

Missouri Transportation by the Numbers

MEETING THE STATE'S NEED FOR
SAFE, SMOOTH AND EFFICIENT MOBILITY



OCTOBER 2018


a national transportation research group

TRIPNET.ORG

Founded in 1971, TRIP® of Washington, DC, is a nonprofit organization that researches, evaluates and distributes economic and technical data on surface transportation issues. TRIP is sponsored by insurance companies, equipment manufacturers, distributors and suppliers; businesses involved in highway and transit engineering and construction; labor unions; and organizations concerned with efficient and safe surface transportation.

MISSOURI KEY TRANSPORTATION FACTS

THE HIDDEN COSTS OF DEFICIENT ROADS

Driving on Missouri roads that are deteriorated, congested and that lack some desirable safety features costs Missouri drivers a total of \$7.8 billion each year. TRIP has calculated the cost to the average motorist in the state's largest urban areas in the form of additional vehicle operating costs (VOC) as a result of driving on rough roads, the cost of lost time and wasted fuel due to congestion, and the financial cost of traffic crashes.

Location	VOC	Safety	Congestion	TOTAL
Columbia-Jefferson City	\$702	\$498	\$277	\$1,477
Kansas City	\$667	\$334	\$988	\$1,989
St. Louis	\$611	\$340	\$1,080	\$2,031
Springfield	\$558	\$429	\$589	\$1,576
MISSOURI STATEWIDE	\$3 Billion	\$2.4 Billion	\$2.4 Billion	\$7.8 Billion

MISSOURI ROADS PROVIDE A ROUGH RIDE

Due to inadequate state and local funding, 52 percent of major roads and highways in Missouri are in poor or mediocre condition. Driving on rough roads costs the average Missouri driver \$695 annually in additional vehicle operating costs.

Location	Poor	Mediocre	Fair	Good
Columbia-Jefferson City	28%	32%	12%	28%
Kansas City	26%	27%	17%	30%
St. Louis	22%	29%	17%	32%
Springfield	21%	22%	16%	41%
MISSOURI STATEWIDE	24%	28%	19%	29%

MISSOURI BRIDGE CONDITIONS

Thirteen percent of Missouri's bridges are structurally deficient (the eleventh highest share in the nation), meaning there is significant deterioration of the bridge deck, supports or other major components. Most bridges are designed to last 50 years before major overhaul or replacement, although many newer bridges are being designed to last 75 years or longer. In Missouri, 40 percent of the state's bridges (9,913 of 24,487) were built in 1969 or earlier.

Location	Number Structurally Deficient	Share Structurally Deficient	Total Bridges
Columbia-Jefferson City	93	10%	973
Kansas City	155	5%	2,925
St. Louis	132	7%	1,903
Springfield	28	6%	461
MISSOURI STATEWIDE	3,086	13%	24,487

MISSOURI ROADS ARE INCREASINGLY CONGESTED

Congested roads choke commuting and commerce and cost Missouri drivers \$2.4 billion each year in the form of lost time and wasted fuel. In the most congested urban areas, drivers lose up to \$1,080 and nearly two full days each year in congestion.

Location	Hours Lost to Congestion	Annual Cost Per Driver
Columbia-Jefferson City	13	\$277
Kansas City	41	\$988
St. Louis	45	\$1,080
Springfield	26	\$589

MISSOURI TRAFFIC SAFETY AND FATALITIES

From 2012 to 2016, 4,163 people were killed in traffic crashes in Missouri. Traffic crashes imposed a total of \$7.1 billion in economic costs in Missouri in 2016 and traffic crashes in which roadway features were likely a contributing factor imposed \$2.4 billion in economic costs.

Location	Average Fatalities 2014-2016	Safety Cost
Columbia-Jefferson City	39	\$498
Kansas City	160	\$334
St. Louis	132	\$340
Springfield	32	\$429
MISSOURI STATEWIDE	860	\$2.4 Billion

TRANSPORTATION AND ECONOMIC DEVELOPMENT

The health and future growth of Missouri's economy is riding on its transportation system. Each year, \$495 billion in goods are shipped to and from sites in Missouri, mostly by truck. Increases in passenger and freight movement will place further burdens on the state's already deteriorated and congested network of roads and bridges.

The design, construction and maintenance of transportation infrastructure in Missouri supports 79,083 full-time jobs across all sectors of the state economy. These workers earn \$2.9 billion annually. Approximately 1.3 million full-time jobs in Missouri in key industries like tourism, retail sales, agriculture and manufacturing are completely dependent on the state's transportation network.

INTRODUCTION

Missouri's roads, highways and bridges form vital transportation links for the state's residents, visitors and businesses, providing daily access to homes, jobs, shopping, natural resources and recreation. Modernizing Missouri's transportation system is critical to quality of life and economic competitiveness in the Show Me State. Inadequate transportation investment, which will result in deteriorated transportation facilities and diminished access, will negatively affect Missouri's economic competitiveness and quality of life.

To accommodate population and economic growth, maintain its level of economic competitiveness and achieve further economic growth, Missouri will need to maintain and modernize its roads, highways and bridges by improving the physical condition of its transportation network and enhancing the system's ability to provide efficient, reliable and safe mobility for residents, visitors and businesses. Making needed improvements to Missouri's roads, highways, bridges and transit systems could also provide a significant boost to the state's economy by creating jobs in the short term and stimulating long-term economic growth as a result of enhanced mobility and access.

This report examines the condition, use and safety of Missouri's roads, highways and bridges, and the state's future mobility needs. Sources of information for this report include the Federal Highway Administration (FHWA), the American Association of State Highway and Transportation Officials (AASHTO), the Bureau of Transportation Statistics (BTS), the U.S. Census Bureau, the Texas Transportation Institute (TTI), the American Road & Transportation Builders Association (ARTBA) and the National Highway Traffic Safety Administration (NHTSA).

An urban area is defined as a region's municipalities and surrounding suburbs for pavement condition and congestion data; bridge and traffic fatality data include a region's major counties.¹

POPULATION, TRAVEL AND ECONOMIC TRENDS IN MISSOURI

Missouri motorists and businesses require a high level of personal and commercial mobility. To foster quality of life and spur continued economic growth, it is critical that the state provide a safe and modern transportation system that can accommodate future growth in population, tourism, business, recreation and vehicle travel.

Missouri's population grew to approximately 6.1 million residents in 2017, a nine percent increase since 2000.² Annual vehicle miles of travel (VMT) on the state's transportation system increased ten percent from 2000 to 2016, from 67.1 billion VMT to 74 billion VMT. From 2013 to 2016

VMT in the state increased by seven percent. Missouri had approximately 4.2 million licensed drivers in 2016.³ From 2000 to 2016, Missouri's gross domestic product (GDP), a measure of the state's economic output, increased by 11 percent, when adjusted for inflation.⁴ U.S. GDP increased 30 percent during the same period.⁵

CONDITION OF MISSOURI ROADS

The life cycle of Missouri's roads is greatly affected by the state and local governments' ability to perform timely maintenance and upgrades to ensure that road and highway surfaces last as long as possible.

The pavement data in this report, which is for all arterial and collector roads and highways, is provided by the Federal Highway Administration (FHWA), based on data submitted annually by the Missouri Department of Transportation on the condition of major state and locally maintained roads and highways. Pavement data for Interstate highways and other principal arterials is collected for all system mileage, whereas pavement data for minor arterial and all collector roads and highways is based on sampling portions of roadways as prescribed by FHWA to insure the data collected is adequate to provide an accurate assessment of pavement conditions on these roads and highways.

Statewide, more than half of Missouri's major roads are in poor or mediocre condition. Twenty-four percent of Missouri's locally and state-maintained major roads are in poor condition and twenty-eight percent are in mediocre condition.⁶ Nineteen percent of Missouri's major roads are in fair condition and the remaining 29 percent are in good condition.⁷

Thirty-two percent of Missouri's major locally and state-maintained urban roads and highways have pavements rated in poor condition and 26 percent are in mediocre condition.⁸ Fourteen percent of Missouri's major urban roads are rated in fair condition and the remaining 28 percent are rated in good condition.⁹

Twenty-two percent of Missouri's major locally and state-maintained rural roads and highways have pavements rated in poor condition and 28 percent are in mediocre condition.¹⁰ Twenty percent of Missouri's major rural roads are rated in fair condition and the remaining 29 percent are rated in good condition.¹¹ The chart below details pavement conditions on major urban roads in the state's largest urban areas.¹²

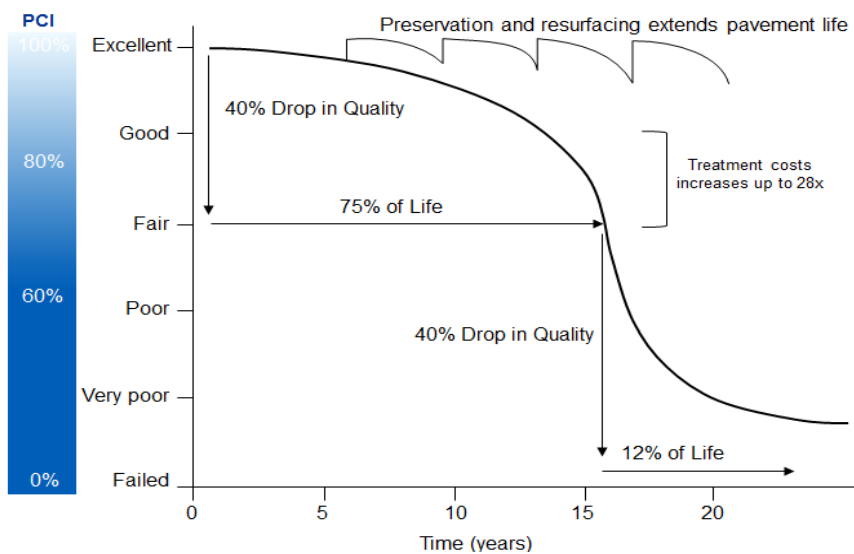
Chart 1. Pavement conditions on major roads in Missouri’s largest urban areas and statewide.

Location	Poor	Mediocre	Fair	Good
Columbia-Jefferson City	28%	32%	12%	28%
Kansas City	26%	27%	17%	30%
St. Louis	22%	29%	17%	32%
Springfield	21%	22%	16%	41%
MISSOURI STATEWIDE	24%	28%	19%	29%

Source: TRIP analysis of Federal Highway Administration data.

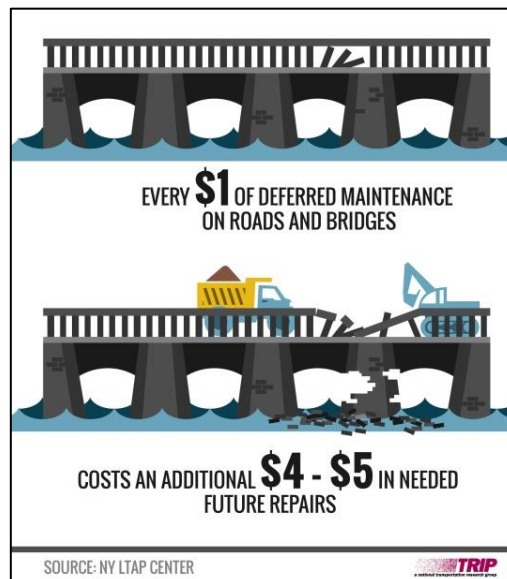
Pavement failure is caused by a combination of traffic, moisture and climate. Moisture often works its way into road surfaces and the materials that form the road’s foundation. Road surfaces at intersections are more prone to deterioration because the slow-moving or standing loads occurring at these sites subject the pavement to higher levels of stress. It is critical that roads are fixed before they require major repairs because reconstructing roads costs approximately four times more than resurfacing them.¹³ As roads and highways continue to age, they will reach a point of deterioration where routine paving and maintenance will not be adequate to keep pavement surfaces in good condition and costly reconstruction of the roadway and its underlying surfaces will become necessary.

Chart 2. Pavement Condition Cycle Time with Treatment and Cost



Source: North Carolina Department of Transportation (2016). [2016 Maintenance Operations and Performance Analysis Report](#)

Long-term repair costs increase significantly when road and bridge maintenance is deferred, as road and bridge deterioration accelerates later in the service life of a transportation facility and requires more costly repairs. A [report on maintaining pavements](#) found that every \$1 of deferred maintenance on roads and bridges costs an additional \$4 to \$5 in needed future repairs.¹⁴



THE COST TO MOTORISTS OF ROADS IN INADEQUATE CONDITION

TRIP has calculated the additional cost to motorists of driving on roads in poor, mediocre or fair condition. When roads are in poor, mediocre or fair condition – which may include potholes, rutting or rough surfaces – the cost to operate and maintain a vehicle increases. These additional vehicle operating costs (VOC) include accelerated vehicle depreciation, additional vehicle repair costs, increased fuel consumption and increased tire wear. TRIP estimates that additional VOC borne by Missouri motorists as a result of deteriorated road conditions is \$3 billion annually, an average of \$695 per driver statewide.¹⁵ The chart below details additional VOC per motorist in the state’s largest urban areas.

Chart 3. Vehicle operating costs per motorist as a result of driving on deteriorated roads.

Location	VOC
Columbia-Jefferson City	\$702
Kansas City	\$667
St. Louis	\$611
Springfield	\$558
MISSOURI STATEWIDE	\$3 Billion

Source: TRIP estimates.

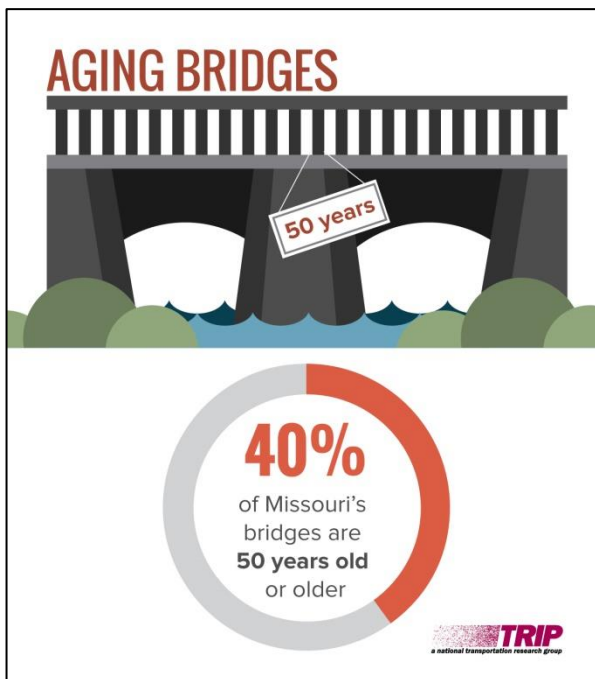
Additional vehicle operating costs have been calculated in the Highway Development and Management Model (HDM), which is recognized by the U.S. Department of Transportation and more than 100 other countries as the definitive analysis of the impact of road conditions on vehicle operating costs. The HDM report is based on numerous studies that have measured the impact of various factors, including road conditions, on vehicle operating costs.¹⁶ The HDM study found that road

deterioration increases ownership, repair, fuel and tire costs. The report found that deteriorated roads accelerate the pace of depreciation of vehicles and the need for repairs because the stress on the vehicle increases in proportion to the level of roughness of the pavement surface. Similarly, tire wear and fuel consumption increase as roads deteriorate since there is less efficient transfer of power to the drive train and additional friction between the road and the tires.

TRIP's additional VOC estimate is based on taking the average number of miles driven annually by a motorist, calculating current VOC based on AAA's 2017 VOC and then using the HDM model to estimate the additional VOC paid by drivers as a result of substandard roads.¹⁷ Additional research on the impact of road conditions on fuel consumption by the Texas Transportation Institute (TTI) is also factored in to TRIP's vehicle operating cost methodology.

BRIDGE CONDITIONS IN MISSOURI

Missouri's bridges form key links in the state's highway system, providing communities and individuals access to employment, schools, shopping and medical facilities, and facilitating commerce and access for emergency vehicles.



Thirteen percent of Missouri's locally and state-maintained bridges are rated as structurally deficient, the eleventh highest share in the nation.¹⁸ This includes all bridges that are 20 feet or more in length. A bridge is structurally deficient if there is significant deterioration of the bridge deck, supports or other major components. Bridges that are structurally deficient may be posted for lower weight limits or closed if their condition warrants such action. Deteriorated bridges can have a significant impact on daily life. Restrictions on vehicle weight may cause many vehicles – especially emergency vehicles,

commercial trucks, school buses and farm equipment – to use alternate routes to avoid posted bridges. Redirected trips also lengthen travel time, waste fuel and reduce the efficiency of the local economy.

Most bridges are designed to last 50 years before major overhaul or replacement, although many newer bridges are being designed to last 75 years or longer. In Missouri, 40 percent of the state's bridges (9,913 of 24,487) were built in 1969 or earlier.¹⁹

The chart below details the number and share of bridges in the state’s largest urban areas and statewide that are structurally deficient.

Chart 4. Number and share of structurally deficient bridges statewide and in Missouri’s largest urban areas.

Location	Number Structurally Deficient	Share Structurally Deficient	Total Bridges
Columbia-Jefferson City	93	10%	973
Kansas City	155	5%	2,925
St. Louis	132	7%	1,903
Springfield	28	6%	461
MISSOURI STATEWIDE	3,086	13%	24,487

Source: TRIP analysis of Federal Highway Administration National Bridge Inventory (2017).

The service life of bridges can be extended by performing routine maintenance such as resurfacing decks, painting surfaces, insuring that a facility has good drainage and replacing deteriorating components. But, most bridges will eventually require more costly reconstruction or major rehabilitation to remain operable.

TRAFFIC SAFETY IN MISSOURI

A total of 4,163 people were killed in Missouri traffic crashes from 2012 to 2016, an average of 833 fatalities per year.²⁰

Chart 5. Traffic Fatalities in Missouri 2012 – 2016

Year	Fatalities
2012	826
2013	757
2014	766
2015	869
2016	945
TOTAL	4,163

Source: National Highway Traffic Safety Administration.

Three major factors are associated with fatal vehicle crashes: driver behavior, vehicle characteristics and roadway features. It is estimated that roadway features are likely a contributing factor in approximately one-third of fatal traffic crashes. Roadway features that impact safety include

the number of lanes, lane widths, lighting, lane markings, rumble strips, shoulders, guard rails, other shielding devices, median barriers and intersection design.

Missouri’s overall traffic fatality rate of 1.28 fatalities per 100 million vehicle miles of travel in 2016 is higher than the national average of 1.18.²¹ The traffic fatality rate on the state’s rural roads is disproportionately high. The fatality rate on Missouri’s non-interstate rural roads is nearly two and a half times that on all other roads in the state (2.15 fatalities per 100 million vehicle miles of travel vs. 0.88).²²

The chart below details the number of people killed in traffic crashes in the state’s largest urban areas between 2014 and 2016, and the cost of traffic crashes per driver.

Chart 6. Average fatalities between 2014 and 2016 and crash cost per driver.

Location	Average Fatalities 2014-2016	Safety Cost
Columbia-Jefferson City	39	\$498
Kansas City	160	\$334
St. Louis	132	\$340
Springfield	32	\$429
MISSOURI STATEWIDE	860	\$2.4 Billion

Source: TRIP analysis.

Traffic crashes in Missouri imposed a total of \$7.1 billion in economic costs in 2016.²³ TRIP estimates that roadway features were likely a contributing factor in approximately one-third of all fatal traffic crashes, resulting in \$2.4 billion in economic costs in 2016.²⁴ According to a 2015 National Highway Traffic Safety Administration (NHTSA) report, the economic costs of traffic crashes includes work and household productivity losses, property damage, medical costs, rehabilitation costs, legal and court costs, congestion costs and emergency services.²⁵

Improving safety on Missouri’s roadways can be achieved through further improvements in vehicle safety; improvements in driver, pedestrian, and bicyclist behavior; and, a variety of improvements in roadway safety features.

The severity of serious traffic crashes could be reduced through roadway improvements, where appropriate, such as adding turn lanes, removing or shielding obstacles, adding or improving medians, widening lanes, widening and paving shoulders, improving intersection layout, and providing better

road markings and upgrading or installing traffic signals. Roads with poor geometry, with insufficient clear distances, without turn lanes, having inadequate shoulders for the posted speed limits, or poorly laid out intersections or interchanges, pose greater risks to motorists, pedestrians and bicyclists.

Investments in rural traffic safety have been found to result in significant reductions in serious traffic crashes. A [2012 report by TTI](#) found that improvements completed recently by TxDOT that widened lanes, improved shoulders and made other safety improvements on 1,159 miles of rural state roadways resulted in 133 fewer fatalities on these roads in the first three years after the improvements were completed (as compared to the three years prior).²⁶ TTI estimates that the improvements on these roads are likely to save 880 lives over 20 years.²⁷

TRAFFIC CONGESTION IN MISSOURI

Increasing levels of traffic congestion cause significant delays in Missouri, particularly in its larger urban areas, choking commuting and commerce. Traffic congestion robs commuters of time and money and imposes increased costs on businesses, shippers and manufacturers, which are often passed along to the consumer. Increased levels of congestion can also reduce the attractiveness of a location to a company when considering expansion or where to locate a new facility.

Based on TTI methodology, TRIP estimates the value of lost time and wasted fuel in Missouri is approximately \$2.4 billion a year. The chart below details the number of hours lost annually for each driver in the state’s largest urban areas, and the per-driver cost of lost time and wasted fuel due to congestion.

Chart 7. Annual hours lost to congestion and congestion costs per driver.

Location	Hours Lost to Congestion	Annual Cost Per Driver
Columbia-Jefferson City	13	\$277
Kansas City	41	\$988
St. Louis	45	\$1,080
Springfield	26	\$589

Source: TRIP estimates based on Texas Transportation Institute Urban Mobility Report.

TRANSPORTATION AND ECONOMIC GROWTH

Today's culture of business demands that an area have well-maintained and efficient roads, highways and bridges if it is to remain economically competitive. Global communications and the impact of free trade in North America and elsewhere have resulted in a significant increase in freight movement, making the quality of a region's transportation system a key component in a business's ability to compete locally, nationally and internationally.

Businesses have responded to improved communications and the need to cut costs with a variety of innovations including just-in-time delivery, increased small package delivery, demand-side inventory management and e-commerce. The result of these changes has been a significant improvement in logistics efficiency as firms move from a push-style distribution system, which relies on large-scale warehousing of materials, to a pull-style distribution system, which relies on smaller, more strategic movement of goods. These improvements have made mobile inventories the norm, resulting in the nation's trucks literally becoming rolling warehouses.

Highways are vitally important to continued economic development in Missouri. As the economy expands, creating more jobs and increasing consumer confidence, the demand for consumer and business products grows. In turn, manufacturers ship greater quantities of goods to market to meet this demand, a process that adds to truck traffic on the state's highways and major arterial roads.

Every year, \$495 billion in goods are shipped to and from sites in Missouri, mostly by trucks.²⁸ Seventy-five percent of the goods shipped annually to and from sites in Missouri are carried by trucks and another 16 percent are carried by courier services or multiple-mode deliveries, which include trucking.²⁹

The design, construction and maintenance of transportation infrastructure in Missouri play a critical role in the state's economy, supporting the equivalent of 79,083 full-time jobs across all sectors of the state economy, earning these workers approximately \$2.9 billion annually.³⁰ These jobs include 39,397 full-time jobs directly involved in transportation infrastructure construction and related activities. Spending by employees and companies in the transportation design and construction industry support an additional 39,687 full-time jobs.³¹

Transportation construction in Missouri contributes an estimated \$527 billion annually in state and local income, corporate and unemployment insurance taxes and the federal payroll tax.³²

Approximately 1.3 million full-time jobs in Missouri in key industries like tourism, retail sales, agriculture and manufacturing are dependent on the quality, safety and reliability of the state's

transportation infrastructure network. These workers earn \$45 billion in wages and contribute an estimated \$8.2 billion in state and local income, corporate and unemployment insurance taxes and the federal payroll tax.³³

Local, regional and state economic performance is improved when a region’s surface transportation system is expanded or repaired. This improvement comes as a result of the initial job creation and increased employment created over the long-term because of improved access, reduced transport costs and improved safety.

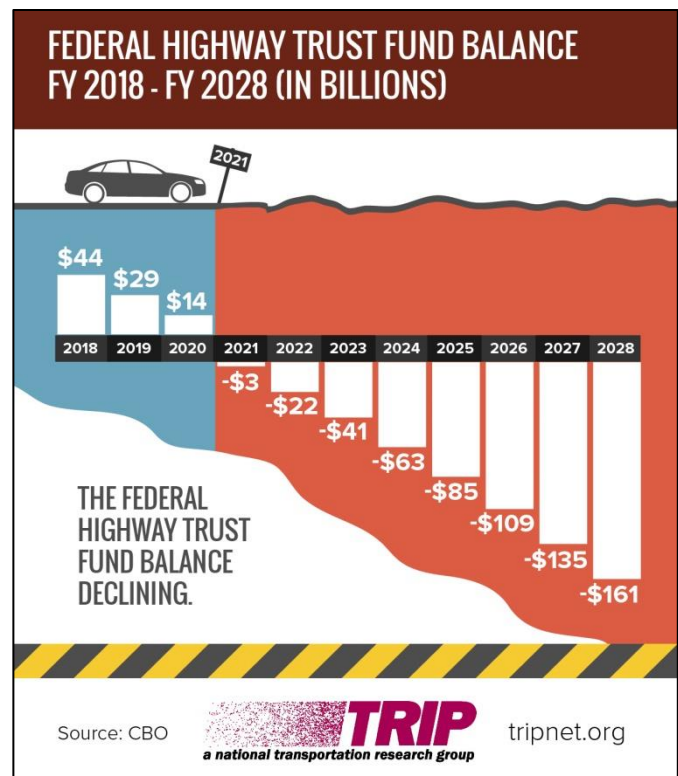
Increasingly, companies are looking at the quality of a region’s transportation system when deciding where to re-locate or expand. Regions with congested or poorly maintained roads may see businesses relocate to areas with a smoother, more efficient and more modern transportation system. Highway accessibility was ranked the number one site selection factor in a 2017 survey of corporate executives by [Area Development Magazine](#). Labor costs and the availability of skilled labor, which are both impacted by a site's level of accessibility, were rated second and third, respectively.³⁴

TRANSPORTATION FUNDING

Investment in Missouri’s roads, highways and bridges is funded by local, state and federal governments. A lack of sufficient funding at all levels will make it difficult to adequately maintain and improve the state’s existing transportation system.

The federal government is a critical source of funding for Missouri’s roads, highways, bridges and transit systems and provides a significant return in road and bridge funding based on the revenue generated in the state by the federal motor fuel tax.

Most federal funds for highway and transit improvements in Missouri are provided by federal highway user fees, largely an 18.4 cents-per-gallon tax on gasoline and a 24.4 cents-per-gallon tax on diesel fuel. Since 2008 revenue into the federal Highway Trust Fund has been inadequate to support legislatively set funding levels so Congress has transferred approximately



\$53 billion in general funds and an additional \$2 billion from a related trust fund into the federal Highway Trust Fund.³⁵

Signed into law in December 2015, the [Fixing America's Surface Transportation Act \(FAST Act\)](#), provides modest increases in federal highway and transit spending. The five-year bill also provides states with greater funding certainty and streamlines the federal project approval process. But, the FAST Act does not provide adequate funding to meet the nation's need for highway and transit improvements and does not include a long-term and sustainable funding source.

The five-year, \$305 billion FAST Act will provide a boost of approximately 15 percent in highway funding and 18 percent in transit funding over the duration of the program, which expires in 2020.³⁶ In addition to federal motor fuel tax revenues, the FAST Act will also be funded by \$70 billion in U.S. general funds, which will rely on offsets from several unrelated federal programs including the Strategic Petroleum Reserve, the Federal Reserve and U.S. Customs.

According to the [2015 Status of the Nation's Highways, Bridges and Transit: Conditions and Performance](#) report submitted by the United States Department of Transportation (USDOT) to Congress, the nation faces an \$836 billion backlog in needed repairs and improvements to the nation's roads, highways and bridges.³⁷ The USDOT [report](#) found that the nation's current \$105 billion investment in roads, highways and bridges by all levels of government should be increased by 35 percent to \$142.5 billion annually to improve the conditions of roads, highways and bridges, relieve traffic congestion and improve traffic safety.

President Trump's infrastructure plan, released in February 2018, would provide \$200 billion in new federal grants and loans over 10 years to leverage \$1.5 trillion in total project spending on infrastructure, including surface transportation. State and local governments and the private sector would be required to raise the additional \$1.3 trillion to access the federal grants and loans provided under this initiative. Congress has not yet crafted a transportation program in response to the Trump proposal and would need to identify a long-term, sustainable source of funding to support increased funding for the federal Highway Trust Fund.

CONCLUSION

As Missouri works to build and enhance a thriving, growing and dynamic state, it will be critical that it is able to address the state's most significant transportation issues by providing a 21st century network of roads, highways, bridges and transit that can accommodate the mobility demands of a modern society.

Missouri will need to modernize its surface transportation system by improving the physical condition of its transportation network and enhancing the system's ability to provide efficient, safe and reliable mobility for residents, visitors and businesses. Making needed improvements to the state's roads, highways, bridges and transit systems would provide a significant boost to the economy by creating jobs in the short term and stimulating long-term economic growth as a result of enhanced mobility and access.

Despite the modest funding increase provided by the FAST Act, numerous projects to improve the condition and expand the capacity of Missouri's roads, highways, bridges and transit systems will not be able to proceed without a substantial boost in state or local transportation funding. If Missouri is unable to complete needed transportation projects it will hamper the state's ability to improve the condition and efficiency of its transportation system or enhance economic development opportunities and quality of life.

###

ENDNOTES

-
- ¹ Bridge condition data and safety data for each urban area includes the counties noted: Columbia-Jefferson City: Boone, Cole, Osage and Callaway Counties; Kansas City: Clay, Jackson, Platte, Johnson (KS), Wyandotte (KS) and Leavenworth (KS) Counties; St. Louis: St. Louis, Madison (IL) and St. Claire (IL) Counties; Springfield: Green County.
- ² U.S. Census Bureau (2017).
- ³ Highway Statistics (2016). Federal Highway Administration. DL-1C.
- ⁴ TRIP analysis of Bureau of Economic Analysis data.
- ⁵ Ibid.
- ⁶ Federal Highway Administration (2017). Pavement condition data is for 2016.
- ⁷ Ibid.
- ⁸ Ibid.
- ⁹ Ibid.
- ¹⁰ Ibid.
- ¹¹ Ibid.
- ¹² Ibid.
- ¹³ Selecting a Preventative Maintenance Treatment for Flexible Pavements. R. Hicks, J. Moulthrop. Transportation Research Board. 1999. Figure 1.
- ¹⁴ Pavement Maintenance, by David P. Orr, PE Senior Engineer, Cornell Local Roads Program, March 2006.
- ¹⁵ TRIP calculation.
- ¹⁶ Highway Development and Management: Volume Seven. Modeling Road User and Environmental Effects in HDM-4. Bennett, C. and Greenwood, I. 2000.
- ¹⁷ Your Driving Costs. American Automobile Association. 2017.
- ¹⁸ Federal Highway Administration National Bridge Inventory. 2017.
- ¹⁹ TRIP analysis of Federal Highway Administration National Bridge Inventory data (2018).
- ²⁰ Federal Highway Administration National Highway Traffic Safety Administration, 2012-2016.
- ²¹ TRIP analysis of National Highway Traffic Safety Administration and Federal Highway Administration data (2017). Data is for 2016.
- ²² TRIP analysis of National Highway Traffic Safety Administration and Federal Highway Administration data (2016).
- ²³ TRIP estimate based on NHTSA report “The Economic and Societal Impact of Motor Vehicle Crashes, 2010 (Revised), 2016. P. 146.
- ²⁴ Ibid.
- ²⁵ The Economic and Societal Impact of Motor Vehicle Crashes, 2010 (Revised) (2015). National Highway Traffic Safety Administration. P. 1. <https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812013>
- ²⁶ Adding Highway Shoulders, Width, Reduce Crash Numbers and Save Lives (August 9, 2012). Texas Transportation Institute. <https://tti.tamu.edu/2012/08/09/tti-study-analyzes-roadway-improvements/>
- ²⁷ Ibid.
- ²⁸ TRIP analysis of Bureau of Transportation Statistics, U.S. Department of Transportation. 2012 Commodity Flow Survey, State Summaries.
- ²⁹ Ibid.
- ³⁰ American Road & Transportation Builders Association (2015). The 2015 U.S. Transportation Construction Industry Profile. https://www.transportationcreatesjobs.org/pdf/Economic_Profile.pdf
- ³¹ Ibid.
- ³² Ibid.
- ³³ Ibid.
- ³⁴ Area Development Magazine (2018). 32nd Annual Survey of Corporate Executives: Availability of Skilled Labor New Top Priority. <http://www.areadevelopment.com/Corporate-Consultants-Survey-Results/Q1-2018/32nd-annual-corporate-survey-14th-annual-consultants-survey.shtml>

³⁵ “Surface Transportation Reauthorization and the Solvency of the Highway Trust Fund,” presentation by Jim Tymon, American Association of State Highway and Transportation Officials (2014).

³⁶ 2015 “Fixing America’s Surface Transportation Act.” (2015) American Road and Transportation Builders Association. <http://www.artba.org/newsline/wp-content/uploads/2015/12/ANALYSIS-FINAL.pdf>

³⁷ United States Department of Transportation (2015). 2015 Status of the Nation’s Highways, Bridges, and Transit: Conditions and Performance. Executive Summary, Chapter 8.

<https://www.fhwa.dot.gov/policy/2015cpr/es.cfm#8h>