varying criteria and varying levels of expected growth. Selected results important to gaining a comprehensive sense of national investment needs are presented here.

**Highways and Bridges Maximum Economic Investments**

| Growth Rate of VMT per Year | Maximum Economic Investment – ------ Needed Spending per Year (Billions of Year 2012 Dollars) |
|---|---|
| **Modal Comparison Scenario -- 1.6 Percent Annual Growth** | **$156.5** |
| **Mid Level Scenario – 1.4 Percent Annual Growth** | **$144.4** |
| **2009 BL Policy Scenario - 1.0 Percent Annual Growth** | **$120.2** |

At a 1.6 percent growth rate in VMT, called a Modal Comparison Scenario wherein both highways and transit are shown at the same growth rate that each has averaged over the last twenty years, annual average investment requirements for highways and bridges total $156.5 billion. In the Mid Level Scenario, at a 1.4% VMT growth rate, investment requirements are $144.4 billion. Under a Policy Variant Scenario of nearly constant VMT/capita, at a 1.0 percent annual VMT growth rate, the investment requirements decline to $120.2 billion.

These scenarios represent a 13 percent and a 9 percent decline from the comparable 2009 Bottom Line scenarios which also used the growth rates of 1.4 percent and 1.0 percent. The 1.4 percent growth rate is consistent with the trend since 1995 and reflects judgments of recent state estimates of highway travel growth.

The decline in investment needs from the 2009 Bottom Line is primarily due to the decline in the FHWA's cost index from 2006 (which was used in the 2009 Bottom Line) to the cost index in 2012 (which was used in the 2015 Executive Bottom Line). The cost index declined after 2006 but began to rise again after 2010 to the levels in 2012 and then moderated with only slight change in 2013.

## The Highway and Bridge Backlog

There has been a substantial expansion in the overall backlog of investment requirements for Highways and Bridges, that amount needed to meet today's need independent of future growth prospects, as funding has failed to reach the necessary levels to sustain condition and performance. At this time, given present lower construction costs, the investment required to restore the system to the level of condition and performance to serve today's demand is $740 billion: of that amount highway system rehabilitation accounts for $392 billion; highway system expansion $237; and bridges $112 billion.

ARRA (the American Recovery and Reinvestment Act) funding has succeeded in making a contribution to reducing those backlog deficiencies, not all of which have been fully tallied in current reporting. The 2013 C&P (2013 Status of the Nation's Highways, Bridges and Transit) included spending under ARRA as current spending, but that spending had concluded at the start of the Bottom Line analysis period for this study. Therefore this report estimates current spending as the level of capital investment as developed by the 2013 C&P but excluding spending from the ARRA. The current highway and bridge capital spending is at about $88.3 Billion per year under this updated definition.

### A Full Employment Sub-Scenario

As part of these analyses it was recognized, given the key role that employment plays in travel demand, that, while late in 2014 total national employment reached the levels that pertained before the recession, the proportion of population at work has not reached the same levels that had pertained prior to the recession. Thus, a scenario was developed for estimating the travel effects of a return in 2015 to the previous share of employment (employment/population ratio) that applied before the recession. Such a level would add on the order of an additional 10 million workers in the society. Based on BLS consumer expenditure estimates of fuel spending of workers vs non-workers an estimated incremental VMT level of 50 billion VMT was derived as the added VMT for the enhanced or full employment scenario. This was treated as an increment to the various VMT growth rates of the main scenarios.

It is worth noting that this estimate is a simple, straightforward illustration of the role that employment plays resulting in direct changes to travel demand; it does not include estimates of the second order effects in the economy of an added 10 million workers, which would be substantial. It is also of interest that this estimate of full employment returns national VMT to at least the levels that pertained pre-recession. Here in summary are the four scenarios of maximum economic investment adding in the full employment increment to the 1.4 percent regular scenario and to the 1.0 percent regular scenario.

| **Scenario** | **At Base Level of Employment** | **At Full Level of Employment** |
|---|---|---|
| **Mid Level Scenario – 1.4 Percent Annual Growth** | **$144.37** | **$148.17** |
| **Bottom Line Policy Scenario - 1.0 Percent Annual Growth** | **$120.17** | **$124.19** |

## Transit Investment Requirements

The economic growth or improve conditions, improve performance scenario for transit is shown for three levels of growth in transit passenger miles. This scenario has traditionally been referred to as “improve conditions, improve performance.” The table below illustrates the average annual public transportation capital needs for the preferred scenario of improving conditions and improving performance under the three different passenger miles growth scenarios. In addition, to conform to FTA’s current practice in the 2013 C&P report, the cost of only achieving a state of good repair (SGR) for current transit assets is also identified. The state of good repair estimate is independent of passenger miles. The SGR estimate in the 2013 C&P was $18.5 billion per year in 2010 dollars for reducing the backlog over twenty years, and this estimate was adjusted to $19.1 billion for 2012 dollars to conform to the cost adjustments for the other scenario estimates. The estimate used of current transit capital investment spending is $17.1 billion for the year 2011, taken from APTA’s 2013 Fact Book.

The three scenarios which constitute improve/improve at different growth rates are highlighted as in recent Bottom Line reports. In addition, to conform to FTA's current practice in the 2010 C&P report, levels of continuing current spending and the level of only achieving a state of good repair (SGR) for existing current transit assets are also identified. These latter two are adjusted from the 2013 C&P report results using cost index factors.

**Public Transportation Capital Investments (Average Annual 2012 $ Billions) – Levels For Current Spending, and Improve Conditions and Performance**

| | Current Level | 1.6 Percent Annual Growth | 2.4 Percent Annual Growth | 3.53 Percent Annual Growth |
|---|---|---|---|---|
| **Total Annual Needs** | **$17.1** | **$34.4** | **$43.3** | **$55.6** |

## An Annual State of Good Repair (SGR) Estimate

The concept of State of Good Repair has been recently introduced in investment analysis. It identifies what funding levels would be required to reestablish the entire system to a level of what would be considered good condition or good repair. A highway and bridge State of Good Repair (SGR) value is presented here, based on the SGR scenario included in the 2013 C&P report, adjusted only for cost index changes. When adjusted, the comparable 2015 Bottom Line estimate would be $83.1 billion per year. This should be considered to be an approximation to be applied across all the different VMT growth rates. Pavement and bridge damage will vary somewhat based on different heavy truck VMT growth rates, but these analyses have not been done for the 2015 Bottom Line and so the SGR numbers are shown as the same for the alternative VMT growth rates. Absent a full national survey these estimates are not able to include a comprehensive national need for full future reconstruction of the aging Interstate and other facilities.

A parallel value for SGR for transit amounts to 19.1 Billion based on an adjusted cost for 2012 compared to the 2010 costs in the latest C&P. As in highways and bridges this value is independent of capacity needs.

# THE VALUE OF TRANSPORTATION INVESTMENTS

## TRANSPORTATION EMPLOYMENT

As of 2012 the nation's transportation-related labor force stood at 11.7 million workers, just under a 9% share of total national employment. Those numbers are down from the peak at the start of this century of 13.9 million transportation workers and a 10.5% share of employment. The largest component of that is the transportation and warehousing occupational group which has remained relatively stable at 4.4 million throughout the period. Some of the main occupational groups include:

**MAIN TRANSPORTATION OCCUPATIONS 2012**

| Occupational Group | Number 000's |
|---|---:|
| Truck Transportation | 1,351 |
| Urban Rural Intercity Bus Transit | 96 |
| Freight Transportation Arrangement | 183 |
| Couriers and Messengers | 533 |
| Warehouse and Storage | 682 |
| Transportation Equipment Manufacturing | 1,456 |
| Highway Street and Bridge Construction | 292 |
| Motor Vehicle and Parts Dealers | 1,732 |
| Gasoline Stations | 841 |
| Automotive Equipment Rental and Leasing | 173 |
| Travel Arrangement and Reservation Services | 193 |
| Ambulatory and Health Care | 266 |
| Automotive Repair and Maintenance | 830 |
| Parking Lots and Garages | 119 |
| Postal Service | 611 |
| USDOT | 58 |
| State and Local Government (2011) | 834 |

Source: BTS, USDOT – categories identified by BTS

It is clear from this how substantial the nation's dependence is on a properly functioning road transportation system and the services that operate over it such as transit, trucking, couriers and the postal service. Of major importance is the substantial role of freight movement in our employment and economy. Other public vehicle operations beyond transit are also critically affected by the state of the system including police, fire and other emergency services vehicles, and the military.

# THE ROLE OF TOURISM

Although rarely specifically recognized, the United States is number one in the world in revenues received from international visitors, as of 2012. In 2013, spending by international visitors to the United States reached $180.7 billion. Of this, $41 billion consisted of purchases by foreigners of US air carrier services and $140 billion was expended within the United States. This generated a major trade surplus of over $57 billion in 2013. The US has benefited from such a surplus in travel since 1989. This places tourism at 27% of all services exports in 2013, and places it ahead of exports of motor vehicles or of agricultural goods. Both domestic and international transportation services are a key part of attracting and serving visitations. An important shift has occurred in the visit arrangements of rapidly growing number of Asian visitors in particular. This shift has been toward independent vehicle travel rather than the group travel of earlier times. Both will see important growth in the future.

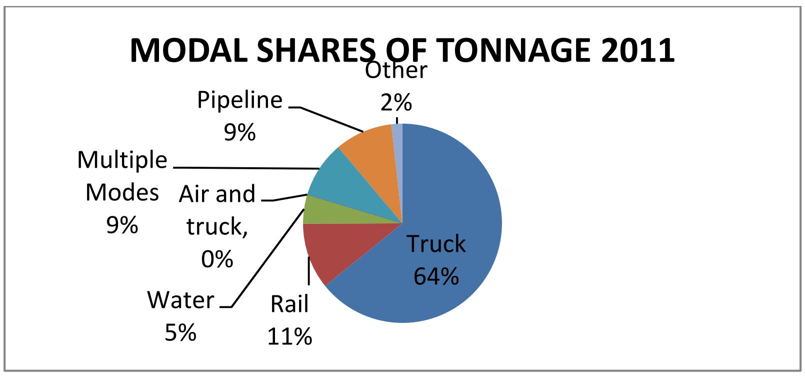
Consistent with the revenue increase, the US registered a record number of international visitors in 2013, at just below 70 million visitors. Visitations have increased significantly each year since the recession year of 2009 when 55 million visitors were counted. Significantly for transportation concerns, the National Travel and Tourism Office forecasts a 20% increase in visitors by 2018, reaching almost 84 million, equivalent to about an addition of 25% to the total US population.

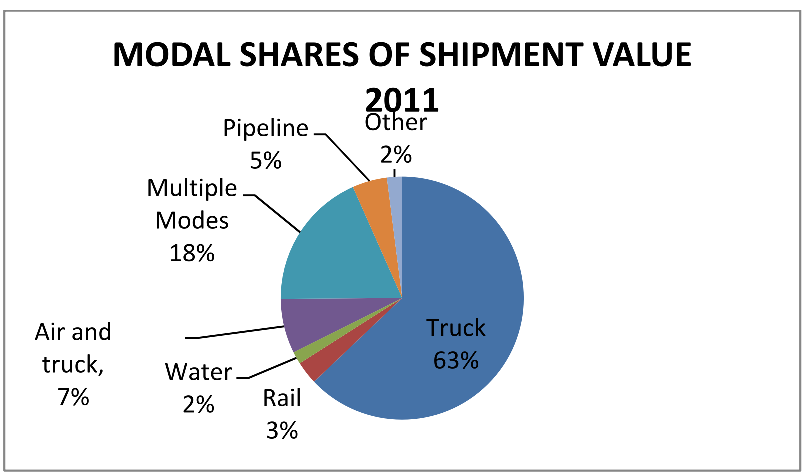
Prodigious as that number is, international visitors are a relatively small part of overall US travel and tourism, although significant in financial terms. While only 4% of total tourism travelers, they account for 17% of total tourism travel demand. They accounted for 15% of all tourism highway tolls and 3% of all tourism gasoline consumption according to the NTTO. Historically, they have been a significant part of car rentals, intercity bus and rail, as well as local transit and taxis.

The overall travel and tourism industry in the United States is a major factor in the US economy with total tourism-related employment at the end of 2013 in excess of 8 million, as estimated by the Bureau of Economic Analysis in their Travel and Tourism Satellite Account. One million of that employment is in transportation-related industries, not including air transportation services. In the fourth quarter of 2013 the BEA placed tourism-related spending at $1.5 trillion. According to the US Travel Association total domestic person trips of over 50 miles, reached a low of 1,900 million, during the recession, but are expected to reach 2,160 million person trips in 2016. Of this travel, about 22% is considered business-related travel and the remainder is leisure and personal travel. A resurgence in the intercity bus industry with low cost carriers as well as traditional tour-based activities is highly dependent on an effective road system.

## FREIGHT MOVEMENT

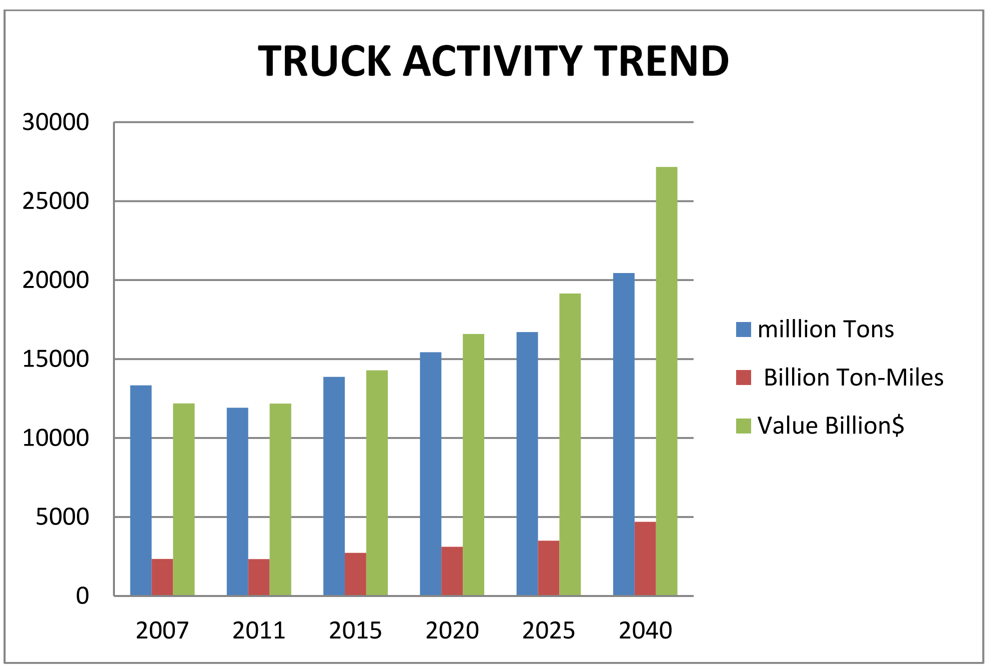
Of the almost 17.6 billion tons shipped in 2011, about 64% were shipped by truck. In addition, trucks were heavily associated with multimode shipping and air and truck combination shipments. This added approximately another 10% to the truck related share. When shipments are examined in terms of their value, the total, including truck only, multimode shipping and air and truck combination shipments rises to 88% of the almost $17 trillion of goods shipped. The Figures below exhibit the patterns.




A recent study was conducted by the ATRI (American Transportation Research Institute) on the cost of congestion to the trucking industry. The study is based on billions of GPS data points of truck flows drawn from a sample truck fleet of half a million vehicles throughout the country. It sets that cost at $9.2 billion per year in increased operational costs as the result of 141 million hours of lost productivity in the national truck fleet. National trucking related congestion costs in 2013 now range at around an average of $2.5 billion per calendar quarter. Many long-haul trucks, which may cover 150,000 miles per year, experience an average added annual cost as a result of congestion of over $5,000. ATRI calculates that 89% of costs occur in urban areas. Costs per interstate mile among the most heavily congested states reach averages of a quarter million dollars per mile.

The US DOT forecasts that freight movement will show substantial growth over the next 25 years in all freight elements, particularly in trucking. The current patterns and forecasted trends are depicted in the figure below which shows the key components of trucking freight: tons moved; ton-miles carried; and total value of goods moved. The FHWA forecasts indicate a 47% increase in tons in the 25 years from 2015 to 2040; ton-miles are expected to increase by 72%; and value by over 90%. This indicates substantial increases in average trip length and in the average value per ton of goods moved. Increasing value places even greater importance on timely movement and control of the logistics of the movements. Overall it represents a dramatic challenge for the national road system. These values are for truck-only moves. Even greater growth is forecasted for combined air and truck movements; and for mail and multiple modes movements, in which trucking plays very prominent roles. The value of air and truck movements are forecasted to more than triple between 2015 and 2040; and the mail and multiple modes categories are forecasted to grow 2.7 times in the same period. As a result there are very few freight moves in which trucking isn't the sole or very crucial part.

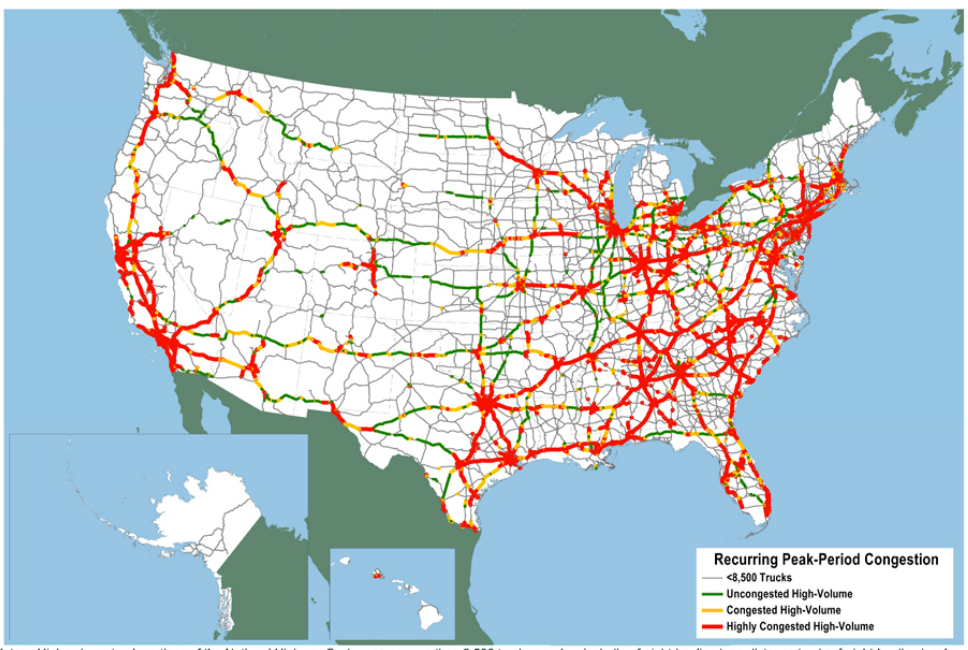



Source: Freight Facts and Figures 2012, US DOT, FHWA

Even in international moves where air and water are the major factors, truck movements are substantial.  In addition to supporting many air and water moves with Canada and Mexico, our number one and three international trade partners, with rapid trade growth trucking accounts for almost 60 percent of moves across our borders, with the total value of trucking trade with Canada and Mexico at the level of over two-thirds of a trillion dollars in 2013 according to BTS statistics.  The value of such trade grew by 50% between 2004 and 2013.

As a result truck congestion on already crowded long distance routes is expected to increase substantially.  The adjacent map below depicts the forecasted patterns of congestion in 2040.

Peak-Period Congestion on High-Volume Truck Portions of the National Highway System: 2040




Notes: High-volume truck portions of the National Highway System carry more than 8,500 trucks per day, including freight-hauling long-distance trucks, freight-hauling local trucks, and other trucks with six or more tires. Highly congested segments are stop-and-go conditions with volume/service flow ratios greater than 0.95. Congested segments have reduced traffic speeds with volume/service flow ratios between 0.75 and 0.95. The volume/service flow ratio is estimated using the procedures outlined in the HPMS Field Manual, Appendix N
Source: U. S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework, version 3.4, 2012

# RURAL CONNECTEDNESS

The history of the Nation has been inextricably tied to its ability to overcome the tyranny of distance.  America is a vast country in geographic extent, in population, in economic power and technological capabilities.  Few nations combine those four characteristics as we do.  At the same time it is a sparsely populated nation with extremely low average densities and vast distances to traverse to meet the nation’s needs and support the well-being of its population.

At least in potential, it has among the best connected rural populations in the world. The combination of an extensive transportation system and high levels of communication, including radio, television, telephone and internet connections provide the potential for high levels of access to information and services and connection with the larger society. However, the nation will need the full participation of rural populations in the economy and the society more than ever in the future. Among the keys will be:

- Access to agricultural products
- Access to manufacturing facilities
- Access to natural resources
- Access to cultural and recreational opportunities such as National Parks
- Access to viable retirement communities with the medical and other services requisite for the aging.

But most of all it will be the resource represented by a well-educated rural population, depending on definitions amounting to on the order of 50 million persons, that the nation will need to integrate fully into the future economy in order to meet the nation's requirements for skilled workers.

As it is, of the 20 million workers living in rural areas, more than 3 million each day leave rural areas for metropolitan jobs, and notably, the rural areas receive in return almost 2 million workers from metro areas. The predominant flows are the very substantial flows within rural areas within and between micropolitan centers, small urban clusters of between 10,000 and 50,000 population defined by the Census, that are emerging centers of economic activity. About 10 million of the rural workforce live and work in these micropolitan areas. About 6.3 million work within their own rural non-micro areas and another 1.3 million flow between micropolitan areas. These 20 million workers represent a great national resource who can make even greater contributions to national GDP with expanded access to job opportunities.

While there has been a net decline in overall rural populations in recent times, there are, in fact, substantial flows of new households from suburbs to rural areas (240,000 in 2011) and from central cities (206,000), and directly from abroad as well. These indicate that there are strong incentives and preferences for the rural life style among many.

It is critical to expand transportation capabilities to more effectively integrate rural capabilities into the national structure for the sake of the nation's rural population, and for the sake of a greater national productivity and coherence. The nation cannot afford to have a large segment of its population isolated from the economic opportunity and support services they require.

Our transportation system must meet the test of providing greater access and connectivity to this population.

# A NEW ECONOMIC FOCUS FOR THE BOTTOM LINE

## GLOBAL COMPETITIVENESS AND INFRASTRUCTURE

The World Economic Forum produces a Global Competitiveness Report that helps identify the roles that infrastructure plays in world competitiveness. The rankings are based on 12 pillars of competitiveness grouped into three broad sub indexes:

#1 Basic Requirements;
#2 Efficiency Enhancers; and
#3 Innovation and Sophistication Factors.

Infrastructure is Pillar number 2 of 4 in the Basic Requirements Subindex as shown below:

- Pillar one. Institutions
- **Pillar two. Infrastructure**
- Pillar three. Macroeconomic environment
- Pillar four. Health and Primary Education

The key transportation elements of the Infrastructure Pillar, with their US rank for each, are shown below:

| Country | Rank |
|---|---|
| Germany | 3 |
| France | 4 |
| Switzerland | 6 |
| Netherlands | 7 |
| United Kingdom | 8 |
| Japan | 9 |
| Spain | 10 |
| Korea | 11 |
| Canada | 12 |
| Taiwan, China | 14 |
| United States | 15 |

| Elements of the Infrastructure Pillar Rank | US Rank |
|---|---|
| 2.01 quality of overall infrastructure | 19 |
| 2.02 quality of roads | 18 |
| 2.03 quality of railroad infrastructure | 17 |
| 2.04 quality of port infrastructure | 16 |
| 2.05 quality of air transport infrastructure | 18 |
| 2.06 available airline seat kilometers | 1 |

Inadequate supply of infrastructure is listed among the most problematic factors for doing business in the United States. All US transportation infrastructure quality elements are uniformly poor ranging from 16th to 19th in the world. The only service-level statistic, available airline seat miles, stands out in terms of its top rank.

The structure and mechanisms employed by the world economic forum have pertinence here because they form a large part of the guidance that informed the US Chamber of Commerce's Transportation Performance Index first released in 2010. In another recent study by the McKinsey Global Institute[1] aimed at increasing the productivity of infrastructure investments, the US is calculated to be investing at a rate of 2.6% of GDP; whereas, based on their estimate of needs for all infrastructure investment derived from international norms and expected national economic growth rates, the US ought to be investing at a level of 3.6% of GDP.

## EVOLUTION FROM JOB IMPACTS TO OVERALL ECONOMIC IMPACTS

Assessments of the economic development effects of transportation investment have been limited in past years. Many past assessments, often keyed to periods of economic stress, tended to place focus on near-term job creation generated by the immediate stimulus to construction work and materials production. These assessments often failed to account for the longer term effects of improved travel times and access to opportunities afforded by new transportation investment. Limited evaluation of the effects of transportation investments via Before/After Studies may have missed the opportunity to demonstrate both the near-term and longer term effects of major investments. The recent recession and slow growth aftermath has aroused greater interest in ascertaining the linkages between highway investment and other forms of transportation investment on overall long term economic development.

More and more attention is now being given to utilizing transportation investment to improve the economic well being of households, businesses, and the nation as a whole. Benefits assessed include both short and long term changes in employment, household and business income, land values, and the improvements in access to workers, jobs, suppliers of materials and services, and potential customers. Recent analyses for all modes have provided evidence of the substantial long term economic benefits of additional investments in highways and public transportation. Several of these analyses have analyzed the investment scenarios from the previous Bottom Line or the previous Condition and Performance Reports. The newer analyses have also extended economic analyses beyond the topic of user benefits to the consideration of the overall economic impacts of investments on household income and business income.

The analyses of user benefits included in recent Condition and Performance reports provide a starting point for the broader consideration of economic benefits. Both the 2010 C&P report and the 2013 C&P report included sensitivity analyses which developed estimates of the user

[1] Infrastructure Productivity, McKinsey Global Institute, Jan 2013

benefits of increments of highway capital investment and increments of transit capital investment. The 2010 C&P included a particularly detailed development of incremental benefits from additional investments in highway capital projects. The table below shows the results of the 2010 C&P sensitivity analysis of annual benefit cost ratios by the twentieth year of investment for various levels of incremental annual investments in highways, developed from analyses using the FHWA's HERS model. It should be emphasized that this example shows a calculation for only the HERS-modeled portion of highway investments which is related to the federal aid highway system.

The results show very strong annual streams of benefits in relation to annual costs. Because the HERS model chooses projects based on benefits versus costs, successively higher and higher levels of investment in the HERS model result in successively lower and lower average ratios of the total incremental benefits to the total incremental costs, simply because a rational system invests in the highest pay-off projects first. However, total benefits still increase at a rate faster than total costs, and very strong returns are shown at all levels of capital investment.

## Incremental User Benefits From Added Highway Capital Investment

## HERS Analyses for the 2010 Condition and Performance Report

| Level of Annual Investment as Modeled by HERS (Billions of 2010 $) | Increment of Annual Investment Over Base Case Investment (Billions of 2010 $) | Increment of 2028 Annual User Cost Savings Over Base (Billions of 2010 $) | Ratio of 2028 Added User Annual Cost Savings to Added Investment |
|---|---|---|---|
| $54.7 (baseline) | NA | NA | NA |
| $58.0 | $3.3 | $12.6 | 3.8 |
| $62.9 | $8.2 | $29.9 | 3.6 |
| $74.7 | $20.0 | $66.0 | 3.3 |
| $80.3 | $25.4 | $79.7 | 3.1 |
| $93.4 | $38.7 | $109.5 | 2.8 |
| $105.4 | $50.7 | $132.0 | 2.6 |

Source: 2010 Status of the Nation's Highway 's, Bridges, and Transit: Conditions and Performance, and additional calculations.

These results are also confirmed by more limited numbers of incremental investment analysis done for the 2009 Bottom Line and for the 2013 Condition and Performance Report. Since the highway construction cost index declined modestly from the time of the 2010 C&P until now, and since the cost factors for benefits have increased modestly until now due to inflation of consumer prices, the ratios of benefits to costs are now somewhat higher. Additional evidence of the strong returns from highway investments have been developed in research for the United States Chamber of Commerce, which showed that there were net benefits that more than "paid back" the additional investment in a short period of time, even with cautious assumptions that benefits would not accrue until several years after an investment.

Similar analyses have been done for incremental investments of transit capital, and similar results are shown in the tables included in the sections of this report focusing on transit capital investment. Other recent economic analyses of highway and transit investments, including the Chamber work and research by the Economic Development Research Group for the American Society of Civil Engineers, have extended these economic studies to include both user benefits and broader economic benefits.

The broader economic analyses strengthen the results of the user related analyses in the more recent 2010 and 2013 Condition and Performance reports. The set of studies conducted by EDRG for the American Society of Civil Engineers (ASCE) covers all types of infrastructure. This enables some comparison between investment in highway and public transportation systems and investment in other types of infrastructure. Most interestingly, the studies utilized the HERS and TERM model frameworks for analyzing highway and transit capital investments and for estimating the funding gaps.

The table below shows the shortfalls by type of infrastructure that were estimated in the EDRG study. The largest shortfall is in surface transportation. The shortfall was estimated by comparing expected funding to needs, which for surface transportation were based on the results of the analysis using HERS and TERM. The study forecasts of revenues for each infrastructure category were based on existing sources of revenue for each category. The surface transportation funding gap between 2012 and 2020 is estimated at $846 billion and by 2040 is estimated at $3,664 billion. In each case, the gap for surface transportation represents the majority of the gap for all infrastructure categories combined: 77 percent of the total gap by 2020 and 78 percent of the total gap by 2040.

## Failure To Act Report - Funding Needs, Expected Funding, and Shortfalls By Infrastructure Category - Cumulative Amounts By Year 2020 and Year 2040 (All Amounts in Billions of 2010 Dollars)

| | 2020 | | | 2040 | | |
|---|---|---|---|---|---|---|
| | Total Need | Expected Funding | Funding Gap | Total Need | Expected Funding | Funding Gap |
| Surface Transportation | $1,723 | $877 | $846 | $6,751 | $3,087 | $3,664 |
| Water/Wastewater | $126 | $42 | $84 | $195 | $52 | $144 |
| Electricity | $736 | $629 | $107 | $2,619 | $1,887 | $732 |
| Airports* | $134 | $95 | $39 | $404 | $309 | $95 |
| Inland Waterways & Marine Ports | $30 | $14 | $16 | $92 | $46 | $46 |
| **Totals** | $2,749 | $1,657 | $1,092 | $10,061 | $5,381 | $4,681 |

The economic consequences of the infrastructure funding gaps are shown in the immediately following tables which show the impacts on households and businesses by 2020 and 2040. By 2020, the shortfalls have caused a net loss for businesses and households as shown in the tables just below. The net loss is after subtracting out what the businesses and households would have paid as part of the investments made in infrastructure, so these amounts represent unnecessary and undesirable net losses which cannot be recovered.

## Failure to Act: 2020 Cumulative Losses ($2010 B)

| Infrastructure Systems | Households | Businesses | Total |
|---|---|---|---|
| Surface Transportation | $481 | $430 | $911 |
| Water/Wastewater | $59 | $147 | $206 |
| Electricity | $71 | $126 | $197 |
| Airports | N/A | $258 | $258 |
| Inland Waterways & Marine Ports | N/A | $258 | $258 |
| Totals | $611 | $1,219 | $1,830 |

Note: Costs do not include personal income or value of time other than business travel.

For 2020, 79 per cent of the net losses are due to the surface transportation funding gap, which is shown in the table above, and about 50 percent of total losses to households and business are due to the surface transportation shortfall. The surface transportation category includes a small portion of intercity rail investment but the vast bulk of this is highways and public transportation. For 2040, household losses are 66 percent due to surface transportation shortfalls, and 34 percent of all losses are due to surface transportation shortfalls. These are extremely conservative estimates of the negative consequences, despite how deleterious the impacts shown are. Some of the impacts on households are missing for the other infrastructure categories since no personal income effects are included.

## Failure to Act: Cumulative Losses 2040 ($2010 B)

| Infrastructure Systems | Households | Businesses | Total |
|---|---|---|---|
| Surface Transportation | $1,880 | $1,092 | $2,972 |
| Water/Wastewater | $616 | $1,634 | $2,250 |
| Electricity | $354 | $640 | $994 |
| Airports | N/A | $1,212 | $1,212 |
| Inland Waterways & Marine Ports | N/A | $1,233 | $1,233 |
| Totals | $2,850 | $5,811 | $8,661 |

Note: Costs do not include personal income or value of time other than business travel.

Same here

The table below shows the impacts on households as per household impacts on an annual basis and amounts which are cumulative through 2010 and 2040. Since 79 percent of the impacts on households by 2020 is due to the shortfall in surface transportation, the impact of the surface transportation shortfall per household is a cumulative loss of $22,400 per household through 2020. Since the loss per household by 2040 is 66 percent due to the surface transportation shortfall, the loss per household due to the surface transportation shortfall is $103, 800 per household. Median household income in 2010 was just below $50,000, so these total losses from a failure to invest in surface transportation for every household are equal to half of a median household's annual income by 2020 and equal to twice a median household income by 2040.

## Failure To Act: Net Impacts Per Household

| | 2012-2020 | 2021-2040 | 2012-2040 |
|---|---|---|---|
| **Average Annual Disposable Income Per Household** | **– $3,100** | **– $6,300** | **– $5,400** |
| **Total Disposable Income Per Household** | **–$28,300** | **– $126,300** | **– $157,200** |

Note: Dollars rounded to nearest $100. Totals may not multiply due to rounding.
Sources LIFT/Inforum Model of the University of Maryland, and EDR Group.

## PROJECT ECONOMIC IMPACTS: SHRP2 RESEARCH

There is also a large and growing body of work which provides examples of the impacts of investments in projects of various typologies. The second Strategic Highway Research Program (SHRP2) has developed several products. A recent product of SHRP 2 Capacity Research[2] assembled effective case studies of the impacts on economic and land development of highway projects across a broad spectrum of types and situations. The study compiled before-and-after information on 100 case studies in 10 different categories of investment in various geographic, social, and economic settings with a set of observations balanced by region of the nation.

Of the 100, positive benefits were identified in 85 in the five year retrospective as elaborated below. It was noted that in some cases longer term effects need to be recognized as well as more immediate effects, especially for major facilities, that occur at sites far distant from the facility.

| Project Type | Total Cases |
|---|---|
| Beltway | 8 |
| Bridge | 10 |
| Bypass | 13 |
| Connector | 8 |
| Interchange | 12 |
| Industrial access road | 7 |
| Major highway (limited access route) | 14 |
| Widening | 9 |
| Freight Intermodal Terminal | 10 |
| Passenger Intermodal Terminal | 9 |
| Total | 100 |

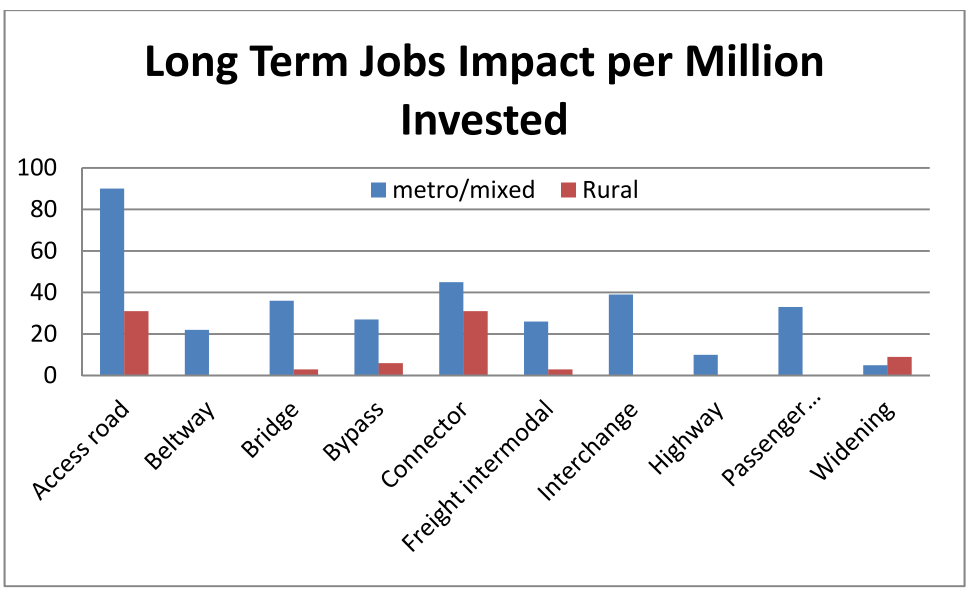
The selection criteria included projects, greater than $10 million in cost, which represented new highways, or major extensions, expansions, or other significant performance enhancement to existing highways. Only facilities more than five years old were considered to give economic development potential sufficient time to exhibit effects. A key factor was the project

[2] Report S2-C03-RR-1; Interactions Between Transportation Capacity, Economic Systems, and Land Use, EDRG et al, SHRP2@, TRB, 2012

motivation by project type. Of the 97 projects reporting motivation, 58 identified an access issue, 54 a congestion management issue, and 65 an economic development issue. The distribution of project motivations by urban and rural locations is shown in the figure presented later in this text. (In some cases multiple motivations apply).

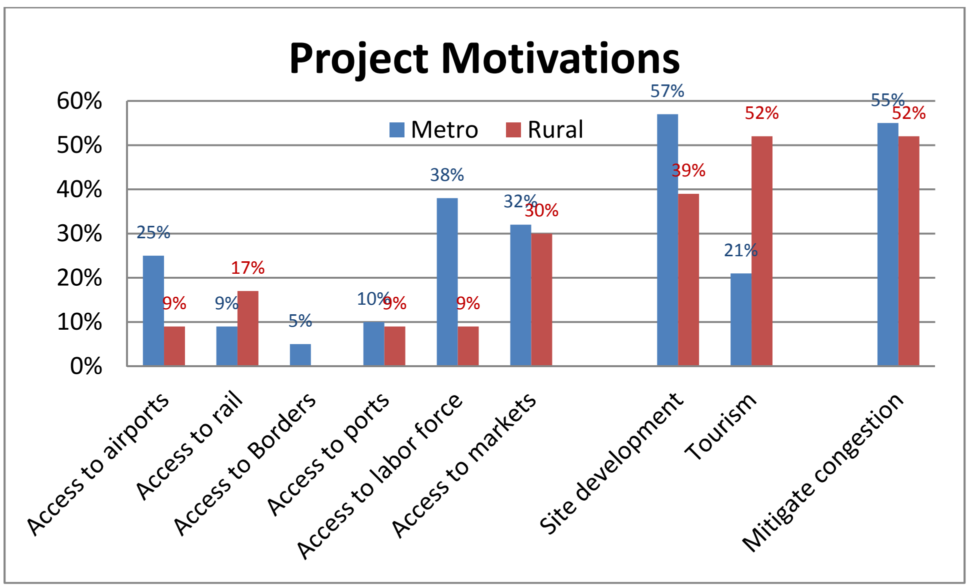
It is often the case that major surface transportation investments are assessed in terms of the jobs created by the investment, especially during economic downturns. While this was covered quite effectively, broader impacts, such as income, business output building development, direct private investment, property values, and property tax revenues were assessed. Of the 15 projects that showed zero or negative job impacts other benefits were identified: eight of the cases showed gains in business sales; 10 of the cases demonstrated local per capita income increases; and six documented property value increases. The one area which demonstrated net negative job impacts was in the case of two bypasses studied. This was expected given the positive and negative trade-offs inherent in such investments in the near term.

The study employed a job impact ratio to assess project effects. Overall the case studies indicated a median ratio of seven long-term jobs generated per million dollars of highway investment. The distribution of job impacts was very broad by type of investment; access roads, interchanges and connectors tended to have the highest average ratios as shown in the figure below.




Many of the projects which show limited job generation per project are those of a major scale such as beltways or major interchanges where the economic effects are often interstate and inter-Metropolitan. Their major roles are often providing access to job opportunities or freight logistics benefits. Metropolitan investments generate more substantial job returns than rural investments in the studies. Many of the rural investments are in the category of providing for job benefits in areas far distant than the proximate construction area, or are in the category of requiring longer periods to fully develop. It is notable that 66% of the metro level investments identify long-term job growth impacts exceeding 1000 jobs.

The study also identified significant motivations for projects which can be a guide to future economic development planning. The following figure shows the distribution of motivations for the highway projects[3]. The graphic is notable not only for the rich information but also the broad array of motivations that generated the highway projects. The key frequently is access to other transportation facilities and international borders, as well as access to markets, and to a broader labor force. Developments at specific sites, such as tourism venues, are highly significant to rural areas studied. It is notable that mitigation of congestion is a significant factor in both metropolitan and rural areas.




The study makes the distinction between point-to-point projects and continuous roadway projects. It is often the point-to-point projects which create access to industrial parks, office parks and other industrial sites and therefore show demonstrable direct and immediate benefits, whereas continuous roadway projects may generate important job effects hundreds of miles away – – no less important, but more difficult to pinpoint.

[3] Multiple motivations apply so numbers will not add to 100%

# THE SAFETY BENEFITS OF HIGHWAY INVESTMENT

**NHTSA Study** -- In a recent report[4] NHTSA placed the 2010 economic costs of motor vehicle crashes at $277 billion, based on the 32,999 fatalities in that year. Approximately a third of that cost was the result of lost work place and household productivity and congestion costs accounted for another 10%. About 9% of those costs were incurred by governments.

**Roadway Safety Guide** – A related report[5] addresses the interaction between roadway design and condition and roadway safety focusing on that portion of overall highway safety that is determined by the roadway's physical features, and surrounding environment. The report indicates that nearly 53% of fatalities on America's highways occur in crashes in which the condition of the roadway is a contributing factor. From an economic point of view just the economic cost of these crashes is greater than three times the annual investment by all levels of government nationwide in roadway improvements. This, of course, does not include the distress, personal losses and social dislocation generated by such crashes.

The Guide describes some of the cost beneficial crash countermeasures and design strategies that have been shown to be effective in reducing the number and/or severity of highway crashes as shown below:

| Crash Countermeasures | Potential Effects |
|---|---|
| relocate roadside objects | Reduce fatal or injury crashes 64% |
| install median barriers | Reduce fatal or injury crashes 88% |
| Construct roundabouts | Replacing signalized intersections reduces crash 35% and fatalities by up to 90% |
| rumble strips | Reduces drift off road crashes by up to 80% |
| timely ice and snow removal | Restoring friction reduces crashes by over 88% |

The guide notes that roadway departure crashes account for over 50% of all US highway fatalities each year. In 2011 16,948 people were killed in fatal crashes of this kind. A TRB study[6] is cited in the guide which found that many of these casualties result from collisions with roadside objects such as trees or poles that are located dangerously close to the side of the road.

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[4] The Economic and Societal Impact of Motor Vehicle Crashes, 2010: National Highway Traffic Safety Administration, May 2014

[5] *A Roadway Safety Guide:* The Roadway Safety Foundation *2014*

[6] *Strategies for Improving Roadside Safety,* NCHRP Research Results Digest 220

In 2005 fatalities were 43,510; in 2006, SAFTEA-LU was enacted with increased funding for safety and related investments marking the start of a long consistent and steady decline in highway fatalities. By 2011 deaths had fallen to the lowest level, 32,479, since 1949.

A study by SAIC in June 2010, cited in the Guide, indicated that a large part of the benefits came from the increased investment in lifesaving. The study concluded that increased seatbelts use, increased air bags, reductions in VMT were not the main factors in the decline. They noted that for every million dollars in Highway Safety Improvement Program, HSIP, funds seven lives were saved, a benefit cost ratio of 42.7 to 1.
An approach proposed in the report is called the “safe systems” approach, defined as safe vehicles driven at safe speeds on infrastructure that is designed to be forgiving of inevitable mistakes. Seven principal safety concerns to be addressed, particularly in rural areas, are addressing roadway departure hazards,

- road surface conditions,
- narrow roadways and bridges,
- railroad crossings,
- work zones,
- intersections and
- roadway design limitations

Example benefits from effective actions cited included:

- A $59,000 installation of center line rumble strips at a cost of $.15 per foot was made on a curved rural two-lane road located in the National Forest in North Central Arkansas with particularly high crash and fatality rates. Analysis of three years experience before and after showed a 41% reduction in all crashes; a 56% decrease in sideswipes; and fatal crashes fell 64% with an annual benefit of $3.7 million.
- High friction surface treatment is shown to save lives on curves; Pennsylvania and Kentucky show 60% to 70% crash reductions. In the Kentucky example, in the three years prior to treatment there were 56 total crashes. In the two and a half years since there have been only five.

# THE VALUE OF PUBLIC TRANSPORTATION INVESTMENT

Transit economic studies recently developed for APTA by the Economic Development Research Group (EDRG) provide excellent evidence of the benefits of public transportation investment and the impacts of investment on economic growth. The 2009 report *Economic Impact of Public Transportation Investment,* October 2009, prepared by Glen Weisbrod and Arlee Reno, and a 2014 update is available at www.apta.com. The reports analyze the overall economic impacts of increasing public transportation investments and each was based on the scenarios in the 2009 Bottom Line Report. These documents provide a comprehensive evaluation of the economic benefits and the economic impacts of the actual transit investment scenarios in the 2009 Bottom Line report, some of which are the scenarios of this report.

The 2009 and 2014 economic benefit reports also present a comprehensive methodology for calculating the broad economic impacts of public transportation investment. The results in the table below from the 2014 update show that, per $1 billion of annual investment, public transportation investment over time can lead to more than $2.0 billion of net annual additional GDP due to cost savings. This is in addition to the $1.7 billion of additional GDP supported by the pattern of public transportation spending.

Thus, the total economic impact is $3.7 billion of additional GDP generated per year per $1 billion of investment in public transportation. This is a very substantial return on investment of 3.7 to 1. In interpreting those findings, it is important to note that this analysis does not include environmental benefits, social benefits or many of the other benefits of transit which have been discussed elsewhere.

## Economic Impacts Per Billion Dollars of Sustained Transit Investment (Annual Effect By The 20th Year)

| Economic Impact by Type | Economic Impacts (Value Added per $Billion Invested) |
|---|---|
| Effects of Investment Spending | $ 1.7 billion |
| Effects of Long Term Cost Changes | $ 2.0 billion |
| Total Economic Impacts | $ 3.7 billion |

Source: ***Economic Impact of Public Transportation Investment: 2014 Update,*** prepared for APTA by the Economic Development Research Group, 2014.

The table below, also from the 2014 update report which shows an “Estimate of Scenario Impacts on the Economy, 2030. Differences Between “Current Trend” Scenario and “Doubling Ridership” provides comprehensive estimates of the consequences of increasing the annual transit investment by the $13 billion per year difference between the 2009 Bottom Line scenario of a 2.4 percent growth rate and the 2009 scenario of a 3.5 percent growth rate. The impacts of transit capital and operating spending on business sales are an increase of $3 billion per $1 billion of investment, and the impacts on labor income and on government revenues are also estimated. The economic consequences of the similar 2014 Executive Bottom Line transit growth scenarios are likely to be similar.

**Economic Impact Per Billion Dollars of National Investment in Transit**

| Economic Impact | Per $Billion of Capital Investment | Per $Billion Operations Investment | Per $Billion of Average Investment |
|---|---|---|---|
| Output (Business Sales) | $2.9 billion | $3.1 billion | $3.0 billion |
| GDP (Value Added) | $1.3 billion | $2.0 billion | $1.7 billion |
| Labor Income | $0.9 billion | $1.4 billion | $1.3 billion |
| Tax Revenue in Millions of Dollars (Rounded) | $266 million | $500 million | $432 million |

(a) *Economic Impact of Public Transportation Investment: 2014 Update,* Available at www.apta.com.

The 2009 study and the update also discussed a wide range of long-term economic benefits of public transportation investment, including:

- Travel and vehicle ownership cost savings for public transportation passengers and those switching from automobiles, leading to shifts in consumer spending.
- Reduced traffic congestion for those traveling by automobile and truck, leading to further direct travel cost savings for businesses and households.
- Business operating cost savings associated with worker wage and reliability effects of reduced congestion.
- Business productivity gained from access to broader labor markets with more diverse skills, enabled by reduced traffic congestion and expanded transit service areas.
- Additional regional business growth enabled by indirect impacts of business growth on supplies and induced impacts on spending of worker wages. At a national level, cost savings and other productivity impacts can affect competitiveness in international markets.

A second important recent study for APTA prepared by EDRG is the report ""The Role of Transit in Support of High Growth Business Clusters in the U.S.", which focuses on high growth clusters in either central cities or suburban areas which are facing current and future congestion issues and estimates the contribution which transit can make to allowing and encouraging growth in these important clusters. Exhibit 10-1 "Potential Magnitude of Economic Effects of Limited Mobility to Clusters, and Potential Impact of Improved Transit Access" provides specific estimates of the contributions which transit improvements could make in these business clusters, some of which are not usually considered to be targets for enhanced transit. Although only a few specific clusters were analyzed, the results could be similar across many others.

The findings of this study are important because they show that transit can support jobs in these most important and diverse clusters of economic activity. Specifically the study found:

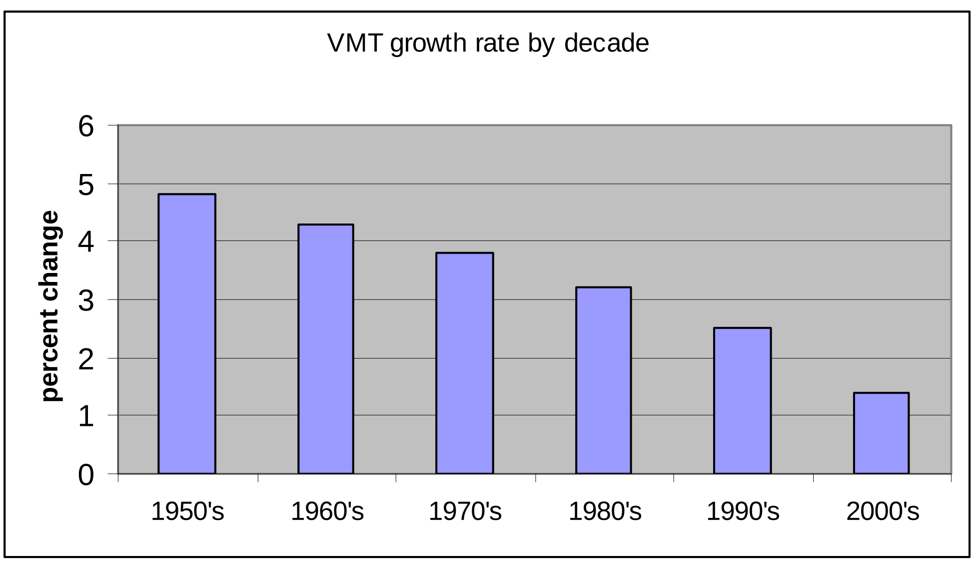
- “There are very real transportation access constraints looming that will affect the growth of high tech business clusters and the competitiveness of US firms.
- Those constraints apply (to some extent) across all such business clusters.
- Efforts are currently being spearheaded by the private sector to develop transit to sustain the cluster location and ensure workforce accessibility.
- Between 379,000 and 480,000 jobs could potentially be affected by the year 2040, depending on steps taken to address the transportation capacity constraint.
- Transit access to clusters could support approximately 104,000 of these jobs, along with their associated $13.6 Billion in annual business output, $5.7 Billion in wage income and nearly $8.6 Billion in GDP.
- Given constraints on continued roadway system expansion (detailed in the case studies), there is a solid case for expanding the future role of public transportation to support growth of high tech business clusters.”

# PRESENT AND FUTURE TRAVEL DEMAND

The current slow recovery from the great recession has seriously affected travel activity and prospective growth to the extent that some question whether there will ever be a return to the population growth, economic growth and consequent travel growth of the past. The key question of this era has become: " Is what we are seeing in present statistical patterns and trends a continuing expression of the cyclical effects wrought by the recession or a structural change auguring a new normal?"

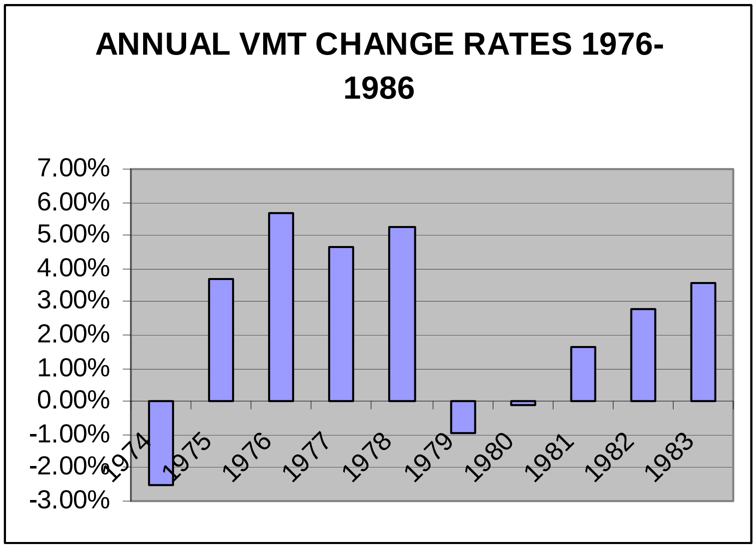
## WHERE IS VMT HEADING?

Dramatic growth in Vehicle Miles of Travel (VMT) was a product of the exceptional growth in workers during the first working decades of the baby boom generation and the economic surge it generated. It was an exceptional period as boomers came of working age and women joined the labor force in unprecedented numbers. As a result, average annual miles traveled grew in the 4%-5% ranges in the 50's and 60's and began tapering off slowly as the last boomers reached working age. In the '70's and '80's VMT growth slowed to a range of 3% to 4% per year with several recessions affecting the trend as well as the changing demography. The '90's saw further declines as population growth slowed and the working population aged. In this century these trends continued, further exacerbated by a brief recession, and then a severe recession followed by an erratic, slow recovery. By early 2008 in the new century, prior to the full effects of the recession, the VMT growth rate was down to 1.4 percent per year, which was the VMT forecast which was used for the 2009 Bottom Line. The following figure shows the continuously declining growth rates witnessed in successive decades since the inception of the Interstate era.



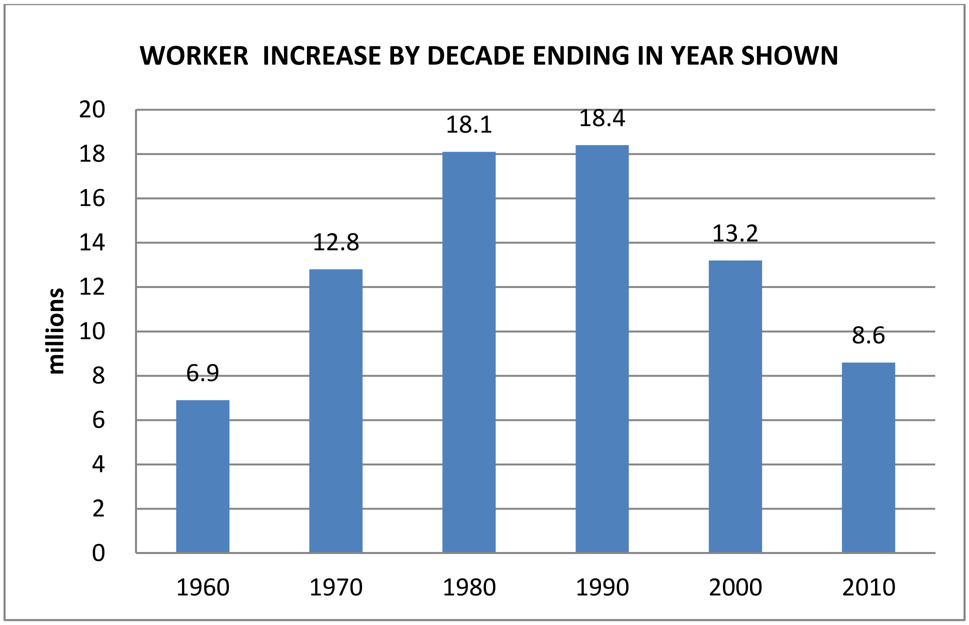
Even were substantial declines in fuel prices to occur the growth rate most likely would only return to levels hovering in the mid one to two percent range in keeping with the trends driven by demographic changes so far in this decade. However, a one percent increase in this decade still produces substantial amounts of growth that need to be addressed.

Declines have happened before and rebounds have happened before. The adjacent figure demonstrates the rebounds in the past to VMT declines.

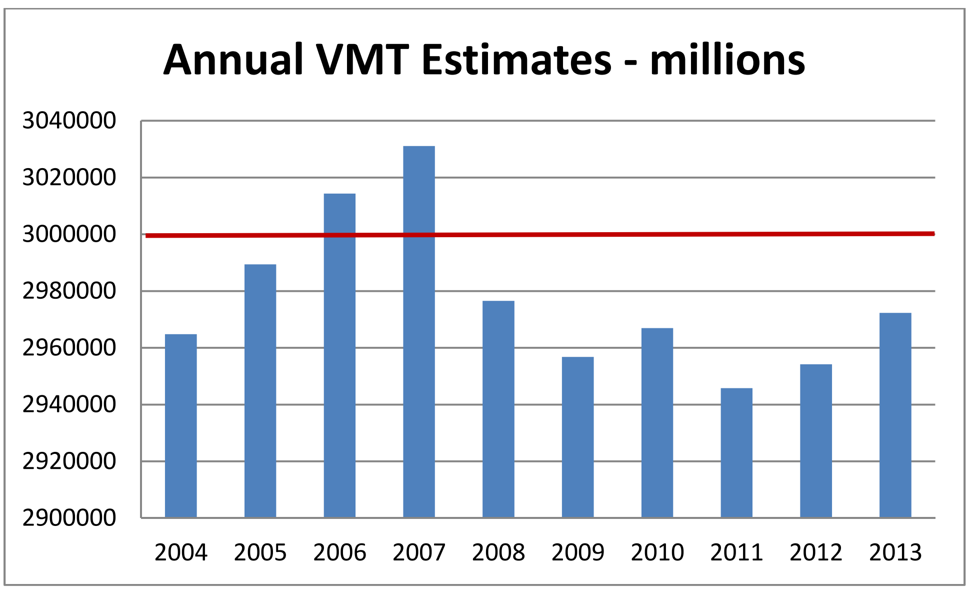



Whether a similar rebound might happen again in this present situation is more speculative. Perhaps the most important reason not to expect a strong rebound is that the overall trend in VMT growth has been moving lower over the decades. While the seventies were already witnessing some declines from the past decades of very strong growth the levels of growth were still quite substantial in that period. In this decade we have reached stages of relatively limited growth.

The figure on worker increase by decade shows the exceptional growth and then decline in workers added per decade in the current era. It is crucial to recognize that this occurred in a period in which the population almost doubled. The first decade of the new century was the only decade since 1950 in which the percentage growth in population exceeded the percentage growth in workers.




Source: Commuting in America series




Source: FHWA, Travel Volume Trends, series.

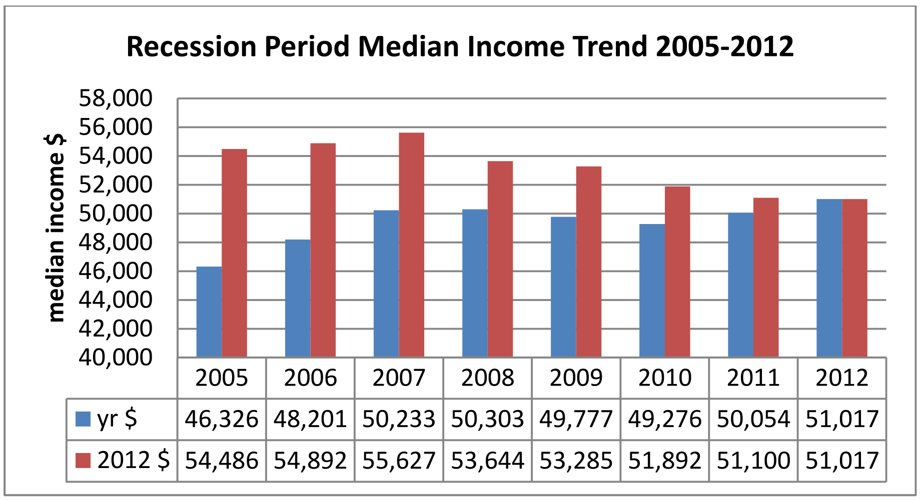
As the above figure on current annual VMT shows, for a decade national VMT has hovered around the 3 trillion VMT level. Since 2008 there has been very limited growth in travel, hitting bottom in 2011, with slow recovery since. Growth in 2013 reached plus 0.6% for the year. This was well below the ranges presented in the 2009 Bottom Line report with estimates of positive growth in VMT which were bounded at 1.4% and 1.0% average per year. Those forecasts were based in part on projections of past trends, as well as assumptions of expected increases in population in the range of 1% a year and a factor for increases in economic growth in the society.   Both of these were lower than expected.  Preliminary first half 2014 VMT growth indicates a stronger return to expected growth levels.

What factors are involved here?  Are they fundamentally cyclical or structural?  The long term structural trend is clear and will be discussed in some detail below, but many of the key factors at this time are fundamentally cyclical in nature.  These include:

- Employment – recent recessions have recovered employment levels within 30 months (1990); and within 48 months (2001); but the 2007 “great” recession had just returned total national employment levels to positive territory in late 2014.
- Birth Rate – dropped sharply after 2007 and began a slow recovery after 2010.
- Household formation rates – substantial decline in household formation due to increases in children not leaving home or returning home.
- Debt – much higher household debt levels from the early 2000s housing bubble; many mortgage balances now above home values; and much higher college loan debt levels, all of which have been further inhibiting spending and economic activity.
- Immigration – foreign immigration, particularly from Mexico, has dropped, particularly as construction declined.
- Population mobility – persons moving to other parts of the country have dropped to the lowest levels ever recorded since surveying started in 1948, to 11.6% by 2011, and 11.7% in 2013.
- Part time work – the more recent gains in employment have been heavily in part time work –workers working part time for economic reasons – in 2010 at 8.9 million, double the number in 2007 of 4.3 million, and has receded somewhat into 2014 but still above 7 million.
- Freight – much of the decline in highway travel has been the product of the decline in trucking, particularly longer distance interstate trucking.

Incomes have struggled to recover– aside from distributional issues the median income of the population did not grow for 5 years until rising somewhat in 2012, as shown in the figure.  On an inflation- adjusted basis the situation is even more negative. The peak year for median income adjusted to match 2012 dollars was 1999 at just over $56,000, declining throughout the decade and into 2012 reaching a low of just at $51,000.   For a further example, the 2009 value observed in the FHWA National Household Travel Survey, on which many insights are based, would be in the range of $54,500 today.

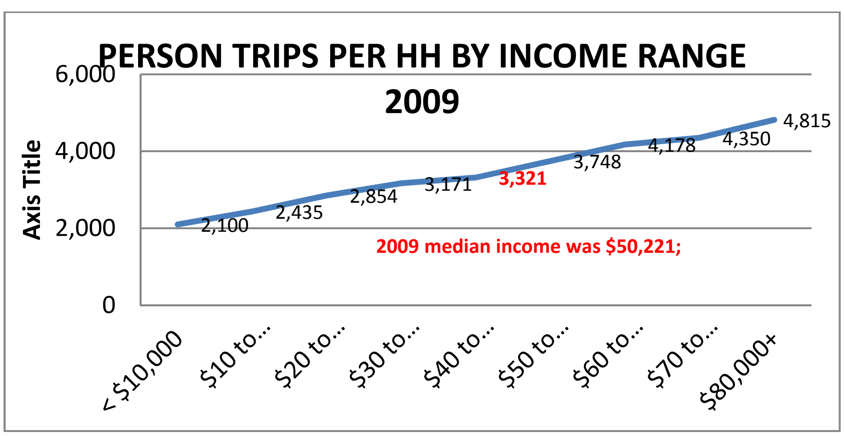
To assume that these patterns will persist into the future is to assume that America is entering a period of decline with a society and economy that cannot support itself with productivity and a robust economy.  Much has been made ascribing a change in values to the so-called millennial generation, the youngest working age generation,  but it is clear that the economic factors affecting them especially, are a perfectly adequate explanation of their failures to obtain work, form households, own vehicles and travel.   They are in far worse condition at their age than any recent parallel generation, despite being our most educated generation, with 16% in poverty, 14% living with their parents, and only 38% as homeowners.  Analysts are concerned whether, having lost a large part of their foundational years in the labor force, they will ever be an effective element of our future work force.  The latest Consumer Expenditure Survey indicated that income levels actually declined marginally in 2013.




| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|
| yr $ | 46,326 | 48,201 | 50,233 | 50,303 | 49,777 | 49,276 | 50,054 | 51,017 |
| 2012 $ | 54,486 | 54,892 | 55,627 | 53,644 | 53,285 | 51,892 | 51,100 | 51,017 |

Source: Continuing Population Survey, Bureau of the Census

The critical linkage between household incomes and travel demand is shown in the figure below.  As household incomes rise it is no surprise that travel increases as business activities increase and recreational and social opportunities expand.  The decline in VMT as fuel costs reached the psychologically damaging level of $4.00 a gallon for the first time in 2008 was the equivalent of one fewer 5 mile trip to a restaurant per week for a household.

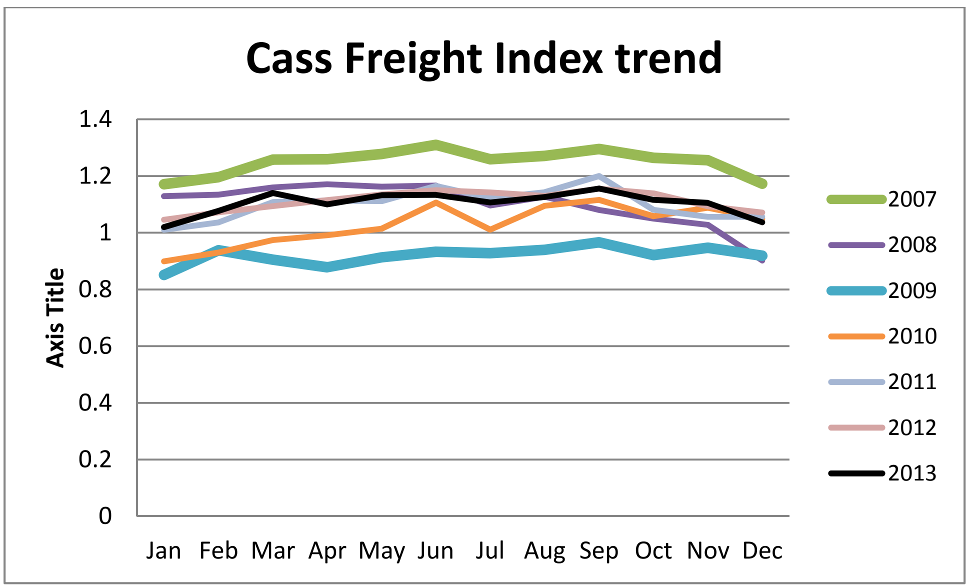


Source: NHTS 2009

## HARBINGERS OF RECOVERY

### Freight Gains

To assume that this litany of painful circumstances will continue indefinitely is to assume that America is destined for a long twilight period of stasis or decline. Such assumptions are at best self-defeating. Fortunately, in the available current statistics are the signs, already, of a return to a healthier more robust economy – households' debt is declining; births are up; job increases are occurring; and freight movements are rebounding slowly. Car sales in 2013 topped 15 million for the first time since 2007 and the seasonally adjusted annual rate for 2014 is exceeding 16 million. Note in the figure that the freight index while well above the base set in 2009 has not yet reached the levels of the peak year of 2007.



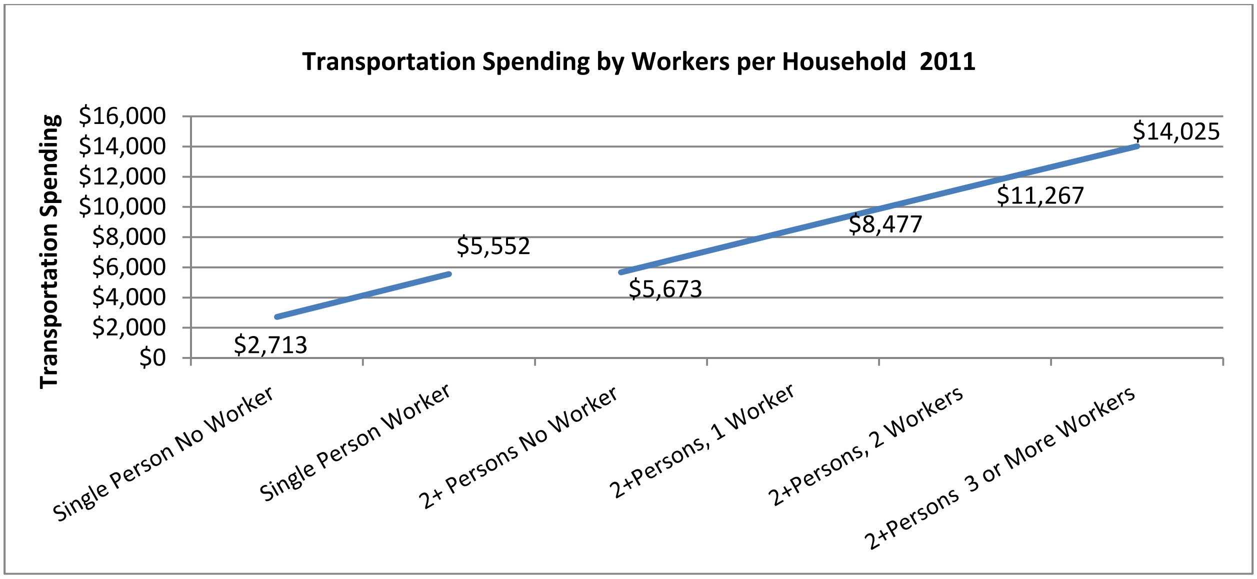

Source: Cass Freight Index Reports; Cass Information Systems

### Work and Work Travel Gains

In 2013, the most recent work travel mode use data available, there were 143 million workers at work, up by 4.5 million from 2010, a gain of 3.8%. Of those workers added, a little more than 4.4 million got to work by driving alone. Carpooling, very often manufacturing or construction related, increased only slightly by about 100,000 in the period. The components of the remaining increase of 1,500,000 workers who did not use private vehicles were arrayed in the followed way: transit use gained 620,000; working at home gained 330,000; walking gained

200,000; bicycling gained 150,000, a significant relative gain; and "other" (motorcycles and taxis, etc.) accounted for the 200,000 remainder. This is certainly to be seen as positive in terms of worker gains, but illustrates the challenges being faced by the transportation system today, even in a slow growth period.

What increments to the worker population mean in transportation spending terms is shown in the figure drawn from the Consumer Expenditure Survey.

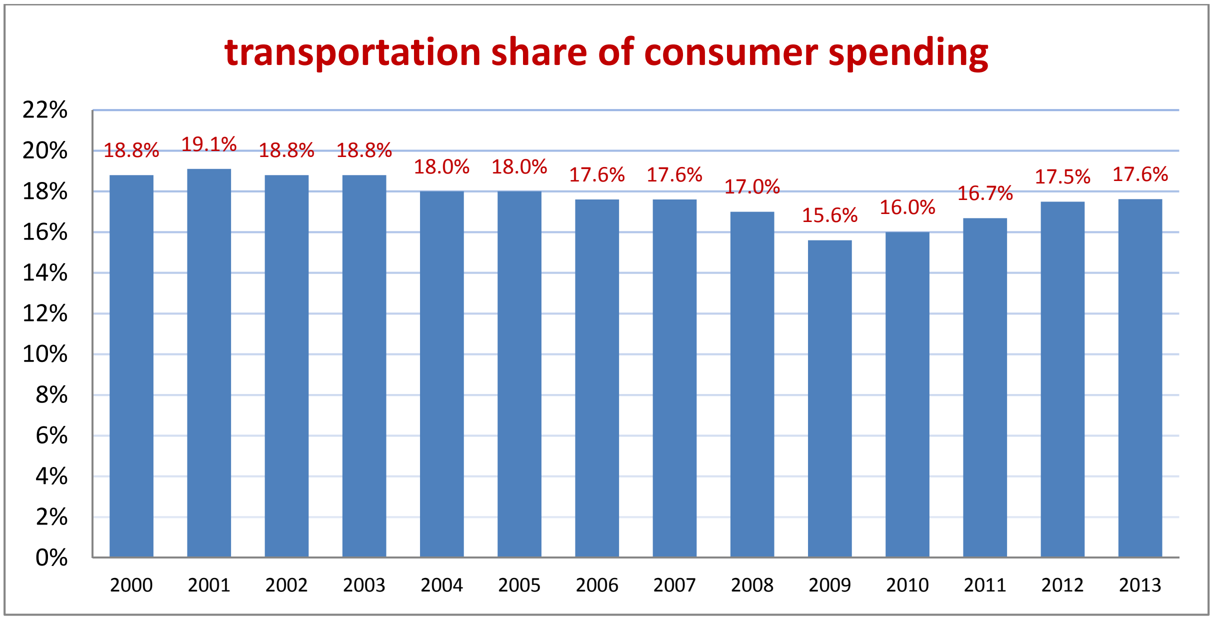



This figure reveals that as workers are added households spend increasing amounts on transportation – roughly $2,800 per additional worker whether in one person or multi-person households. Each additional worker adds about .5 vehicles to the household, and about $1,400 in annual fuel purchases. It is notable that there is a close symmetry in the society between workers and vehicles. While about 9% of households in America are without vehicles, only about 4% of households with workers have no vehicles.

## Consumer Spending on Transportation Gains

A key measure for the purposes here is the share of household expenditures going to transportation. This measures only the direct expenditures made by the household and does not include transportation spending made by workers that are paid for by their employer or the costs of transportation embedded in other household purchases. The trend in consumer spending in the figure depicts this pattern in the new century. The transportation share of household spending has been in the range of 18% to 20% since surveying in detail began in the eighties, with only one occasion, during the early nineties recession, in which it dropped below

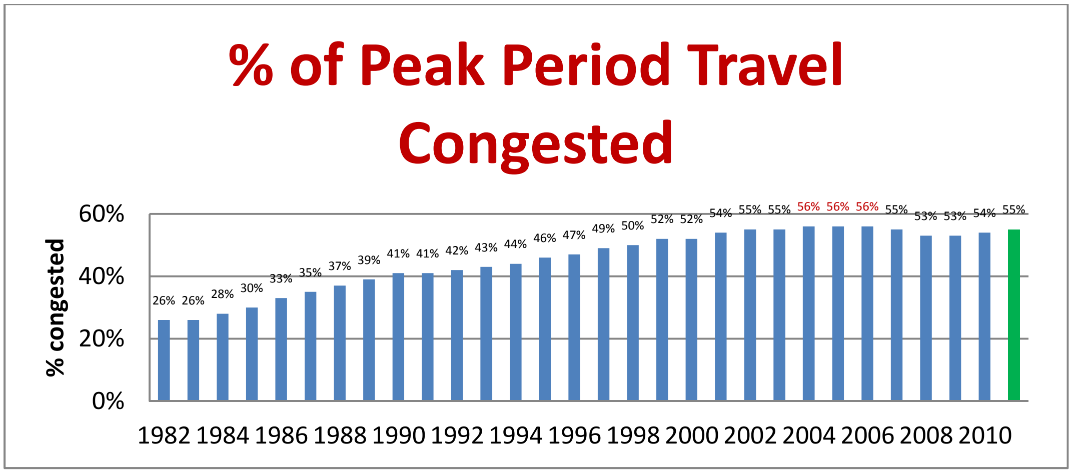
18%. In 2006 the share of spending for transportation dropped below 18%, as fuel prices rose, and reached an all-time low of 15.6% in 2009. The share has risen slowly each year since then to just on the edge of the 18% historical range in 2012 and is equivalent to where we were as a nation in 2006 and 2007. The latest Consumer Expenditure Survey indicates only a slight gain to 17.6% in 2013, a small shift in the prospective return to a more typical pattern.




Source: Consumer Expenditure Survey , US BLS

## Congestion "Gains"

In a perhaps less attractive, but equally pertinent pattern, many of the important indexes of congestion which had shown declines in congestion as part of the recession's effects, have begun to show resumption of increased congestion patterns throughout the country into 2013. The Congestion figure, drawn from the annual Urban Mobility Report of the Texas Transportation Institute, shows a bottoming of congestion in 2008, and a slow rise back to levels such that by 2011 it was equal to 2007. INRIX, another organization that tracks congestion, saw significant increases in 2013, with 61 of the top 100 Metro areas showing increased congestion, which they saw as an important economic indicator, albeit of course a mixed blessing.




Source: TTI (Urban Mobility Report) Preliminary

## THE FUTURE TRAVEL DEMAND STRUCTURE

Having established the case for an economy-led recovery to a more normal although moderate travel growth situation, it is evident that the 3% and 4% growth rates for VMT of times past are very unlikely in the coming decades. Prior to the recession, average annual VMT growth rates of from 1.0 percent per year to 1.4 percent per year were considered likely as a result of the more detailed analyses of these factors for the 2009 Bottom Line report. An array of factors support this:

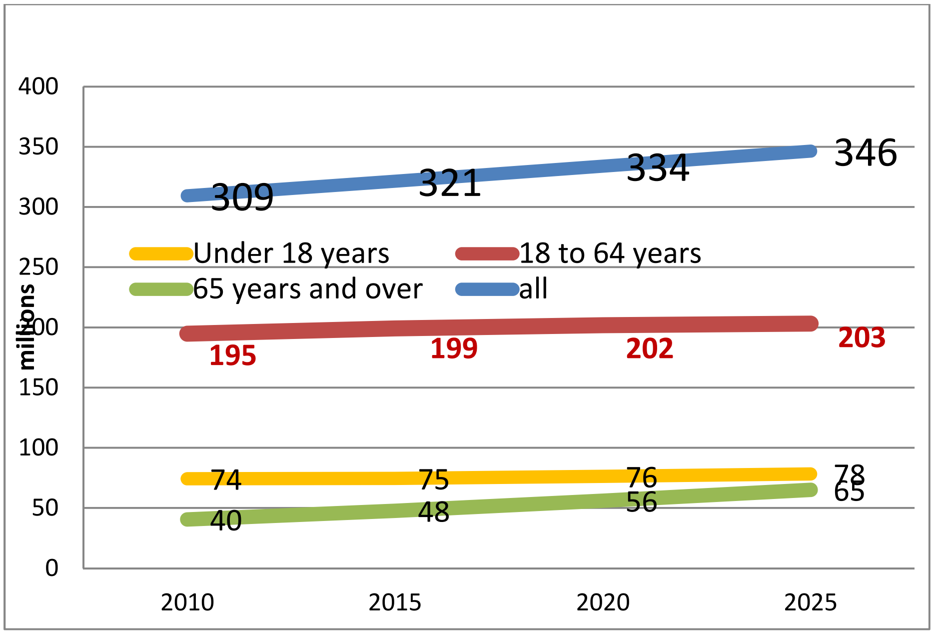
- Relatively low population growth rates projected out into the future;
- The historical declining trend in travel with advancing age in the population;
- The limited share of and growth of the future population in the most active working age years;
- Relatively low prospective future immigration rates.

While these patterns can be seen as too pessimistic given their projection from depressed present trends, there are demographic patterns affecting our future prospects for which transportation investments will be required, not only to serve a prospectively larger and richer population, but also to help make that more productive society a reality. At a minimum, we must assure that transportation capability for passengers and for freight is not an impediment to realizing that potential. The economic research reported below leads to the conclusion that additional capital investment in transportation in future years can play a very important and very positive role in assuring a stronger overall economy and fostering higher future household incomes.

Perhaps the key challenge will be demographic as the figure depicts. Population growth is expected to be slow in the period for which the Census Bureau has produced recent projections, rising by only 25 million in this decade (2010 to 2020), in the low range of previous decades. More importantly, the population in the prime working age years of from 18 to 64 years old is projected to grow only slightly, by only 7 million in the present decade, with limited growth thereafter. The population under 18, which constitutes the prospective future work force and future new travelers, also grows little.

A very large portion of the overall growth will occur in the population 65 years and over. From 2010 to 2020, the over 65 net population growth will account for 16 million of the projected 25 million of total net population growth, and over the entire period from 2010 to 2025, the over 65 net population growth will account for 25 million of the projected 37 million of total net population growth.

Population Change By Age Group



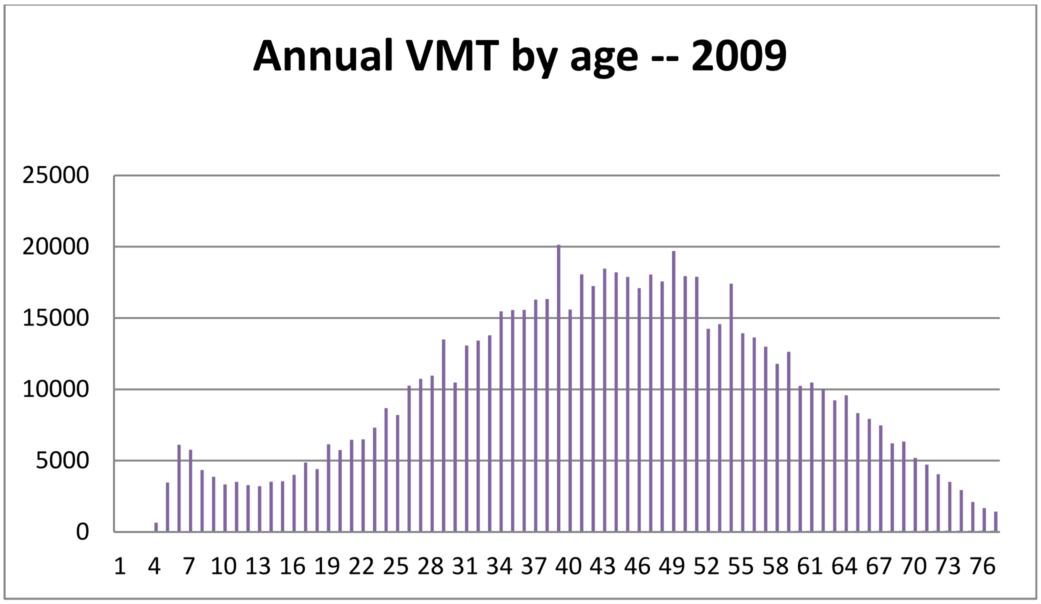

Source: Population Projections 2013, Bureau of the Census

Among the challenges and prospective solutions, all of which have important transportation components, are the following:

- Retaining older workers; this is already happening as the number of workers over 65 is expanding, whether by preference or economic circumstances, job access for this group will be key.
- Attracting even more women into the work force; expanding flexibility in the workforce regarding hours and working arrangements will be a big factor.
- Expanding mobility and access to more jobs and services; a key will be engaging rural workers and the under-employed.

The number of persons over 65 who are at work has been rising. It grew by 70% between 1990 and 2010. More significantly, perhaps, is that the share of those over 65 who are workers has also grown dramatically from around 11% in 1990 to 15% today. Just applying that current 15% share to the future 65+ population means that workers in this age group would number 8.4 million in 2020 and almost 11 million by 2030; and could reach 15 million, were the share of the over-65 population at work to continue to rise at current rates. Assuring that there are responsive mobility opportunities for this population will be critical to sustaining their very necessary and productive participation in the future workforce.

The adjacent figure taken from 2009 NHTS data showing the decline in travel activity with age may prove to be outdated as more and more older persons remain economically active. Historically, the dominant age group for travel has been the 40 to 55 year old group with active business-related and family activities. With the current economic forces at play this could shift to the right toward the age group around 65.



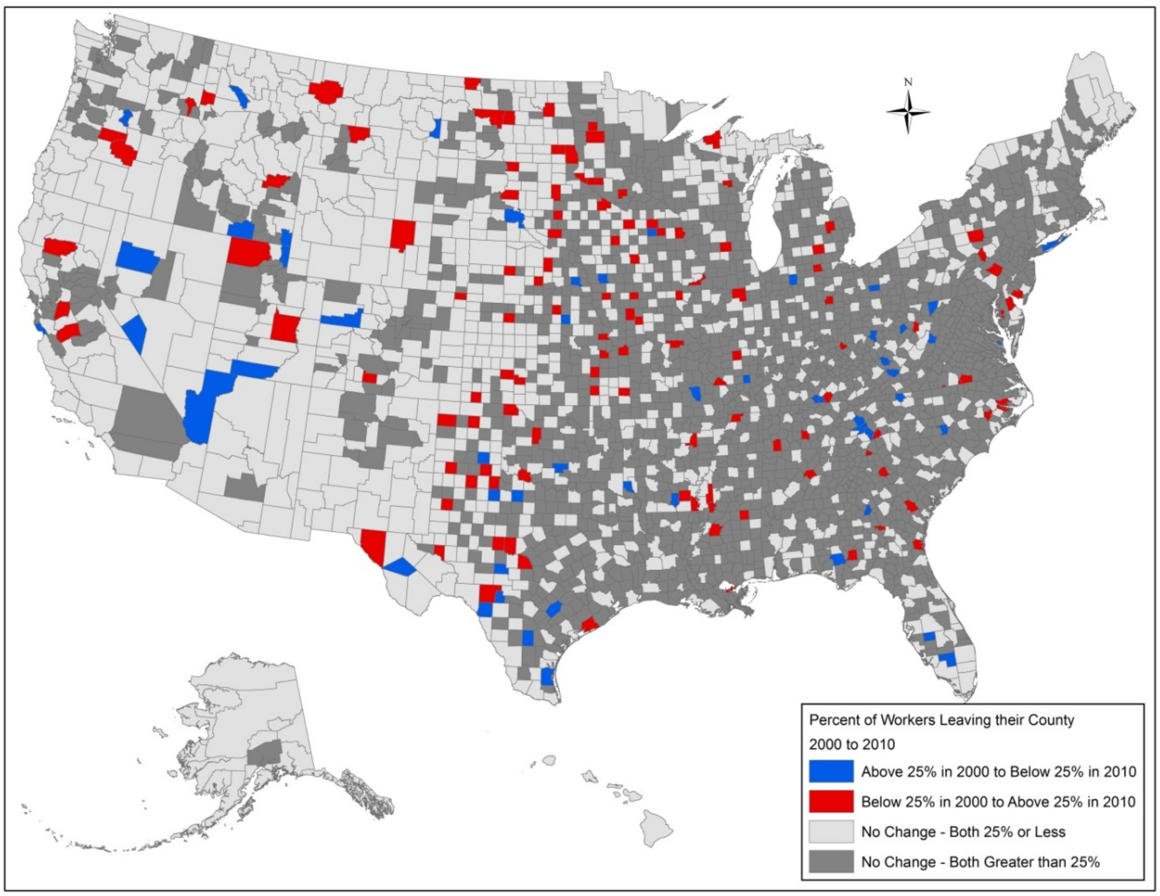

Source: 2009 NHTS

A second factor for the over 65 year old group is that those who do retire, or who choose to work part time, will have the free time for greater social and recreational travel. If this group also has the economic freedom to go with the freedom in time availability, then the next two decades could become the golden age of American tourism! Tourism has been addressed elsewhere in this document.

A key transportation factor will be the geographic distribution of jobs and skilled workers to match the skills requirements of jobs in supply. One would expect that in a job-scarce environment workers will be willing to travel farther to attain the jobs they desire. In fact, the long-term trend in America has been for workers to be willing to travel farther for work even before the current job scarcity. The map presents the national pattern in terms of the percentage of workers who leave their home county each day to work. At present this is roughly 28% of all workers and has been growing steadily for decades. The states of Virginia, Maryland, and New Jersey lead the nation with percentages of around half of all workers leaving their home counties. While the number of workers in America roughly doubled from 1950 to 2010, workers leaving for jobs in counties outside their residence county quadrupled from 9.4 million to 37.5 million. There are multiple causes for this pattern which will likely persist into the long-term:

- more and more workers are attracted to the largest metropolitan areas where broad choices of job opportunities exist; such areas expand the potential for very long intra-metropolitan trips;
- the vast majority of workers in America live in households which have other workers as well, making the prospect for living near work a difficult and complex trade-off;
- job changes are typically more frequent today, making the prospect of a housing move to be near a new job, especially when there are other workers in the household, difficult and expensive, and perhaps counter-productive.

While it is true that carpooling is typically a very long distance work trip, this is not a narrow modal phenomenon. In fact, transit users have a greater tendency for inter-county work travel than auto users.

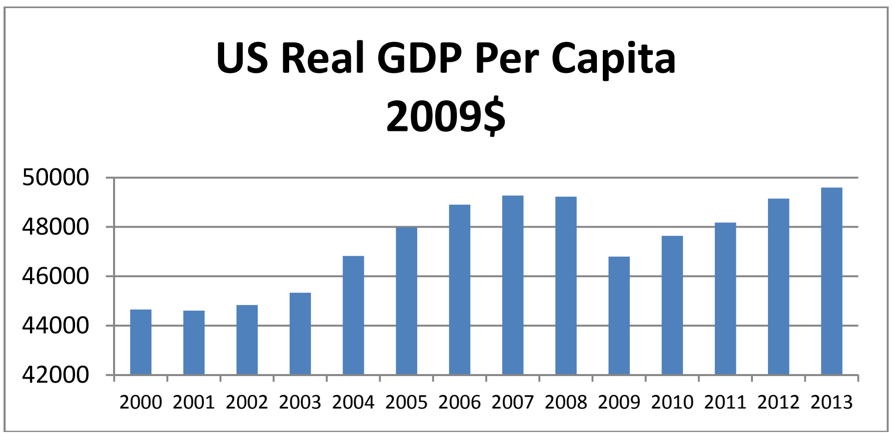



Source: Commuting in America 2013

# DETERMINING HIGHWAY INVESTMENT REQUIREMENTS

## HIGHWAY OWNERSHIP AND CONDITION

There are over 4 million miles of roads in America connecting our vast land area. At the start of the new century our nation had 281 million people and our road system was 3.9 million miles serving a vehicle fleet of some 221 million vehicles of all kinds, traveling about 2.8 trillion miles per year. From 2000 to 2012 the nation's population has grown by 11.6%, roughly 1% a year, and the vehicle fleet has increased by 10.7%, but the road system has grown by only about 4 percent in road miles, or 4.6% if measured in lane miles. Recognizing that Vehicle Miles of Travel has increased 7.4% in the same period means VMT/lane mile has increased by 2.6% in a period of strongly retarded growth and reduced incomes.




We are also a larger society, with a GDP that is growing again (see Figure), and living longer with a far greater impetus to travel and to interact socially and economically today. Serving that interaction among people and freight both directly and as the connector to all other modes of transportation is the fundamental challenge of our national road system. The summary table of key factors summarizes the current social and economic situation.

**Summary Table of Key Factors**

| | 2000 | 2012 | Change | % chg |
|---|---|---|---|---|
| Population (millions) | 281.4 | 313.9 | 32.5 | 11.6% |
| Vehicles (millions) | 221.4 | 245.2 | 23.7 | 10.7% |
| Road System miles (millions) | 3.936 | 4.092 | .156 | 4.0% |
| Lane Miles (millions) | 8.224 | 8.606 | .381 | 4.6% |
| Vehicle Miles of Travel (trillions) | 2.764 | 2.968 | .204 | 7.4% |
| VMT/ lane mile (thousands) | 336 | 345 | 8.8 | 2.6% |

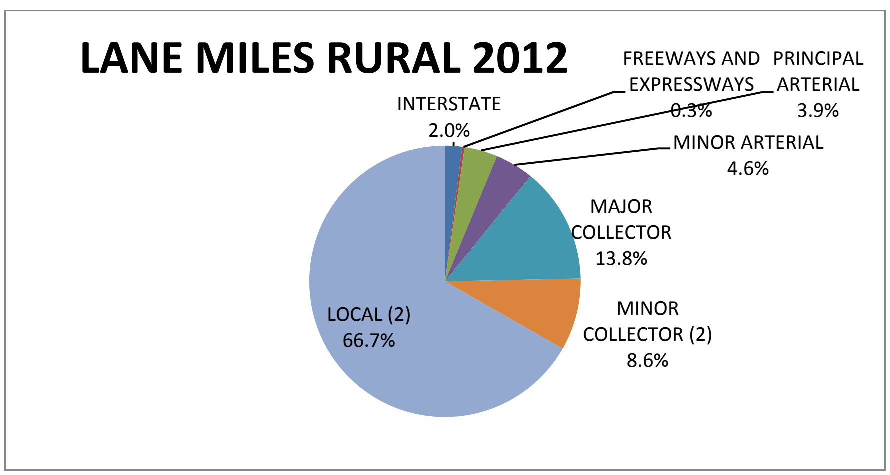
That road mileage is owned by different levels of government and is divided into functional classes that do different levels of work in the national system. Of the 4.09 million miles, only 2.65 million are paved, providing the core of our road system.

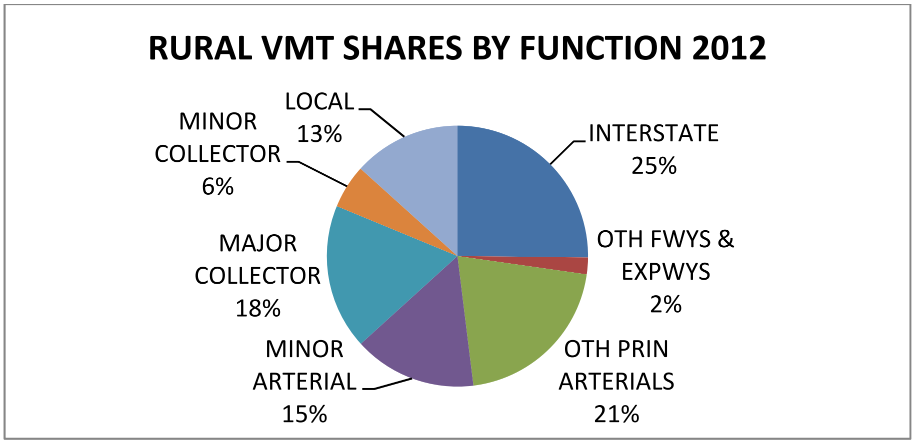
States hold about 19 percent of the road system with 21 percent of rural roads and 13.5 percent of the urban system. The Federal government has only about 3.4 percent of the road system, typically on Federal lands. The majority road holders in the nation are the counties, towns, and municipalities of the nation. The table presents the shares of the road system held by states.

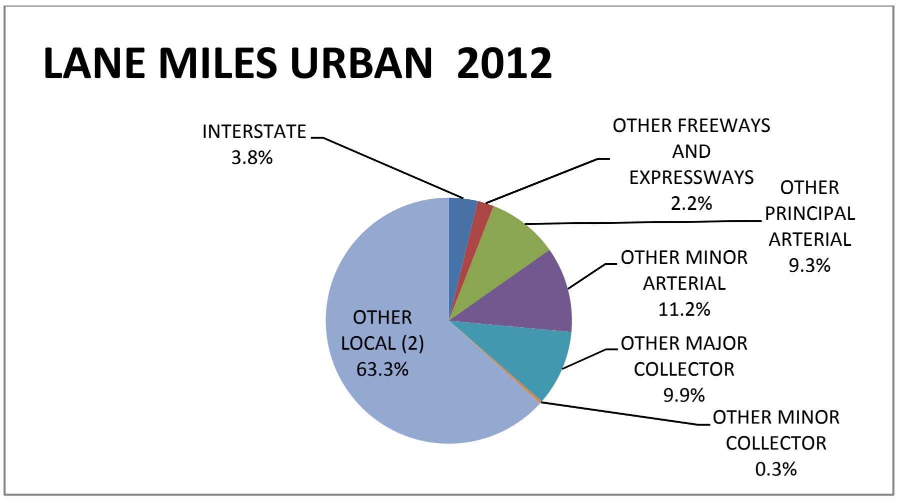
State Road Shares

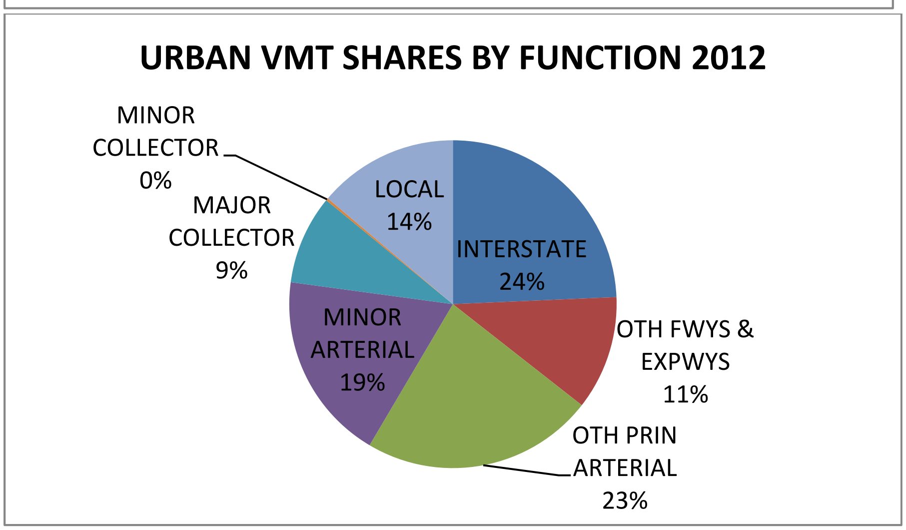
| | NHS Interstate | NHS other | Other Fed Aid | Non-Fed-Aid | Total |
|---|---|---|---|---|---|
| State Share of Rural Roads | 94.97% | 98.88% | 56.70% | 8.28% | 21.13% |
| State Share of Urban Roads | 92.58% | 70.50% | 22.52% | 3.71% | 13.51% |
| State Share of All Roads | 94.12% | 86.49% | 46.71% | 7.11% | 19.06% |

It is important to note that the states own the overwhelming share of the interstate system and the predominant share of the remainder of the national highway system, as well as major portions of the other federal-aid system roads. The table indicates that above 94% of the interstate is owned by states. That percentage is, in fact, larger as much of the remainder is held by non-Highway Department state agencies such as toll road authorities. While constituting only 2% of rural Lane miles, the Interstate System accounts for 25% of rural VMT. Similarly, the urban Interstate with under 4% of Lane miles carries 24% of urban VMT. The series of Figures shows the mileage and travel by functional class of road system.



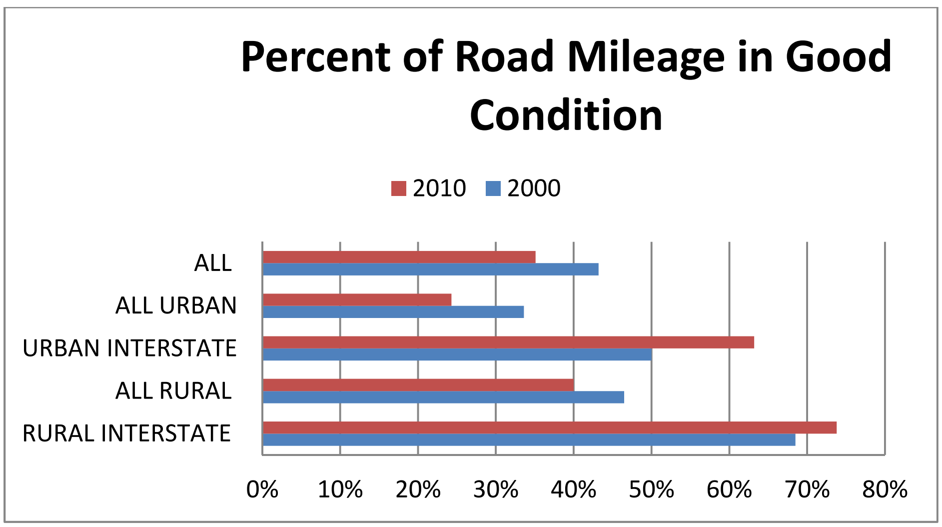


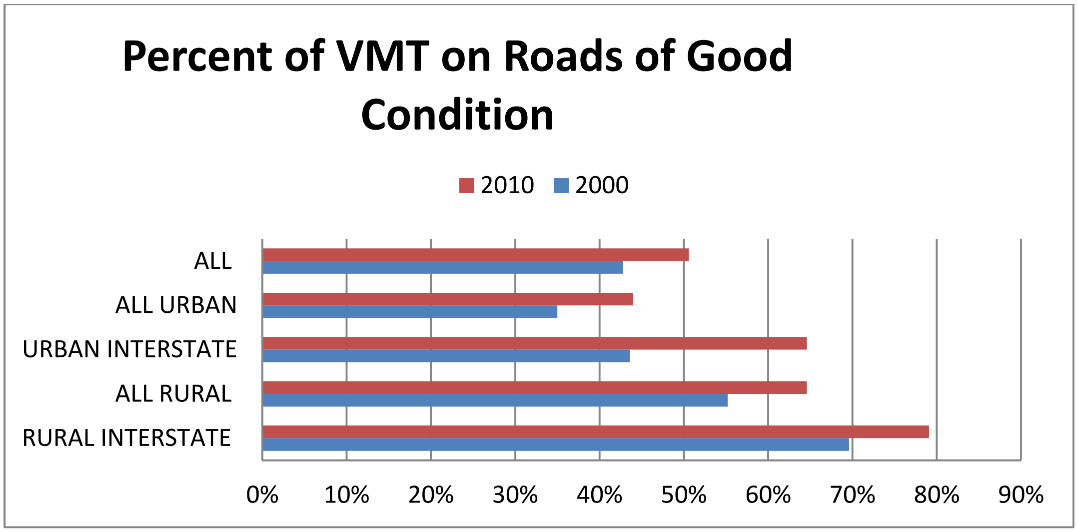




The picture regarding road conditions is a mixed one. Viewed at the level of the road mileage in the country there has been a significant decline in the percentage of roads deemed to be in good[7] condition. Overall, roads in good condition have declined from 43% in 2000 to 35% in 2010; the drop was even worse in already weak urban areas from 33.6% to 24.3%. At the rural level the decline was from 46.5% to 40%.

Note in the figures below that both rural and urban interstates showed improvement while the overall ratings for rural and urban road systems indicated a decline in the percentage of roads in good condition. This is largely because states and other owners of the road system have increasingly focused their limited resources on improving the road systems that are used most extensively by passengers and goods movement. As a result, as shown in the second figure, the percentage of vehicle miles of travel on roads identified as in good condition has improved over the 10 year period in all road classes observed. The US DOT has set a national performance goal for 2013 of having 57% of VMT on the newly expanded NHS to be on pavements with good ride quality.

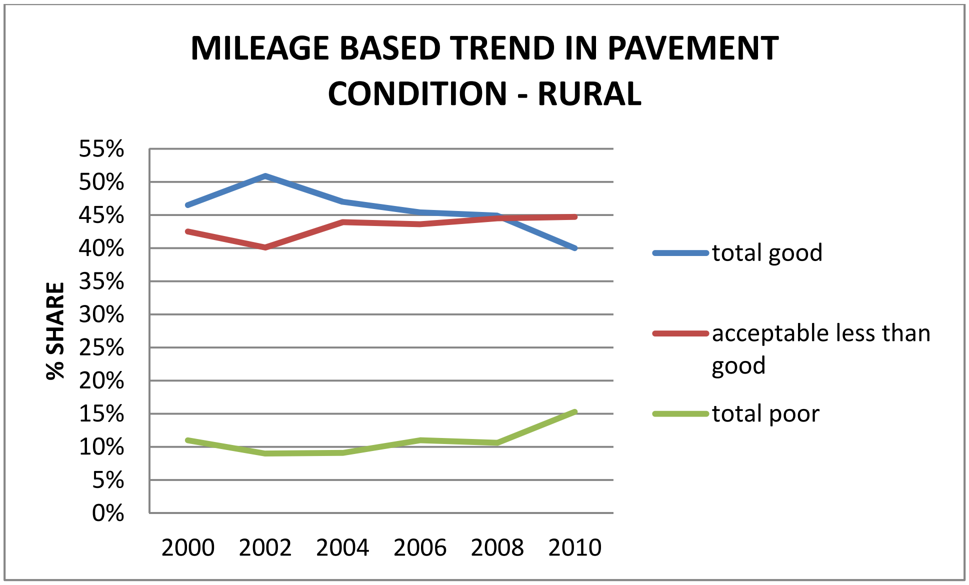


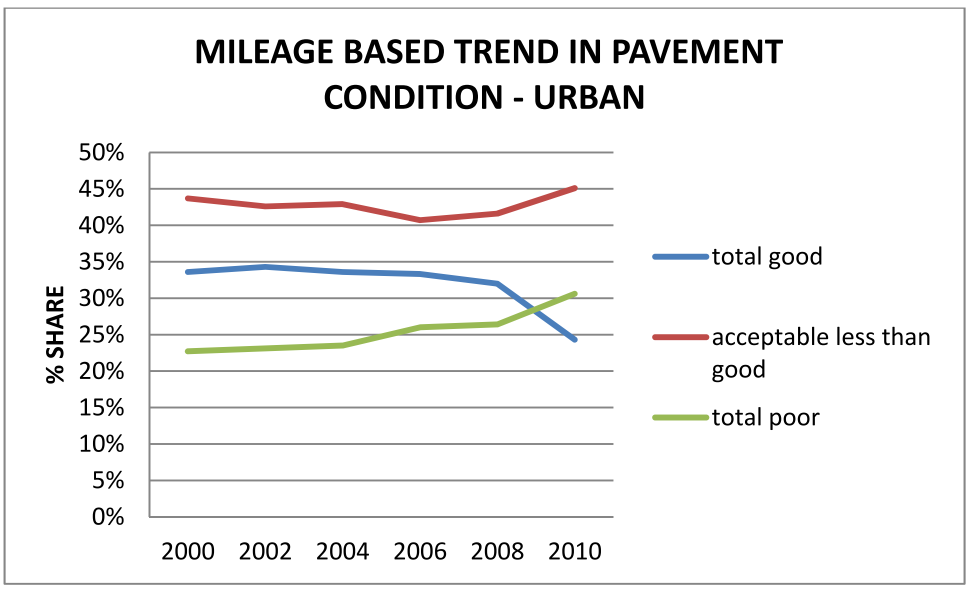

[7] "Good" condition roads are those with an international roughness index, IRI, of less than 95 (inches of deflection per mile). A standard for “Acceptable” is an IRI of less than 170.




Recognizing  what is actually happening with the condition of the road system is a complex undertaking.  While focusing investments on those roads with the largest volumes of travel when funding is as limited as today is a necessary approach, it must be recognized that that leads inevitably to declining conditions in the overall system and increased costs to users when measured on a mileage basis.  The charts below, keyed on a mileage basis for urban and for rural systems, show similar patterns.   Those roads deemed acceptable but not at the good level, have remained roughly stable in share over the past decade, but in both the urban and rural cases that category's stability has been obtained at the price of reduced levels of roads in good condition balancing the increasing  shares of roads in poor condition.

In both cases the category of acceptable but less than good pavements are about a share of 40%-45% of roads over the period. But that stability is a product of shifts of pavements from good down to the acceptable but not good category compensating for shifts away from that category into the poor category in effect, a shift downward in road quality in all cases. The significant difference in the urban and rural cases is that the urban category exhibits a greater share of roads in poor condition by 2010 at 31% compared to just above 15% in the rural case.

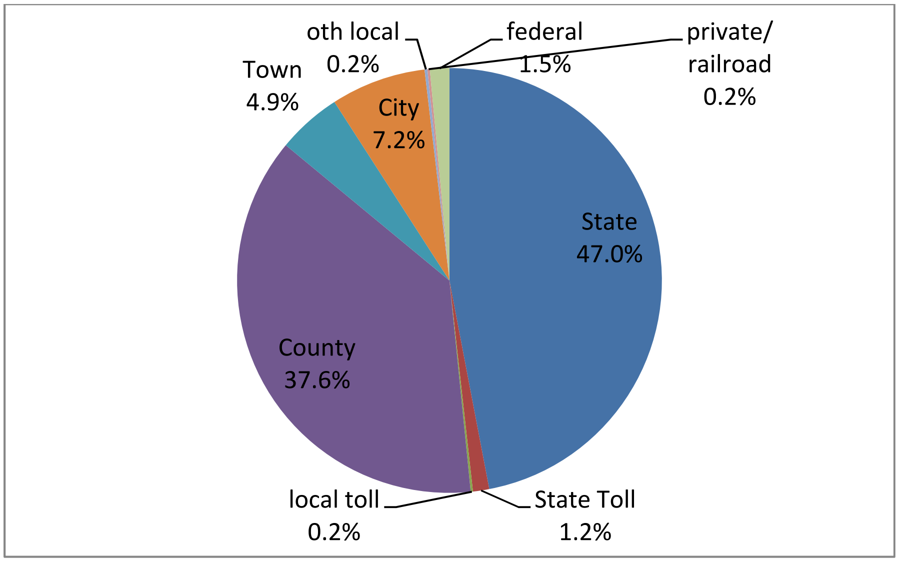

MILEAGE BASED TREND IN PAVEMENT CONDITION - RURAL
% SHARE
55%
50%
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
2000
2002
2004
2006
2008
2010
total good
acceptable less than good
total poor


MILEAGE BASED TREND IN PAVEMENT CONDITION - URBAN
% SHARE
50%
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
2000
2002
2004
2006
2008
2010
total good
acceptable less than good
total poor

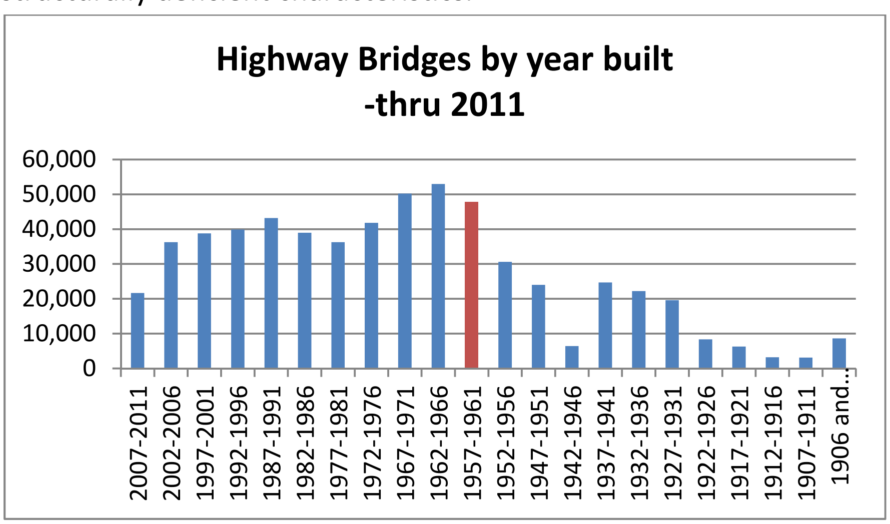
# BRIDGES AND THEIR CONDITION

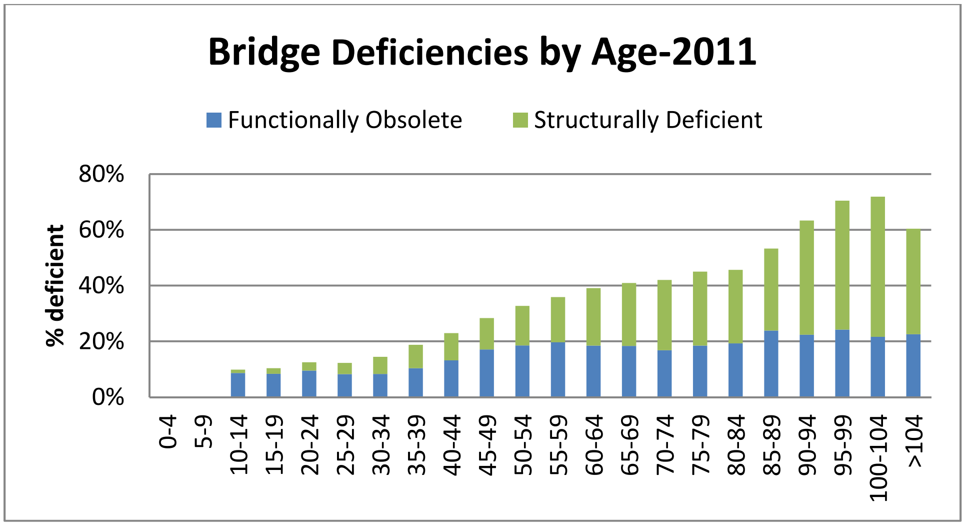
As of 2013 there were over 607,000 bridges in America. Of these, about 48% were state owned, less than 2% were federally owned and the balance was owned by local governments. The pie chart figure below provides a more detailed presentation of the ownership distribution.

**Bridges by Ownership 2013**




Today, the age of bridges is an important concern. The accompanying figure tallies the nation's collection of bridges by year built, indicating that 26% of our bridges were built prior to the start of the interstate era, identified by the red bar. More importantly those bridges constitute 45% of the structurally deficient bridges in the nation. As the second figure shows it is those bridges more than 55 years old that have high proportions of both functionally obsolete and structurally deficient characteristics.



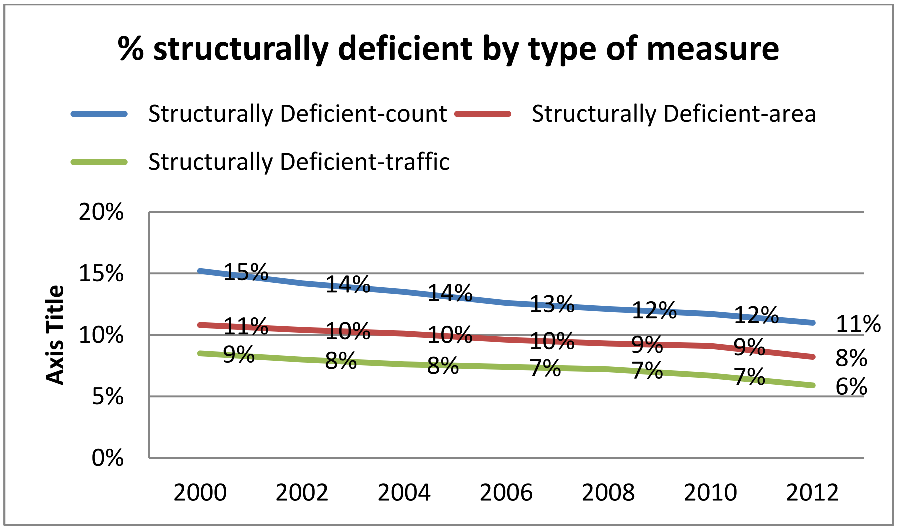


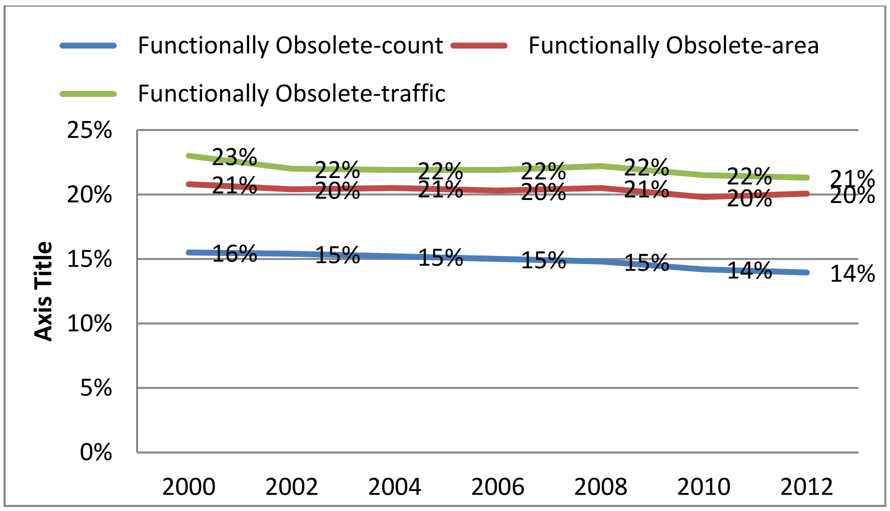

**Measures of Bridge Condition**

The two key measures of bridge condition, structural deficiency and functional obsolescence, can be measured in several ways. One, as above, is simply based on the number of bridges; a second way is by the size of the bridge, typically the area of the bridge deck; finally, the rating can be based on the amount of the traffic the bridge carries. Two figures below present the trend so far in this century based on each of these approaches to bridge evaluation.

The first figure presenting the trend in structural deficiency shows continuing progress in all three measures. The fact that deficiencies by size of bridge or by the amount of traffic show lower deficiency levels then the general count of bridges indicates that investment has been heavily focused on the larger, more heavily traveled bridges. Note that there has been a one third reduction in structurally deficient bridges based on traffic volumes.

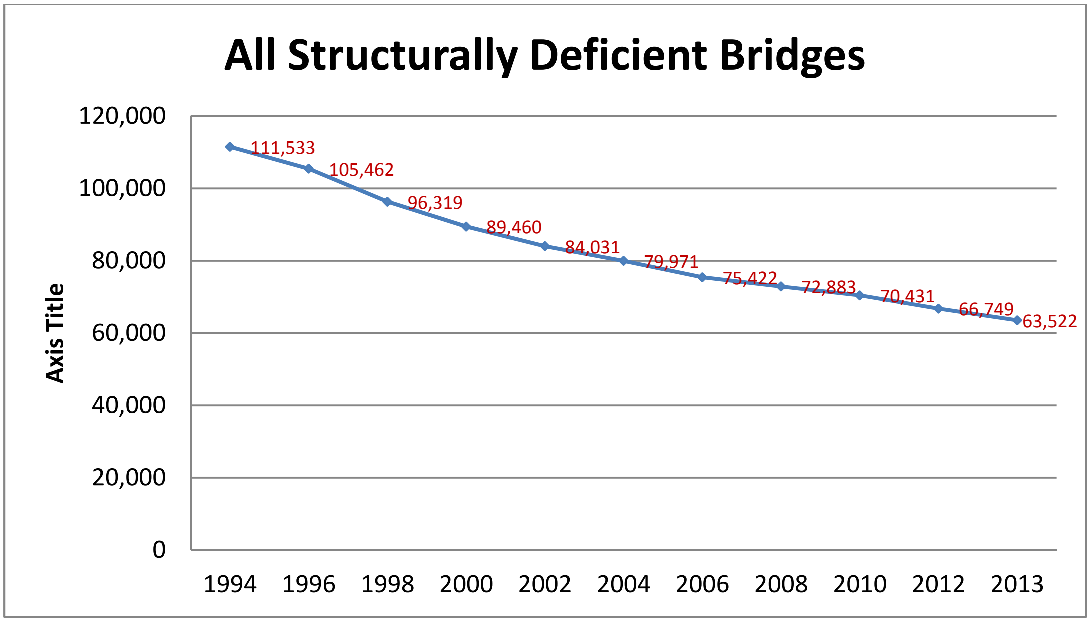
The second figure presents a less dramatic picture. It indicates that small gains have been made in the area of functional obsolescence. Also, it is not surprising, that both the larger bridges and those with heavier traffic are the most prone to functional obsolescence. Only limited progress has been made in these areas.



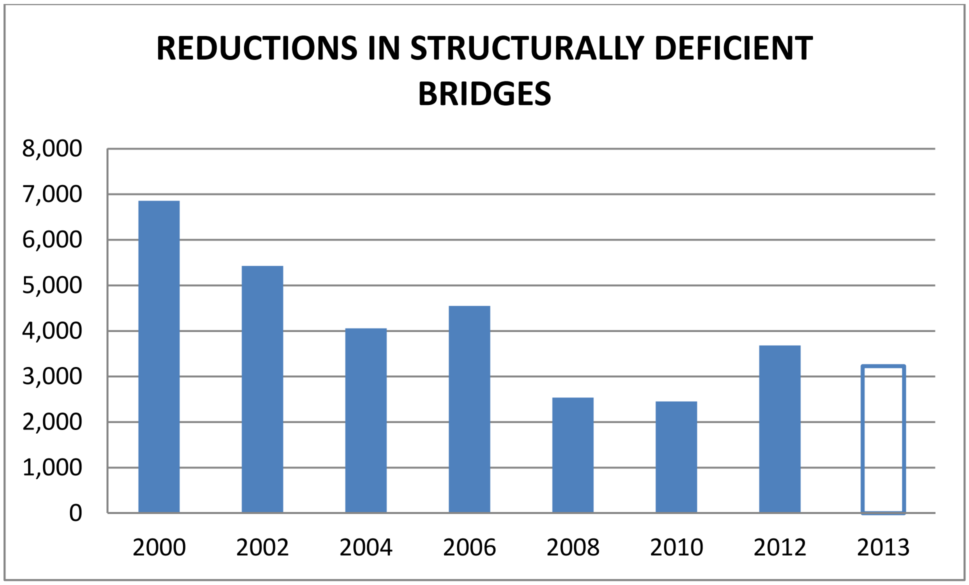




States own about 293,000 of the over 607,000 bridges in America. While this is about 48% of the nation's bridges they are responsible for fewer than 30% of the bridges that are structurally deficient. Given the fact that most of their bridges are on the highest level facilities, their share of functionally obsolete bridges is greater than their overall share of bridges, at just about 52%. Significantly, if the concept called deck area, which encompasses bridge length and width is employed, states own almost 73% of the bridge area and about 64% of the structurally deficient deck area. Their share of functionally obsolete deck area is about 70%.

Importantly, the number of structurally deficient bridges in the nation continues to decline as shown in the figure. In 1994, there were almost 108,000 structurally deficient bridges. That has declined to fewer than 67,000 in 2012, a reduction of 41%. When measured by bridge size, using a bridge deck area measure, the reduction was at 31%, indicating that the bridges improved tended to be smaller in area.




The 2009 Bottom Line report showed that there were just under 74,000 structurally deficient bridges in 2006. This indicates that improvement has continued during recent difficult times. But, with a reduction of roughly 10,000 bridges from 2006 to 2013, improvement has slowed during the recession and post-recession period with less than a 2% reduction each year of that period. A further figure provides detail on the sharp decline in reductions during the period with slow improvement in the most recent years.

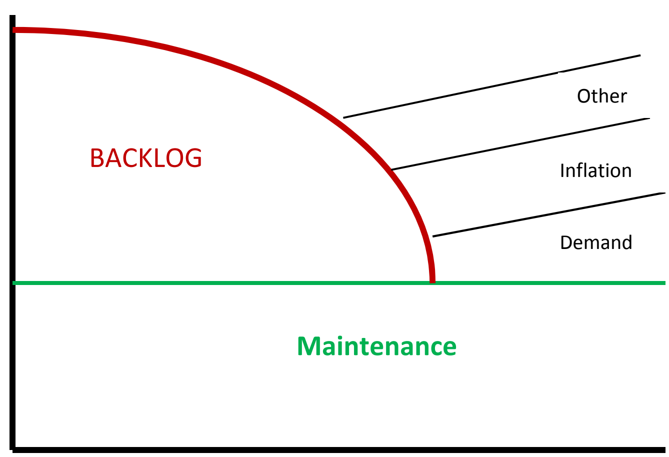

REDUCTIONS IN STRUCTURALLY DEFICIENT BRIDGES
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
2000
2002
2004
2006
2008
2010
2012
2013

# THE HIGHWAY AND BRIDGE BACKLOG – A CRITICAL CONCERN

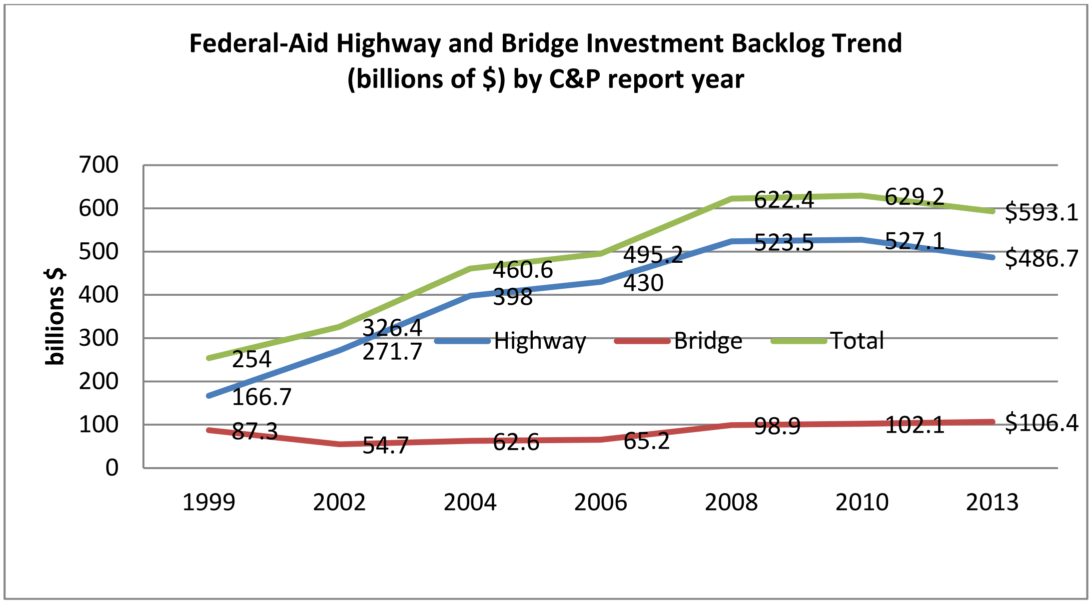
Over time the investment backlog for highways has grown as annual investments have failed to meet requirements for sustaining the condition or the performance of the nation's system. A scenario, which FHWA had employed over the years, was a "maintain conditions" scenario in which the goal was to not have things deteriorate further than they had already. Each year, as this scenario's investment requirements were not met, the conditions to be maintained in a subsequent year became worse – in what has been dubbed a "death spiral"—wherein ever poorer conditions became the new investment goal. In large part this explains why the Bottom Line series does not assess the cost of "maintaining" conditions and performance, and why the backlog has grown in relevance.

The backlog measures the investments required to restore the system to the level of condition and performance the system requires to meet today's demand. Simply stated, the backlog is the investment needed today that does not require future growth in demand, future system deterioration based on system wear or the effects of weather over the coming years, to define its requirements. It responds to the question: "What investment needs are there today to meet past growth and wear effects?" It can be viewed as a zero VMT growth scenario basing needs solely on past change to date. The graphic displays this situation conceptually.

The long term historical pattern has been for the backlog for highways and bridges to grow over time as needs are unmet. The following figure after the graphic identifies and describes that trend.



While it is not possible at this time and level of reporting to establish the full extent to which the ARRA had some effect on the total backlog, the current basis for assessing the backlog is the adjusted 2013 Condition and Performance Report. The limited expansion in the backlog from 2010 to 2012 is a product of the declining rate of increase in the construction cost index. It also reflects the focus of past investments on reducing structurally deficient bridges. As a result the bridge investment backlog has remained relatively stable in the new century, while the highway backlog has more than tripled.




Note Inclusions and exclusions: The backlog estimates shown in the figure excludes so-called enhancements which incorporate safety enhancements, traffic operations improvements such as ITS, and environmental enhancements. Enhancements in the C&P 2013 report amounted to $108 billion.

**Elements of the Backlog**

The table below breaks out some of the detail in the Highway System backlog. Among the key elements:

- System rehabilitation requirements of $392 billion is, in fact, a very viable estimate of a State of Good Repair, SGR, investment need for the nation's highway system;
- urban system rehabilitation requirements on the federal-aid system exceed rural requirements on a four to one basis;
- non-federal-aid highways system of rehabilitation requirements are a relatively small part of the total rehabilitation need;
- System rehabilitation backlog requirements exceed system expansion backlog requirements by a considerable amount; $392 billion versus $237 billion;

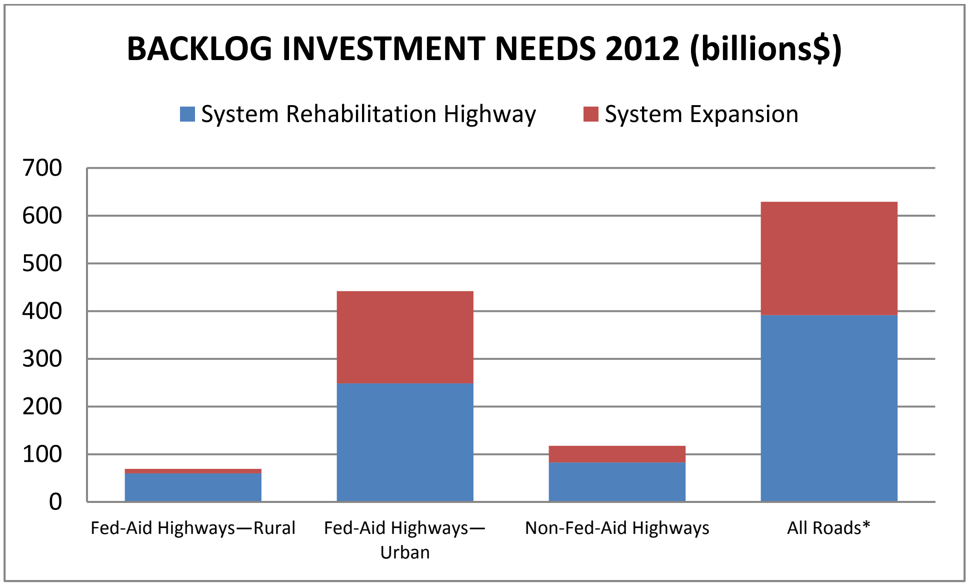
- System expansion backlog requirements of $237 billion are a response to current levels of demand, in effect a zero growth level requirement;
- federal-aid urban highways are the overwhelming component of system expansion needs, exceeding 80% of the expansion requirement;
- federal-aid rural highway investment requirements represent only 15% of rehabilitation needs and 4% of expansion needs; however, many of the non-federal-aid highway requirements are rural in nature and represent 21% of rehabilitation needs and 15% of expansion needs:
- The overall NHS rehabilitation requirements constitute more than half of total highway rehabilitation needs;
- The NHS expansion investment requirements exceed two thirds of total system expansion needs;
- The Interstate Highway System constitutes about 30% of National Highway System rehabilitation needs but only about 15%, therefore, of total rehabilitation requirements;
- However, the dominant portion of system expansion needs are on the Interstate Highway System, exceeding more than half of total National Highway System expansion needs and representing almost 40% of total national road system expansion requirements.

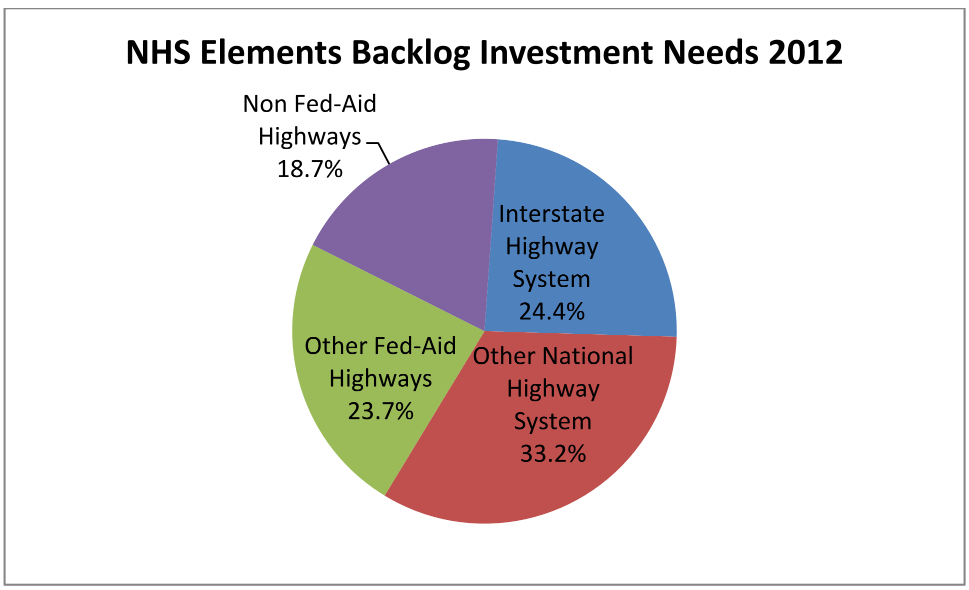
**Table HIGHWAY BACKLOG ESTIMATE 2012**

| | System Rehabilitation Highway | System Expansion | Total Backlog | Share of Rehabilitation Needs | Share of System Expansion Needs | Share of Total Backlog |
|---|---|---|---|---|---|---|
| | | | | | | |
| Fed-Aid Highways—Rural | 60.22 | 9.25 | 69.47 | 15.4% | 3.9% | 11.0% |
| Fed-Aid Highways—Urban | 248.56 | 193.38 | 441.95 | 63.5% | 81.5% | 70.2% |
| Fed-Aid Highways—Total | 308.78 | 202.74 | 511.52 | 78.8% | 85.4% | 81.3% |
| Non-Fed-Aid Highways | 82.92 | 34.79 | 117.71 | 21.2% | 14.7% | 18.7% |
| All Roads | 391.71 | 237.42 | 629.13 | 100.0% | 100.0% | 100.0% |
| | | | | | | |
| Interstate Highway Systen | 62.43 | 90.81 | 153.24 | | | |
| Remainder of National Highway System | 138.63 | 70.42 | 209.04 | | | |
| Total National Highway System* | 201.06 | 161.22 | 362.28 | 51.3% | 67.9% | 57.6% |
| Other Fed-Aid Highways | 107.73 | 41.51 | 149.24 | 27.5% | 17.5% | 23.7% |
| Non-Fed-Aid Highways | 82.92 | 34.79 | 117.71 | 21.2% | 14.6% | 18.7% |
| All Roads | 391.71 | 237.53 | 629.23 | 100.0% | 100.0% | 100.0% |

*The National Highway System requirements identified here are FHWA estimates based on current knowledge of the extent of the prospective complete National Highway System when fully elaborated

The two accompanying figures provide a sense of proportion of the two main elements of the backlog.




## THE HIGHWAY BACKLOG – IMPROVING ESTIMATES OF LONG TERM NEEDS

The backlog investment requirements shown here do not provide the full long-term rehabilitation investment requirements that the nation faces in regard to its highway system.

Without a comprehensive national survey of reconstruction requirements, particularly for the Interstate Highway System and the complete National Highway System, a complete statement of national reconstruction needs is not possible. The current computer modeling attempts to take into account reconstruction needs after several rehabilitation cycles of each road segment, but this cannot fully substitute for a complete survey of reconstruction requirements.

The Federal Highway Administration and AASHTO have long recognized that, despite their very substantial capabilities, the existing modeling and needs estimation procedures do not take account of the very long term needs for reconstruction or replacement of infrastructure. The HERS model programs rehabilitation or reconstruction of pavement structures, but the data on which it is based has not included information related to the long term state of the entire pavement structure. While FHWA and the states are in the process of making substantial improvements to the needed data and to the pavement model used in HERS, that revised data and model structure has not yet been completely implemented. In addition, after implementation, it will take testing over a considerable period of time to assure that the analysis system is actually forecasting long term needs that include reconstruction and replacement.

The FHWA has attempted to address the issue of long term pavement needs by limiting the number of rehabilitations that a particular pavement can be subject to prior to full reconstruction. However this is an approximation and will not be fully calibrated until it is tested against actual enhanced data on the conditions of pavements and the reconstructions programmed by the states. It would be valuable to have a complete national evaluation of Interstate needs compiled from states' periodic full engineering evaluations of their Interstate needs and reconstruction records, focusing on when reconstruction might be necessary. The Nebraska Department of Roads prepares such updates of its investment program for its Interstate system.

Both FHWA and AASHTO are engaged in research to address the question of estimation of the longer term needs for pavement and bridge reconstruction and replacement not captured in current modeling. AASHTO has completed preliminary research projects in 2009 and 2014 that identify potential approaches to addressing full needs for reconstruction of the Interstate System pavements and bridges. At the current time, the consensus is that current models underestimate the value of long term pavement and bridge needs. Ongoing research to determine the extent and magnitude of the need remains important and unanswered.

# THE BRIDGE BACKLOG

The long term trend in the bridge backlog, as presented in the US DOT Condition and Performance reports is presented in the figure, shown earlier. As noted, the overall bridge backlog investment requirements have not shown the dramatic changes indicated in the overall highway backlog. The overall bridge backlog estimate for 2012 is $111.8 billion. This is detailed in the following table.

| ROAD SYSTEM | BACKLOG B$ | % |
|---|---|---|
| Fed-Aid Rural Highways | 29.9 | 26.7% |
| Fed-Aid Urban Highways | 61.5 | 55.0% |
| Non-Federal Aid Highways | 20.6 | 18.4% |
| All Roads | 111.8 | 100.0% |
| | | |
| Interstate Highway System Share | 32.0 | 28.6% |
| Overall National Highway System Share | 62.2 | 55.6% |

Note that the NHS component of the backlog is greater than half the investment requirement.

The 2013 Condition And Performance Report of the US DOT indicates that 2010 was an exceptional year for bridges in that of the $100.2 billion invested in highways, $17.1 billion was used for bridge system rehabilitation, a third greater than in 2008, in part a result of the ARRA funding. This level of funding, if continued, would reduce the existing bridge investment backlog by 92.6% by 2030 from its 2010 level of $106.4 billion, leaving a small backlog of $7.9 billion in 2030. The report further indicates that a level of spending of $20.2 billion per year would be sufficient to totally eliminate the economic backlog by 2030. This clearly indicates that this is a problem that can be met.

The FHWA has calculated the costs of eliminating the structural deficiency backlog for the NHS and non-NHS. For their 2012 work they identified over 66,000 structurally deficient bridges that needed to be addressed. Using alternative approaches, they arrived at a range of between 48.5 and 51.8 billion to respond to the total replacement/rehabilitation requirement for structurally deficient bridges. Of these amounts less than 8% of the deficient bridges are on the NHS system; but they account for 42% of the total deck area of the deficient bridges; and, therefore, their share of the total cost of complete reduction ranges between 43% and 45%.

# A SCENARIO APPROACH TO FUTURE HIGHWAY AND TRANSIT INVESTMENTS

## NEED FOR A SCENARIOS APPROACH

To project investment needs several scenarios were employed in response to the changes in highway travel demand and dramatic economic changes in the period. The scenarios are adapted from previous Bottom Line scenarios and previous Condition and Performance Report scenarios. No new model runs were done.

The scenarios cover a time span of the next six years and the next twenty years. The average annual needs are based on the 20-year perspective and thus each scenario's average annual investment levels assume that accomplishment of the goals of the scenario will occur at the end of twenty years. The scenarios consider the following factors:

- The primary highway scenarios are based on three VMT growth rate estimates ranging from 1.0 percent to a maximum of 1.6 percent per year growth for the six-year period and for the twenty year period. The base case is 1.0 percent growth per year. In 2013, highway VMT increased by 0.6%. Estimates for a 0.6 percent VMT growth forecast have also been prepared. The base case for the 2009 report was 1.4 percent per year and this level is also estimated. It reflects the expectations of the most recent state by state estimates of highway travel growth. A scenario of 1.6 percent is also shown, representing the long term average growth in VMT over twenty years through 2011, which was also the average growth rate for transit passenger miles for that twenty year period. It is also anticipated that this 1.6 percent level will be close to HPMS forecasts that may be used in the upcoming C&P reports (2015 or 2016), because states generally utilize trend based twenty year VMT forecasts for the sample highway segments in the HPMS data set, and the average annual growth of VMT for the last twenty years has been 1.6 percent.

- The primary transit scenarios are also based on three transit passenger miles of travel (PMT) growth estimates ranging from 1.6 percent per year to a maximum of 3.5 percent per year (which represents the AASHTO policy scenario of achieving a doubling of transit usage in 20 years). The base case for transit is 2.4 percent growth per year as it was in the 2009 Bottom Line. The 1.6 percent growth rate allows a comparison of transit and highway results at a common rate of growth, and is also the average annual growth rate for transit PMT over the last twenty years. In 2013 transit ridership increased by 1.1 percent. The 2015 Executive Bottom Line has changed transit growth estimates from passengers to passenger miles of travel to make the highway and transit scenarios more consistent (apples to apples).

- Capital investment totals shown are the total national capital program estimates for highways and bridges and transit by all levels of government for all levels of the nation’s highway systems and transit systems.

- All scenarios assume that the cost effective operations deployments designed to ease the flow of traffic and to enhance the efficiency of existing investments have been made, which have also been included in the C&P reports.

- Backlogs are also shown based on the analyses of highway and bridge backlogs and based on the estimates of highway and transit state of good repair (SGR) needs that were presented in the 2013 C&P report.

# CONSTRUCTING THE 2015 EXECUTIVE BOTTOM LINE INVESTMENT SCENARIOS

## HOW HIGHWAY AND BRIDGE INVESTMENT SCENARIOS ARE CONSTRUCTED

- The starting point for the 2015 Bottom Line estimates are the scenario investment estimates in the 2013 C&P Report (which are the latest highway and bridge scenario estimates and which are based on the latest available complete state HPMS data set, which is still for the year 2008.
- The 2008 state HPMS data (which is the most recent full HPMS data set at this time), the 2008 state travel forecasts, and the 2010 FHWA estimated costs were used in the 2013 C&P Report.
- Bridge data is now current as of 2012, and this data is cited in addition to references to the 2010 bridge data which was presented and analyzed in the 2013 C&P report.
- The 2015 Executive Bottom Line has estimated future highway needs based on FHWA estimates of the cost index for year 2012 highway construction costs, which was the latest available full year of the FHWA cost index, compared to the 2010 FHWA cost index, which was used by FHWA for the 2013 C&P investment scenario cost estimates. The changes in the index in 2013 were marginal.
- The Executive Bottom Line re-estimates changes to investment needs based both upon benefits and costs and adjusts the 2012 scenario cost estimates to account not just for straight cost index changes but also for estimated changes to the numbers of projects which will pass b/c threshold levels when the cost indices change up or down.
- The  Executive Bottom Line has utilized its own scenario forecasts of average annual levels of 1.0 percent, 1.4 percent, and 1.6 percent for future VMT growth, and needs have been adjusted to these 2015 Executive Bottom Line VMT growth levels by adjusting from the 2013 C&P scenarios of 1.36 percent VMT growth and 1.85 percent VMT growth scenarios as starting points.
- The Executive Bottom Line highway investment requirements for this report were thus adjusted from the 2013 C&P highway investment requirements by accounting for both the highway cost changes from 2010 to 2012 and by accounting for the differences in VMT forecasts for the 2015 Executive Bottom Line scenarios versus the 2013 C&P scenarios.
- The 2015 and 2009 Bottom Lines report annual highway and bridge investment needs estimates for periods starting at three years after the 2013 and 2008 C&P started reporting investment needs.
- Thus the 2013 C&P reports needs estimates which include 3 years of relatively low and already completed years of highway and bridge investment averaged into its 20 year averages, whereas the Bottom Line scenarios use strictly the post-reauthorization years in estimating average annual investments.

- The different reporting periods for the Bottom Line report compared to the C&P report thus make the Bottom Line reported average annual investment needs higher than the C&P reported average annual investment needs.
- Bridge deficiency conditions are updated in the 2015 Executive Bottom Line to the most current period available (2012).
- A highway and bridge state of good repair (SGR) scenario is also shown, based on the SGR scenario included in the 2013 C&P report, adjusted only for cost index changes. The SGR estimate in the 2013 C&P report identified SGR needs as the $78.3 billion of the $145.9 billion of needed investment for the C&P's improve conditions and performance scenario which was directed towards improving the physical condition of the existing infrastructure assets. Adjusting this only for cost index changes from the 2010 to the 2012 costs, the comparable 2015 Bottom Line estimate would be $83.1 billion per year. This should be considered to be an approximation to be applied across all the different VMT growth rates. Pavement and bridge damage will vary somewhat based on different heavy truck VMT growth rates, but these analyses have not been done for the 2014 Bottom Line.
- As with the past C&P and past Bottom Line reports, a current spending scenario is also shown for reference purposes as well as for use in estimating the benefits of the higher investment levels. No 2012 current spending levels have yet been published in FHWA's Highway Statistics or in its other documents. The 2013 C&P used a figure for 2010 estimated highway spending by all levels of government which it estimated at $100.2 billion. Since this included the very substantial highway capital investment of $11.9 billion from the now-expired ARRA program, the actual baseline of current spending for 2010 was probably $88.3 billion, which is the amount the 2015 Executive Bottom Line uses for current spending in lieu of more recent current spending estimates which are not yet available from FHWA.
- A new scenario of "full employment" has been constructed to illustrate the marginal impacts of achieving a more full employment level. The full employment scenario was estimated by adding VMT to the other scenarios of 1.0 percent or 1.4 percent growth and by estimating the additional investment needs associated with the additional VMT that would occur due to achieving full employment. An estimate of 50 billion additional VMT per year was used for the full employment scenario.

## HOW TRANSIT INVESTMENT SCENARIOS ARE CONSTRUCTED

- The starting points for the 2015 Executive Bottom Line transit investment scenarios are the 2009 Bottom Line transit investment scenarios.
- The 2009 Bottom Line had four transit investment scenarios of maintain or improve conditions and/or services for each of three growth rates: (2.4%, 3.5%, and 4.6% per year). These same four scenarios are used in this report, but for three Executive Bottom Line 2015 growth rates for passenger miles of travel (PMT) of 1.6%, 2.4% and 3.5%.
- There is no transit construction cost index so FTA adjusts their costs using the CPI, although they also use updated project costs whenever available from their own studies and from data supplied by major transit agencies.
- The Executive Bottom Line 2015 update uses the highway cost index to make cost adjustments to those transit expenditure categories which are strongly related to the highway construction cost index (59% of transit capital costs) but not for other categories (41% of transit capital costs).
- Costs of the transit scenarios are also adjusted because, according to FTA sensitivity analyses, more or fewer investments will pass the benefit/cost thresholds when cost indices change.
- The 2015 Executive Bottom Line continues the 2009 Bottom Line report's use of cost data from FTA's New Starts cost files for a portion of system expansion costs as the best available guide to actual costs. New Starts costs per added rider are higher than TERM calculated costs per added rider.
- This is the primary cause of differences between the 2015 Bottom Line transit investment requirements estimates and the 2013 C&P transit investment requirements estimates; the differences are also impacted by the differences in the assumed passenger mile of travel (PMT) growth rates which are forecast for the transit scenarios.
- A transit state of good (SGR) repair scenario is also shown, based on the latest SGR estimate made for the 2013 C&P report
- A transit current spending scenario was estimated at $16.7 billion per year based on APTA reports for the year 2011. This scenario is not highlighted in this analysis.

# Executive Bottom Line 2015 Scenarios

## HIGHWAY AND BRIDGE INVESTMENT SCENARIOS

Three primary highway and bridge investment scenarios are presented and evaluated, along with their sub-scenario variations which are identified here:

1. A traditional "cost to improve," or "maximum economic investment[8]," scenario which is the same scenario that has traditionally been highlighted in the past Bottom Line reports and which has also been included in every C&P report (although FHWA has changed the name from "improve" to "maximum economic performance)". Variations on this scenario which are traditionally noted and included are estimates of investment needs for the three different forecasts of VMT growth and for different discount rates.

2. A variation addressed is the likely impact of "full employment" on VMT growth and on needs.

3. A continuation of the current highway investment funding levels, which has also always been estimated in the C&P reports. Differences in performance between this scenario and the first "maximum economic investment" scenario are highlighted. Variations on this scenario could include identifying the implications of continuing different past years of funding levels. These variations have been suggested by AASHTO and their implications are noted although not presented as full scenarios.

**Highways and Bridges Maximum Economic Investment Scenarios**

| Growth Rate of VMT per Year | Maximum Economic Investment – ------ Needed Spending per Year (Billions of Year 2012 Dollars) |
|---|---|
| **Modal Comparison Scenario -- 1.6 Percent Annual Growth** | **$156.5** |
| **Mid Level Scenario – 1.4 Percent Annual Growth** | **$144.4** |
| **2009 BL Policy Scenario - 1.0 Percent Annual Growth** | **$120.2** |

[8] The term maximum economic investment may be misleading. It is really an abbreviated expression of maximum economically-justified investment, that is that amount of investment which passes a benefit-cost threshold test.

At a 1.6 percent growth rate in VMT, annual average investment requirements for highways and bridges total $156.5 billion. At the mid level scenario investment requirements are $144.4 billion. Under a policy variant scenario of nearly constant VMT/capita of a 1.0 percent annual VMT growth rate, the investment requirements decline to $120.2 billion.

These scenarios represent a 13 percent and a 9 percent decline from the 2009 Bottom Line scenarios which used the growth rates of 1.4 percent and 1.0 percent. The decline is primarily due to the decline in the FHWA's cost index from 2006 (used in the 2009 Bottom Line) to 2012 (used in the 2015 Executive Bottom Line). The cost index rose after 2010 and then moderated slightly from 2012 to 2013.

## FULL EMPLOYMENT SCENARIOS

Full employment scenarios have been estimated very simply by adding on 50 billion VMT to the VMT after 20 years, based on fuel expenditures by workers compared to non-workers. This would have the impact of raising the VMT for either the 1.4 or for the 1.0 VMT growth scenario. It was assumed the raise was 50 billion total for full employment no matter when it occurred. This estimate does not include all the other effects that an addition of an estimated 10 million workers would have on the economy. For estimating the impact of the full employment assumption on the 1.4 scenario, a calculation was made of what the added cost would be for going to the 1.6 percent growth rate scenario based on the end year (20$^{th}$ year) VMT. The VMT growth over 20 years at 1.4 is 1.320 times base year VMT. The VMT growth at 1.6 over 20 years is 1.3736 times base year VMT.

Using 3,000 billion VMT for the base year gives a 159 billion change in future year VMT between these two scenarios. Then, looking at the 50 billion added VMT due to full employment over and above this as a twenty year VMT change for full employment versus not full employment, the added annual costs of the full employment over the annual costs of the 1.4 VMT scenario would be .314 of the added costs of the 1.6 scenario over the 1.4 scenario. This comes out to $3.8 billion per year added to the 1.4 scenario to get to the full employment scenario. Thus the full employment scenario for 1.4 percent is $144.37 billion plus $3.8 billion per year or $148.17 billion per year.

A similar calculation for adding full employment to the 1.0 scenario results in an added 50 billion VMT at the end of 20 years which is on a smaller base, so the percent of costs increases a little faster than for taking the 1.4 VMT scenario up by the same 50 billion of added VMT. The 1.0 scenario adds $4.0 billion per year for the full employment calculation versus the regular 1.0 scenario's needs. Here is a summary showing four scenarios of maximum economic investment adding in the full employment increment to the 1.4 percent regular scenario and adding in full employment to the 1.0 percent regular scenario.

**1.4 percent regular $144.37**
**1.4 percent full employment $148.17**
**1.0 percent regular $120.17**
**1.0 percent full employment $124.19**

## Other Highway and Bridge Scenarios

The 2013 C&P included spending under ARRA (the American Recovery and Reinvestment Act) as current spending, but that spending did not exist at the start of the Bottom Line analysis period. Therefore this report estimates current spending as the level of capital investment as estimated by the 2013 C&P but without the increment provided by ARRA. The current highway and bridge capital spending is at about $88.3 Billion per year under this updated definition. The current spending scenario by definition simply keeps investment at the specified level no matter what growth rate occurs for vehicle miles of travel.

**Highways and Bridges Other Scenarios**

| Growth Rate of VMT per Year | Current Spending | State of Good Repair |
|---|---|---|
| Modal Comparison Scenario -- 1.6 Percent Annual Growth | $88.3 billion | $83.1 |
| Mid Level Scenario – 1.4 Percent Annual Growth | $88.3 billion | $83.1 |
| 2009 BL Policy Scenario - 1.0 Percent Annual Growth | $88.3 billion | $83.1 |

A highway and bridge state of good repair (SGR) scenario is also shown, based on the SGR scenario included in the 2013 C&P report, adjusted only for cost index changes. The SGR estimate in the 2013 C&P report identified SGR needs as $78.3 billion of the $145.9 billion of needed investment for the C&P's improve conditions and performance scenario which was directed towards improving the physical condition of the existing infrastructure assets. Adjusting this only for cost index changes from the 2010 to the 2012 costs, the comparable 2014 Bottom Line estimate would be $83.1 billion per year. This should be considered to be an approximation to be applied across all the different VMT growth rates. Pavement and bridge damage will vary somewhat based on different heavy truck VMT growth rates, but these analyses have not been done for the 2015 Bottom Line and so the SGR numbers are shown as the same for the alternative VMT growth rates..

## ELEMENTS NOT FULLY INCLUDED IN THE IDENTIFIED INVESTMENT REQUIREMENTS

In the 2009 Bottom Line Report a series of special studies were conducted to respond to the need to recognize certain areas of investment needs that stood outside the traditional modeling capabilities of the existing technical analysis system. These included:

- Cost increases to mitigate community and environmental impacts
- System Operations
- Safety
- Security
- Infrastructure Reconstruction

This 2015 Executive Version of the Bottom Line series has not sought to update or extend the research presented then. However, it is important to incorporate in this report the significant progress that has been made in these areas in the ensuing years despite the economic distress that has been prevalent since the previous report. Progress has been made in significant part due to legislative enactments in MAP-21 regarding safety and environmental assessment costs.

### Safety

It is important to recognize the substantial progress that has been made in the area of safety and the important commitments that have been made to assuring continuing progress in this area. The progress against fatalities, noted earlier, as a reduction in fatalities from 41,000 in 2007 to an estimate just below 33,000 in 2013 are rewarding, but emphasize the need for even greater focus and funding in this area. America has fallen behind other nations in reducing crashes and fatalities, where instead it should be leading.

Important research studies continue, notably those in the SHRP2 program, that will make continuing contributions to our ability to improve the protection of the public and property. New investment requirements will be identified in the future as a result of this and other research.

## Operations, Security and Emergency Management

The terrible events of 911 brought home to the nation and transportation professionals the critical concerns about addressing emergencies, either those occurring in the transportation system or where the transportation system is critical to response to those emergencies; whether as a product of weather, other natural events or a product of human behavior. Since 911 other national emergencies due to hurricanes or other weather calamities have re-emphasized the importance of the need to prepare for security and emergency management of all forms of hazards.

The 2009 Bottom Line addressed these concerns in several disparate studies which since that time have been increasingly recognized as linked – operations, security, and emergency management – all linked also to broader safety concerns. The focus in this period has shifted beyond facility hardening and protection to preparation, response and recovery from any emergency event. A pending study, NCHRP 20-59(14B) , is addressing the strategic long term business plan to assist the states in updating previous plans and establishing the tools required in the future to address these needs as part of an integrated approach, including a National Operations Center of Excellence.

The vision of this approach embodied in the work of the AASHTO Special Committee on Transportation Security and Emergency Management is: *A secure transportation system that assures the mobility and prosperity of all Americans through resiliency to threats from all hazards.*

## PUBLIC TRANSPORTATION INVESTMENT SCENARIOS

The economic growth or improve conditions, improve performance scenario is shown for three levels of growth in transit passenger miles. This scenario has traditionally been referred to as "improve conditions, improve performance." The table below illustrates the average annual public transportation capital needs for the preferred scenario of improving conditions and improving performance under the three different passenger miles growth scenarios. In addition, to conform to FTA's current practice in the 2013 C&P report, the cost of only achieving a state of good repair (SGR) for current transit assets is also identified. The state of good repair estimate is independent of passenger miles. The SGR estimate in the 2013 C&P was $18.5 billion per year in 2010 dollars for reducing the backlog over twenty years, and this estimate was adjusted to $19.1 billion for 2012 dollars to conform to the other scenario estimates. The estimate used of current transit capital investment spending is $17.1 billion in 2011, taken from APTA's 2013 Fact Book.

**Public Transportation Capital Investments (Average Annual 2012 $ Billions) – Levels For Current Spending, SGR, and Improve Conditions and Performance**

| | Current Level | State of Good Repair (SGR) Update of 2013 C&P Needs | 1.6 Percent Annual Growth | 2.4 Percent Annual Growth | 3.53 Percent Annual Growth |
|---|---|---|---|---|---|
| **Total Annual Needs** | **$17.1** | **$19.1** | **$34.4** | **$43.3** | **$55.6** |

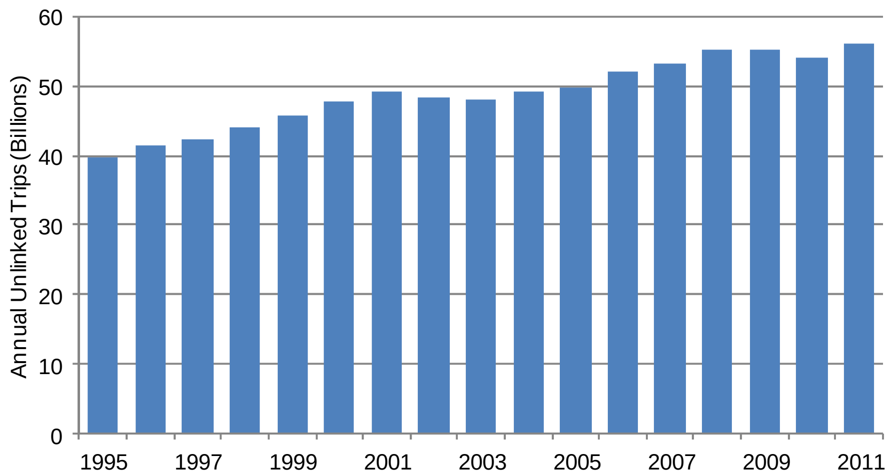
The three scenarios which constitute improve/improve at different growth rates are highlighted as in recent Bottom Line reports. In addition, to conform to FTA's current practice in the 2010 C&P report, levels of continuing current spending and the level of only achieving a state of good repair (SGR) for existing current transit assets are also identified. These latter two are adjusted from the 2013 C&P report results using cost index factors.

# PUBLIC TRANSPORTATION – THE BOTTOM LINE

## RIDERSHIP AND PASSENGER MILES OF TRAVEL

From 1995 to 2011 data compiled in the Transit Fact Book show that the miles traveled by transit passengers grew by 41 percent.[i] This is more than the 22 percent growth of vehicle miles traveled on highways over the same time period. Heavy rail and light rail had particularly high rates of growth.

**Figure 1: Transit Passenger Miles of Travel Increased 41 Percent from 1995 to 2011**




Source: *Requirements for Public Transportation Capital Investment During the 2015 – 2020 Period.* APTA. May 24, 2013

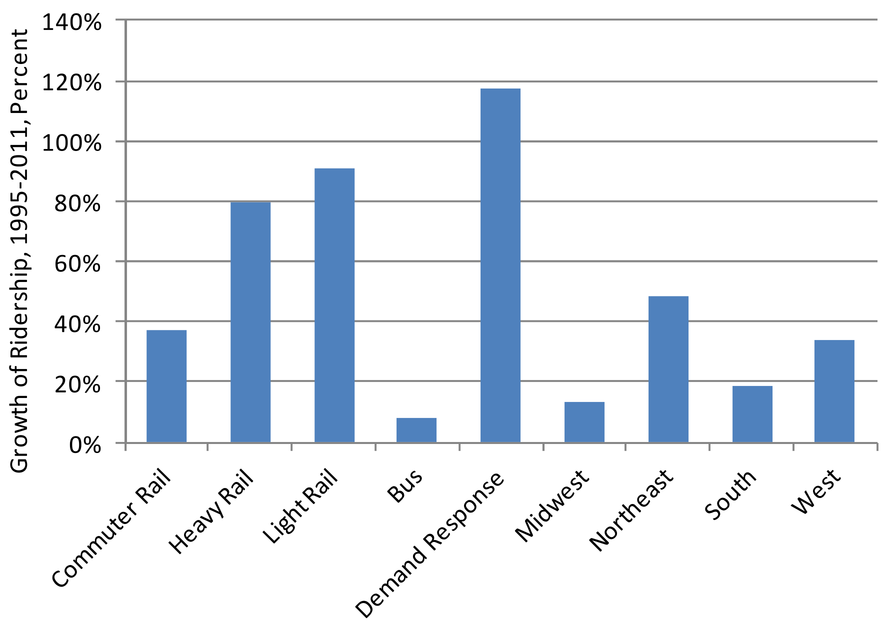
**Millions of Passenger Miles by Mode**

| Report Year | Bus | Commuter Rail | Demand Response | Heavy Rail | Light Rail | Trolleybus | Other | Total |
|---|---|---|---|---|---|---|---|---|
| 2000 | 21,241 | 9,402 | 839 | 13,844 | 1,356 | 192 | 792 | 47,666 |
| 2001 | 22,022 | 9,548 | 855 | 14,178 | 1,437 | 187 | 843 | 49,070 |
| 2002 | 21,841 | 9,504 | 853 | 13,663 | 1,432 | 188 | 843 | 48,324 |
| 2003 | 21,262 | 9,559 | 930 | 13,606 | 1,476 | 176 | 893 | 47,903 |
| 2004 | 21,377 | 9,719 | 962 | 14,354 | 1,576 | 173 | 911 | 49,073 |
| 2005 | 21,825 | 9,473 | 1,058 | 14,418 | 1,700 | 173 | 1,033 | 49,678 |
| 2006 | 22,821 | 10,361 | 1,078 | 14,721 | 1,866 | 164 | 1,143 | 52,154 |
| 2007 | (a) 20,976 | 11,153 | (a) 1,502 | 16,138 | 1,932 | 156 | (a) 1,496 | 53,353 |
| 2008 | 21,757 | 11,049 | 1,412 | 16,848 | 2,093 | 161 | 1,837 | 55,157 |
| 2009 | 21,477 | 11,232 | 1,477 | 16,805 | 2,199 | 168 | 1,875 | 55,233 |
| 2010 | 21,013 | 10,874 | 1,494 | 16,407 | 2,173 | 159 | 1,893 | 54,012 |
| 2010 % | 38.9% | 20.1% | 2.8% | 30.4% | 4.0% | 0.3% | 3.5% | 100.0% |

(a) Series not continuous for mode under line between 2006 and 2007.
Passenger Miles by Mode data from 1977 through 2010 can be found in the *2012 Public Transportation Fact Book, Appendix A: Historical Tables* at www.apta.com.

Another chart developed by APTA shows growth of bus by 18 percent, commuter rail by 37 percent, heavy rail by 79 percent, light rail by 91 percent, and demand response service by 117 percent. APTA's chart also shows the different rates of growth in different regions. In the Midwest transit ridership grew by 13 percent, in the South by 18 percent, in the West by 34 percent, and in the Northeast by 49 percent with higher growth in the Northeast associated with the high growth of rail.

**Figure 2: Growth of Transit Ridership by Mode of Service and Region, 1995-2011 (Percent)**




Source: *Requirements for Public Transportation Capital Investment During the 2015 – 2020 Period.* APTA. May 24, 2013

## PUBLIC TRANSPORTATION SERVICES

Transit inventory, conditions, performance, and backlog information has been compiled below from the primary sources which include the transit chapters of the U.S. DOT's 2013 Condition and Performance Report, the 2013 APTA Transit Fact Book, and an APTA 2013 memorandum "Requirements for Public Transportation Capital Investment During The 2015-2020 Period; A Survey Of Published Needs Statements and Estimates Calculated From Published Data". Many of the tables included here are taken directly from these primary sources.

The APTA Transit Fact Book indicates that U.S. public transportation was provided by 7,100 organizations ranging from large multi-modal systems to single-vehicle special demand response service providers. The table below shows the number of transit agencies in the United States in three categories for each mode (urbanized, rural, and non-profit providers). Exact boundaries for these types of service providers are not certain because many agencies headquartered in urbanized areas provide service outside of those areas and similarly many rural providers operate service into other areas.

**Number of Public Transportation Systems by Mode in 2011**

| Mode | Number of Systems, 2011 (a) | | | |
|---|---|---|---|---|
| | Urbanized Areas (b) | Rural (b) | Non-Profit Providers (c) | Total |
| Aerial Tramway | 2 | 0 | 0 | 2 |
| Automated Guideway Transit | 7 | 0 | 0 | 7 |
| Bus | 520 | 558 | 0 | 1,078 |
| Bus Rapid Transit | 5 | 0 | 0 | 5 |
| Cable Car | 1 | 0 | 0 | 1 |
| Commuter Bus | 37 | 55 | 0 | 92 |
| Commuter Rail | 27 | 0 | 0 | 27 |
| Demand Response (b,d) | 645 | 1,120 | 4,835 | 6,600 |
| Ferryboat | 34 | 4 | 0 | 38 |
| Heavy Rail | 15 | 0 | 0 | 15 |
| Hybrid Rail | 4 | 0 | 0 | 4 |
| Inclined Plane | 4 | 0 | 0 | 4 |
| Light Rail | 27 | 0 | 0 | 27 |
| Monorail | 2 | 0 | 0 | 2 |
| Publico | 1 | 0 | 0 | 1 |
| Streetcar | 7 | 0 | 0 | 7 |
| Transit Vanpool | 66 | 18 | 0 | 84 |
| Trolleybus | 5 | 0 | 0 | 5 |
| Total (d,e) | 825 | 1,440 | 4,835 | 7,100 |

Source: Public Transportation Fact Book. 2013, APTA
(a) Systems operating during 2011, all amounts are estimated.
(b) Some urban providers operate service into surrounding rural areas and rural providers operate service into nearby urban areas.
(c) May be either urban or rural.
(d) Includes non-profit providers of service for seniors and persons with disabilities.
(e) Total is not sum of all modes since many providers operate more than one mode.

In 2011, the most recent year for which full data has been compiled, transit systems in the United States provided 4.8 billion vehicle revenue miles of service; operating transit vehicles for 313 million hours of revenue service. The fastest service was provided by transit vanpool and commuter rail service, which carry passengers on long trips.

**Vehicle Miles Operated, Vehicle Hours Operated, and Speed of Transit Service by Mode, Report Year 2011**

| Mode | Total Vehicle Miles (Millions) | Vehicle Revenue Miles (Millions) | Total Vehicle Hours (Millions) | Vehicle Revenue Hours (Millions) | Average Speed in Revenue Service (Miles per Hour) |
|---|---|---|---|---|---|
| Bus | 2,339.2 | 2,030.5 | 176.9 | 159.8 | 12.7 |
| Bus Rapid Transit | 2.1 | 1.9 | 0.2 | 0.1 | 12.7 |
| Commuter Bus | 72.2 | 50.8 | 2.8 | 2.0 | 25.6 |
| Commuter Rail | 345.2 | 316.9 | 10.9 | 9.7 | 32.7 |
| Demand Response | 1,611.8 | 1,393.9 | 106.4 | 92.9 | 15.0 |
| Ferryboat | 4.3 | 4.2 | 0.4 | 0.4 | 9.6 |
| Heavy Rail | 654.9 | 636.3 | 33.9 | 31.7 | 20.0 |
| Hybrid Rail | 2.1 | 2.1 | 0.1 | 0.1 | 23.6 |
| Light Rail | 89.2 | 87.5 | 5.8 | 5.6 | 15.6 |
| Other Rail Modes (a) | 5.0 | 5.0 | 0.6 | 0.6 | 8.1 |
| Publico | 40.2 | 37.8 | 3.4 | 3.2 | 11.9 |
| Streetcar | 5.1 | 5.0 | 0.6 | 0.6 | 8.2 |
| Transit Vanpool | 195.0 | 195.0 | 5.0 | 5.0 | 39.3 |
| Trolleybus | 11.6 | 11.2 | 1.6 | 1.6 | 7.1 |
| Total | 5,377.8 | 4,778.0 | 348.4 | 313.4 | 15.2 |

Source: 2013 Public Transportation Fact Book, APTA

(a) Aerial tramway, automated guideway transit, cable car, inclined plane, and monorail.

Vehicle mile data by mode from 1926 through 2011; vehicle hour data by mode from 1996 through 2011; and average speed data by mode from 1996 through 2011 can be found in the *2013 Public Transportation Fact Book, Appendix A: Historical Tables* at www

# PUBLIC TRANSPORTATION INFRASTRUCTURE

## Vehicles

U.S. transit systems operated 141,448 railcars, buses, and vans in a typical peak period during 2011, out of a total of 175,258 vehicles available for service.

**Revenue Vehicles by Mode**

**Report Year 2011**

| Mode | Vehicles Available for Maximum Service | | Vehicles Used in Maximum Period Service | |
|---|---|---|---|---|
| | Number | Percent | Number | Percent |
| Bus | 67,288 | 38.4% | 53,805 | 38.0% |
| Bus Rapid Transit | 80 | < 0.1% | 59 | < 0.1% |
| Commuter Bus | 1,807 | 1.0% | 1,400 | 1.0% |
| Commuter Rail | 7,193 | 4.1% | 6,198 | 4.4% |
| Demand Response | 65,336 | 37.3% | 53,648 | 37.9% |
| Ferryboat | 184 | 0.1% | 148 | 0.1% |
| Heavy Rail | 11,342 | 6.5% | 9,089 | 6.4% |
| Hybrid Rail | 44 | < 0.1% | 29 | < 0.1% |
| Light Rail | 1,986 | 1.1% | 1,338 | 0.9% |
| Other Rail Modes (a) | 282 | 0.2% | 185 | 0.1% |
| Publico | 5,624 | 3.2% | 3,259 | 2.3% |
| Streetcar | 271 | 0.2% | 174 | 0.1% |
| Transit Vanpool | 13,342 | 7.6% | 11,713 | 8.3% |
| Trolleybus | 479 | 0.3% | 403 | 0.3% |
| Total | 175,258 | 100.0% | 141,448 | 100.0% |

Source: 2013 Public Transportation Fact Book, APTA

Revenue vehicles by mode data from 1926 through 2011 can be found in the *2013 Public Transportation Fact Book, Appendix A: Historical Tables* at www.apta.com.

## TRANSIT ASSETS – CONDITIONS AND PERFORMANCE

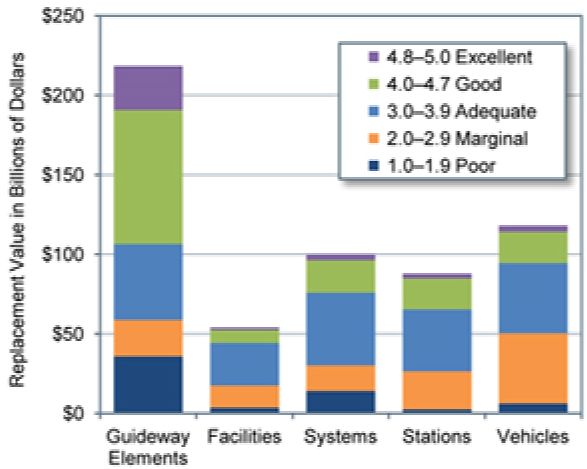
The FTA uses a numerical transit asset condition rating ranging from 1 to 5 as shown below. Assets rated below 2.5 are already at or close to the need for replacement or repair.

| Definitions of Transit Asset Conditions | | |
|---|---|---|
| **Rating** | **Condition** | **Description** |
| Excellent | 4.8–5.0 | No visible defects, near-new condition. |
| Good | 4.0–4.7 | Some slightly defective or deteriorated components. |
| Adequate | 3.0–3.9 | Moderately defective or deteriorated components. |
| Marginal | 2.0–2.9 | Defective or deteriorated components in need of replacement. |
| Poor | 1.0–1.9 | Seriously damaged components in need of immediate repair. |

*Source: Transit Economic Requirements Model.*

FTA considers an asset to be in a state of good repair when the physical condition of that asset is at or above a condition rating value of 2.5 (the mid-point of the marginal range). FTA has no comprehensive source of condition information, but blends the use of vehicle age and use data, estimated maintenance expenditures, and estimated deterioration schedules for vehicles, maintenance facilities, stations, train control systems, electric power systems, and communication systems that have been developed by FTA through special on-site surveys and studies. These are updated and used for the TERM model's asset inventory for all assets. *Exhibit 3-19* from the 2013 C&P report shows the distribution of asset conditions, by replacement value, across all transit asset categories.

**Exhibit 3-19 Distribution of Asset Physical Conditions by Asset Type for All Modes**




*Source: Transit Economic Requirements Model.*

## Bus Vehicles Age and Condition

When measured across all vehicle types, the average age and the average condition and the percentage below condition 2.5 of the Nation's bus fleet have remained essentially unchanged since 2004 as shown in the table from the 2013 C&P. The standard and mid size buses both had 12.5 percent below condition 2.5 percent in 2010, while the average across all categories was 10.5 percent below condition 2.5 in 2010.

## Urban Transit Bus Fleet Count, Age, and Condition, 2000–2010

| | 2000 | 2002 | 2004 | 2006 | 2008 | 2010 |
|---|---|---|---|---|---|---|
| **Articulated Buses** | | | | | | |
| Fleet Count | 2,002 | 2,799 | 3,074 | 3,445 | 4,302 | 4,896 |
| Average Age (Years) | 6.6 | 7.2 | 5.0 | 5.3 | 6.3 | 6.5 |
| Average Condition Rating | 3.5 | 3.3 | 3.5 | 3.5 | 3.3 | 3.2 |
| Below Condition 2.50 (Percent) | 24.9% | 16.6% | 5.0% | 2.1% | 2.6% | 3.7% |
| **Full-Size Buses** | | | | | | |
| Fleet Count | 46,380 | 46,573 | 46,139 | 46,714 | 45,985 | 45,441 |
| Average Age (Years) | 8.1 | 7.5 | 7.2 | 7.4 | 7.9 | 7.8 |
| Average Condition Rating | 3.2 | 3.2 | 3.2 | 3.2 | 3.1 | 3.1 |
| Below Condition 2.50 (Percent) | 14.5% | 13.1% | 12.3% | 11.3% | 15.2% | 12.5% |
| **Mid-Size Buses** | | | | | | |
| Fleet Count | 7,203 | 7,269 | 7,114 | 6,844 | 7,009 | 7,218 |
| Average Age (Years) | 5.5 | 8.4 | 8.1 | 8.2 | 8.3 | 8.1 |
| Average Condition Rating | 3.4 | 3.1 | 3.1 | 3.1 | 3.1 | 3.1 |
| Below Condition 2.50 (Percent) | 8.3% | 14.1% | 13.2% | 14.2% | 12.4% | 12.5% |
| **Small Buses** | | | | | | |
| Fleet Count | 8,646 | 14,857 | 15,972 | 16,156 | 19,366 | 19,493 |
| Average Age (Years) | 4.2 | 4.5 | 4.6 | 5.1 | 5.1 | 5.2 |
| Average Condition Rating | 3.6 | 3.4 | 3.5 | 3.4 | 3.4 | 3.4 |
| Below Condition 2.50 (Percent) | 2.2% | 8.8% | 10.1% | 10.3% | 11.6% | 10.2% |
| **Vans** | | | | | | |
| Fleet Count | 14,583 | 17,147 | 18,713 | 19,515 | 26,823 | 28,531 |
| Average Age (Years) | 3.2 | 3.2 | 3.3 | 3.0 | 3.2 | 3.4 |
| Average Condition Rating | 3.8 | 3.7 | 3.8 | 3.8 | 3.8 | 3.7 |
| Below Condition 2.50 (Percent) | 0.2% | 7.2% | 6.7% | 8.4% | 8.0% | 8.2% |
| **Total Buses and Vans** | | | | | | |
| Total Fleet Count | 78,814 | 88,645 | 91,012 | 92,674 | 103,485 | 105,579 |
| Weighted Average Age (Years) | 6.5 | 6.2 | 6.0 | 6.0 | 6.1 | 6.1 |
| Weighted Average Condition Rating | 3.3 | 3.2 | 3.3 | 3.3 | 3.1 | 3.0 |
| Below Condition 2.50 (Percent) | 10.2% | 11.8% | 10.6% | 10.4% | 12.0% | 10.5% |

*Source: National Transit Data Base (NTD)*

The Nation's bus fleet has grown at an average annual rate of roughly 3 percent over the last decade.

## Rail Vehicles Age and Conditions

The average condition of rail vehicles has remained fairly steady since 2004, and the percent of rail vehicles below condition 2.5 has declined, as shown in this table from the 2013 C&P.

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

| | 2000 | 2002 | 2004 | 2006 | 2008 | 2010 |
|---|---|---|---|---|---|---|
| **Commuter Rail Locomotives** | | | | | | |
| Fleet Count | 576 | 709 | 710 | 740 | 790 | 822 |
| Average Age (Years) | 15.2 | 17.2 | 17.8 | 16.7 | 19.6 | 19.4 |
| Average Condition Rating | 4.5 | 3.7 | 3.7 | 4.0 | 3.6 | 3.6 |
| Below Condition 2.50 (Percent) | 5.7% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| **Commuter Rail Passenger Coaches** | | | | | | |
| Fleet Count | 2,743 | 2,985 | 3,513 | 3,671 | 3,539 | 3,711 |
| Average Age (Years) | 17.5 | 19.2 | 17.7 | 16.8 | 19.9 | 19.1 |
| Average Condition Rating | 4.3 | 3.7 | 3.8 | 4.1 | 3.6 | 3.7 |
| Below Condition 2.50 (Percent) | 10.8% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| **Commuter Rail Self-Propelled Passenger Coaches** | | | | | | |
| Fleet Count | 2,466 | 2,389 | 2,470 | 2,933 | 2,665 | 2,659 |
| Average Age (Years) | 25.2 | 27.1 | 23.6 | 14.7 | 18.9 | 19.7 |
| Average Condition Rating | 4.1 | 3.5 | 3.7 | 3.8 | 3.7 | 3.7 |
| Below Condition 2.50 (Percent) | 4.1% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| **Heavy Rail** | | | | | | |
| Fleet Count | 10,028 | 11,093 | 11,046 | 11,075 | 11,570 | 11,648 |
| Average Age (Years) | 23.1 | 19.8 | 19.8 | 22.3 | 21.0 | 18.8 |
| Average Condition Rating | 3.2 | 3.4 | 3.4 | 3.3 | 3.3 | 3.4 |
| Below Condition 2.50 (Percent) | 4.8% | 6.1% | 5.6% | 5.5% | 6.1% | 5.2% |
| **Light Rail** | | | | | | |
| Fleet Count | 1,335 | 1,637 | 1,884 | 1,832 | 2,151 | 2,222 |
| Average Age (Years) | 15.8 | 17.9 | 16.5 | 14.6 | 17.1 | 18.1 |
| Average Condition Rating | 3.6 | 3.5 | 3.6 | 3.7 | 3.6 | 3.5 |
| Below Condition 2.50 (Percent) | 8.4% | 11.8% | 9.3% | 6.4% | 7.1% | 6.9% |
| **Total Rail** | | | | | | |
| Total Fleet Count | 17,148 | 18,813 | 19,623 | 20,251 | 20,715 | 21,062 |
| Weighted Average Age (Years) | 21.7 | 20.4 | 19.5 | 19.3 | 20.1 | 18.9 |
| Weighted Average Condition Rating | 3.5 | 3.5 | 3.5 | 3.6 | 3.5 | 3.5 |
| Below Condition 2.50 (Percent) | 6.0% | 4.6% | 4.1% | 3.6% | 4.2% | 3.6% |

*Source: Transit Economic Requirements Model and National Transit Database.*

After 2002, the percentage of all commuter rail vehicles below 2.5 dropped to zero percent and remained there through 2010. By 2010, 5.2 percent of heavy rail vehicles and 6.9 percent of light rail vehicles were below 2.5.

From 2000 to 2010, the Nation's rail transit fleet grew at an annual average rate of roughly 2.0 percent.

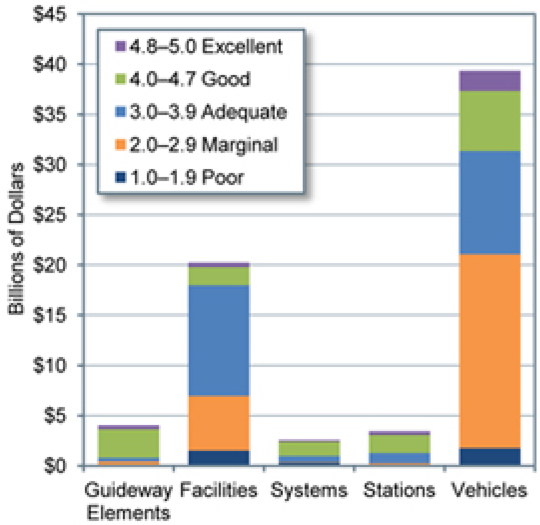
## Other Bus Assets (Urban Areas) and Other Rail Assets

Vehicles constitute roughly half of all fixed-route bus assets by value, and maintenance facilities make up another third. Roughly one-third of bus maintenance facilities are rated below condition 3.0, as shown below in the Exhibit 3-23 from the 2013 C&P.

Non-vehicle transit rail assets can be divided into four general categories: guideway elements, facilities, systems, and stations and the condition distribution for each of these categories are shown in the Exhibit 3-26 from the 2013 C&P.

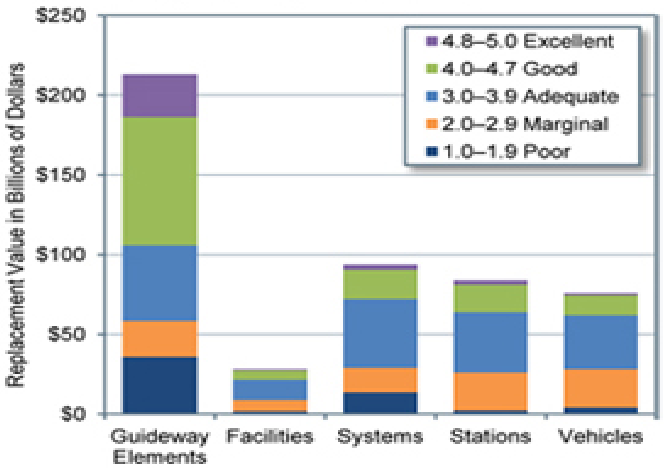
The largest category by value for rail assets is guideway elements including tracks, ties, switches, ballasts, tunnels, and elevated structures. The replacement value of this category is $213.0 billion, of which $35.8 billion is rated below condition 2.0 (17 percent) and $22.6 billion is rated between condition 2.0 and 3.0. Systems, which consist of power, communication, and train control equipment, have a replacement value of $93.6 billion, of which $13.7 billion is rated below condition 2.0 (19 percent) and $15.3 billion is rated between condition 2.0 and 3.0. Stations have a replacement value of $83.8 billion with only $2.3 billion rated below condition 2.0 and $23.8 billion rated between condition 2.0 and 3.0. Facilities, mostly consisting of maintenance and administration buildings, have a replacement value of $28.1 billion with $1.8 billion rated below condition 2.0 and $7.0 billion rated between condition 2.0 and 3.0. Rail vehicle assets have replacement value below those values for guideway elements, systems, and stations.

**Exhibit 3-23 Distribution of Estimated Asset Conditions by Asset Type for Bus**




*Source: Transit Economic Requirements Model.*

**Exhibit 3-26 Distribution of Asset Physical Conditions by Asset Type for All Rail**




*Source: Transit Economic Requirements Model.*

## Rural Transit Vehicles and Facilities

All transit vehicles owned by rural systems are buses, vans, or other small passenger vehicles. Data on the number and age of rural vehicles and the number of maintenance facilities is now collected in the NTD.

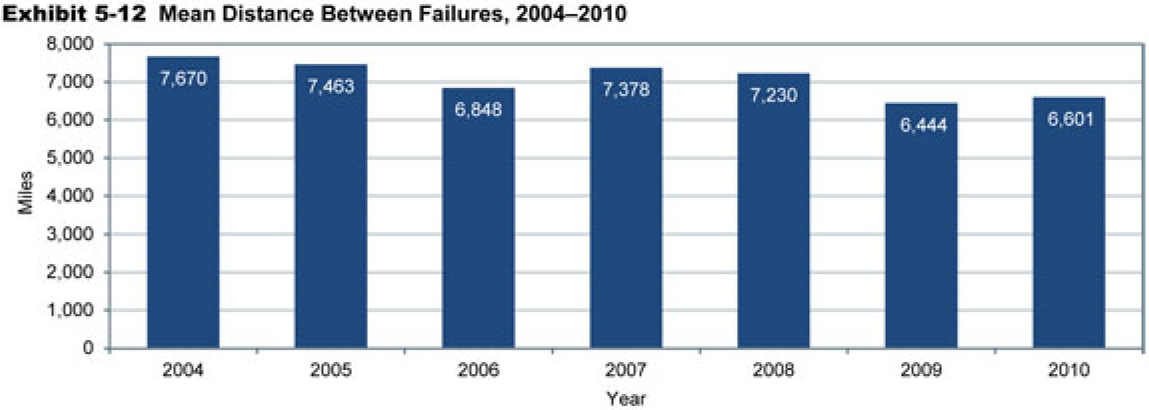
For 2010, data reported to the NTD indicated that 8.1 percent of rural buses, 18.4 percent of small rural buses, and 38.6 percent of rural vans were past their FTA minimum life expectancies (12 years for buses, 7 to 10 for small buses, and 4 for vans).

The rural transit fleet had an average age of 4.5 years in 2010; buses, with an average age of 5.9 years, were older than vans and small buses, which had an average age of 4.1 years and 4.4 years, respectively.

## Transit Vehicle Performance

Average distance between failures, as shown in the 2013 C&P *Exhibit 5-12*, has been relatively stable since 2003 at around 7,000 miles. These delays are those due to mechanical difficulties of the vehicle, rather than road or track issues.

**Exhibit 5-12** **Mean Distance Between Failures, 2004–2010**




*Source: National Transit Database.*

## Transit Impacts on Highway Performance

As shown in the *2012 Urban Mobility Report*, by the Texas Transportation Institute, Texas A&M University, see http://mobility.tamu.edu/ums/, transit's impact on reducing congestion has also resulted in significant savings for drivers and their communities. Without transit, drivers would have used 450 million more gallons of gasoline because of added roadway congestion during 2011, would spend an additional 865 million hours, and would have incurred an additional $20.8 billion in costs.

## TRANSIT INFRASTRUCTURE –THE STATE OF GOOD REPAIR

The Federal Transit Administration has begun to place emphasis on a "State of Good Repair" which identifies the investments necessary to achieve a state of good repair for current transit assets and then to keep current transit assets in a state of good repair. This estimate is made independent of ridership growth or consequent service requirements. There are very large existing investments in current assets, as shown below.

**ESTIMATED REPLACEMENT VALUE OF THE NATION'S TRANSIT ASSETS (2008 $BILLIONS)**

| Type of Transit Asset | Non-Rail | Rail | Joint Assets | Total |
|---|---|---|---|---|
| Maintenance Facilities | $56.4 | $33.2 | $3.8 | $93.4 |
| Guideway Elements | $13.1 | $234.5 | $1.0 | $248.6 |
| Stations | $3.8 | $84.8 | $0.6 | $89.1 |
| Systems | $3.4 | $107.5 | $1.3 | $112.1 |
| Vehicles | $41.1 | $78.5 | $0.5 | $120.1 |
| Total | $117.7 | $538.6 | $7.0 | $663.3 |

Source: FTA TERM Model

Some transit vehicles are beyond their minimum useful life spans or are in poor condition. This table shows the portion of vehicles which are older than minimum life spans.

**PERCENT OF VEHICLES OLDER THAN FTA MINIMUM USEFUL LIFE (2011)**

| Type of In Service Vehicle | Percentage Older Than FTA Minimum Life |
|---|---|
| Bus | 17.7% |
| Commuter Rail Car | 31.0% |
| Commuter Rail Locomotive | 35.4% |
| Demand Response | 40.6% |
| Heavy Rail | 33.2% |
| Light Rail | 15.8% |
| Trolleybus | 00.0% |
| Ferry Boat | 27.2% |

Source: APTA, Public Transportation Fact Book 2013

The results of FTA's National State of Good Repair Assessment are shown in the table below. The three columns to the right show annual funding needs in addition to regular on-going replacement or repair of aging assets, which requires $14.4 billion per year after SGR is achieved. To eliminate the backlog would require $12.9 billion per year over a six-year period, or 6.5 billion per year over a twelve-year period, or $3.9 billion per year if done over a 20-year period.

## State of Good Repair Funding Needs Found by FTA National State of Good Repair Assessment (Billions of 2009 Dollars)[ii]

| Mode | Current State of Good Repair Backlog | Annual Normal Replacement After State of Good Repair is Attained | Annual Investment to Attain State of Good Repair (Including Normal Replacement) Over | | | Annual Investment to Attain State of Good Repair (Excluding Normal Replacement) Over | | |
|---|---|---|---|---|---|---|---|---|
| | | | 6 Years | 12 Years | 20 years | 6 Years | 12 Years | 20 years |
| Heavy Rail | 42.7 | 5.1 | 12.2 | 8.7 | 7.3 | 7.1 | 3.6 | 2.1 |
| Bus | 13.5 | 4.5 | 6.8 | 5.7 | 5.2 | 2.3 | 1.1 | 0.7 |
| Commuter Rail | 12.6 | 2.2 | 4.4 | 3.3 | 2.9 | 2.1 | 1.1 | 0.6 |
| Light Rail | 3.6 | 0.8 | 1.4 | 1.1 | 1.0 | 0.6 | 0.3 | 0.2 |
| Demand Response | 2.8 | 0.9 | 1.4 | 1.2 | 1.1 | 0.5 | 0.2 | 0.1 |
| Joint Assets | 1.3 | 0.3 | 0.6 | 0.5 | 0.4 | 0.2 | 0.1 | 0.1 |
| Other Modes | 1.3 | 0.4 | 0.6 | 0.5 | 0.4 | 0.2 | 0.1 | 0.1 |
| Total | 77.7 | 14.4 | 27.3 | 20.9 | 18.3 | 12.9 | 6.5 | 3.9 |

[i] Source: *2013 Public Transportation Fact Book, Appendix A: Historical Tables*. Washington: American Public Transportation Association, 2013. at http://www.apta.com/resources/statistics/Documents/FactBook/2013-Fact-Book-Appendix-A.pdf

[ii] Ibid, p. 19.

## Appendix:  Derivation of Other Highway and Bridge Scenarios

The 2013 C&P included spending under ARRA (the Recovery Act) as current spending, but that spending will not exist by the start of the Bottom Line analysis period.  Therefore this report estimates current spending as the level of capital investment as estimated by the 2013 C&P but without ARRA.  The current highway and bridge capital spending is at about $88.3 Billion per year under this updated definition.  The current spending scenario by definition simply keeps investment at the specified level no matter what growth rate occurs for vehicle miles of travel.

A highway and bridge state of good repair (SGR) scenario is also shown, based on the SGR scenario included in the 2013 C&P report, adjusted only for cost index changes. The SGR estimate in the 2013 C&P report identified SGR needs as the $78.3 billion of the $145.9 billion of needed investment for the C&P's improve conditions and performance scenario which was directed towards improving the physical condition of the existing infrastructure assets. Adjusting this only for cost index changes from the 2010 to the 2012 costs, the comparable 2015 Bottom Line estimate would be $83.1 billion per year.  This should be considered to be an approximation to be applied across all the different VMT growth rates.  Pavement and bridge damage will vary somewhat based on different heavy truck VMT growth rates, but these analyses have not been done for the 2014 Bottom Line and so the SGR numbers are shown as the same for the alternative VMT growth rates.

**Highways and Bridges Other Scenarios**

| Growth Rate of VMT per Year | Current Spending | State of Good Repair |
|---|---|---|
| **Modal Comparison Scenario -- 1.6 Percent Annual Growth** | **$88.3 billion** | **$83.1** |
| **Mid Level Scenario – 1.4 Percent Annual Growth** | **$88.3 billion** | **$83.1** |
| **2009 BL Policy Scenario - 1.0 Percent Annual Growth** | **$88.3 billion** | **$83.1** |

## Appendix: Details of Transit Infrastructure

The Federal Transit Administration establishes a minimum useful life that a vehicle must exceed before federal financial assistance can be used to replace the vehicle. Many transit vehicles, however, have been rehabilitated, which not only extends their useful lives and reduces their maintenance costs, but also extends the age at which they may be replaced.

**Vehicle Characteristics by Mode**
**As of January 2011**

| Mode | Average Age | Percent with Alternative Power (a) | Minimum Useful Life (b) | Percent Accessible (c) | Percent Rehabilitated During Lifetime | Average Length (Feet) |
|---|---|---|---|---|---|---|
| Bus, All Modes | 8.0 | 35.6% | 12 | 99.8% | 5.0% | 40.4 |
| Commuter and Hybrid Rail Cars | 18.2 | (d) 99.8% | 25 | 85.1% | 34.1% | 85.0 |
| Commuter Rail Locomotives | 20.4 | 11.8% | 25 | 1.9% | 43.1% | 62.5 |
| Demand Response | 4.1 | 7.7% | 4 | 89.2% | 0.5% | 21.8 |
| Ferryboat | 18.8 | 45.5% | 25 | 100.0% | 4.3% | 165.4 |
| Heavy Rail | 20.2 | 100.0% | 25 | 98.7% | 27.7% | 61.7 |
| Light Rail and Streetcar | 16.6 | 98.4% | 25 | 88.2% | 28.4% | 81.7 |
| Other Rail Modes | 57.4 | 58.4% | 25 | 59.4% | 7.5% | 35.7 |
| Transit Vanpool | 4.3 | 2.8% | 4 | 5.5% | 0.0% | 17.5 |
| Trolleybus | 9.9 | 100.0% | 15 | 100.0% | 9.4% | 44.9 |
| All Modes | --- | 39.9% | --- | 90.5% | --- | --- |

Source: 2-13 Public Transportation Fact Book, APTA
Based on a sample from annual APTA *Public Transportation Vehicle Database.*
(a) Alternative-powered is defined as vehicles powered by anything other than diesel or gasoline, but including particulate-trap-equipped buses.
(b) Federal requirement for "Minimum Useful Life" in *FTA C 9300.1B Capital Investment Program Guidance and Application Instruction*, at www.fta.dot.gov.
(c) Accessible by lift, ramp, or station infrastructure.
(d) Self-propelled cars only
Vehicle Characteristics data by mode from 1990 through 2011 can be found in the *2013 Public Transportation Fact Book, Appendix A: Historical Tables* at www.apta.com.

### Infrastructure - Miles

The table below shows the miles of track owned and operated by rail systems and the directional route miles over which rail cars are operated. Directional route miles are a National Transit Database metric that counts all the right-of-way rail vehicles operate over. If they operate in one direction the right-of way is counted as one mile for each physical mile; if vehicles operate in both directions the right-of-way is counted as 2 miles. The number of "routes" in the normal sense of trains going to different destinations does not affect the count of directional route miles. Although most bus service is operated in mixed service on roads and streets, bus service is also operated over nearly 5,000 miles of exclusive and controlled right-of-way directional route miles.

**Rail Track Miles and Directional Route Miles, Report Year 2011 (a)**

| Mode | Miles of Track (a) | | | | | | Directional Route Miles (a) |
|---|---|---|---|---|---|---|---|
| | At Grade | Elevated on Structure | Elevated on Fill | Open-Cut | Subway | Total | |
| Cable Car | 8.8 | --- | --- | --- | --- | 8.8 | 8.8 |
| Commuter Rail | 7,647.3 | 79.6 | 460.1 | 68.3 | 40.4 | 8,295.7 | 8,536.3 |
| Heavy Rail | 782.3 | 506.1 | 113.4 | 69.0 | 800.4 | 2,271.2 | 1,617.2 |
| Hybrid Rail | 170.7 | 1.5 | 0.8 | 0.0 | 0.0 | 173.0 | 207.2 |
| Inclined Plane | 1.8 | --- | --- | --- | --- | 1.8 | 2.8 |
| Light Rail | 1,068.2 | 137.3 | 75.0 | 52.6 | 80.8 | 1,413.9 | 1,397.5 |
| Monorail/Automated Guideway | --- | 19.5 | --- | --- | --- | 19.5 | 18.6 |
| Streetcar | 254.9 | 0.1 | 0.2 | 0.0 | 5.0 | 260.2 | 135.7 |
| All Rail Modes | 9,934.0 | 744.1 | 649.5 | 189.9 | 926.6 | 12,444.1 | 11,924.2 |

Source: 2013 Public Transportation Fact Book, APTA
(a) Summary Data from *2011 National Transit Database*; includes systems reporting to the *National Transit Database* only.
Rail Track Miles and Directional Route Miles data by mode from 2002 through 2011 can be found in the *2013 Public Transportation Fact Book, Appendix A: Historical Tables* at www.apta.com.

**Bus and Ferryboat Lane Miles and Directional Route Miles, Report Year 2011 (a)**

| | Lane Miles (a) | | Directional Route Miles (a) | | |
|---|---|---|---|---|---|
| | Exclusive Right-of-Way | Controlled Right-of-Way | Exclusive Right-of-Way | Controlled Right-of-Way | Mixed Traffic |
| Bus | 1,110.8 | 1,071.5 | 1,177.9 | 1,046.5 | 158,940.1 |
| Bus Rapid Transit | 12.0 | 1.2 | 12.0 | 1.2 | 70.3 |
| Commuter Bus | 455.9 | 174.2 | 474.5 | 159.4 | 10,087.4 |
| Ferryboat | 0.0 | 0.0 | 675.0 | 0.0 | 0.0 |
| Trolleybus | 128.1 | 0.0 | 4.5 | 0.0 | 451.4 |
| Total Non-Rail Modes | 2,206.1 | 2,229.3 | 2,882.0 | 2,149.5 | 227,015.7 |

Source: 2013 Public Transportation Fact Book, APTA
(a) Summary Data from *2011 National Transit Database*; includes systems reporting to the *National Transit Database* only.
Bus and Ferryboat Lane Miles and Directional Route Miles data by mode from 2002 through 2011 can be found in the *2013 Public Transportation Fact Book, Appendix A: Historical Tables* at www.apta.com.

## Infrastructure - Stations

Approximately one-third of the 4,680 passenger stations in urbanized areas are multi-modal. As shown, there are over 1,000 stations for each of three modes: bus, commuter rail, and heavy rail.

### Passenger Stations by Mode, Report Year 2011 (a)

| Mode | Number of Stations | | | Number of Escalators | Number of Elevators |
|---|---|---|---|---|---|
| | Total | ADA Accessible | Multimodal | | |
| Bus | 1,247 | 1,239 | 308 | 155 | 348 |
| Bus Rapid Transit | 54 | 54 | 2 | 5 | 2 |
| Commuter Bus | 71 | 71 | 18 | 82 | 51 |
| Commuter Rail | 1,229 | 812 | 569 | 178 | 455 |
| Ferryboat | 87 | 82 | 14 | 7 | 13 |
| Heavy Rail | 1,041 | 530 | 232 | 1,785 | 1,193 |
| Hybrid Rail | 49 | 49 | 42 | 0 | 1 |
| Inclined Plane | 8 | 7 | 0 | 0 | 2 |
| Light Rail | 761 | 691 | 290 | 197 | 332 |
| Monorail/Automated Guideway | 43 | 42 | 3 | 51 | 39 |
| Street Car Rail | 85 | 41 | 7 | 1 | 4 |
| Trolleybus | 5 | 5 | 1 | 0 | 0 |
| Total | 4,680 | 3,623 | 1,486 | 2,461 | 2,440 |

Source: 2013 Public Transportation Fact Book, APTA
(a) Summary Data from *2011 National Transit Database*; includes systems reporting to the *National Transit Database* only.
Passenger Stations data by mode from 2002 through 2011 can be found in the *2013 Public Transportation Fact Book, Appendix A: Historical Tables* at www.apta.com.

## Infrastructure – Maintenance Facilities

Transit agencies in urbanized areas operate over 1,600 maintenance facilities.

### Maintenance Facilities by Mode, Report Year 2011 (a)

| Mode | Number of Maintenance Facilities (a) | | | | | |
|---|---|---|---|---|---|---|
| | General Purpose Maintenance Facilities | | | | Heavy Maintenance Facilities | Total Maintenance Facilities |
| | Under 200 Vehicles | 200 to 300 Vehicles | Over 300 Vehicles | Total General Facilities | | |
| Bus | 680.3 | 94.8 | 17.4 | 792.5 | 30.6 | 823.1 |
| Bus Rapid Transit | 2.3 | 0.1 | 0.0 | 2.4 | 0.0 | 2.4 |
| Cable Car | 1.0 | 0.0 | 0.0 | 1.0 | 0.0 | 1.0 |
| Commuter Bus | 31.1 | 2.1 | 0.0 | 33.2 | 0.0 | 33.2 |
| Commuter Rail | 59.0 | 7.0 | 7.0 | 73.0 | 15.9 | 88.9 |
| Demand Response | 469.5 | 14.0 | 5.4 | 488.9 | 2.4 | 491.3 |
| Ferryboat | 15.0 | 0.0 | 0.0 | 15.0 | 1.0 | 16.0 |
| Heavy Rail | 28.6 | 8.0 | 12.0 | 48.6 | 11.3 | 59.9 |
| Hybrid Rail | 6.0 | 0.0 | 0.0 | 6.0 | 1.0 | 7.0 |
| Light Rail | 33.4 | 1.0 | 0.0 | 34.4 | 4.3 | 38.7 |
| Monorail/Automated Guideway | 4.0 | 0.0 | 0.0 | 4.0 | 0.0 | 4.0 |
| Street Car Rail | 9.3 | 0.0 | 0.0 | 9.3 | 1.5 | 10.8 |
| Transit Vanpool | 20.3 | 0.0 | 2.2 | 22.5 | 0.0 | 22.5 |
| Trolleybus | 4.0 | 1.0 | 0.0 | 5.0 | 0.0 | 5.0 |
| Total | 1,363.8 | 128.0 | 44.0 | 1,535.8 | 68.0 | 1,603.8 |

Source: 2013 Public Transportation Fact Book, APTA
(a) Summary Data from *2011 National Transit Database*; includes systems reporting to the *National Transit Database* only.
Maintenance Facilities data by mode from 2002 through 2011 can be found in the *2013 Public Transportation Fact Book, Appendix A: Historical Tables* at www.apta.com.

## Appendix: Transit Finance

Transit finance sources are shown as compiled in the 2013 Public Transportation Fact Book. Passenger fares were the largest source of total funding at 22.1 percent, with state assistance at 21.6 percent, federal assistance at 19.3 percent, and local funding at 18.5 percent. Transit agency directly generated tax sources (under the government funds category) were 14.8 percent, and other transit agency earnings were at 3.7 percent.

### Transit Funding Sources Report Year 2010

| Type | Transit Agency Funds | | | Government Funds | | | | | Total Funds |
|---|---|---|---|---|---|---|---|---|---|
| | Passenger Fares | Other Earnings | Total | Directly Generated | Local | State | Federal | Total | |
| Capital Funding, Millions of Dollars | --- | --- | --- | 5,852.5 | 2,099.0 | 2,536.9 | 7,336.1 | 17,824.4 | 17,824.4 |
| Percent of Capital Funding | --- | --- | --- | 32.8% | 11.8% | 14.2% | 41.2% | 100.0% | 100.0% |
| Operating Funding, Millions of Dollars | 12,556.1 | 2,118.9 | 14,675.0 | 2,548.8 | 8,457.9 | 9,760.8 | 3,674.6 | 24,442.1 | 39,117.2 |
| Percent of Operating Funding | 32.1% | 5.4% | 37.5% | 6.5% | 21.6% | 25.0% | 9.4% | 62.5% | 100.0% |
| Total Funding, Millions of Dollars | 12,556.1 | 2,118.9 | 14,675.0 | 8,401.3 | 10,557.0 | 12,297.7 | 11,010.6 | 42,266.6 | 56,941.6 |
| Percent of Total Funding | 22.1% | 3.7% | 25.8% | 14.8% | 18.5% | 21.6% | 19.3% | 74.2% | 100.0% |

Source: 2013 Public Transportation Fact Book, APTA
Funding sources data from 1926 through 2010 can be found in the *2012 Public Transportation Fact Book, Appendix A: Historical Tables* at www.apta.com.

Figure 18 from APTA reports the change in funding sources for capital over the past decade and Figure 19 reports the change in funding sources for operations. Federal capital funds increased $4.5 billion to $7.2 billion over the 11-year period but dropped from 47 percent of all capital revenue to 43 percent. Tax sources which were directly generated by transit agencies and local capital assistance increased from 42 percent of capital funds in 2000 to 43 percent in 2011 and state assistance went from 11 percent to 13 percent.

Operating funding from all sources increased from 2000 through 2011 as shown in figure 19 from APTA. Passenger fares and other transit system earnings were 38 percent of all revenues for operations. Directly generated and local funds were 28 percent of operating revenue, state funds were 24 percent and federal funds were 10 percent.

Figure 18: Growth in Capital Funding by Source, 2000-2011

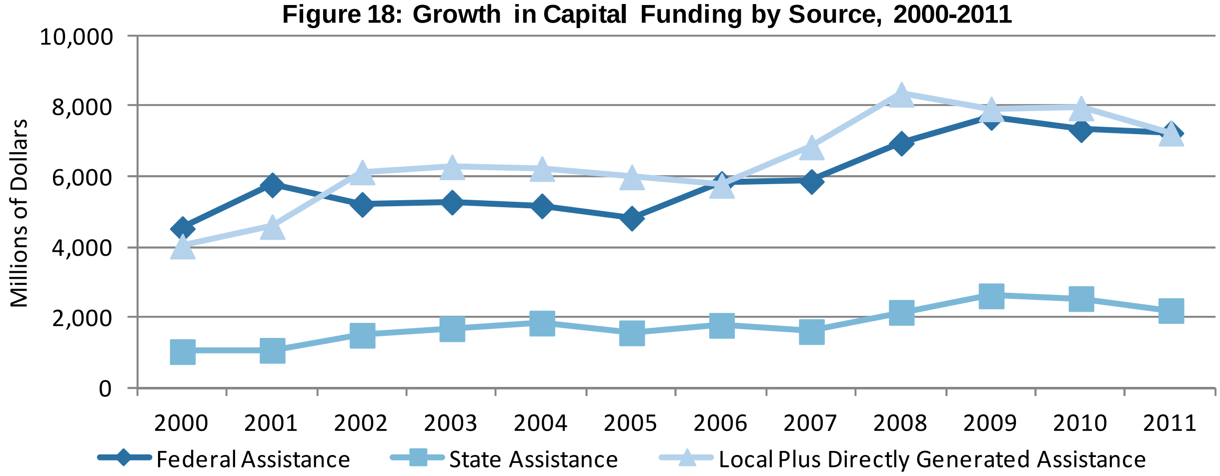
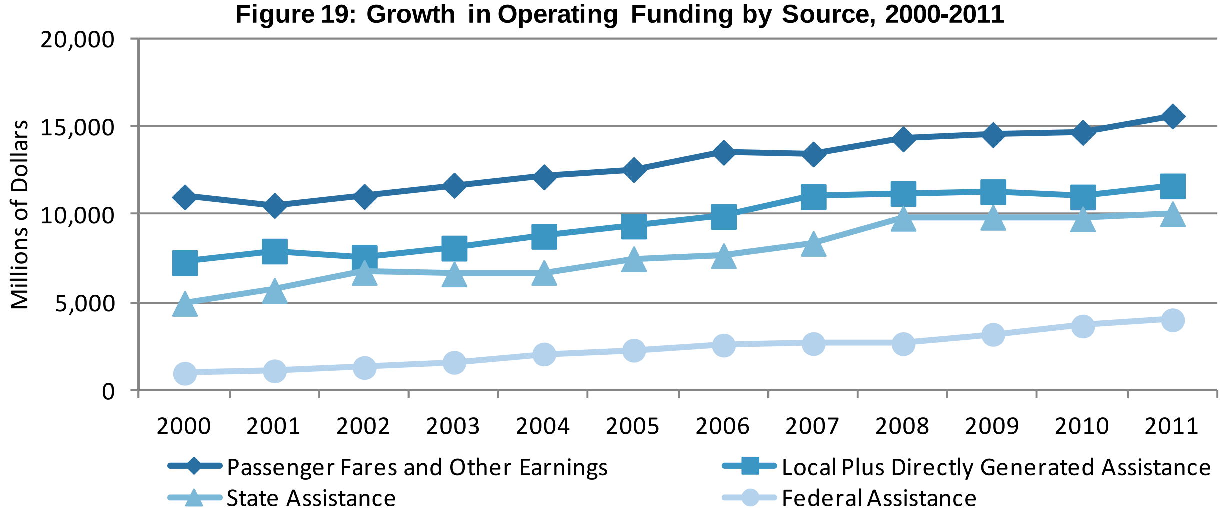



Figure 19: Growth in Operating Funding by Source, 2000-2011




[ii] Source: *2013 Public Transportation Fact Book, Appendix A: Historical Tables*. Washington: American Public Transportation Association, 2013. at http://www.apta.com/resources/statistics/Documents/FactBook/2013-Fact-Book-Appendix-A.pdf

[ii] Ibid, p. 19.

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