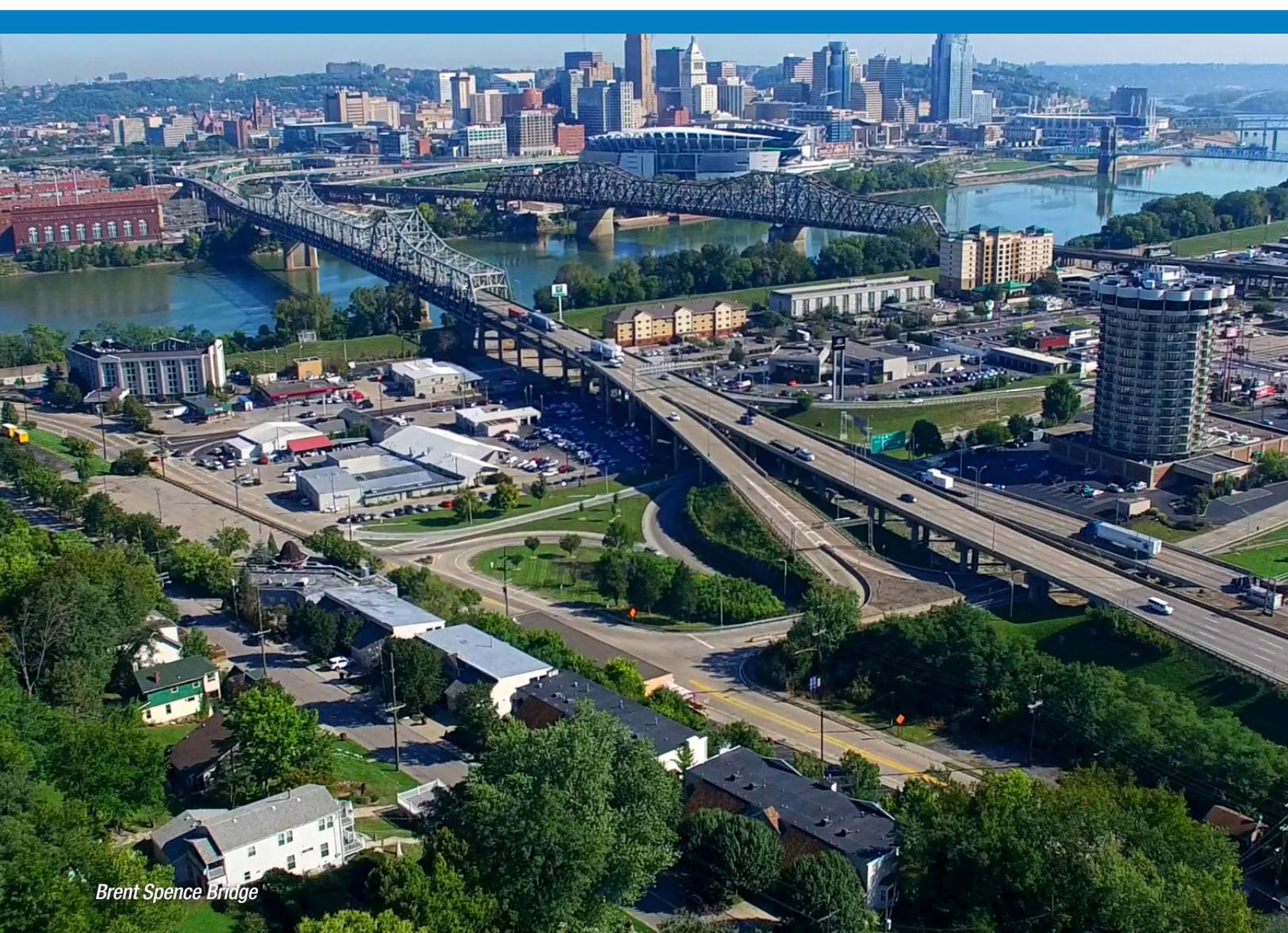


Contributions and Crossroads:

Our National Road System's Impact on the
U.S. Economy and Way of Life (1916-2016)



Brent Spence Bridge

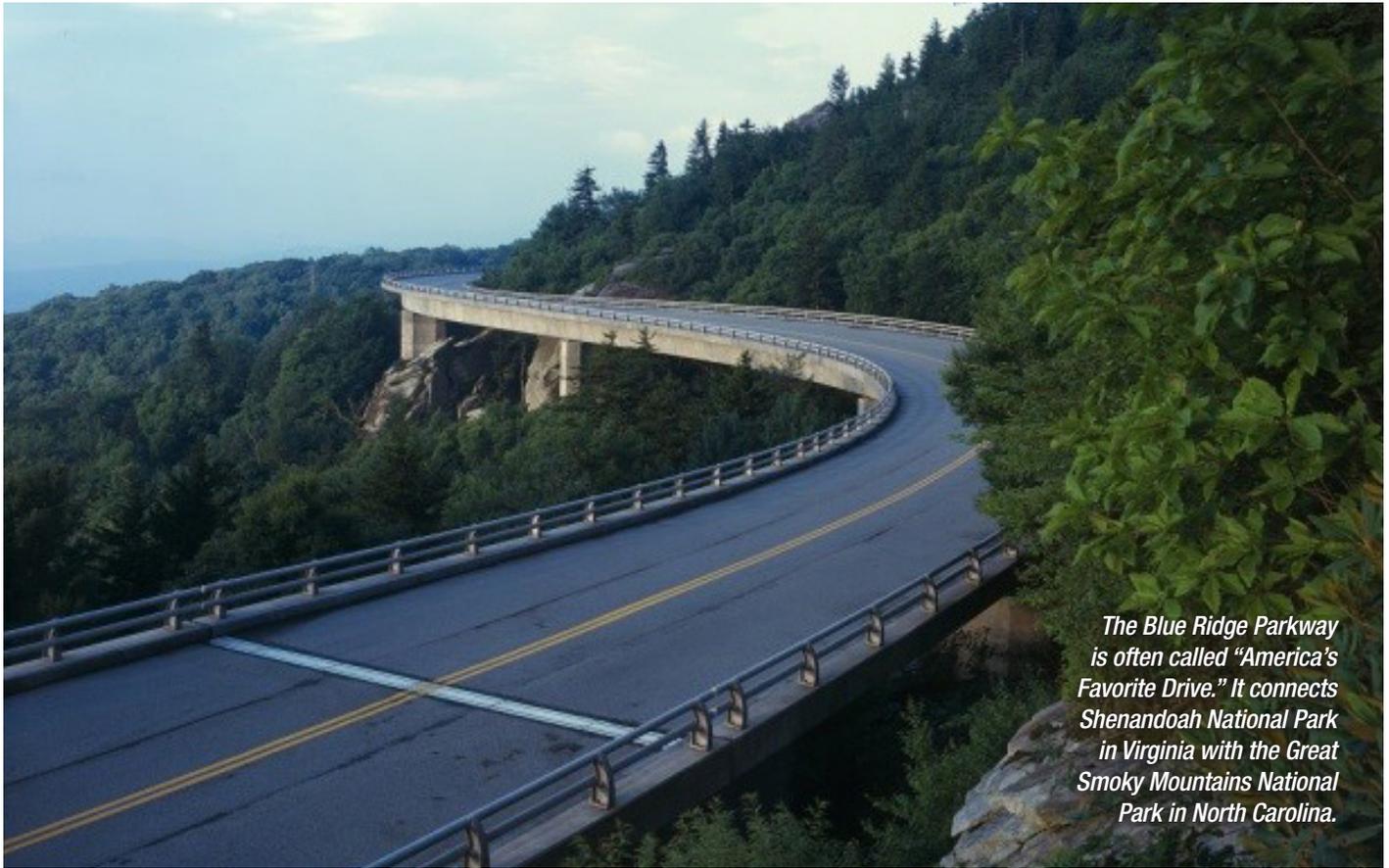


U.S. Department of Transportation
Federal Highway Administration

FHWA-PL-17-013

Technical Documentation Page

1. Report No. FHWA-PL-17-013	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle Contributions and Crossroads: Our National Road System's Impact on the U.S. Economy and Way of Life (1916-2016)		5. Report Date January 2017	
		6. Performing Organization Code	
7. Author(s) Erica Interrante and Bingxin Yu		8. Performing Organization Report No.	
9. Performing Organization Name and Address Federal Highway Administration and Applied Research Associates, Inc		10. Work Unit No. (TR AIS)	
		11. Contract or Grant No. DTFH61-13-D-00023	
12. Sponsoring Agency Name and Address Federal Highway Administration Office of Policy and Governmental Affairs, Transportation Studies		13. Type of Report and Period Covered Final Report	
		14. Sponsoring Agency Code HPL	
15. Supplementary Notes A 7-minute-long mini-documentary video, titled after the report name, accompanies the historical information presented in this document. The video can be accessed on FHWA's history page: https://www.fhwa.dot.gov/highwayhistory/history_misc.cfm .			
16. Abstract This report provides a glimpse into the legacy of the Federal Highway Administration (FHWA) since the passage of the first Federal-Aid Road Act in 1916, one century ago. This landmark legislation created the Federal-aid highway program and authorized \$75 million over 5 years for the new Federal-State partnership. It was the first federal legislation that appropriated significant funding to improve and expand the country's road system. The report discusses the federal impact during wars and recession times, federal role in providing access to the nation and moving people and freight, federal impact on equity and the environment, and progress for the next century. These are reviewed through the lens of the how our national road systems impacted the U.S. economy, personal mobility, freight transport, military, travel safety, national parks, and tourism.			
17. Key Words FHWA Legacy, Contributions and Crossroads, National Highway System, U.S. Economy, FHWA History		18. Distribution Statement No restrictions. This document is available to the public through the National Technical Information Service Alexandria, Virginia 22312	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 40	22. Price



The Blue Ridge Parkway is often called "America's Favorite Drive." It connects Shenandoah National Park in Virginia with the Great Smoky Mountains National Park in North Carolina.

Table of Contents

Introduction5

Chapter One
War, Recession and the Federal Impact9

Chapter Two
Access for the Nation17

Chapter Three
Refining the Model:
Equity and the Environment27

Chapter Four
America at the Crossroads:
Progress for the Next Century35

Notice

This document is disseminated under the sponsorship of the U.S. Department of Transportation in the interest of information exchange. The U.S. Government assumes no liability for the use of the information contained in this document.

The U.S. Government does not endorse products or manufacturers. Trademarks or manufacturers' names appear in this report only because they are considered essential to the objective of the document.

Quality Assurance Statement

The Federal Highway Administration (FHWA) provides high-quality information to serve Government, industry, and the public in a manner that promotes public understanding. Standards and policies are used to ensure and maximize the quality, objectivity, utility, and integrity of its information. FHWA periodically reviews quality issues and adjusts its programs and processes to ensure continuous quality improvement.

Introduction



In the early 1900s, muddy, nearly impassable roads were a sign of the times. The need for better roads became a focus as a way to unite various parts of the country and help farmers get their products to market.

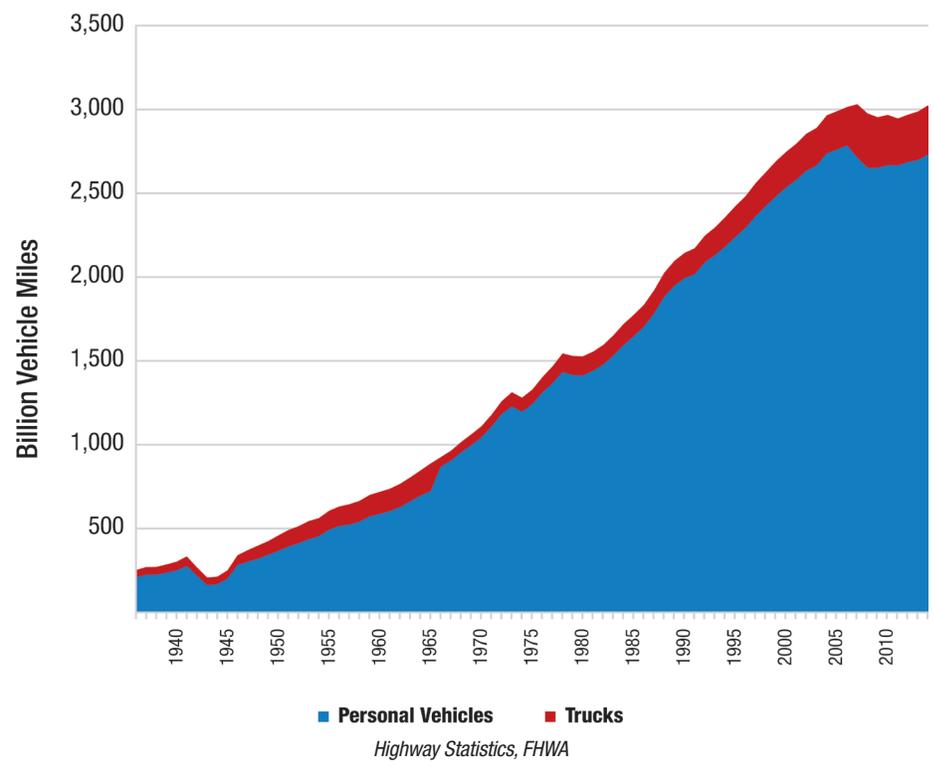
Texas Department of Transportation

“Our system of transportation is the greatest of any country in the world.”

-Lyndon B. Johnson, 1966

America is a nation on the go, and our highway system is our lifeblood. Through a century of public investment, we have built a national network of highways and bridges that connect us to each other and our vast Nation. It moves food from the farm to our table and brings the products we enjoy to our doorstep. It provides access to jobs, schools, and medical care. It is an engine for economic growth and opportunity. A century of sustained investments has fundamentally transformed our economy and society. This report presents a thoughtful reflection of past accomplishments and contributions of the transportation system to national connectivity and way of life for all.

Vehicle Miles Travel Grew Over Decades



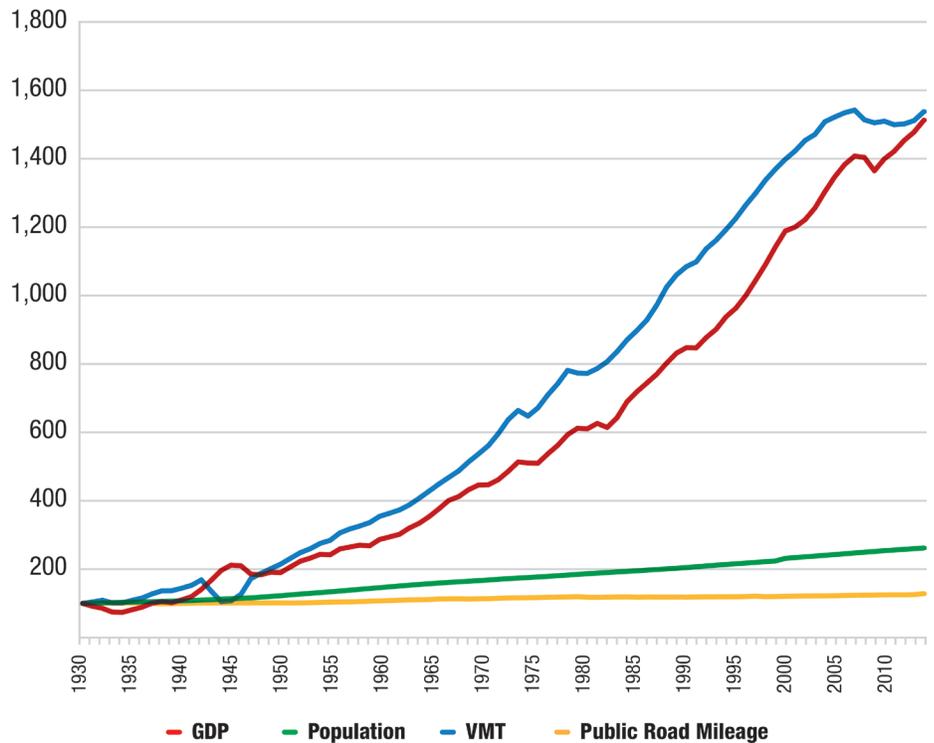
The Federal road agency was formed in 1893 when the U.S. Office of Road Inquiry in the Department of Agriculture conducted a nationwide survey of the best methods used in road construction and maintenance. The Federal-aid Road Act of 1916 formally created the Federal-aid highway program, as substantial funding for the time was allocated to the States for the construction of rural post roads. Decades later, the construction of the Interstate System would begin after the passage of the Federal-Aid Highway Act of 1956, which also created the Highway Trust Fund as the primary mechanism for funding.

In 1966, the Federal Highway Administration became an agency within the new U.S. Department of Transportation to provide program oversight, technical assistance, and training to transportation professionals worldwide. In partnership with State departments of transportation (DOTs), a national highway system has been created that has kept the Nation on the move, as shown by decades of increase in vehicle miles traveled (VMT).

Outside of short stagnation periods during economic recessions, VMT has grown in step with our Nation's population, industries, and economy. While passenger cars for household travel have shown consistent growth in VMT, commercial vehicles for moving freight is now growing at a faster rate.

Using a system of roads that was designed and built when the U.S. had a population of 168.9 million (in 1955), VMT growth outpaced the expansion of economy (GDP), which grew by more than 1,400 percent over the same period. The VMT growth also far surpassed population growth, implying intensified road usage by Americans. Today, FHWA continues to work closely with State and local agencies and other stakeholders to build, maintain, and improve U.S. roads and plan for future transportation needs as our Nation's population and economy grows.

U.S. Road Travel Grew Faster than GDP (1930=100)



Highway Statistics, Bureau of Economic Analysis, Census Bureau.

The Need for Roads

In the early days, people walked or used horses and carriages to travel (railroads did provide long distance travel for some). This travel was often arduous on dirt roadways, usually requiring several days just to purchase essential goods. Even for long distances, there were limited options for travel. Rail dominated interstate goods movement and wealthy travelers until the turn of the 20th century.

"I remember my granddaddy would go to town and it would take him two days to go... he would go and buy the groceries... load up and go back part of the way and camp before he would go on home. It would take him two days to get the month's supply."

- Angelyn Bowdoin, Restaurant Owner, 95 years old

The mass production of the bicycle in the early 1890s improved mobility and also raised awareness of the need for better roads. By 1890, over 1 million bi-



Library of Congress/Rt. Y. Young

The bicycle movement of the late 1800s brought attention to the need for better roads. Cyclists of the era made a push for safer, more efficient roads.

cycles were being manufactured in the country each year.¹ This new and innovative mode of travel was well received by the U.S. population, especially in urban areas. Bicycle enthusiasts were the first champions of what became known as the Good Roads Movement (late 1870s-1920s), because the prospect of traveling outside of one's city was dangerous due to the poor condition of roads.

In 1908, Henry Ford's Model T arrived on the market. Assembly-line production lowered the vehicle's price and made it affordable for the average American worker. Between 1913 and 1927, Ford factories produced more than 15 million Model Ts for a U.S. population of 119 million people.² It soon became one of the most popular cars in the world.

In 1904, the first inventory of all rural roads in the nation was launched. Only about seven percent of 2.1 million miles of rural roads had any kind of surfacing, not including 1,101 miles of toll roads in Pennsylvania and 497 miles of toll roads in Maryland which had stone surfaces.

As automobile travel increased, it became apparent that greater funding would be needed to build roads that provided a safe and efficient means of travel. In 1916, Congress passed the Federal-Aid Road Act, which authorized \$75 million for road construction and improvement in States under the Federal-aid highway program.

“The Federal-Aid Road Act of 1916 established a partnership between the Federal government and States in providing for transportation services in this country. Many of the routes that were initially constructed ultimately became those same roads that are a part of what we now call the National Highway System.”

- Bud Wright, American Association of State Highway and Transportation Officials

It was the first federal legislation that appropriated significant funding to improve and expand the country's road system. For the first time roads became a national priority as a way to connect people and facilitate the movement of goods. Under the State-Federal partnership, each State was responsible for up to 50 percent of eligible construction costs, and required to have a highway agency capable of delivering the program. By 1917, all States were equipped with a highway agency.



Today the Nation comprises 4.12 million miles of roads, connecting cities, and towns from coast to coast.

- **1890** A surge in bicycle use draws attention to the need for better roads.
- **1893** Department of Agriculture formed the Office of Road Inquiry (ORI), predecessor to FHWA.
- **1899** ORI becomes the Office of Public Road Inquiry (OPRI).
- **1901** OPRI's "tech transfer" initiatives expanded to the Good Roads Train.
- **1905** Congress gave permanent status to the Office of Public Roads (OPR) within the Department of Agriculture.
- **1907** First national road inventory is published (for 1904).
- **1908** Henry Ford's Model T arrived on the market.
- **1912** First annual Federal Aid Good Roads Convention.
- **1914** The National Park and Forest Roads Division is formed within OPR, and the American Association of State Highway Officials (AASHO) is established.
- **1916** Congress passed the first Federal-Aid Road Act for "the construction of rural post roads."

1 Weingroff, Richard, *A Peaceful Campaign of Progress and Reform: The Federal Highway Administration at 100*

2 <http://www.history.com/topics/model-t>

Chapter One | War, Recession, and the Federal Impact

Eisenhower Collection/Dwight D. Eisenhower Presidential Library



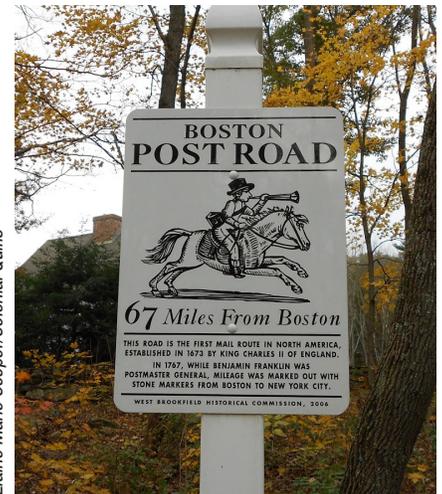
A military convoy moves supplies through Salt Lake City in 1919 on a trek across the country during World War I. Military convoys during the war often encountered difficult road conditions, which led to delays in delivering supplies and manpower.

World War I

In 1914, Europe went to war, with the United States joining the effort in 1917. Entry into the war put a great demand on our military, the public, and the Nation's transportation system. Supplies and equipment had to be moved regionally and across the Nation for shipment to Europe. Servicemen and women needed to be transported overseas. On the home front, manufacturing plants had to be converted to meet wartime needs. The Nation was not prepared to handle the transport and travel needs of the times, financially and logistically.

The planning and construction of road projects was significantly slowed by U.S. entry into WWI. As workers and raw materials were shifted to war-related industries, there were fewer resources available for road construction. As a result, many road projects were delayed for a number of years. By war's end, only five Federal-aid projects, totaling 17.6 miles, had been completed.³

During this time, the railroad industry was heavily regulated and prohibited to merge, limiting its ability to coordinate the quick and efficient movement of



Elaine Marie Cooper/Colonial Quills

A sign marks the route of the Old Boston Post Road. Designated by Congress for the purpose of delivering mail, certain post roads date back to the 1820s. They were originally used by riders on horseback and were often nothing more than narrow pathways.

³ *Highway Existence: 100 Years and Beyond*, Richard Weingroff (Autumn 1993, Vol. 57 No.2), <http://www.fhwa.dot.gov/publications/publicroads/93fall/p93au1.cfm>



Library of Congress



National Archives/Department of the Interior

The first U.S. Army Transcontinental Motor Convoy (top) occurred in the summer of 1919 with 81 motorized Army vehicles crossing the United States from Washington, DC to San Francisco. The trip covered 3,251 miles and took 61 days and was a test of mobility for the military during wartime conditions. Many of the roads were impassable, and that meant frequent breakdowns of the military vehicles.

President Dwight D. Eisenhower (above) is often referred to as the “Father of the Interstate Highway System.” His experiences in the Transcontinental Motor Convoy during World War I were the basis for his vision of an Interstate Highway System.

freight. Railroad lines became overly congested and there was difficulty moving shipments in and out of terminals. As railroads were unable to handle all war shipments, the trucking industry grew considerably.⁴

By 1917, trucks were being used to carry outgoing shipments from congested city terminals to outlying towns and from manufacturing plants in the Midwest to the East Coast, for shipment to Europe. “Truck roads” were selected and maintained for the delivery of vehicles from manufacturing to port, but were often used by the general public since they were kept in good condition and free of snow in winter.⁵

With increased truck traffic came increased wear and tear on existing roadways. The frequent transport of heavy loads often caused roads to fall into disrepair, especially as spring weather warmed and softened road surfaces causing rut-

4 *Highway Existence: 100 Years and Beyond*, Richard Weingroff (Autumn 1993, Vol. 57 No.2), <http://www.fhwa.dot.gov/publications/publicroads/93fall/p93au1.cfm>

5 *America’s Highways, 1776-1996: A History of the Federal-Aid Program*, U.S. DOT Federal Highway Administration, pg. 95



ting and cracking, leading to structural failure. For example, New York roads that had been maintained well for 5-10 years became impassable under truck traffic averaging only 30 heavy vehicles per day. Roads that cost \$11,000 per mile to build in 1912 were estimated to cost \$32,000 per mile to repair at inflated 1918 costs.⁶

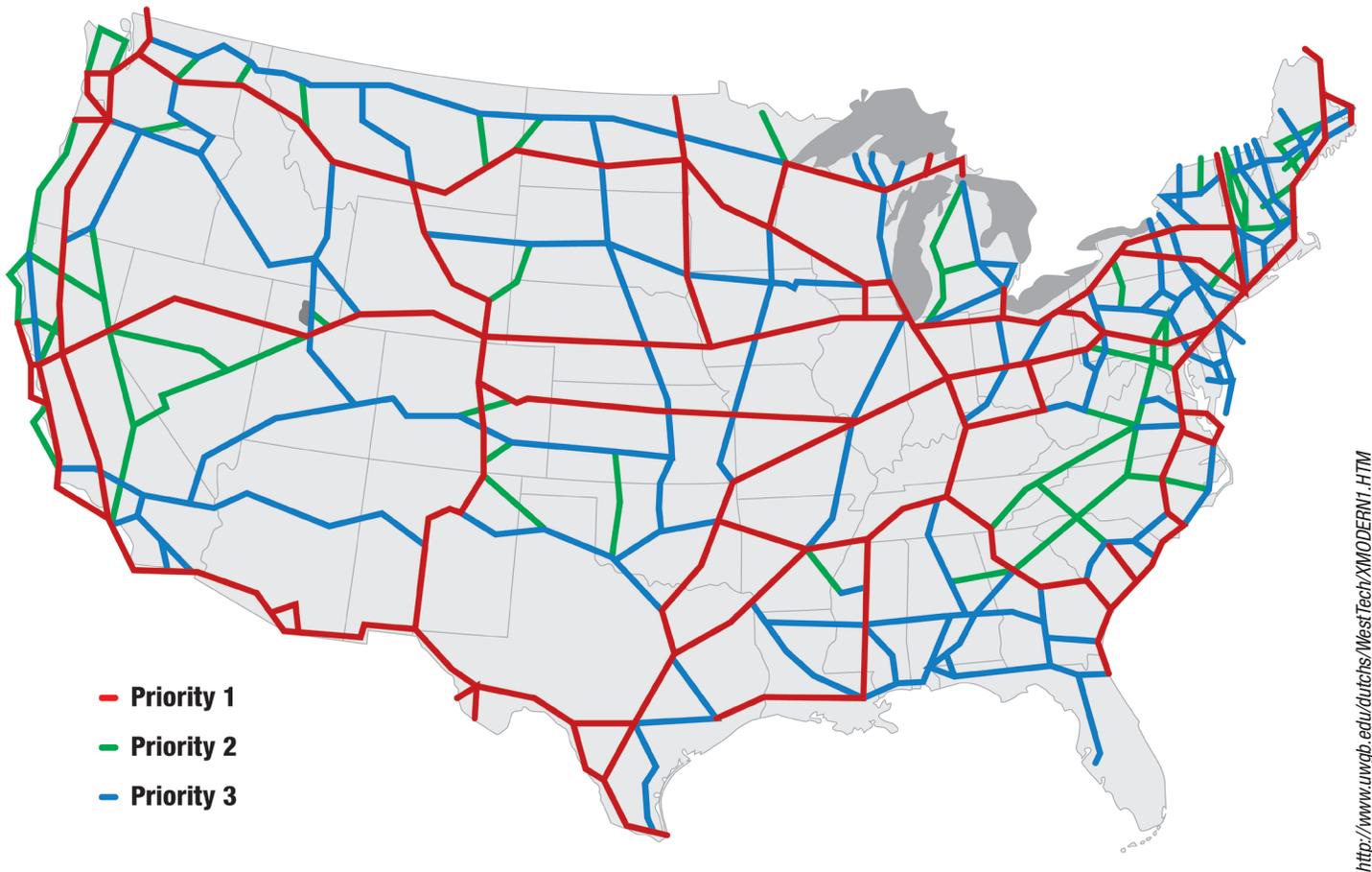
In an attempt to limit excessive damage to roadways by trucks, States began to make laws limiting vehicle loads. Recognizing the need for consistency across States, in 1917, the American Association of State Highway Officials (AASHO) requested the U.S. government create guidelines on road and street construction and maintenance.⁷ AASHO had initiated the need for federal standards and guidelines in the national road program.

By the end of the war, most States implemented a postwar road program to repair damage to country roads caused by moving war shipments. Transportation demands from the military, industry, and the public due to population growth underscored the need for paved roads. The number of motor vehicles in the United States soared from 55,000 in 1904 to 470,000 in 1910 to about 10 million in 1922.

A bridge for a section of the Alcan Highway (top) is constructed over a tributary of the Peace River. The Alaska-Canadian Highway was constructed during World War II, in 1942 and 1943, for the purpose of connecting the contiguous United States to Alaska across Canada

6 *America's Highways, 1776-1996: A History of the Federal-Aid Program*, U.S. DOT Federal Highway Administration, pg. 97

7 *America's Highways, 1776-1996: A History of the Federal-Aid Program*, U.S. DOT Federal Highway Administration, pg. 96



In 1922, the Bureau of Public Roads commissioned Gen. John J. Pershing to draw up the Pershing Map for construction purposes and to give the government a clear understanding of which roads in the United States were the most important in the event of war. The “Pershing Map” was the first official topographic road map of the United States. It included 78,000 miles of roads with an emphasis of coverage in coastal areas and border crossings.⁸

The Pershing Map (above), the first topographic road map of the United States, was used for construction purposes and to highlight roads that took priority in the event of war.

Most of the roads identified in the Pershing Map were incorporated into the Federal-aid system of highways. The War Department’s position was that a highway network that was adequate for industrial and commercial needs would also adequately serve military requirements.⁹

Early International Contributions

The United States also made significant contributions to the development of road systems in other countries during this time period, through both highway construction and providing technical assistance. This has led to economic development in these regions, providing seamless travel between continents and facilitating world-wide trade.

In 1914, the Panama Canal opened. Built by the United States, the 48-mile long canal was of critical importance to the movement of goods from the Pacific to Atlantic Ocean. In addition to control of the canal operations, the United States completed several public works projects related to its development. The Trans-Isthmian Highway was built across the isthmus connecting Colon to Madden Dam in Panamanian territory. Completed in 1941, its purpose was to provide an alternate means of travel to the Panama Railroad in the event of bombing or sabotage.

8 https://en.wikipedia.org/wiki/Pershing_Map

9 *America’s Highways, 1776-1996: A History of the Federal-Aid Program*, U.S. DOT Federal Highway Administration, page 142



President Roosevelt receiving the Brazilian Highway Expedition committee after they charted the most practical route for the construction of the Pan-American Highway.

The Pan-American Highway was planned through a collaboration of several countries in the Americas, proposed at the Fifth International Conference of American States in 1923. It is a network of roads that connects North America to Central and South America, from Prudhoe Bay, AK, to Ushuaia, Argentina. It is on record as the longest, drivable highway in the world, stretching nearly 30,000 miles, which supports international trade and travel between the regions.

The New Deal

From 1929-1939, the United States experienced the deepest and longest-lasting economic downturn in this country's history—the Great Depression. It began soon after the stock market crash in October 1929, which resulted in catastrophic loss and a steep decline in consumer spending leading to declines in industrial output and lay-offs. At its peak in 1933, 25 percent of all workers and 37 percent of all non-farm workers were completely out of work.¹⁰ Thirteen to fifteen million Americans were unemployed and nearly half of the country's banks had failed.¹¹

In his effort to put people back to work during the Great Depression, Roosevelt implemented a number of programs

¹⁰ <http://www.econlib.org/library/Enc/GreatDepression.html>

¹¹ HISTORY.com, The Great Depression, <http://www.history.com/topics/great-depression>

Project Spotlight



George Washington Memorial Parkway

Access to Scenic Wonders

The earliest parks in the country were established to preserve and protect the Nation's most scenic and historically-significant areas from economic exploitation and provide places of recreation for the general public. Today, millions of people visit the national parks other recreational areas each year using roads that were constructed by the federal government. The first park system roads were built in Yellowstone by the U.S. Army Corps of Engineers from 1883-1918. In 1924, Congress enacted legislation which launched the first coordinated road construction program in National Parks, implemented through a partnership between the Bureau of Public Roads and the National Park Service.

In 1932, the Mount Vernon Memorial Parkway was designed and built along the Potomac River in Washington, D.C. Today, the parkway provides scenic views of the river and general vicinity and serves as one of the most highly-traveled thoroughfares into the Nation's Capital. Many of today's parkways, which were once intended for scenic, recreational driving, have evolved into major urban and commuter routes.

Highways built through rugged terrains have enabled travel and the movement of freight between eastern and western areas of the U.S. contributing to regional and interregional economic development and making rural areas, once relatively inaccessible, more interconnected to the rest of the country.

Project Spotlight



Library of Congress

Route 66: Chicago, IL, to Los Angeles, CA 1920s-30s, 1938

Stretching from Chicago, IL, to Los Angeles, CA, Route 66, also known as “The Mother Road” and “The Main Street of America,” was one of the country’s major thoroughfares for nearly half a century. Route 66 became one of the most famous roads in America, having been popularized in American culture through books, songs, music, magazines, movies, and television shows.



Library of Congress

During the Dust Bowl of the 1930s, it was the primary route for the migration of farm workers from the Midwest to California. The migration continued during World War II due to opportunities in California. During World War II, it also became one of the key routes for moving military equipment across the country. The traffic along Route 66 also resulted in the opening on many mom-and-pop establishments such as restaurants, motels, and gas stations along the route, to service the needs of passing motorists. Route 66 captured the imagination of generations of Americans like no motor highway did before, and the many sights and roadside attractions along the Route became an important part of the tourism experience of “getting your kicks on” Route 66.

collectively named the New Deal (1933-1938). New Deal policies sought to stimulate employment through a variety of Federal programs. Public Works Administration (PWA), part of the New Deal of 1933, was a large-scale public works construction agency in the United States. The PWA built thousands of miles of roads¹² employing 1,714,797,910 person hours from 1933-1939, the equivalent of an estimated 137,404 individuals employed continually for six years, paying \$1.2 billion in wages in 1939 dollars.¹³

Projects including streets and highways represented about one-third of all projects. One of those highways was Route 66, which was completed in 1938, linking Chicago to California. Known as “The Main Street of America,” it was 2,448 miles long and crossed eight states and three time zones. For 50 years it was one of the country’s main thoroughfare, bringing farm workers from the Midwest to California, and it became a part of Americana. Many traveled Route 66 just for the sheer pleasure of driving and the sights and tourist attractions along the way.

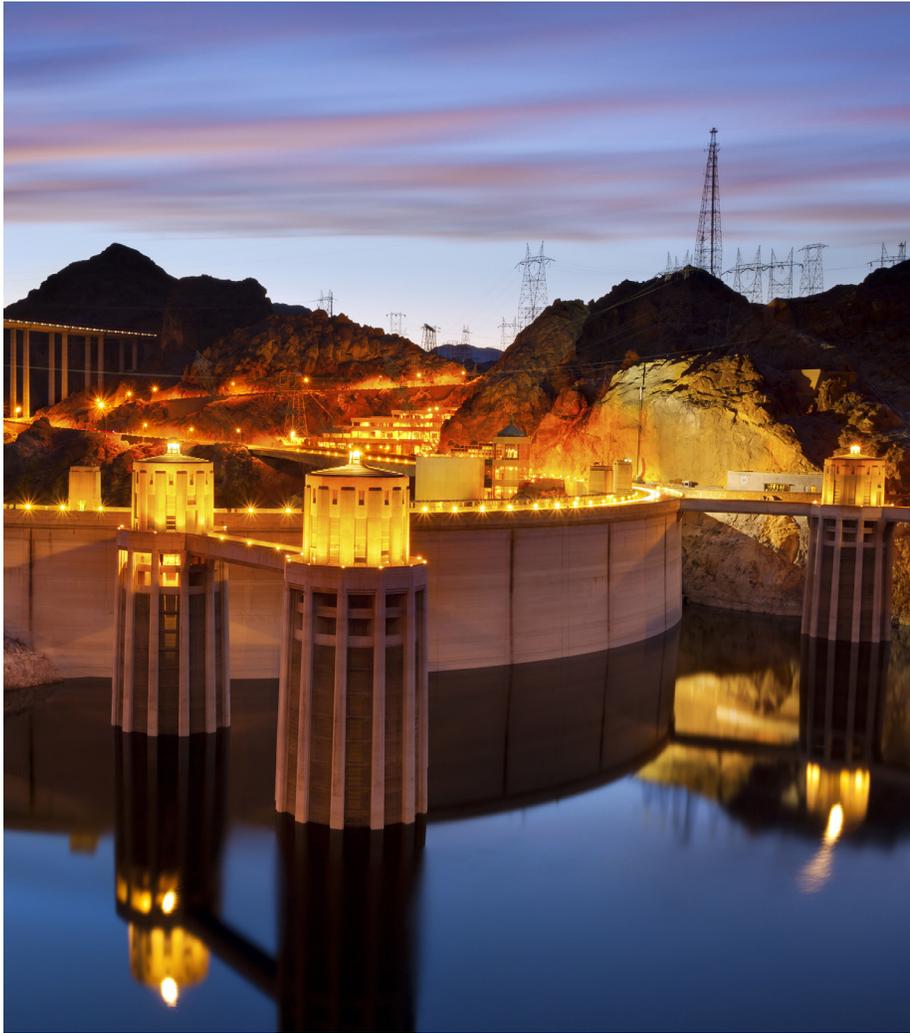


Triborough Bridge in New York City

Other notable projects included Lincoln Tunnel and Triborough Bridge. The Lincoln Tunnel is an approximately 1.5-mile-long tunnel under the Hudson River, connecting New York and New Jersey. Construction began on the Lincoln Tunnel in March 1934. It opened to traffic on December 22, 1937, charging \$0.50 per passenger car, equal to \$8.24 today. The cost of construction was \$85 million, equal to \$1.51 billion today. Hoover Dam (originally Boulder Dam) was built at the height of the Great Depression, employing a total of 21,000 men during its five years of construction.

12 PBS. (June 5, 2009). “Bridge to Somewhere: Public Works Administration”

13 Public Works Administration. (1939). “America Builds: the Record of PWA”; employment number based on author calculations using on a 40-hour work week and 52-week year.



Hoover Dam, Nevada and Arizona

1936

Rising 726.4 feet, Hoover Dam was the world's tallest dam when it was built in the 1930s. These days, it's the second-tallest dam in the United States, having been surpassed by the 770-foot-high Oroville Dam in Northern California in 1968.

- **1917** The U.S. entered World War I, and "Truck Roads" are identified as roads outpace rail in the movement of freight.
- **1918** OPRRE becomes Bureau of Public Roads (BPR).
- **1919** U.S. Army's first motor convoy travels across the country.
- **1922** The Pershing Map, the first road map showing priority roads in the event of war, is completed.
- **1924** Congress launched the first road construction program in National Parks.
- **1929** The Stock Market Crash marked the beginning of the Great Depression.
- **1932** The Emergency and Construction Act of 1932 created jobs for the unemployed.
- **1933** President Roosevelt implemented the New Deal policies.
- **1936** Construction of the Hoover Dam is completed.
- **1938** Route 66 is completed under New Deal initiatives.

Chapter Two | Access for the Nation

Library of Congress/U.S. Office of War Information



The U.S. involvement in World War II lasted 4 years (1941-1945). At the onset of World War II, government purchases rose significantly, leading to the rapid expansion of industrial output by investing vast amounts of funds into business to expand production. During this time, war traffic pounded the highways. Despite earlier Federal initiatives to add more strategic routes to the network, many of the existing roads and bridges did not meet adequate standards for military or even civilian traffic.

Large-scale highway projects of significance during WWII years were connected to the war effort. These projects were most often built in coordination with other countries. One of the most notable was the Alaska Highway, built through Canada to Alaska for military purposes. Canada supplied the right-of-way and waived customs duties, and the United States built and agreed to maintain the road during the war. The over 1,400 miles of roadway from Dawson Creek, British Columbia, to Big Delta, AK, was built in less than 2 years for a cost of \$130.6 million.¹⁴ The Alaska Highway was built to defend the territory of Alaska from threats in the Pacific and stands today as one of the boldest homeland security initiatives ever undertaken.¹⁵

One of the most notable, large-scale highway projects during World War II was the Alaska Highway, which was built in coordination with Canada. The highway was built to defend America from threats in the Pacific. Over 1,400 miles of roadway were built in less than 2 years at a cost of \$130.6 million.

14 *America's Highways, 1776-1996: A History of the Federal-Aid Program*, U.S. DOT Federal Highway Administration, pg. 149

15 <http://www.pbs.org/wgbh/americanexperience/films/alaska/>



Library of Congress/Office of War Information

As the States struggled financially to rebuild highways after the war, tolling became a way to finance large-scale projects, such as the Golden Gate Bridge and the San Francisco-Oakland Bay Bridge in California. By issuing bonds, a toll authority received funds from investors who would be repaid, with interest, from toll receipts. Some States created independent authorities to sell bonds and build toll roads. With help from Federal funding sources, Pennsylvania sold sufficient bonds to open up a 162-mile stretch of highway, called the Pennsylvania Turnpike, in October 1940. It was the first long-distance stretch of four-lane, limited-access (i.e., high speed) highway in the United States. The toll road was successful in drawing ridership and set the standard for the future design and construction of the superhighway; although many accidents occurred because of reckless speeding, as there was no speed limit. Other States began considering construction of turnpikes, but America's entry into World War II put the ideas on hold for the duration.

Proposal of a National System of Highways

President Franklin D. Roosevelt addressed Congress in 1939 with a call for action on the development of "a special system of direct interregional highways, with all necessary connections through and around cities, designed to meet the requirements of the national defense and the needs of peacetime traffic of longer range." This call to action would later lead to the design and construction of the Nation's nearly 47,000 miles of Interstate.

The increased productivity of the war years not only ended the Great Depression, but created a more prosperous nation. By 1945, the United States was the leading producer of goods in the world. This included products such as food, raw materials, vehicles, equipment, fabric, weapons, and ammunition. The Nation could no longer risk or afford to get stuck in the mud. The ability to transport goods, raw materials, and workers across the country remained a priority in the post-war years as planning continued for a national highway system.

In 1941, President Roosevelt appointed a National Interregional Highway Committee to investigate the development of a limited-access, national system of highways to improve interregional transportation. In 1943, the Interregional Highway report was completed, which proposed six possible combinations of interregional routes within a nearly 34,000-mile system of roads, 4,500 miles within the city and 29,500 miles in rural areas. The proposed system was estimated to comprise a little over 1 percent of total street and highway miles, but would carry 20 percent of all vehicle miles traveled. As rural roads were expected to carry much less traffic, they would be built with only two lanes. Standards were recommended and an estimated cost



Jeffrey M. Vinocur

The PA Turnpike then and now. The Pennsylvania Turnpike was the first long-distance stretch of four-lane, limited-access (i.e., high speed) highway in the United States. The Laurel Hill Tunnel (top) on the Pennsylvania Turnpike in July 1942. Above, a current day look at the PA Turnpike.



was proposed of \$500 million per year in rural areas and \$250 million per year in urban areas.¹⁶

The interregional highway was one of a number of postwar highway proposals used to develop the Federal-aid highway system. The Federal-Aid Act of 1944 authorized a 40,000-mile National System of Interstate Highways, but did not provide funds for its construction. The Interstate would retain many elements of the Federal-State partnership and satisfy the public's demand for long-distance highways; however, it would not be until 12 years later that such a system would be built.

Today the United States is connected by an intricate Interstate System. Thanks to the Interstate System, Eisenhower's 2-month, transcontinental journey in 1919 could now be done in 2 days.

The Interstate

In 1990, what became known as the National Interstate System was given a new name: the Dwight D. Eisenhower National System of Interstate and Defense Highways, and for a good reason. President Eisenhower (presidential years, 1953-1961) understood the need for a national, interconnected system of roads from his earlier days as Lieutenant Colonel in the U.S. Army. In 1919, he participated in the Transcontinental Motor Convoy from Washington DC to San Francisco and witnessed the woes of vehicles getting stuck in the mud, wooden bridges collapsing, and the impact of weather extremes on roadways, causing travel delays and dangerous conditions.

"A modern highway system is essential to meet the needs of our growing population, our expanding economy, and our national security."

— Dwight D. Eisenhower

16 *America's Highways, 1776-1996: A History of the Federal-Aid Program*, U.S. DOT Federal Highway Administration, pg. 152



Dwight D. Eisenhower Library

President Dwight D. Eisenhower receives members of the President's Advisory Committee on a National Highway Program on January 11, 1955.

While in office, he formed the National Highway Program Advisory Committee; which became known as the “Clay Committee” after General Lucius Clay, who Eisenhower placed in charge of proposing a financing mechanism for the Interstate System. The Clay Committee surmised that because the Interstate was predominantly national in scope and function, the Federal Government should pay for most of its cost. As a result, the Federal share would be increased to 90 percent on Interstate roads. The committee also proposed to finance the system through bonds backed by expected increases in gas tax revenue. This proposal sparked ongoing debate between the U.S. Senate and House as some representatives did not favor debt financing as a way to pay for the Interstate. Instead, a decision was made to create a fund credited with revenue from highway user taxes (primarily gas) for paying

expenses solely from the highway program. It became known as the Highway Trust Fund, created by the Highway Revenue Act of 1956.

Interstate funds would be apportioned to States based on road mileage, population, and land area. In addition, the 1956 Federal-Aid Highway Act would require that the Interstate be designed to a uniform set of standards and to accommodate a 20-year traffic forecast. The PRA would work with AASHO to develop minimum standards that would ensure uniformity of design, full control of access, and elimination of highway and railroad-highway grade crossings.¹⁷ By the summer of 1957, construction of the Interstate was underway and would continue for another 40 years.

The Interstate was initially designed to serve three main purposes: (1) connect by routes, as direct as practicable, the principal metropolitan areas, cities, and industrial centers; (2) serve the national defense; and (3) to the maximum extent practicable, connect at suitable border points with routes of continental importance in Canada and Mexico.¹⁸ President Eisenhower additionally noted four key aspects of its construction, which remain priorities to this day: (1) to reduce fatalities and injuries on the Nation's highways; (2) to keep the roads maintained and in good condition to reduce vehicle operating costs; (3) to permit a means of quick evacuation, military mobilization, and movement of goods; and (4) to manage congestion.¹⁹

Over time, the Interstate became a 41,000-mile network that connected regions, metropolitan areas, cities, and industrial and commercial centers and linked other important highways and modes of transportation. Designed for high-speed driving, it was built with controlled access points (entry and exits) and no at-grade crossings.

In his memoir, *Mandate for Change (1953-1956)*, Eisenhower writes, “more than any single action by the government since the end of the war, this would change the face of America.” The Dwight D. Eisenhower National System of Interstate and Defense Highways is regarded as one of the greatest and most important public works projects ever undertaken in the history of the United States. It is engineering marvel, credited with connecting the country beyond what anyone could have

¹⁷ Weingroff, Richard, *Federal-Aid Highway Act of 1956: Creating the Interstate System*, 1996

¹⁸ 23 U.S.C. § 103(c)(1)(C)

¹⁹ Message from the President in transmitting the Clay Committee Report to Congress, February 22, 1955

ever imagined. It has, as President Eisenhower predicted, changed the face of America.

Moving People and Freight

The Interstate system has helped shape the growth of local and regional economies. There are many cases of small towns which became burgeoning metropolises and centers for business as a result of the construction of a major highway nearby. It has also increased access for those traveling longer distances to work.

The Interstate has connected places throughout the country to intermodal hubs, such as rail yards, marine ports, and airports. These connections also help to spur non-roadway shipments for the long-haul portion of freight.

“The port has a tremendous impact on our local economy. And the highway system provides us with much needed connectivity, enabling our customers to deliver their products and goods to the storefronts and enabling our other customers to deliver their raw products and their components to manufacturers.”

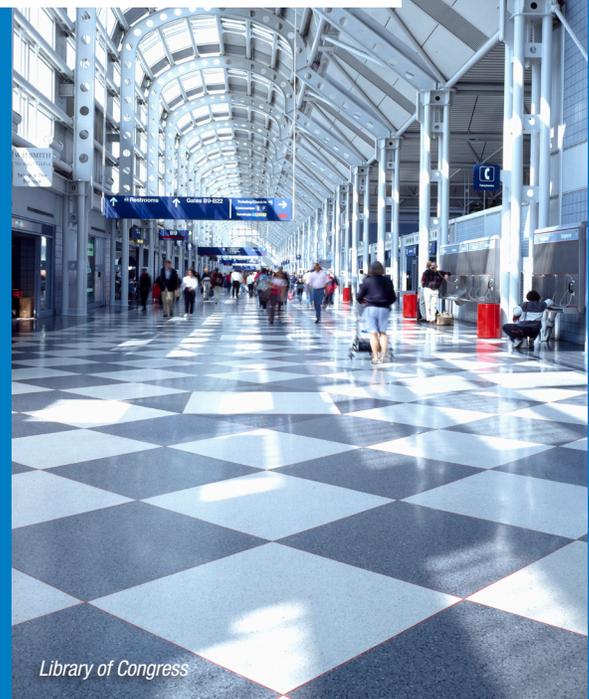
– Elizabeth Walters, Board Member
Port Panama City, Florida Port Authority

In addition, highway construction in “hard-to-travel” areas, such as mountainous regions in the Rockies, Sierras, Cascades, Pacific Coast Ranges, Appalachians, and Ozarks/Ouachitas, has opened up east-west freight transport in the United States, contributing to economic development in these regions and beyond.

The Interstate system of highways are among the safest roads to travel. The limited access nature of interstate highways reduced the number of intersections with stoplights and stop signs, helping decrease the number of car accidents and related injuries and fatalities.²⁰

The Interstate has had a significant impact on U.S. productivity. It reduced travel times in rural areas, as much as twenty percent and, by as much as fifty percent in some urban locations.²¹ Its expansion helped companies keep their transportation costs relatively low, which, in turn, has decreased product costs and increased product availability.

Project Spotlight



Library of Congress

Golden Corridor along Interstate 90, Chicago Metropolitan Area Technology and Research Corridor

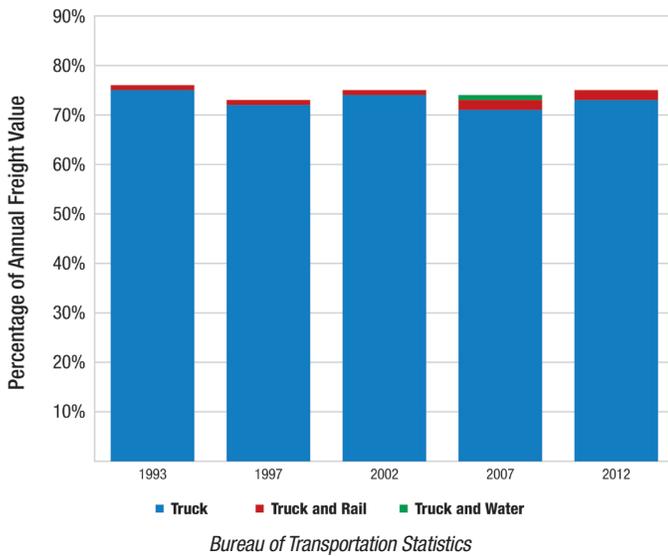
The 76-mile northwest portion of Interstate 90 opened on August 20, 1958. The Golden Corridor generates a “gold” mine of economic profit for communities in the area. Several Fortune 500 company headquarters, office parks, industrial parks, exhibition and entertainment centers, medical facilities, hotels, shopping centers, and restaurants are located along the Golden Corridor. Key to this transformation has been the improvements to the highway infrastructure. Whereas Chicago-focused travel used to be the primary factor in transportation infrastructure development, there has been a recognition of the value of pushing those improvements further west. The adjustments have already caused an economic boon, particularly in the northwest suburbs of Chicago.

O’Hare International Airport, one of the busiest airports in the world for both passengers and cargo, is just east of the Golden Corridor.

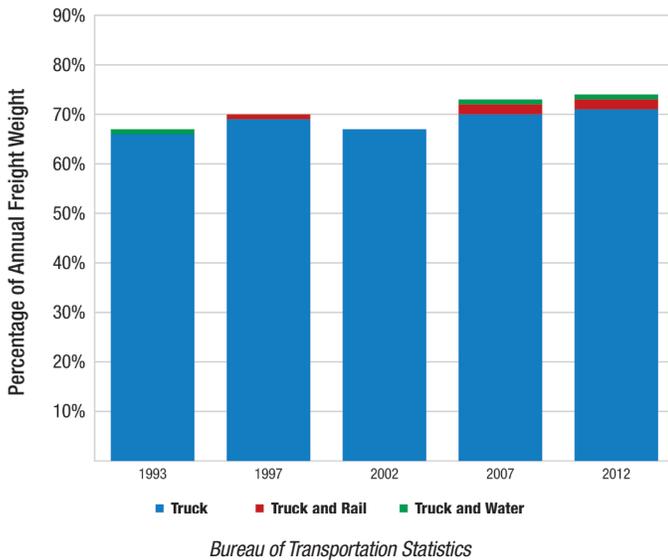
20 Friedlaender, A.F. (1965). “Table B-2”. *The Interstate Highway System: A Study in Public Investment*

21 Friedlaender, A.F. (1965). “Table B-1”. *The Interstate Highway System: A Study in Public Investment*

Trucks Move Greatest Percent of Freight by Value



Trucks Move Greatest Percent of Freight by Weight



ty. High-productivity transportation investments increase connectivity and reduce congestion; by doing so they improve economic well-being.²²

Increasing Movement of Freight

For the United States of America, 1947 to 1964 was a time of high economic growth, facilitated by the construction of the Interstate Highway System. The gross domestic product (GDP) grew at an annual compounded rate of 3.9 percent. The transport of freight in the U.S. grew considerably during this time.

Total shipment rose from 9.7 billion tons in 1993 to 11.3 billion tons in 2012, while the value of freight increased from \$5.8 trillion to \$13.9 trillion. Most freight is moved by trucks: truck or truck combined with another mode accounted for 75 percent of total freight value and 74 percent of volume in 2012.

Today, nearly 54 million tons of freight is moved across the Nation each day.²³ Nearly all freight moved by trucks is long distance (greater than 50 miles),²⁴ dependent on a network of roads that connect to intermodal centers and manufacturing plants. This intermodal system links businesses with suppliers and markets throughout the Nation and the world.

In 1994, the North American Free Trade Agreement (NAFTA) reduced trade barriers between the United States and Canada and Mexico, increasing the Nation's truck travel. Trucks carry 60 percent of U.S.-NAFTA freight and are the most heavily utilized mode for moving goods to and from both U.S.-NAFTA partners.²⁵

The shift from the manufacture of goods in the United States to countries where goods can be made and shipped for less cost has significantly increased shipments into America's ports. From 1990 to 2006, foreign trade grew from 13 percent to nearly 22 percent of the GDP, and it is expected to grow to 35 percent of GDP by 2020 and may grow to 60 percent in 2030.²⁶ Recent projects, including the Panama Canal expansion (2016), new water routes through the Suez Canal, and the possibility of an Arctic sea route may further facilitate the movement of goods, adding to congestion and security concerns, as cargo may be diverted to non-U.S. port facilities.

22 Wachs, Martin, *Transportation, Jobs and Economic Growth*, 2016

23 Bureau of Transportation Statistics, *Freight Facts and Figures 2015*, Table 2-1M

24 2010 Conditions and Performance Report to Congress, USDOT-FHWA, pg. 2-15

25 http://www.rita.dot.gov/bts/sites/rita.dot.gov/bts/files/bts45_14.pdf, 2014

26 *America's Ports and Intermodal System*, U.S. Maritime Administration, 2009



A new segment of I-78 is the missing link for travel between western New Jersey and eastern Pennsylvania.

Interstate 78

Late 1980s construction of Interstate 78, Allentown, PA to Phillipsburg, NJ – the Construction of the roughly 30-mile-long segment of Interstate 78 during the late 1980s in eastern Pennsylvania and western New Jersey provided both metropolitan area and regional-scale benefits. By opening up this previously missing segment of Interstate 78, most through-truck traffic no longer had to use U.S. 22, the primary east-west limited access highway for commuter and other metropolitan area traffic connecting Allentown, Bethlehem, Easton, and Phillipsburg. The new roadway segment improved long distance east-west truck flows between the New York City area and Harrisburg, Pittsburgh, and various Midwest and Southeast U.S. metropolitan areas.

By 2040, freight tonnage on U.S. roads is expected to increase by 45 percent.²⁷ Trucks have become a major source of congestion on the Nation's busiest highways. Increasing urbanization has led to greater challenges for moving freight in and out of cities. Population growth in metro areas is expected to increase the transport of freight to and from rural areas, requiring greater road maintenance along these corridors and creating a potential cost burden to surrounding rural communities.²⁸

Growing Vehicle Miles Traveled

Travel by people in the U.S. contribute to the greatest percentage of total vehicle miles traveled (VMT) on the Nation's roads. In 2013, nearly 90 percent of VMT was from passenger vehicles, while 9 percent was from large trucks, and the remaining 1 percent belonged to buses and motorcycles.

VMT has grown significantly since WWII. Brief interruptions in the trend occurred during recessions, but outside of these anomalies, VMT growth has been remarkably consistent and predictable for much of its measured history.



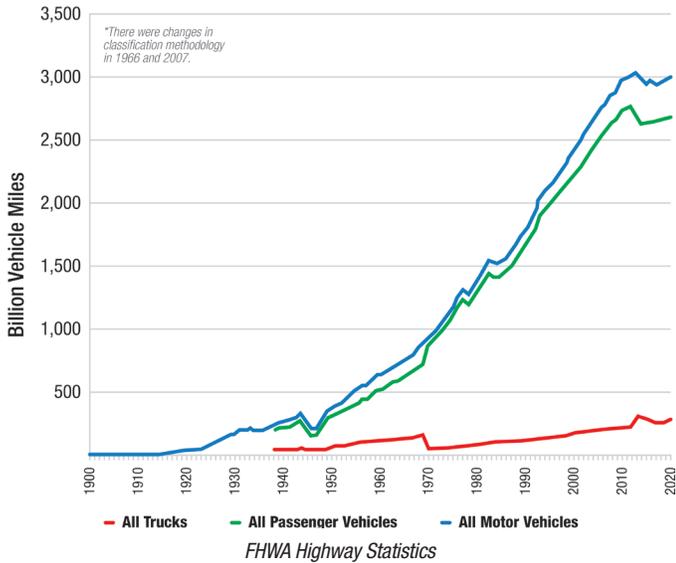
Port of Los Angeles

On December 26, 2015, the CMA CGM Benjamin Franklin container ship docked at the Port of Los Angeles. This was the first time a ship of this size docked at a U.S. port. The Benjamin Franklin is longer than the Empire State Building is high. It is wider than a football field and as tall as a 20-story building. It can carry 18,000 containers. Nine cranes were used to offload more than 11,000 containers over 56 operating hours.

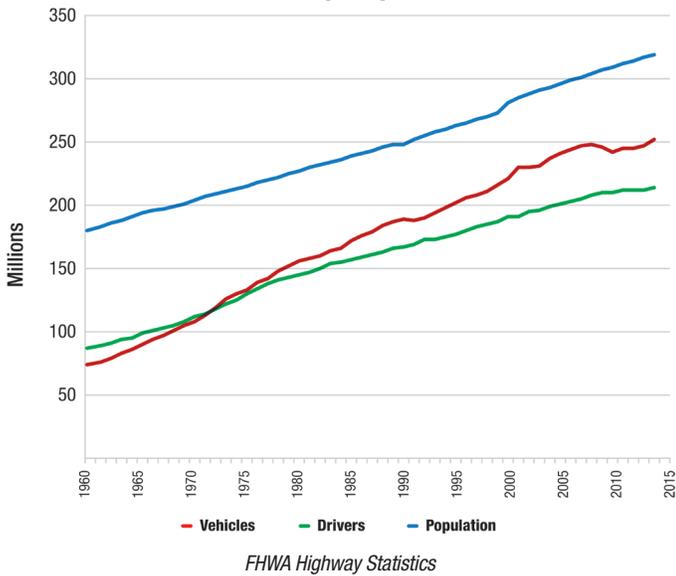
27 *Beyond Traffic 2045: Trends and Choices*, pg. 47

28 *Impact of Megaregion Growth on the Freight Needs of Rural Mid-America*, FHWA-HPTS, pg. 3

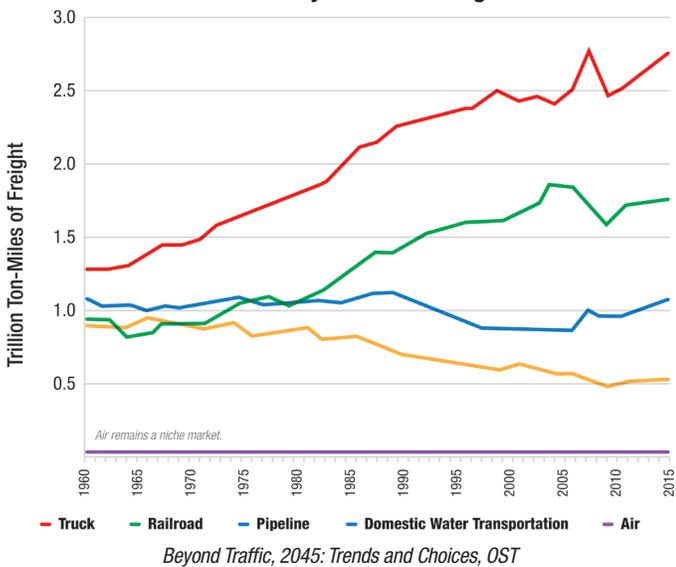
Vehicle Miles Traveled Grew over Decades



Vehicle Ownership Surpasses Drivers



Truck is a Major Mode of Freight



That was the case until November 2007, when the series peaked at 3,039 billion miles and then exhibited a decline in magnitude not seen at any other time during the post-World War II era. This decline was followed by an extended period of no growth. More recently, VMT passed the 2007 peak at 3,056 billion miles in February 2015.²⁹

All this travel on the U.S. road system could not be possible without vehicles. Private vehicle ownership expanded at roughly the same pace as population growth, as the ratio of vehicles to total population plateaued at below 0.8 since the 1990s. Drivers used to have very limited options about which household vehicle to drive in 1960, because there were fewer automobiles than licensed drivers. The situation has reversed and now there are more vehicles than drivers, and the average vehicles per licensed drivers remained slightly below 1.2 since 2000.

People travel for several reasons. While the trip to and from work is the backbone of trip making for many American families, travel for other reasons such as shopping, medical visits, and recreation make up the largest share of trips. About 80 percent of trips are generally for non-work purposes.

Jobs

Investment in infrastructure is essential during economic downturns in boosting demand and increasing market confidence. According to the International Monetary Fund, the Great Recession of late 2000s-2010 was the worst global recession since World War II.³⁰ Unemployment rose from 4.7 percent in November 2007 to peak at 10 percent in October 2009.³¹ In 2009, President Barack Obama signed into law the American Recovery and Reinvestment Act (ARRA). Much like the New Deal programs in 1933 (as discussed in Chapter 2), ARRA was an economic stimulus package with a primary objective to save and create jobs and build/rebuild the Nation's infrastructure. ARRA was the largest public works and employment program since the New Deal.

ARRA provided \$830 billion in a broad-based program of unemployment assistance, funds for State Governments, infrastructure spending, and tax breaks to assist in the recovery from the Great Recession. Of those funds, \$46 billion in Federal expenditures were for transportation and States added another \$62 billion in transportation expen-

29 FHWA Traffic Volume Trends

30 Davis, Bob (22 April 2009). "What's a Global Recession?". The Wall Street Journal. Retrieved 17 September 2013.

31 Department of Labor



ARRA, the largest public works and employment program since the New Deal, invested billions of dollars into the U.S. economy, creating millions of jobs, and lowering the unemployment rate.

ditures.³² Studies show that ARRA funding was responsible for creating 0.9 to 4.7 million jobs in 2010, lowering the unemployment rate in that year between 0.4 to 1.8 percentage points.

Jobs created during a recession as part of a Federal stimulus package to boost the economy contribute to short-term job growth, but also foster longer-term economic growth in creating a more efficient transportation system.

Percent of Average Annual Household Person Trips

Total	1990	1995	2001	2009
To or From Work	17%	18%	16%	16%
Work-Related Business	1%	3%	3%	3%
Family/Personal Errands	46%	46%	44%	42%
School/Church	9%	9%	10%	10%
Social and Recreational	27%	25%	27%	27%
Other	1%	0%	1%	2%

FHWA, National Household Travel Survey

32 U.S. Economic Impacts Attributable to ARRA, from the Congressional Budget Office (2014)

- **1939** Report to Congress on “Toll Roads and Free Roads” contained the first formal concept of the Interstate Highway System.
- **1940** The Pennsylvania Turnpike opens to the public.
- **1941** Attack on Pearl Harbor sparked U.S. involvement in World War II.
- **1944** The Federal-Aid Highway Act of 1944 established the first program for urban projects and authorized the National System of Interstate Highways.
- **1947** Interstate System announced following coordination with states and Department of Defense.
- **1952** Federal-Aid Highway Act of 1952 authorized first funding specifically for Interstate System.
- **1956** The Federal-Aid Highway Act of 1956 was signed, creating the Highway Trust Fund and providing a mechanism for financing the Interstate System.

Chapter Three | Refining the Model: Equity and the Environment

Library of Congress



Given all its contributions to national connectivity, the Interstate's high-speed nature and design had negative consequences for certain local areas. Many small towns and economically depressed areas were uprooted and/or divided due to its construction. In the early years of planning transportation projects, public involvement was encouraged, but not enforced. It wasn't until the Federal-Aid Highway Act of 1962 that States were required to engage in a cooperative planning process (3Cs) with local representation when developing highway plans and programs.³³ Within the same decade, a number of legislative acts were passed that affected the way transportation systems were planned. The Clean Air Act of 1963, and its subsequent amendments, was the first Federal legislation to control pollution on a national level. By the 1970s, transportation projects were evaluated at the regional level for their effect on six common air pollutants in areas experiencing air quality problems. The development of an Environmental Impact Statement (EIS) was required, under the National Environmental Policy Act of 1969 (NEPA), to assess impacts of certain projects on the surrounding environment; and the National Historic Preservation Act of 1966 (NHPA) would additionally require an impact assessment of projects on historical properties.

Going-to-the-Sun Road was one of the first National Park Service roadways specifically intended to accommodate the automobile tourist. The road had a significant impact on road design policy and is an example of the National Park Service's sensitive response to topography and scenic features.

In 1994, President Bill Clinton signed Executive Order 12898, which directed Federal agencies to identify and address the adverse effects of Federal projects on the health and environment of minority and low-income populations. These became known as environmental justice (EJ) requirements to include an evaluation of the potential social and economic impacts of a proposed transportation project through the NEPA review.

In recent years, there have been many Federal, State, and local initiatives by the transportation sector to resolve issues of lost system connectivity. In 2009, under U.S. DOT Transportation Secretary Ray LaHood, a partnership was formed

33 Weiner, Edward, *History of Urban Transportation Planning*, Chapter 3, 1974, <http://media.tmiponline.org/clearinghouse/utp/ch5.htm>

Project Spotlight



Park Over the Highway (CityArchRiver) I-44, St. Louis, MO 2017

Construction of the St. Louis Gateway Arch was completed in 1965. However, it was soon cut off from the rest of the city by I-44 (then I-70). In 2015, I-44 carried more than 100,000 vehicles, including about 20,000 trucks, per day.

The CityArchRiver project is now reconnecting the Arch and the community. Public engagement and public-private partnerships were key aspects of the planning process. The design includes a new, dramatic Park Over the Highway that will, for the first time, allow visitors to walk from the Old Courthouse to the Arch grounds to the riverfront on one continuous greenway, without a curb or stair step in their way. Currently pedestrians have to cross two intersections to reach the Arch grounds.

“You had a group of people that had very different cultures and goals coming together to accomplish common goals. It will be an entirely different experience for the better, in terms of getting to work and getting around the Arch grounds.”

-Ryan McClure, Director of Communications,
CityArchRiver Foundation



CityArchRiver Foundation

between FHWA, the Department of Housing and Urban Development (HUD), and the Environmental Protection Agency (EPA) called the *Partnership for Sustainable Communities Initiative*. The outcome of this partnership promoted nationwide initiatives for establishing “livable communities,” defined as areas that have demonstrated efforts through local planning and public investment to meet the various needs of the community, including the availability of affordable housing and access to jobs, healthcare, and a transportation system that supports the needs of daily life. Livable communities often have policies and programs that accommodate all modes of travel, such as “complete street” design and transit-oriented developments (TODs). Other projects may include the widening of paved shoulders along higher speed roads for walking, an interconnected network of pedestrian walkways and bike paths, and transit stops or park-and-ride lots that are located within close proximity to residential housing.

In 2015, U.S. DOT Transportation Secretary Anthony Foxx launched the *Ladders of Opportunity* and *Connecting Communities* initiatives to emphasize the practice of planning transportation projects in the context of community-level needs. Transportation projects that fall under these initiatives help to facilitate economic growth, provide access to jobs, and reconnect neighborhoods that have been negatively impacted by the placement of past, large-scale highway projects.

Initiatives to improve local connectivity and accessibility to transportation are federally-supported through a number of ways, including: grants, competitive programs, research, facilitation and technical assistance. The Federal-aid highway program also provides a small amount of funding to the States for bike and pedestrian projects, supported through past and ongoing programs such as Transportation Enhancements (SAFETEA-LU) and Transportation Alternatives (MAP-21, FAST Act).

Urbanization, Suburbanization, and Growing Metropolitan Areas

The postwar baby boom accounted for significant population increases in the United States and abroad in the 1950s and 60s. For the United States, it was a time of high economic growth and general prosperity. Mechanization of agriculture resulted in a declining need for hired labor. The farm population shrank steadily as families moved to urban areas, where on average they earned a higher standard of living.³⁴ As wages increased, a greater number of house-

34 [https://en.wikipedia.org/wiki/History_of_the_United_States_\(1945%E2%80%931964\)](https://en.wikipedia.org/wiki/History_of_the_United_States_(1945%E2%80%931964))



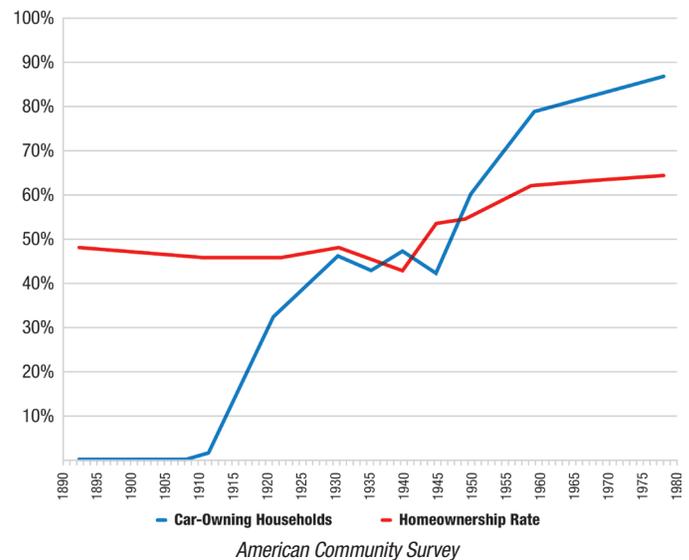
In the 1950s and 60s, technology provided for the mechanization of agriculture, which led to a declining need for hired labor. Farm populations shrank as people moved to urban areas, where they could earn a higher wage.

holds were able to afford cars. In 1945, nearly 45 percent of households in the United States owned a car; by 1965, over 80 percent of U.S. households owned a car. The landscape of America changed as more people, more cars, and more highways led to increased nationwide travel and mobility, contributing to and supporting the expansion of towns and cities and growing metropolises.

Two significant migration trends occurred in the United States after 1950, which were supported by the burgeoning highway system: 1) a movement of people away from older cities in the Midwest and to newer urban centers in the South, and 2) a movement from central cities to the suburbs.³⁵ By 1960, one-third of the Nation's population lived in the suburbs. Today, by Census definition, more than half (53 percent) of the U.S. population lives in a suburban area, 26 percent live in urban areas, and 21 percent live in rural areas.³⁶

The postwar growth of suburbs in the U.S. occurred mostly because of a housing shortage. This led to new housing construction in suburban areas and was supported by availability of low down payment mortgages and interest rates, especially for veterans.³⁷ Some studies have shown, however, that the construction of limited-access highways contributed greatly to suburban migration. A study by Nathaniel Baum-Snow, *Did Highways Cause Suburbanization?* (2006), estimates that about one-third of the change in aggregate central city population to metropolitan area population is due to the development of highways.³⁸ This was because the new, limited-access highway system was designed to link faraway places, not to facilitate local commuting. Today, highways

Car and Home Ownership Rates Grew Immediately after WWII



35 Pisarski, Alan, chapter on "US Roads" in *Millennium Book*, (International Road Federation, 2001)

36 Kolko, Ted, "How Suburban Are Big America Cities?" May 21, 2015; Data used from the 2008-2012 American Community Survey

37 <http://columbusneighborhoods.org/neighborhood/south-side/south-side-lesson-plan/1950s-1960s-boom-migration-industrial-decline/>

38 Baum-Snow, Nathaniel, *Did Highways Cause Suburbanization?* July 26, 2006, pg. 1

SAFETY FOCUS

Since the 1960s, car ownership in the United States and vehicle miles traveled (VMT) have increased, but the fatality rate on the highway system has significantly decreased. There has been a 78 percent reduction in the fatality rate from 1962 to 2012.¹ Gains in roadway safety are a result of a combination of regulatory actions, policy changes, law enforcements, and improved technologies and safety measures.

Reducing fatalities and injuries and improving roadway safety is a priority goal of the U.S. DOT. Among Americans aged 1 to 34, motor vehicle crashes are the leading cause of death.² Crash injuries have resulted in billions of dollars of lost work and medical costs. The FHWA has a history of partnering and advancing research in the area of safety, which has led to safer highway design and development of infrastructure that mitigates crashes.

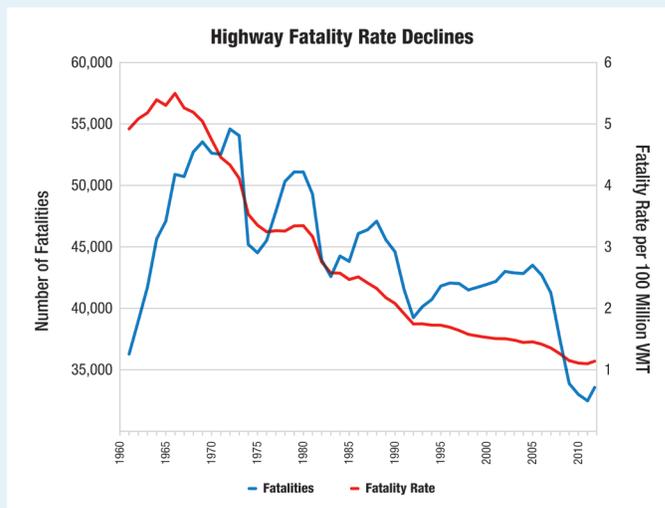
In 1966, Congress passed the Highway Safety Act,³ which required all States to create a highway safety program and to adhere to uniform standards promoted by the U.S. DOT as a condition of receiving federal highway-aid funds. In the same year, AASHTO conducted a nationwide survey of highways which resulted in a number of published reports on making highways safer. *Highway Design and Operational Practices Related to Highway Safety* (1974), known as the “yellow book,” included recommendations on highways designed with safety features. One of the first advocated features of design was the “clear roadside” concept, as more than one-third of accidents were vehicles running off the road and colliding with roadside objects.⁴ Highway design integrated this concept by keeping shoulders clear of formidable objects and creating roadside infrastructure to assist vehicles to recover and reenter the roadway, such as placing guardrails in front of essential roadside objects.

Also in 1966, the National Traffic and Motor Vehicle Safety Act made the installation of seatbelts in motor vehicles mandatory. Seat belts prevent drivers and passengers from being ejected from a crash. Among drivers and front-seat passengers, seat belts reduce the risk of death by 45 percent, and cut the risk of serious injury by 50 percent.⁵ Advancing vehicle technologies have included the installation of air bags in the 1980s and passenger restraints such as child safety seats, to present-day vehicle warning systems using sensors and GPS and other automated features.

The standardization of signs and devices on the highway system promoted greater familiarity, and were designed to guide, warn, and inform drivers. Traffic control devices include signs, pavement markings, roadside delineators, and traffic signals. In 1971, the Manual on Uniform Traffic Control Devices (MUTCD) was approved by the FHWA as the national standard for all highways open to public travel.⁶ The manual is widely used by practitioners as guide for implementing standards for design, location, installation, and operation of all forms of traffic control devices and is updated periodically. The National Committee on Uniform Traffic Control Devices advises the FHWA on additions, revisions, and changes to the MUTCD.

Research at the national level has made significant contributions to improving roadway safety infrastructure and analysis. In 1980, the Haddon Matrix (developed by William Haddon in 1970) became the most commonly used approach for analyzing a crash site and developing countermeasures or interventions that could have been implemented to reduce the likelihood or lesson the severity of the collision. The matrix provides a range of potential issues addressed through a variety of counter-measures, including education, enforcement, engineering, and emergency response solutions.⁷

Recent innovations as a result of investment in roadway safety and design have produced a number of safety features which have been implemented in areas across the Nation, including alternative intersection designs such as roundabouts, rumble strips, reduced pavement edge drop-offs, and the application of high-friction surface treatments at critical locations. Also, the collection of electronic roadway and crash data has provided insight into better understanding characteristics of high-risk crash locations and strategies for mitigation.



Fatality Analysis Reporting System/National Center for Statistics and Analysis, NHTSA

1 Beyond Traffic, 2045: Trends and Choices, OST

2 NHTSA, Traffic Safety Facts, 2009

3 P.L. 89-564, 72 Stat. 885 (1966); codified at 23 U.S.C. § 401 et seq.

4 America's Highways, 1776-1996: A History of the Federal-Aid Program, U.S. DOT Federal Highway Administration, pg. 403

5 Center for Disease Control, Motor Vehicle Safety, <http://www.cdc.gov/motorvehiclesafety/seatbelts/index.html>

6 America's Highways, 1776-1996: A History of the Federal-Aid Program, U.S. DOT Federal Highway Administration

7 Highway Safety Improvement Program Manual, FHWA, C. The Haddon Matrix

that once linked distant towns may also serve as major local arterials.³⁹ These roads can become easily congested and costly to maintain, placing greater demands on local and regional transportation systems.

Multimodal Emphasis

It was not until the Federal-Aid Highway Act of 1944 that a program for urban projects was established.⁴⁰ Before then, most projects took place in rural and underdeveloped areas where the adverse impacts of highways on the environment were minimal or less recognized. After the war, traffic volumes on urban arterials adjacent to the Interstate became so large that there was a need to assess the adverse impacts of pollution and delays on the local population. Metropolitan planning organizations (MPOs) were introduced by Congress, through the Federal-Aid Highway Act of 1962, to ensure that a transparent and comprehensive (3-C) planning process, which involved public engagement, was used in the selection and planning of projects in urbanized areas with a population greater than 50,000. Federal funding for transportation projects and programs is channeled through this planning process. As of 2015, there are 408 MPOs in the United States.⁴¹

Since the formation of MPOs, greater emphasis has been placed on the integration of other modes of travel to alleviate congestion in higher-density areas. Examples of infrastructure that supports a multimodal system include some of the following: light rail placed in highway right-of-way; bus rapid transit lanes; dedicated bike lanes, paths and facilities; sidewalks and pedestrian walkways; and parking spaces for carpools.

In the 1960s, mass transit also became recognized as a significant means of travel to accommodate the country's population boom and growth in urban areas. President Lyndon Johnson signed the Urban Mass Transportation Act into law on July 9, 1964, which provided \$375 million in capital assistance over 3 years and created the Urban Mass Transit Administration (UMTA). In 1991, UMTA was renamed the Federal Transit Administration (FTA) and became a modal agency under the U.S. DOT.

The completion of the Interstate System in the 1980s led to a shift in highway program focus from constructing roads to supporting long-distance travel to maintenance and managing congestion on existing systems. In the 1990s, greater consideration was given in Federal legislation to planning at

39 Vock, Daniel, "States Try to Unload Local Roads," April 10, 2014

40 *America's Highways, 1776-1996: A History of the Federal-Aid Program*, U.S. DOT Federal Highway Administration, pg. 370

41 https://en.wikipedia.org/wiki/Metropolitan_planning_organization

Project Spotlight

Colorado Department of Transportation



I-70, Colorado, Eisenhower/Johnson Memorial Tunnels and Glenwood Canyon 1973, 1979, 1992

The Eisenhower/Johnson Memorial Tunnels and the Glenwood Canyon Project represent successful partnerships between FHWA and the state of Colorado to complete the U.S. Interstate System and spur economic growth in the region. The projects were largely funded with federal dollars and have become a major contributor to the safe movement of people and goods across the Continental Divide and to the Colorado tourism industry.

The Eisenhower/Johnson Memorial Tunnels, the highest vehicular tunnels in the world, improve connectivity, travel safety and reliability between east and west by uniting the state through the Rocky Mountains and the Continental Divide. The construction of I-70 at Glenwood Canyon was one of the most challenging settings for an Interstate highway. Forty-plus bridges and viaducts as well as a tunnel were used to minimize damage to the environment. Since the route through Glenwood Canyon was upgraded to an interstate, the number of annual crashes dropped nearly 40 percent in the years following construction, despite significant increases in traffic volume.

I-70 has had tremendous impact on tourism in Colorado and improved the efficiency and safety of movement of people and goods through the Rocky Mountains. It has also enabled both residential and commercial development in mountain areas along the route.

TECHNICAL ASSISTANCE

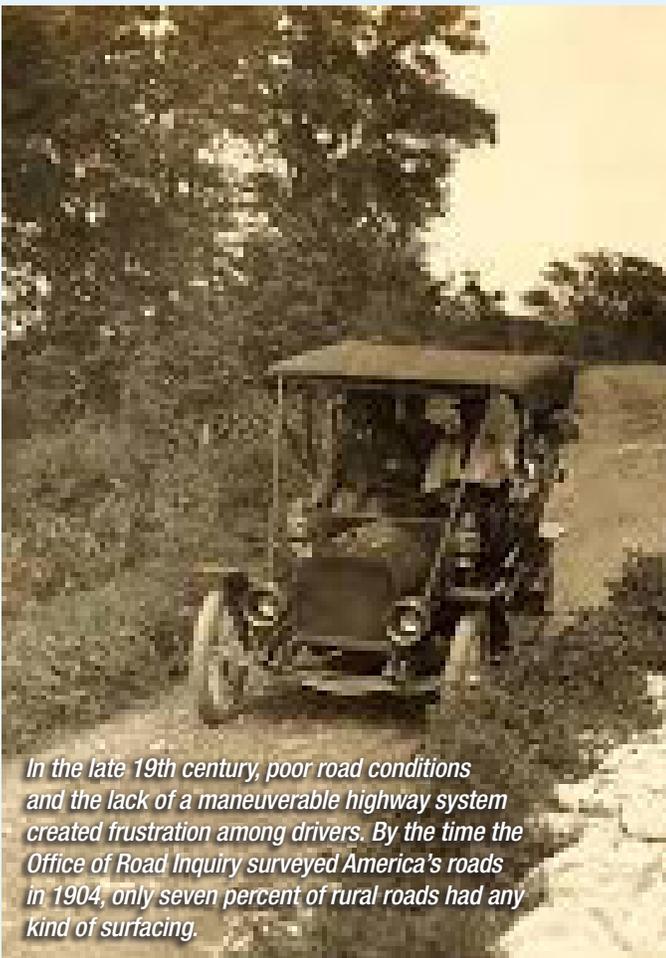
By the late 19th century, roads outside of cities had fallen into terrible shape from lack of State or local interest. The roads were mostly dirt and impassable in rain. On dry days, passing vehicles spewed dust behind them. Lack of funding, the absence of engineering skill, and acceptance of bad roads as normal were among the reasons the general public had a bad opinion of the roads.

In 1893, the Office of Road Inquiry, with a \$10,000 budget, began to gather information on the best ways to build roads that local communities could afford. It shared that information with State and local officials in bulletins and speeches to help them build support for increased road funding. In the mid-1890s, the little office formalized the dissemination of information by launching a program of object lesson roads. An engineer from the office traveled around the country, giving lectures and supervising construction of a short stretch of road while explaining how it was built, using borrowed equipment, on the theory that “seeing is believing.” Once residents saw the value of this short object lesson road, they would want it extended to improve travel.¹

The object lesson approach was expanded in the early 20th century when the Federal agency participated in Good Roads Trains. A railroad line would conduct a special tour of part of the country, with lectures delivered and object lesson roads built at each stop. The train also contained exhibits on road building and the benefits of road improvement. These early efforts helped build support for good roads around the country.

Since the time of “Good Roads Trains” to this present day, much of the work of FHWA has been to provide technical assistance and facilitate information sharing among States and transportation agencies to improve the quality of the road system. The National Highway Institute is the training and education arm of FHWA. Since being established by Congress in 1970, NHI has provided numerous trainings to the transportation community in 16 learning areas from structures and pavements to real estate and communications.

Because of the global nature of transportation today, NHI reaches beyond the Nation’s borders to develop relationships with transportation professionals around the world. For more than 20 years, NHI and FHWA’s Office of International Programs have collaborated to provide training to dozens of countries including Iraq, Korea, and Kuwait. Together, NHI and its partners support the training and educational needs of the transportation workforce.²



Springfield Missouri Convention & Visitors Bureau

In the late 19th century, poor road conditions and the lack of a maneuverable highway system created frustration among drivers. By the time the Office of Road Inquiry surveyed America’s roads in 1904, only seven percent of rural roads had any kind of surfacing.

“The Work of the Office of Public Roads is entirely educational and investigative. In our educational work we endeavor to arouse a vigorous yet conservative public sentiment in favor of a betterment of the public roads. We endeavor by advice and suggestion to aid in bringing about needed reforms in road legislation and administration and to introduce by practical and instructive methods the form of construction and maintenance best adapted to each locality.”

– Logan Page, Director, OPR, 1909

1 Contributed by Richard Weingroff, FHWA Historian

2 NHI website, <https://www.nhi.fhwa.dot.gov/home.aspx>

Trimet Portland Oregon



CityArchRiver Foundation



the corridor level in the context of the needs of the surrounding environment. Two landmark bills were passed: the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) and the Transportation Equity Act for the 21st Century (TEA-21). In 2005, the Safe, Accountable, Flexible, Efficient, Transportation, and Equity Act: A Legacy for Users (SAFETEA-LU) was passed, which guaranteed funding for highways, highway safety, and public transportation totaling \$244.1 billion—the largest surface transportation investment in the Nation’s history.⁴²

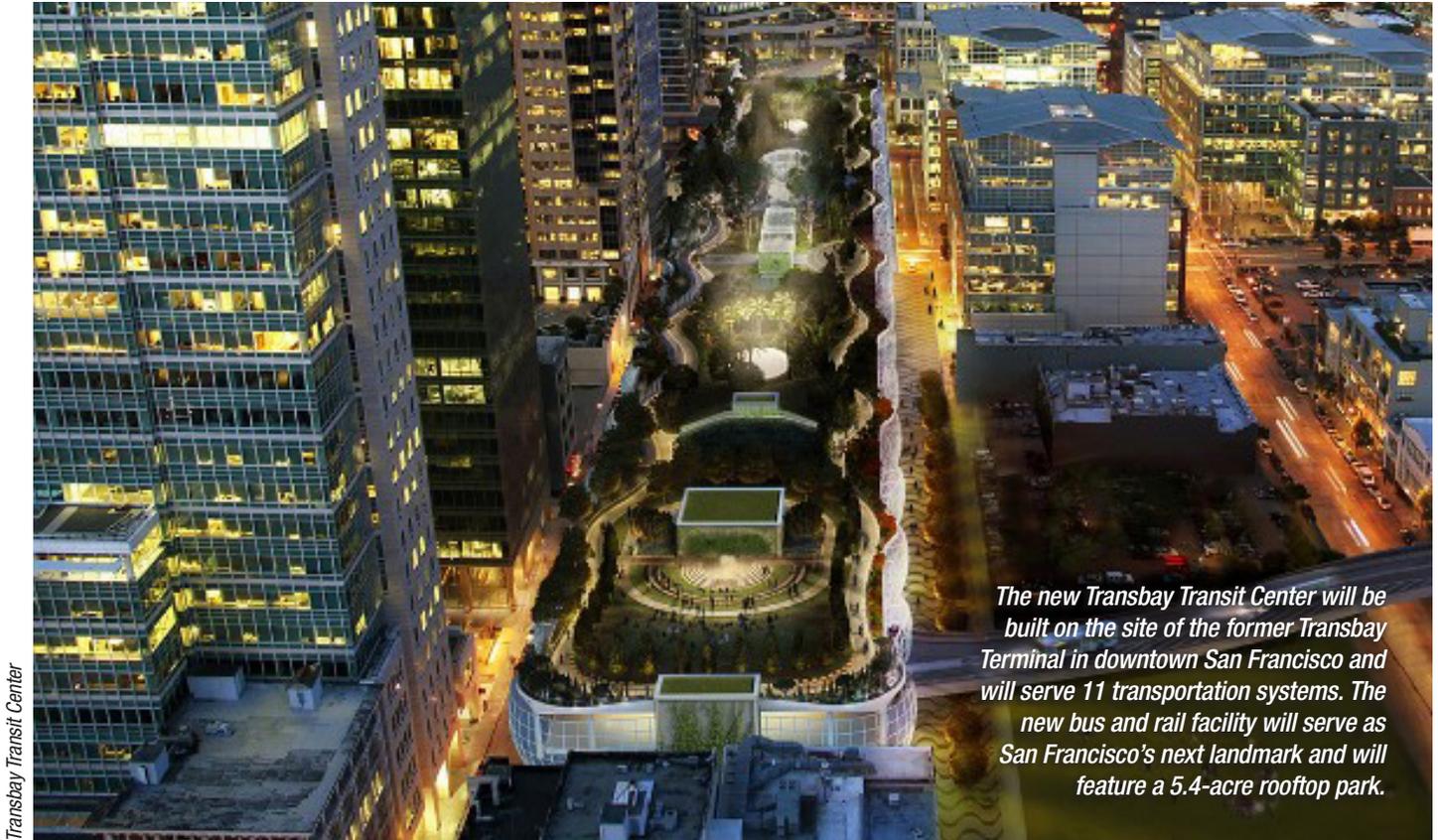
The first bridge of its kind in the U.S., the Tilikum Crossing bridge (top) carries trains, buses, streetcars, cyclists and pedestrians over the Willamette River in Portland, OR.

Cyclists use new bike paths (above) near the Gateway Arch in St. Louis, MO, to get to work and connect with the community. The bike paths are part of the renovation of the Arch and its grounds. The project, led by the CityArchRiver Foundation, connects the Gateway Arch grounds with the riverfront of St. Louis and the region.

42 A Summary of Highway Provisions in SAFETEA LU, <https://www.fhwa.dot.gov/safetealu/summary.htm>, August 25, 2005

- **1962** The Federal-Aid Highway Act of 1962 was signed, requiring cooperative, comprehensive, and continuing (3C) planning process on federal aid projects.
- **1964** The Urban Mass Transportation Act was signed, creating the Urban Mass Transportation Administration (now the Federal Transit Administration).
- **1966** National Traffic and Motor Vehicle Safety Act enacted making seat belt installation mandatory.
- **1967** FHWA is established within the U.S. Department of Transportation.
- **1969** The National Environmental Policy Act of 1969 developed the Environmental Impact Statement.
- **1970** National Highway Institute (NHI) established.
- **1971** Manual on Uniform Traffic Control Devices (MUTCD) approved by FHWA as national standards.
- **1973** The Federal-Aid Highway Act of 1973 was signed, funding the Highway Safety Improvement Program (HSIP).
- **1975** Corporate Average Fuel Economy (CAFE) standards enacted in response to the oil crisis resulting from the oil embargo.
- **1980** Haddon Matrix adopted for crash site analysis.
- **1991** Intermodal Surface Transportation Efficiency Act (ISTEA) was enacted.
- **1998** Transportation Equity Act for the 21st Century (TEA-21) was enacted.
- **2005** Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) was enacted.
- **2009** The American Recovery and Reinvestment (ARRA) Act is signed into law.
- **2011** Every Day Counts (EDC) Innovation Initiative launched by FHWA.
- **2012** Moving Ahead for Progress in the 21st Century is signed into law.
- **2015** The Fixing America’s Surface Transportation (FAST) Act was enacted.

Chapter Four | America at the Crossroads: Progress for the Next Century

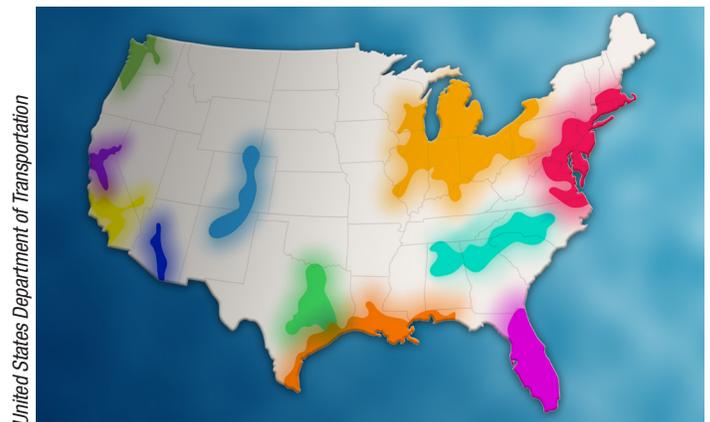


Transbay Transit Center

The U.S. transportation infrastructure system today consists of an extensive network of highways and streets, bridges and tunnels, mass transit facilities, railroads, airports and airways, ports and waterways, and pipelines. It relies heavily on public investment with some public-private partnerships. Virtually everything moves via the transportation system at some point, regardless of what it is or where it is purchased.

A strong economy requires the safe, reliable, and efficient movement of goods. Our Nation's highway system is a critical mode that makes that happen. What would happen if our transportation system became inoperable or ceased to exist? It would have major economic impacts. Within days or even hours, assembly lines come to a stop, hospitals run out of essential supplies, fuel becomes scarce, and grocery stores run out of perishables.

Within the past three decades, expanding metro areas have also spawned a network of metropolitan centers connected to one another by local/regional economies and through shared infrastructure and environmental landscapes, called megaregions. These areas represent over 75 percent of our population and employment.⁴³ The U.S. DOT has identified 11 emerging megaregions:



The U.S. DOT has identified 11 emerging megaregions: the Northeast, Florida, Piedmont Atlantic, Gulf Coast, Great Lakes, Texas Triangle, Arizona Sun Corridor, Front Range, Cascadia, Northern California, and Southern California.

43 Beyond Traffic, 2045: Trends and Choices, OST

gions: the Northeast, Florida, Piedmont Atlantic, Gulf Coast, Great Lakes, Texas Triangle, Arizona Sun Corridor, Front Range, Cascadia, Northern California, and Southern California.

Megaregions connect areas across county and state lines and are linked together by transportation and communication networks. Travel is expected to increase within the megaregions, and it will require a system that most efficiently uses all travel modes and strategies to manage increasing congestion.

The integration of the Internet into daily life has changed the way many goods are sold and purchased. From 2003 to 2013, e-commerce sales quadrupled (U.S. Census), from \$64 billion in sales to \$283 billion. Package deliveries have increased as a result of e-commerce sales. For example, in 2013, UPS delivered about 182 million for the largest online retailer, Amazon, about 30 percent of the total packages delivered,⁴⁴ placing greater demands for travel on highways and local roads.

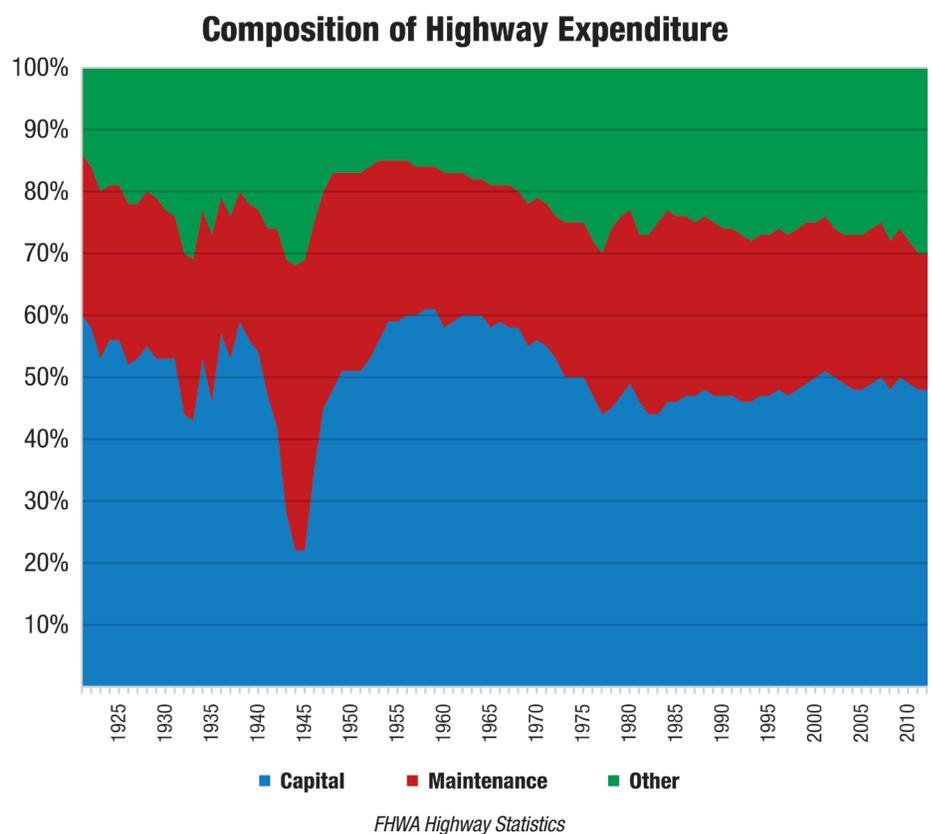
Advancements in Information Communication Technologies (ICT), access to broadband services, and use of Global Positioning Systems (GPS) and real time data will increase personal understanding and use of the transportation system. It is expected that the Nation's highways are soon to be connected by more than asphalt and concrete, but through a virtual network of bands of communication that will become the driving force of the future.

Funding for Highways

Between 1921 and 2012, public funding for highways increased from \$14.9 billion to \$208.5 billion (in 2010 constant dollars), averaging about 2.4 percent per year. Over time, the composition of highway expenditure had shifted and capital investment used accounted for about 60 percent of total spending before the 1960s to support the construction of the National Highway System. This ratio has dropped to around 48 percent in recent years, while the share of maintenance remained relatively stable between 20 to 30 percent.

Combined expenditures for highways by all levels of government totaled \$221.3 billion in 2012, with the Federal Government funding \$47.4 billion [including \$3.0 billion authorized by the American Recovery and Reinvestment Act of 2009 (ARRA)], States \$105.8 billion, and local governments \$68.1 billion. Most of the Federal funding was in the form of grants to State and local governments; direct federal expenditures for federally owned roads, highway research, and program administration totaled \$3.2 billion.

Highway capital spending totaled \$105.2 billion, or 47.5 percent of total highway spending in 2012. Spending on maintenance totaled \$35.1 billion, \$12.9 billion was for highway and traffic services, \$16 billion was for administrative costs (including planning and research), \$17.8 billion was spent on highway patrol and safety, \$11.6 billion was for interest on debt, and \$22.6 billion was used to retire debt.



44 Sanford C. Bernstein Analysts estimate, <http://www.wsj.com/articles/for-ups-e-commerce-brings-big-business-and-big-problems-1410489642>

Increased government spending can have a multiplying effect on other industries in the form of direct and indirect impacts. Direct impacts are from the investment-related industries, and indirect impacts are from up and down stream manufacturing sectors and nonmanufacturing industries and services.⁴⁵

Investment in infrastructure, largely highways and bridges, can spur economic activity. Highway investment usually yields positive returns compared with other types of government spending such as direct purchase, consumer subsidies, and tax credits.⁴⁶

Studies by the Congressional Budget Office and Federal Reserve Bank suggest that every \$10 billion increase in transportation infrastructure investment will lead to an increase in economic output (GDP) between \$13 billion to \$20 billion, depending on the overall state of the economy.

The Bureau of Economic Analysis (BEA) has identified higher multipliers for investment in highways than many other types of infrastructure investment. BEA estimates a highway investment multiplier of 2.0 (meaning a \$2 increase in GDP for every dollar spent), compared to 1.8 for electric power infrastructure and 1.6 for water/sewage infrastructure. A review of economic impacts of highway expenditure by FHWA suggested that the economic multiplier of highway expenditure is in the range between 1.26 and 1.86.

As a fixed asset, the Interstate System itself contributes to the economy. In replacement dollar terms, the total value of the highway and street infrastructure is the “single largest category of public infrastructure capital” (Bhatta 2005). Twenty-five percent of the government fixed assets as reported by the Bureau of Economic Analysis are highways and streets (USBEA 2015). Highway capital is estimated to have accounted for 32 percent of annual productivity growth from 1952 to 1963. As the Nation’s focus has shifted from building to maintaining and selectively adding to the highway network, productivity has moderated.

The level of highway capital expenditure as a share of GDP has fluctuated around 0.6 percent since 2000, which exceeded that of the U.K. and Germany but lagged behind many other industrialized countries including Italy, France, Russia, Canada, and Spain. By way of comparison, Australia invested in highways at about twice the share of GDP as the United States, while Japan devoted more than three times the share of GDP as the United States during the same period.

45 White House, 2016

46 White House 2014, Congressional Budget Office 2015



The image shows the exterior of Denver Union Station, a historic building with ornate architectural details. A large sign above the entrance reads "CRAWFORD HOTEL". Above that, a sign for "UNION STATION" is visible. The image is part of a "Project Spotlight" section, with a blue background and white text. The text describes the FasTracks program and the renovation of Denver Union Station.

Project Spotlight

Denver Union Station, FasTracks Program

The Denver region has been growing rapidly for the past several decades, and the City of Denver is one of the fastest growing large cities in the United States. All of this population growth has increased the need for major transportation system investments. During the past two decades, downtown Denver has transformed from an uninspiring industrial landscape to a trendy urban environment offering a high quality of life for professionals increasingly attracted by what the city has to offer.

Denver-based Regional Transportation District (RTD) launched its FasTracks program in 2004, a multi-billion-dollar expansion effort designed to meet the region’s infrastructure needs. The plan will add 122 new miles of light rail and commuter rail, 21,000 parking spaces at commuter stations (such as RTD Park-n-Ride lots), and 18 miles of Bus Rapid Transit (BRT) to the region. Overall, the FasTracks project includes \$7.8 billion in project expenditures. The project’s financial plan includes \$1.4 billion in Federal New Starts Grant funding as well as \$215.1 million from other Federal grants.

At the heart of the FasTracks program is the renovated Denver Union Station, which opened in 2014 with new commuter rail platforms and an underground bus concourse with 22 gates at the Union Station Transit Center, a multimodal hub where light rail, commuter rail, intercity rail, special rail services, Amtrak, intercity buses, and RTD buses meet. The \$500 million project, a public-private collaboration separate from the FasTracks program, included development of the 10 blocks surrounding the station, adding residential, office, and retail space. The project was funded by a variety of State and local programs, including a \$45.3 million FHWA grant and a \$28.4 million ARRA Stimulus grant. Most of the new rail and bus routes funded by the FasTracks program converge on Union Station, including the new A Line that runs from Denver Union Station to Denver International Airport.

United States Department of Transportation

ADVANCING TECHNOLOGY



The bridge deck was built offsite just next to I-35E on temporary abutments. A self-propelled modular transporter (SPMT) was used to move the new deck into place. With the use of accelerated construction techniques, the closure of Maryland Ave. was reduced from 4 to 2 months. I-35E lane restrictions were also reduced from 12 to 3 days.

Applied Research Associates

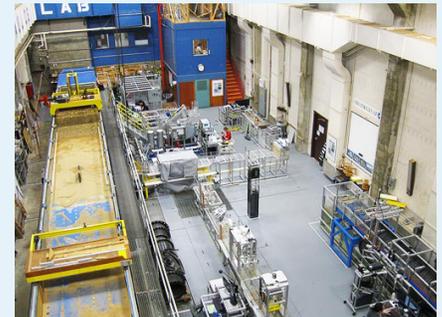
The FHWA is responsible for ensuring that the Nation's roads, bridges, and transportation systems are the safest and most technologically sound in the world. Federal funding has advanced the adoption of technologies and methods that produce clear public benefits when private investment is neither present nor sufficient. FHWA coordinates with State DOTs, and local agencies, industry, and academia to conduct, deploy, and implement products and methods that improve project delivery and lead to system-wide improvements.

From the administrative level, the agency spearheads research initiatives of national interest and facilitates a culture of innovation in the transportation community in partnership with public and private stakeholders. In partnership with the American Association of State Highway and Transportation Officials (AASHTO) and other transportation stakeholders, the agency has worked to foster a culture of innovation through Every Day Counts (2011 to 2018), an initiative that focuses on accelerating project delivery and getting proven innovations quickly and broadly deployed to benefit road users.

Some of these innovations include:

- 3D engineered models
- Data-driven safety analysis
- Smarter work zones
- Accelerated bridge construction

In addition, the FHWA's Turner-Fairbank Highway Research Center (TFHRC) works to implement the agency's research and technology initiatives and coordinates with other entities involved in transportation research within the United States and internationally. TFHRC houses more than 20 laboratories, data centers, and support facilities and conducts and sponsors applied and exploratory advanced research on vehicle-highway interaction, nanotechnology, safety, pavements, bridges and other highway structures, human-centered systems, operations and intelligent transportation systems (ITS), and materials.



The J. Sterling Jones Hydraulics Research Laboratory at the Turner-Fairbank Highway Research Center, which conducts applied and exploratory advanced research.

“The full impact of transportation research and innovations is usually realized over years or decades as the products are implemented across the transportation system and advance the state of the practice.”

The FHWA 2015 R&T Story

As a share of GDP, the transportation infrastructure investment has declined, from 1.4 percent in 1990 to 0.8 percent in 2014. Studies have identified investment needs in the United States of between \$1.7 and \$2.2 trillion (in 2015 dollars) over the next 10 years to maintain the conditions and performance of the surface transportation system, as well as add new capacity to meet future anticipated growth in passenger and freight transportation needs.⁴⁷ Receipts from the existing Federal excise taxes are not adequate to support the current investment levels or meet future capacity needs.

It was estimated that there was an \$830.0 billion backlog of cost-beneficial highway and bridge investments as of 2012. Approximately \$156.8 billion (18.8 percent) of the total backlog is for the Interstate System, \$394.9 billion (47.2 percent) is for the NHS, and \$644.8 billion (77.1 percent) is for Federal-aid highways.

FHWA's study indicated that capital spending was \$105.2 billion in 2012. An annual investment of \$142.5 billion is required in order to fund all the projects which are cost-beneficial by 2032. About \$85.3 billion (59.8 percent) would be directed toward improving the physical condition of existing infrastructure assets (system rehabilitation); this portion is identified as the State of Good Repair benchmark. The remaining \$35.7 billion (25.1 percent) would be directed toward system expansion and \$21.5 billion (15.1 percent) for system enhancement.

Considering the outcomes and the costs associated with a dysfunctional transportation system, what are the results? A system where congestion would become unmanageable, accidents would skyrocket, and access for many areas of the country would be cut off. A century of public investment, along with vision, collaboration, and hard work has afforded us the transportation system that we have today.

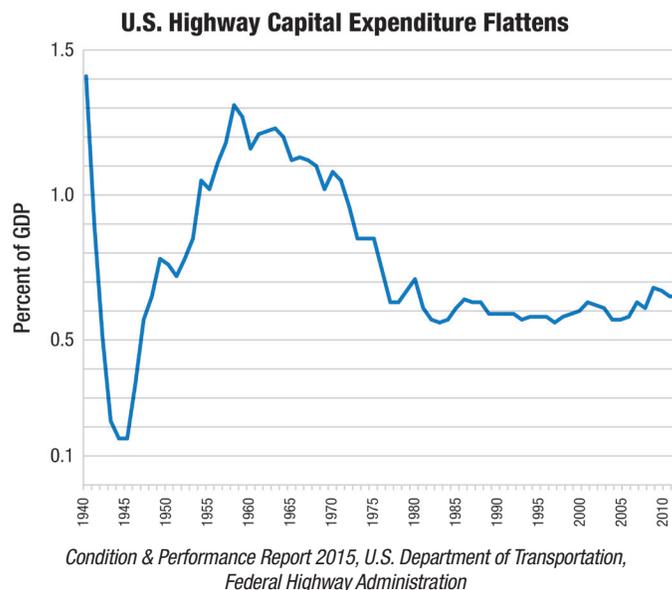
Conclusion

We have lived in and enjoyed an era of great transportation. Safe, efficient, and affordable travel facilitates economic growth and improves quality of life for us all. The U.S. economy has experienced ups and downs, but the demand for safe, fast, and reliable road transportation never diminishes. Through its history, the highway system has supported national economic growth, providing opportunity, and an improved quality of life for all Americans. Not only are the impacts of the U.S. road system multifaceted, the highways are uniquely intertwined with American accomplishments, struggles, and our national identity.

The United States has been and is still heavily dependent on the personal automobile for mobility. Changes in technology, demographics, economics, and attitudes are transforming how mobility is attained, highlighting the importance of roads in a vast transportation system of bike lanes, rail lines, flight paths, and subways. Today, communities benefit from more travel options. Towns that were once divided by highways are now reconnected through projects that promote economic growth and vitality and provide greater access to goods and services.

At the same time, advances in information technology are opening new ways for people and industry to access and share transportation more safely and efficiently. These transformative trends are reshaping how we think about transportation policy, operations, and planning.

From the earliest days of dusty dirt trails and muddy paths to the superhighways of today—transportation touches everyone's life. Keeping America on the move requires thinking ahead about the needs and challenges that await us. What is the vision for the next century of travel and how do we get there?



47 Projections by the FHWA, the American Society of Civil Engineers (ASCE), AASHTO and the Airport Council International-North America (ACI-NA).



U.S. Department of Transportation
Federal Highway Administration