

Planning and Financing Infrastructure in the Trump Years: What Can the Administration Learn from Previous Large Infrastructure Programs?

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ABSTRACT

President Trump has called for a \$1 trillion infrastructure plan. To help inform the current infrastructure debate, this paper examines three major infrastructure initiatives of the past, including the canal and railroad era of the 19th century, the New Deal infrastructure programs during the Great Depression, and the interstate highway program of the 1950s and 1960s. Drawing on those historical infrastructure initiatives, as well as other sources, this paper identifies factors that may be useful to consider when developing a national infrastructure plan for the future.

INTRODUCTION

In June 2017, President Trump released a \$1 trillion infrastructure plan to rebuild America's infrastructure. Although specific provisions have not been released, the plan proposes (1) to decrease the average permit time from 10 years to two years, (2) to "unleash private sector capital and expertise to rebuild our cities and states," (3) to invest in rural infrastructure, (4) to "reimagine America's approach to infrastructure with transformative projects," and (5) to initiate work-force training focused on skill-based apprenticeship education.¹

The plan proposes \$200 billion in federal funding for infrastructure projects, including \$25 billion for rural infrastructure, \$15 billion for transformative projects, and \$100 billion for local prioritization of infrastructure needs. The \$200 billion is intended to leverage additional funds, which would result in a total infrastructure investment of \$1 trillion. The plan also calls for one million apprentices within two years. The White House describes the Rebuild America Infrastructure plan as a major component of President Trump's agenda to promote job creation and economic growth.

To help inform the current debate on how to address the nation's infrastructure, this paper takes a look at three major infrastructure initiatives of the past. The paper begins with background information regarding the definition of infrastructure, historical spending trends, infrastructure needs, and the impact of infrastructure investment. It then provides an overview of major historical infrastructure initiatives, including the 19th century construction of canals and railroads, the New Deal capital programs during the Great Depression, and development of the interstate highway system in the 1950s and 1960s. The paper concludes with a discussion

about future infrastructure needs and financing options, drawing upon the experiences with the historical infrastructure programs, as well as other resources.

BACKGROUND

Public infrastructure usually refers to publicly-owned transportation infrastructure (highways, roads, bridges, mass transit, rail, ports, and airports) and water infrastructure (dams, levees, water supply, and wastewater treatment). The term public infrastructure also can include other types of infrastructure, such as solid waste and hazardous waste facilities and social infrastructure (hospitals, schools, prisons, nursing homes, and other public facilities). A broader definition could incorporate privately-owned infrastructure that serves a public purpose, such as energy generation and distribution, freight rail, information technology, and telecommunications.

The focus of this paper will be on transportation and water infrastructure.

Overview of Infrastructure Investments

This section provide an overview of public infrastructure investments, focusing on transportation and water infrastructure. In the United States, public spending on transportation and water infrastructure as a percent of gross domestic product (GDP) has been about 2.4 to 3.0 percent since the mid-1950s (see Figure 1). The highest percentage occurred in the late 1950s during the initial stages of the construction of the interstate highway system.

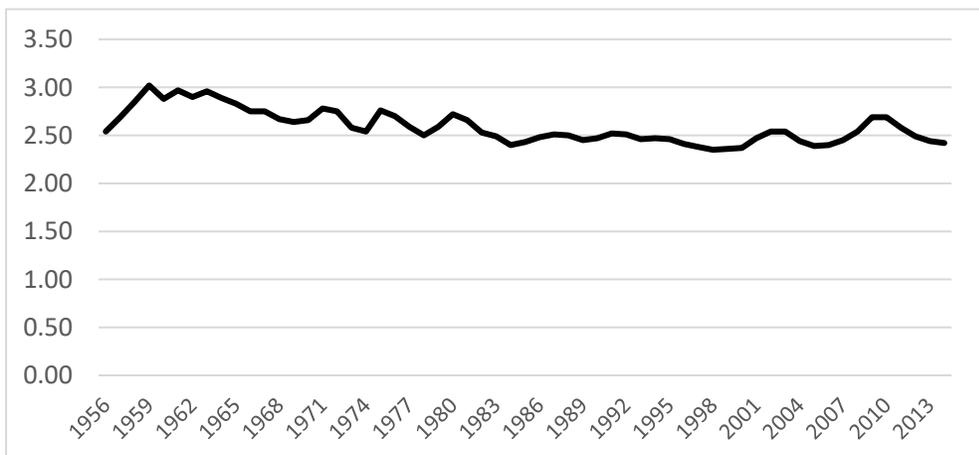


Figure 1: Public Spending on Transportation and Water Infrastructure as a Percentage of Gross Domestic Product

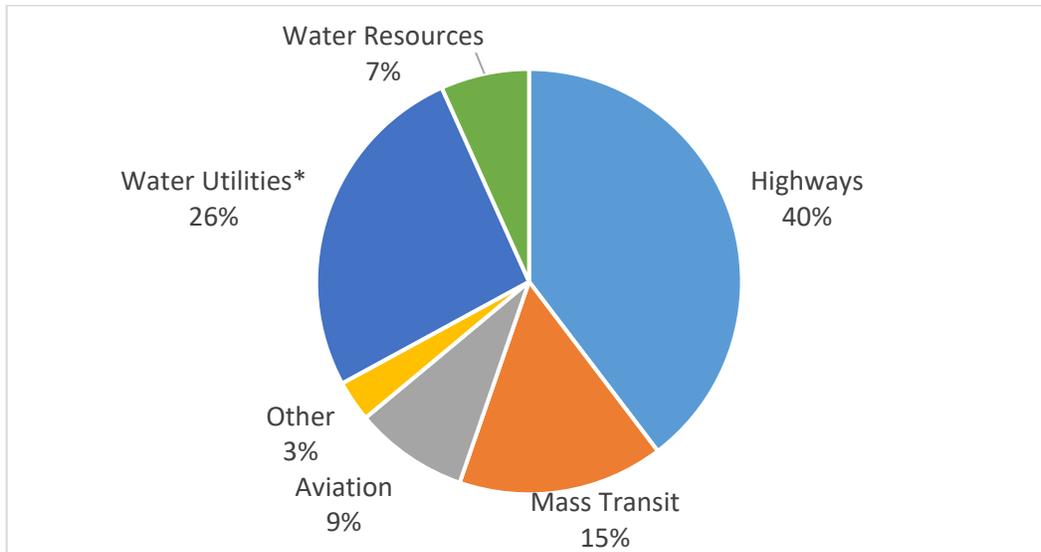
Source: Congressional Budget Office, *Public Spending on Transportation and Water Infrastructure, 1956 to 2014*.

In 2014, public spending on transportation and water infrastructure was about \$416 billion. The largest category of spending was highways (40%), followed by water utilities (26%) which

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includes water and wastewater treatment facilities (see Figure 2). Other major categories include mass transit, aviation, and water resources.



* includes water and wastewater treatment facilities

Figure 2: Public Spending on Transportation and Water Infrastructure, 2014

Source: Congressional Budget Office, *Public Spending on Transportation and Water Infrastructure, 1956 to 2014*.

State and local government spending accounts for about three-fourths (77%) of the total public spending on transportation and water infrastructure, with the federal government accounting for the remainder (see Figure 3). Starting in the 1980s, state and local government spending on infrastructure has increased significantly, while federal infrastructure remained relatively stable. More recently, during the period 2003 through 2014, state and local government spending on water and transportation infrastructure decreased five percent and federal government spending declined 19 percent.²

Over one-half (56%) of public spending on water and transportation infrastructure is for operations and maintenance, with the remainder being attributable to new or expanded infrastructure (see Figure 4). The majority of federal spending (72%) is for new or expanded capital, while state and local governments spend more of their funds on operations and maintenance (65%). In 2014, state and local governments spending accounted for 89 percent of the total public spending on operations and maintenance and 62 percent of the total public spending on new water and transportation infrastructure.

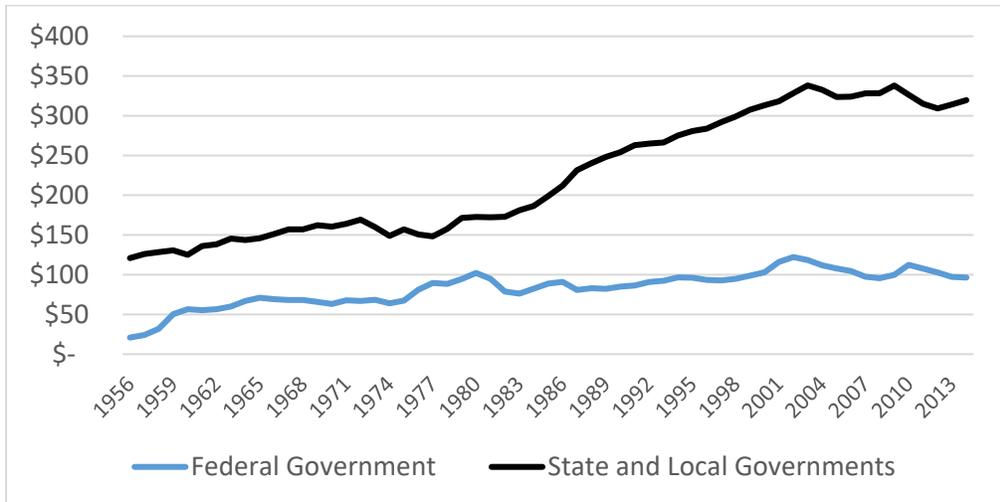


Figure 3: Public Spending on Transportation and Water Infrastructure, by Level of Government (in billions of 2014 dollars)

Source: Congressional Budget Office, *Public Spending on Transportation and Water Infrastructure, 1956 to 2014*.

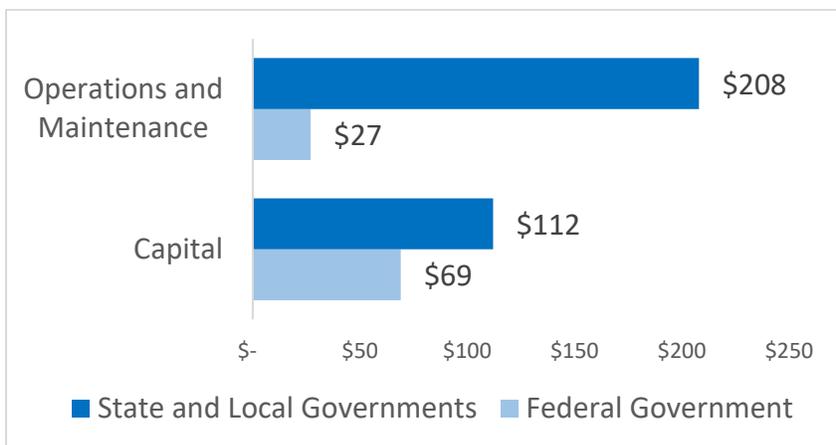


Figure 4: Public Infrastructure Spending on Transportation and Water Infrastructure by Category and Level of Government, 2014 (in billions)

Source: Congressional Budget Office, *Public Spending on Transportation and Water Infrastructure, 1956 to 2014*.

Infrastructure Condition and Needs

Various organizations and reports have called attention to the need to improve the condition of the infrastructure in the United States. This section highlights a few of the most prominent reports.

Every four years since 1988, the American Society of Civil Engineers (ASCE) has assigned a grade to infrastructure in the United States. ASCE uses criteria that address the capacity, condition, funding, future need, operation and maintenance, public safety, resilience, and innovation. In each of the historical report cards, the nation has received a grade of D or D+. The ASCE *2017 Infrastructure Report Card* assigned an overall grade of D+, with some variations among the different types of infrastructure. Among the better grades were rail (B), bridges (C+), ports (C+), and solid waste (C+). The other categories received a D or D+. The ASCE estimates that the United States would need to invest \$4.59 trillion over a 10-year period to meet the nation's infrastructure needs.³

In 2013, the McKinsey Global Institute issued a report calling for the U.S. to increase its annual infrastructure investment by one percentage point of GDP to eliminate the country's competitive disadvantage. This equates to an increase in public infrastructure investment of about \$150 to \$180 billion annually. The report referred to a backlog in maintenance and upgrades for U.S. roads, highways, bridges, transit, and water systems.⁴

A third report focuses on the condition of United States' infrastructure relative to infrastructure in other countries. The World Economic Forum ranked the United States 11th in the world in 2016-17 for overall quality of infrastructure.⁵ This rating is part of a 2016-17 global competitiveness index, in which the U.S. ranked third in the world. For the infrastructure rating, one-half of the score is based on the quality of transportation infrastructure and the other one-half is based on electricity and telephony infrastructure.

Impact of Infrastructure Investment

This section provides an overview of the impact of infrastructure investment. It draws on information prepared by the three organizations cited in the prior section, as well as scholarly studies on the impact of public infrastructure investments on the economy.

In an analysis prepared for the ASCE, the Economic Development Research Group estimates that each household in America will experience an annual decline of \$3,400 in disposable income during the period 2016 to 2025 due to infrastructure deficiencies. This will occur as a result of higher prices due to congested and inefficient transportation systems, delays in personal travel and commuting, and other factors.⁶

The McKinsey Global Institute estimates that increasing the U.S. investment in public infrastructure by one percentage point of GDP could result in a 1.4 to 1.7 percent increase in the GDP between 2013 and 2020 and would create 1.5 to 1.8 million jobs for the duration of

the investment. The McKinsey Global Institute also estimates that the U.S. could increase its annual GDP by \$600 billion by 2030 if the country took a more efficient approach to project selection. This would help relieve congestion, improve competitiveness, and decrease logistics and supply-chain costs.⁷

The World Economic Forum discusses the importance of transportation infrastructure in getting goods and services to market in an efficient manner and allowing movement of workers to the most suitable jobs. It also notes the importance of having reliable electricity supplies and an extensive telecommunications network to facilitate the free flow of information.

Over the years, there has been an ongoing debate among scholars about the impact of public infrastructure on the U.S. economy. In the late 1980s, seminal work by Aschauer found that the elasticity of output with respect to public capital was about 0.34 – 0.39.⁸ This suggested that the annual marginal productivity of public capital spending was about 70 cents per \$1 and that public investments in capital would pay for itself about three times through the generation of additional revenues.⁹

Aschauer's findings sparked a series of subsequent research and debate on the relationship between public infrastructure investments and the economy. In a review of studies conducted over the past 20 years, Pereira and Andraz concluded that the impact of public capital investments on output is positive and significant, but much smaller than earlier estimated, and that the impact can vary by industry.¹⁰ Pereira and Andraz also recommend that scholars take into account how the infrastructure is financed, since tax increases can counter the positive impact of infrastructure investments on output.

Studies also have found that the impact of infrastructure on the economy can vary depending on the type of infrastructure.¹¹ Pereira found that the largest impact on private investments came from electric and gas facilities, mass transit, and airfields and that highways and streets had a much smaller impact.¹²

With this background information on the importance of public infrastructure, the focus will now shift to a discussion of the historical roots of the nation's infrastructure.

HISTORICAL INFRASTRUCTURE DEVELOPMENT

At various points in the nation's history, there have been large infusions of public funds into the development of public infrastructure. This section provides an overview of three major public infrastructure initiatives, discussing the role of the federal, state, and local governments and private firms, the types of investments that were made, how the investments were financed, and the types of challenges that were encountered. The section begins with the development of canals and railroads in the early days of the nation's history.

Canals and Railroads

America's early leaders recognized the importance that transportation infrastructure could play in the development of the new nation. James Madison, in the *Federalist Paper 14*, referred to the importance of roads and canals in connecting the states.¹³ George Washington served as the president of a company which built networks of roads, canals, and locks to expedite transportation between the east and the west.¹⁴

In the late 1700s and early 1800s, state governments played a major role in the development of canals. Total spending on canals during the period 1815 through 1860 is estimated at \$195 million, with public investment accounting for about 70 percent of the total.¹⁵

One of the most significant canal projects was New York State's construction of the Erie Canal, which opened in 1825. The Erie Canal revolutionized trade and transportation by creating a waterway connection between Albany, New York on the Hudson River and Buffalo, New York on Lake Erie. This helped facilitate settlement in the western states and allowed for the shipment of goods at much lower costs. It also helped create an "information superhighway" for the sharing of new ideas, such as abolitionism, women's rights, and various other movements.¹⁶

In the 1800s, state governments issued bonds to finance capital projects. The first recorded municipal bond was issued by New York State in 1812 to finance a canal. The municipal bond market (which includes bonds issued by state and local governments) grew to \$200 million by 1840 and to \$1 billion by 1880.¹⁷

As a result of fiscal strain during the recession in 1837, some states defaulted on their bonds. This led state governments to establish legal debt limits to mitigate future problems. Several decades later, during the depression in 1870, some cities defaulted on their debt. These led state governments to impose debt limits on local governments.¹⁸

The federal government's role in canals was more limited. In 1808, the U.S. Secretary of the Treasurer, Albert Gallatin, proposed a comprehensive plan for a system of canals and turnpikes to be funded by the federal government.¹⁹ This plan met resistance from some government leaders who questioned the constitutionality of the proposed federal role. Although the plan was not formally adopted, following the War of 1812, many of the proposed projects were eventually completed with a combination of state, local, and private funding.²⁰ In the 1820s, the federal government provided funding for four canals and, during the 1850s, the federal government donated about 22.5 million acres of land to the states for internal improvements, such as turnpikes and canals.²¹

With the advent of railroads, canals over time became obsolete as a result of rail lines being easier to construct and allowing for faster travel. Private companies developed and owned

most of the railroads, while the state governments issued charters and owned much of the right of way. The private companies financed construction through loans and stock. At times, the firms entered into barter arrangements in which stock was exchanged for labor.

State governments provided financial assistance for rail projects in the form of stock subscription, loans, or loan guarantees. State governments in the south contributed the highest amounts, financing more than 55 percent of the total costs of railroad construction in the south before 1861. Nationwide, the public contributions in cash or credit were about 25-30 percent or more of the total rail construction.²²

The federal government's role in rail varied over time. During the early 19th century, there were concerns about the constitutionality of using federal funds for rail.²³ Prior to the Civil War, direct federal contributions were about \$7 million. In 1862, Congress passed the Pacific Railway Act, which led to construction of the first transcontinental railroad. The federal government lent the railroad companies about \$65 million for this project.²⁴

During the period 1862-1872, the federal government contributed over 100 million acres in land grants to the railroad companies. The federal land could be used for right of way and the adjacent land could be developed or sold to generate revenues. The State of Texas also contributed about 32 million acres of land, mostly after the Civil War.²⁵ The federal government also provided loans to the railroads, with the amounts varying depending on the terrain.

As rail became more developed, the public contributions declined. During the period 1861-1890, the public contributions were somewhat less than \$350 million, with local governments accounting for about \$175 million. After 1873, the public contributions amounted to no more than a negligible fraction of the total rail investments.²⁶

RELEVANCE TO TODAY'S APPROACH TO INFRASTRUCTURE. The early developments of canals and railroads demonstrated the importance of transportation infrastructure in facilitating commerce and development and in building connections among the states. The early years also demonstrated the role that private companies can play, along with the limitations. Private companies played the lead role in building and operating railroads but, in the early years, needed governmental assistance. This time period also saw the first use of state and local government bonds, the growth of the bond market, and the eventual creation of legal debt limits to help state and local governments avoid future bond defaults.

New Deal Infrastructure Programs

Another major infusion of funds into the nation's infrastructure occurred through the New Deal programs that were initiated by President Franklin Delano Roosevelt in response to the Great Depression. Faced with an unemployment rate of close to 25% and a dearth of private sector spending, the federal government invested billions of dollars in putting people to work on infrastructure and other public projects. This section describes three of the major New Deal programs that had an impact on infrastructure: the Civilian Conservation Corps (CCC, 1933-

1942), the Public Works Administration (PWA, 1933-1942), and the Works Progress Administration (WPA, 1935-1943), which in 1939 was renamed the Work Projects Administration.

One of the most popular New Deal programs was the Civilian Conservation Corps (CCC) program, which hired young unemployed men ages 18-25 to work on conservation projects. About 350,000 men participated at a time (although, at times, the number was closer to 500,000), with an overall enrollment of about 3 million over the life of the program. The men were stationed at a camp for six months to a year and were assigned to work on nearby projects. In exchange for their work, the men received shelter, clothing, food and \$30 a month (\$25 of which had to be sent home to their families). There were over 2,000 camps dispersed throughout the states.

The CCC participants worked on structural improvements (bridges, fire towers, and museums), transportation (roads, trails, and airport landing strips), erosion and flood control projects, reforestation and wildlife projects and various other types of projects. The program was supported through the Department of Labor which selected the participants, the Department of Agriculture and the Department of the Interior which selected the projects, and the Army which set up and managed the camps.²⁷ The participants learned to work in teams and participated in an education program that was offered in the evening hours.

In 1933, the National Industrial Recovery Act established the Public Works Administration (PWA), which was headed by Secretary of the Interior Harold L. Ickes. The act authorized \$3.3 billion for public works projects, including federal projects (roads and ships), as well as state and local government projects. The PWA also took over projects that had been initiated under a loan program started by the Hoover Administration. For new state and local government projects, the program provided federal grants that initially covered 30% of the project costs and offered loans at 4% for the remainder of the costs. (The percentage amount for the grants was later increased.) For local projects, funds were sent directly to the local governments instead of passing through the state governments. As loans were repaid, the WPA program used the funds to make new loans, thus creating a revolving fund.

President Roosevelt established a Special Board for Public Works, to serve as an advisory board for the PWA program. The board consisted of the secretaries of the War, Agriculture, Treasury, Commerce, Labor, and Interior, the director of the Bureau of the Budget and the attorney general. The board identified top priorities as water, sewer, and waste disposal facilities.²⁸

Ickes was known for ensuring careful scrutiny of the proposed projects. This was a balancing act because PWA was under pressure to start projects quickly to help stimulate the economy. At that time, many state and local governments lacked experienced in designing and administering public works projects and faced legal constraints that limited their ability to take on new debt. The PWA introduced governments to the use of revenue bonds and public authorities that were not subject to the debt limits.²⁹

The PWA program undertook about 34,000 projects, including many of the largest and most visible of the New Deal projects, such as the Boulder Dam (later renamed Hoover Dam) and the Triborough Bridge in New York City. PWA funded about \$5 billion in grants and loans for the construction schools, hospitals, libraries, and other public buildings; highways, water and sewer systems; electric power systems; and flood control and reclamation projects.³⁰ PWA also built many airport buildings, including a terminal building at Washington National Airport, later renamed Reagan National Airport.³¹

The federal government imposed controls, including rules related to procurement, labor practices, accounting, and other business procedures. The federal government also assigned a resident engineer-inspector to each site to ensure adherence to federal regulations and the prevention of kickbacks. The federal government required at least three audits³² and the PWA established an inspection division to follow-up on complaints about specific projects.³³ Leighninger notes that these practices were “quite successful in keeping the many attempts to make political or financial profit from becoming full-blown scandals.”³⁴

A third New Deal program, the Works Progress Administration (WPA), was created in 1935 to promote economic development and put people to work. This program was headed by Harry Hopkins, a social worker who was the Secretary of Commerce. The WPA provided employment for about 8 million people and spent about \$4 billion on projects.³⁵

Local governments and their various agencies initiated and planned the majority of WPA projects, including the identification of the types of labor that would be needed. The unskilled workers were to come from local relief roles. Since the majority of people certified for employment on WPA projects were unskilled workers, some sponsors had to use their own funds to hire skilled workers if necessitated by the project. Sponsors also had to agree to maintain the completed project using their own funds.³⁶

Initially there was no local government financial contribution requirements. However, after January 1, 1940, the WPA sponsor contributions in aggregate for a state had to be at least 25%, but there was no minimum requirement for individual projects. In practice, local contributions were about 10 percent in mid-1936 and about 30 percent in the final years of WPA.

The original focus was on roads, rural electrification, water conservation, sanitation, and flood control. Legislation passed in 1936 added public buildings, parks, public utilities, airports, and transit facilities. In 1937 the scope was expanded to include non-construction educational, professional, and women’s projects.³⁷ By 1941, WPA’s focus was on defense-related projects.

The program had multiple stages of review, including the WPA, the Bureau of the Budget, the Advisory Committee on Allotments, and the president. The Advisory Committee on Allotments, which included government officials and representatives of labor, farming, the American Bankers Association, and the U.S. Conference of Mayors, served as the main decision-making entity and advisor to President Roosevelt.³⁸

The final report on the WPA program described the following accomplishments: “Building or improving 651,000 miles of roads, erection or improvement of 125,110 buildings of all kinds, installation of 16,100 miles of water mains and distribution lines, installation of 24,300 miles of sewerage facilities, construction and improvement of many airport facilities, including landing fields, runways, and terminal buildings.”³⁹ The report stated that sponsors of projects contributed \$2.8 billion and the federal government contributed \$10.1 billion.

In 1939, the administration of the PWA and WPA were combined into a single agency called the Federal Works Agency (FWA). The PWA program ended in 1942 and the WPA ended in 1943. The FWA became the General services Administration, which is still in existence today.

RELEVANT TO TODAY’S APPROACH TO INFRASTRUCTURE. The New Deal infrastructure programs embraced Keynesian economic policy by implementing public works spending to stimulate the economy and decrease unemployment. This use of capital spending has continued into modern times, as evidenced by the most recent appropriation of federal stimulus fund during the Great Recession.

The tying of a jobs program to capital projects helped restore people’s dignity,⁴⁰ but also impacted the types of projects that were undertaken. Plus, the New Deal programs were viewed as temporary, which made it difficult to undertake multi-year planning.

The New Deal programs created a vast array of infrastructure that has had a lasting impact on society. The programs resulted in projects that served a functional purpose, but also included projects with aesthetic, cultural, or historical value. Thus, infrastructure was viewed in a broader context in terms of meeting multiple aspects of societal needs.

The New Deal’s decentralized approach in which the federal governments provided funding and state and local governments identified projects and oversaw the construction of the projects has become a mainstay in the nation’s approach to infrastructure. At the federal level, the New Deal program demonstrated the need for and ability of federal agencies to work together toward a common national goal.

Early Roads and the Development of the Interstate Highway System

The next major federal infrastructure program was the development of the interstate highway system in the 1950s and 1960s. This section starts with an overview of the events that led to that undertaking and then discusses major aspects of the program.

In the early years, some local governments built roads within their jurisdictions. Lacking sufficient revenues, the governments often required men in the community to contribute labor to construct and maintain the roads.⁴¹

Also in the early years, private firms built toll roads, which were called turnpikes, to connect communities and facilitate access to agricultural products in rural areas.⁴² However, toll revenues often were insufficient to repay investors and maintain the road. This resulted in

maintenance deferrals, which made the roads less attractive to haulers.⁴³ By the 1860s, many of the turnpikes were not fiscally sustainable and were turned over to local governments.⁴⁴

In the early 1800s, Congress proposed using funds from land sales in Ohio to build a road from Cumberland, Maryland to Wheeling, Virginia (now part of West Virginia). President Jefferson authorized the road in 1806, construction started in 1811, and the road to Wheeling was completed in 1819.⁴⁵ The Cumberland Road (later renamed the National Pike) was the first major road built by the federal government.⁴⁶ The Army Corps of Engineers continued construction of the road west of Wheeling.

The federal government considered converting the road into a toll road to generate funds for the maintenance of the road. However, critics raised questions about the constitutionality of that proposal and in 1822, President James Monroe vetoed the legislation. The federal government then transferred ownership of the road to the respective state governments. The Army Corps of Engineers installed toll gates and the states operated the roads as toll roads.

Further debates about the role of the federal government arose in 1817 when Congress proposed a bill for \$1.5 billion in federal funding for internal improvements. The bill, referred to as the Bonus Bill, proposed to earmark revenues from a bonus and future dividends to the Second Bank of the United States to be used for internal improvements. President Madison vetoed the bill, noting that it was unconstitutional.⁴⁷

Over time, the U.S. Supreme Court provided increased clarity regarding the federal government's authority in regards to roads. In 1824, the U.S. Supreme Court in *Gibbons v. Ogden*, ruled that Congress had the power to regulate interstate commerce under the Commerce Clause in the U.S. Constitution. Later, in 1907, the U.S. Supreme Court ruled that the Commerce Clause allows Congress the power to construct interstate highways, including canals.⁴⁸

In 1913, a private entrepreneur developed the Lincoln Highway, which was one of the first transcontinental auto routes in the United States. It connected existing roads spanning from New York to California, covering 13 states at the time (another state was later added). Other similar initiatives followed.⁴⁹

Over time, various federal actions laid the foundation for the interstate highway program. In 1916, Congress authorized federal matching grants over five years for highway construction and, in 1921, re-authorized the grant program for an additional five years.⁵⁰ In 1922, the military prepared the Pershing Map, which identified roads that would be needed for defense purposes in time of war, foreshadowing the interstate system routes. A Joint Board on Interstate Highways, which included three people from the federal Bureau of Public Roads and 21 state highway officials, established a system which used odd numbers for north-south roads and even numbers for east-west roads.⁵¹

The Federal-Aid Highway Act of 1938 directed the Bureau of Public Roads to conduct a study on the feasibility of a toll-financed highway system that would include several east-west and north-south superhighways. The Bureau concluded that a toll-financed system would not generate sufficient funds to be self-supporting and instead recommended a 26,700 mile network of inter-regional highways.⁵²

The *Federal-Aid Highway Act of 1944* called for the designation of up to 40,000 miles to connect metropolitan areas and serve the national defense. States submitted requests for highways to be included and the Department of Defense reviewed those proposals. On August 2, 1947, the Federal Works Administrator and the Commissioner of Public Roads announced the designation of the first 37,700 miles, including about 2,900 miles of urban thoroughfares.

President Eisenhower led the effort to generate funding for the interstate highway system. He previously had participated in the 1919 Motor Transport Corps Convoy, which experienced many problems while travelling from Washington, D.C. to California to test the nation's highway system's readiness for war. Plus, Eisenhower had studied and been impressed with Germany's network of rural superhighways.⁵³ President Eisenhower stated: "The country urgently needs a modernized interstate highway system to relieve existing congestion, to provide for the expected growth of motor vehicle traffic, to strengthen the Nation's defenses, to reduce the toll of human life exacted each year in highway accidents, and to promote economic development."⁵⁴

The *Federal-Aid Highway Act of 1956* and the *Highway Revenue Act of 1956* (combined into Public Law 84-627) authorized the construction of and funding for the interstate highway system. The system, which was named the National System of Interstate and Defense Highways, included 41,000 miles. Congress approved a 90-10 percent split between federal and state/local funding and authorized \$25 billion for interstate highway projects for the fiscal years 1957 through 1969.

The plan was to connect the nation's 209 cities that had a population of greater than 50,000. The system primarily would be divided highways, with only about 7,000 miles of two-lane roads. The plan incorporated some existing toll roads. Funding was to occur through the Highway Trust Fund, which would obtain revenues from a number of road user taxes, including an increase in the federal fuel tax from 2 to 3 cents per gallon and new excise taxes on motor vehicle purchases, oil, replacement tires, and other replacement parts. (In 1970, most of the revenue sources other than the motor fuel tax were eliminated.)⁵⁵ The funding initially was apportioned based on the formula used for the federal-aid primary category, which was based on mileage, area, and population. Later funds were allocated on the basis of the ratio of the costs of completing the system within a state relative to the cost of completion for the system as a whole.⁵⁶

The development of the interstate highway program occurred over the following decade, with additional funds bringing the total investment to about \$129 billion, which included \$114 billion

in federal funds, for the construction of about 42,000 miles.⁵⁷ States built the roads to conform to design standards that had been agreed to by the Bureau of Public Roads and association of state highway officials.

The interstate program encountered various challenges along the way. Funding shortfalls led to an increase in the gas tax to 4 cents a gallon. Plus, there were problems associated with right-of-way acquisition and land speculation schemes.

Critics claimed that that the new interstates were displacing city residents, in particularly those with low-income, and that the interstates were creating “walls” that divided cities.⁵⁸ Author and social scientist Lewis Mumford stated that the interstate program was bound to lead to destruction given that it had been founded on “a very insufficient study” of highways rather than transportation and relied on “blunders of one-dimensional thinking.”⁵⁹ Protests in some urban areas became intense and led to a change in plans.

Daniel Moynihan, a professor and later a U.S. Senator, expressed concerns about the need to do highway planning in a broader metropolitan land-use planning context that considered economic and social objectives. He also advocated for funding flexibility so cities could choose to use the funds for mass transit instead of highways.⁶⁰

Overall, the interstate highway system made significant advancements in decreasing the amount of time it takes to travel cross country and in reducing highway fatality rates.⁶¹ Today the interstate highway system consists of 47,814 miles and accounts for about 25 percent of the total vehicle miles travelled in the United States.⁶² According to the Federal Highway Administration, the interstate highway system is the safest road system in the country.⁶³

RELEVANCE TO TODAY’S APPROACH TO INFRASTRUCTURE. The development of the nation’s interstate highway system has been referred to as one of the “wonders of the modern world.”⁶⁴ This undertaking demonstrated the significant results that can occur when the federal government works collaboratively with state governments. The approach used to design and implement the interstate highway system involved a strong federal role, combined with a significant role for state governments regarding the routes, design standards and project construction. Some confrontation with local urban areas serve as a reminder that local governments need to be consulted in projects that have substantial impact on their communities.

The construction of the interstate highway system demonstrated the importance of having designated revenue sources, in particularly the federal motor fuel tax, along with the willingness to increase revenues if necessary. But the undertaking fell short in terms of including a provision to finance the future maintenance of the roads. This signifies the importance of addressing life cycle costs, which includes not only the acquisition or construction costs of infrastructure, but also the operation and maintenance costs throughout the life of the asset, and, if applicable, disposal costs.

Having discussed the historical undertaking of much of the nation's infrastructure, the focus now shifts to looking to infrastructure needs and financing for the future.

INFRASTRUCTURE NEEDS AND FINANCING IN THE FUTURE

As the Trump Administration moves forward with its infrastructure plan, the need to identify infrastructure priorities and funding sources will become increasingly important. This section draws from historical experiences with infrastructure programs, as well as other sources, to discuss key points for consideration. This section discusses issues associated with (1) strengthening transportation systems, (2) making infrastructure maintenance a priority, (3) investing in infrastructure to promote health and safety, (4) increasing the role of the private sector, and (5) financing infrastructure.

Strengthening Transportation Systems

Throughout the nation's history, the development of transportation infrastructure has had major impacts on commerce and the daily lives of people. Transportation infrastructure provides firms with access to labor and product markets and allows individuals access to employment, education, and goods and services. As noted with the early development of canals, transportation infrastructure also can support the sharing of new ideas.⁶⁵

The provision of transportation infrastructure in the United States continues to be decentralized and complex. The majority of roads are owned by state (19%) and local governments (77%) and most of the freight rail is operated by private companies.⁶⁶ To sustain and grow the economy, the different transportation modes located throughout the country need to be integrated into a transportation system that serves multiple needs.

In developing a national infrastructure plan to address transportation needs, what insights can be gleaned from past massive infrastructure programs? First, state and local governments need to be viewed as important partners. Throughout history, state and local governments have identified, constructed, owned, and maintained much of the nation's transportation infrastructure. They are the governments closest to the people and their views and perspectives need to be taken into account.

Past infrastructure projects, in particularly the interstate highway system, demonstrate the important role the federal government can play in facilitating projects that span across multiple states. In modern times, that could include projects such as high-speed rail or enhancements to the air traffic control systems. The president and Congress also may want to address the merits of federal funding for large important projects in urban areas, including those, such as the Gateway Project, that involve more than one state. The Gateway project, which is a massive undertaking that includes building rail tunnels under the Hudson River as well other transportation improvements, is a joint project being undertaken by the State of New York and the State of New Jersey.

Past infrastructure initiatives also demonstrate the value in identifying national interests or goals that can be pursued through infrastructure programs. For example, during the New Deal, the infrastructure programs were designed to stimulate the economy and provide jobs, which influenced the types of projects that were undertaken. During the development of the interstate highway system, President

Eisenhower noted the need to relieve congestion, facilitate expected traffic growth, strengthen defense, and improve highway safety. This resulted in a system of connected roads built with a standardized design.

In modern times, the federal government may choose to focus on goals such as expanding the national economy or improving air quality. To facilitate economic growth, the federal government could expand its funding of capital projects that address bottlenecks in the transportation system or that would enhance the system through connecting different modes of transportation. According to the Texas Transportation Institute, congestion costs in the United States in 2014 were about \$160 billion due to increased travel times and fuel consumption.⁶⁷ That equates to about \$960 per year per commuter. Much of this congestion occurs in the largest urban areas, which account for a significant proportion of the U.S. population and economic activity.⁶⁸

In developing a national infrastructure plan, consideration also needs to be given to technology advancements. In the early years, canals revolutionized travel but later became obsolete with the advent of the rail. Policy makers need to give consideration to emergency technologies as well as other technologies that may occur in the future.

Currently, one of the most highly-publicized technological advancements is the advent of the driverless vehicle. State and local governments are addressing the types of infrastructure-related investments that will be needed to support this development, such as sensors that communicate with moving vehicles and improved pavement marking and road signs.⁶⁹ The National Conference of State Legislators (NCSL) reports that 33 state introduced related legislation in 2017 and 20 states have passed related legislation.⁷⁰ Congress also has been addressing policy issues related to autonomous vehicles.

Other technology advancements also may merit consideration. For example, technological advancements in construction materials and techniques may prolong the useful life of roads and bridges and interactive signage with updates on weather conditions and congestion may improve safety.⁷¹ Cell phone applications continue to develop, such as applications that can reroute drivers to avoid congested areas. Advances also are occurring in toll road technology, such as methods for applying differential pricing depending on the time of the day or congestion.

In looking to the future, social and demographic trends also are relevant. Compared to the past, young people drive less now and make greater use of public transit, bicycles, and ride-hailing services.⁷² Planning for transportation and related infrastructure will need to need to take into account these evolving trends. On other end of the age spectrum, seniors who no longer drive are in need of transportation. This is especially a concern in rural areas.⁷³

In summary, the federal government will need to work collaboratively with representatives from state and local governments to develop transportation systems that will achieve national goals and prepare the nation for the future. It will be important to develop a strategic vision for

the future and identify what type of transportation infrastructure will be needed to support that vision.

Prioritizing Infrastructure Maintenance

Historically, the federal government has invested primarily in new infrastructure rather than maintenance of existing infrastructure. The latter primarily has been the responsibility of state and local governments. However, given the magnitude of the infrastructure maintenance needs, this policy needs to be re-evaluated.

Much of the interstate highway system that was built in the 1950s and 1960s is in need of major repair or replacement. Although states are replacing portions of the interstate highway system, a major overhaul of the network would be a vast undertaking – one in which the federal government likely would need to play the lead role, especially in terms of funding. The estimated net economic benefits of recapitalizing the entire interstate highway system is over \$1.6 trillion.⁷⁴

In the mid- 1990s, Rosen expressed a similar concern regarding the infrastructure that was developed during the New Deal. He states: “If there is a “New Frontier” in public works, it may involve the best possible maintenance of New Deal and other public works investments that have formed the nation’s infrastructure. Providing state and local governments with maintenance technologies may be a legitimate and significant federal role that continues the Rooseveltian tradition in public works.”⁷⁵

The American Society of Civil Engineers (ASCE) provides estimates of the nation’s maintenance needs and the impact of insufficient maintenance. The most recent estimates indicate that about two-thirds of the nation’s \$836 billion in highway infrastructure needs is related to maintenance needs. About 20 percent of the nation’s highways had poor pavement in 2014, with urban roads being worse than rural roads (32% compared to 14%). The lack of sufficient maintenance resulted in \$112 billion in additional vehicle repair costs in 2014. Transit infrastructure has about a \$90 billion maintenance backlog. In the water sector, there are about 240,000 water main breaks annually. Leaky pipes result in a loss of about 14 to 18 percent of the daily treated water.⁷⁶

From an economics perspective, governments should invest in public infrastructure projects that yield the highest net present value. Funds invested in maintaining and repairing infrastructure may have higher returns than funds spent on new infrastructure since the large initial capital construction outlays have already occurred. The Congressional Budget Office concluded that federal highway spending could yield greater overall net benefits by increasing spending on major repairs by one percent and decreasing spending on expansion by two percent.⁷⁷

The federal government could consider different types of funding, depending on the nature of the capital project. Pagano, an urban scholar, recommends federal matching grants for the

repair and maintenance of existing infrastructure and federal loans for new and expanded infrastructure.⁷⁸ He also recommends the use of pricing policies that take into account the life-cycle costs of infrastructure.

Ensuring Health and Safety

Historically, the federal government has invested in infrastructure projects that improve the health and safety of people. One of the driving forces for the creation of the interstate highway system was to improve traveler safety.⁷⁹ The major devastation from the levee break in New Orleans during Hurricane Katrina, the I-35W bridge collapse in Minnesota that killed 13 people and injured 145 people, major flooding in coastal areas and other parts of the country, and the lead in the water pipes in Flint, Michigan remind the public and government officials that additional public infrastructure improvements are needed to protect public health and safety.

This section highlights some of the health and safety infrastructure issues and initiatives that are related to the environment, although other health and safety issues also are important (e.g., highway safety, protection of infrastructure from cyberattacks). Local governments can take the lead on many of these infrastructure projects, but they need financial assistance from the federal and state governments. The federal government can play a role in the development of technology and work with state and local government officials to develop policies that are supportive of infrastructure that promotes health and safety. This could be done in a similar spirit as when the federal government worked with state officials during the development of the interstate highway system to develop highway design standards to promote highway safety.

The federal government promotes health and safety through its setting of environmental standards and its funding of state revolving fund programs and the Water Infrastructure Finance and Innovation Act (WIFIA) program. The Clean Water Drinking State Revolving Fund (CWSRF) program and the Drinking Water State Revolving Fund (DWSRF) program provide federal capitalization grants that are used, along with state government funds, to provide financial assistance to localities, usually in the form of subsidized loans. In 2014, Congress authorized the WIFIA program to supplement the SRF programs. The WIFIA program provides long-term supplemental loans for regionally and nationally significant water projects. Although the WIFIA and the SRF programs are helpful, an increase in funding for these programs could help decrease the gap between infrastructure needs and available funding.⁸⁰ Plus, there continue to be communities that struggle to meet the financial requirements associated with loans. The need to replace lead pipes has exacerbated the situation.

The nation also needs resilient infrastructure that can help mitigate the losses from downpours and natural disasters, which have become more severe and frequent.⁸¹ During Hurricane Sandy in 2012, New York and New Jersey experienced storm surges that caused millions of gallons of untreated sewage to spill into waterways.⁸² The more recent devastation from Hurricane Harvey emphasizes the importance of maintaining infrastructure services such as drainage,

roads, water, electricity, and internet connectivity during disasters, as well as the problems created when these types of infrastructure fail.

Some local governments are pursuing infrastructure strategies such as creating seawalls, constructing or expanding tunnels to absorb water, establishing new building codes that require more resilient homes and business structures, and imposing stormwater fees to generate funds to pay for related infrastructure. Some cities also are developing green infrastructure such as rooftop vegetation, porous pavements, and expansion of wetlands.

As climate-related emergencies become more prevalent, an effective communication system is key. Local governments increasingly are using broadband technology to communicate with citizens during emergencies. But to be effective as an emergency alert and communication tool, broadband needs to be accessible to all citizens. In 2016, 10 percent of Americans (34 million people) lacked access to broadband with the benchmark speed used by the Federal Communications Commission (25 Mbps download/3 Mbps upload). This problem is more serious in rural areas (39% lacking) than urban areas (4% lacking).⁸³

Another issue related to public health and safety is President Trump's pledge to decrease the review time for capital projects from an average of 10 years to two years. Although significant benefits could accrue from streamlining portions of the process, care must be taken to ensure that other important public values, such as protecting the environment, ensuring the health and safety of residents, and allowing for public input, are preserved.

In addition to addressing the need for resilient infrastructure, local governments are undertaking infrastructure initiatives to help ensure that future generations will have access to water, clean air, and energy. Some wastewater utilities are reusing wastewater to decrease the demand for fresh water or generating energy from digestive methane to operate their facilities. Some public energy utilities are installing infrastructure to increase the use of renewable energy and are implementing programs to promote energy conservation. Some urban areas are investing in mass transit, which can result in less pollution and more efficient use of resources.

Financing Infrastructure

Identifying priority infrastructure investments is critical, but the public sector also has to identify ways to fund those investments. As discussed in the section on historical infrastructure initiatives, various types of federal, state, and local government funding sources, as well as private sector funds, have been used in the past to support infrastructure.

This section will focus on two key infrastructure financing issues. The first issue is how to address the financial shortfall in the federal highway trust fund. This is important since highways account for a large portion of infrastructure spending. The second issue concerns the availability of debt financing at low interest costs. The role of the private sector, which also relates to the financing of infrastructure, will be addressed in the following section.

FINANCING OF HIGHWAYS. During the development of the interstate highway system, the motor fuel tax emerged as the main revenue source for the funding of highways. When the interstate highway system legislation was passed, Congress passed an increase in the motor fuel tax rate to generate additional funding. When there was a financial shortfall during the construction of the interstate highway system, Congress increased the motor fuel tax rate again.

However, during the past 20 years, Congress has been reluctant to increase the motor fuel tax rate. It currently remains at the same level as it was in 1993, 18.4 cents per gallon on gasoline and 24.4 cents per gallon on diesel.⁸⁴ This, combined with a decrease in fuel consumption due to more energy-efficient vehicles and changes in driving habits, has resulted in financial shortfalls in the highway trust fund.

The Congressional Research Service estimates that during the period FY 2012 through FY 2025, the revenues generated for the highway trust fund, on average, will be about \$20 billion less per year than the amount needed to finance the current federal surface transportation program.⁸⁵ Since 2008, Congress has transferred \$140 billion from the General Fund to the highway trust fund, including \$70 billion that was authorized in the passage of the Fixing America's Surface Transportation (FAST) Act in 2015.⁸⁶

Proposals have been made to increase the federal motor fuel tax rate and to index it to inflation. The administrative costs associated with this option would be relatively low since the collection process already is in place. A higher tax rate would generate additional revenues and could be used to capture external costs from driving, such as the costs of pollution, climate change, and dependence on foreign oil. This would help increase economic efficiency by having users pay based on the marginal costs their usage of roads imposes on society.⁸⁷

However, a more economically efficient approach might be to base a tax on the number of vehicle miles driven.⁸⁸ Compared to the motor fuel tax, a mileage tax could be more directly tied to the cost of pavement repair and be less impacted by increases in energy-efficient vehicles. The mileage tax rate could be fixed or could vary based on factors such as time of the day or how much pollution a vehicle emits. This tax would forge a more direct relationship between those who pay the tax and those who benefit the most from roads and could be used to mitigate pollution and congestion.

A Congressional Research Service report identified the following potential concerns with a mileage tax relative to the motor fuel tax: public concerns about privacy;⁸⁹ higher costs to establish, collect, and enforce; the administrative challenges of billing about 256 million vehicles (compared to 850 taxpayers for the motor fuel tax since it is collected at the refinery or tank farm); and the potential for opposition to rate increases (similar to that facing the motor fuel tax).⁹⁰ If there is an emerging trend for people to drive less, a vehicle-miles based tax may face future challenges.

Toll roads represent another revenue option. Toll roads are a growing source of revenue in more than 30 states.⁹¹ Currently, about 5,900 miles of toll roads in the United States generate about \$13 billion in revenues annually.⁹² Toll road technology has improved so that now sensors can be used to assess charges rather than having vehicles have to stop at a toll booth. Toll roads also can use congestion pricing as a means to encourage people to drive during non-rush hours, thus decreasing the overall capacity demand on roads.

However, there also are concerns regarding increased reliance on toll roads. The Congressional Research Service (CRS) concluded: “Whatever policies Congress adopts, tolls are likely to play only a limited role in funding surface transportation projects.”⁹³ CRS notes that the costs of toll collection (excluding the cost of toll collection infrastructure) often exceeds 10% of revenue even when tolls are collected electronically. This is much higher than the costs of collecting federal motor fuel tax, which is established at about 1% of revenues. CRS also cautions that many roads do not have enough traffic to generate sufficient toll revenue to covers construction, maintenance, and collection costs and that elected officials may be reluctant to raise toll rates.

Although economic theory suggests that user charges that reflect the true costs of infrastructure can be advantageous, political and administrative challenges remain. Government officials need to help the public better understand the importance of providing sufficient funding to pay for infrastructure needs.

DEBT FINANCING. Governments need revenue sources to support infrastructure projects, but they also can benefit from the ability to obtain debt financing at low interest rates. Dating back to the 1800s, and continuing into modern times, state and local government bonds have played an important role in financing infrastructure. Federal loans also have been and will continue to be instrumental in financing infrastructure.

The tax-exempt status of municipal bonds is very important in the financing of public infrastructure. More than 50,000 individual units of governments have outstanding municipal bonds, which collectively total about \$3.6 trillion in par value. According to the National League of Cities, more than two-thirds of public infrastructure is funded with tax-exempt municipal bonds, which results in savings of about 25-30 percent in interest costs.⁹⁴ (McDonald, NLC, 2017). State and local governments and their professional associations have lobbied hard to maintain the tax-exempt status of municipal bonds and will continue to do so as the federal government engages in tax reform discussions.

Some officials have called for the reinstatement of taxable bonds that are subsidized by a direct subsidy payment from the federal government to state and local governments that issue the bonds. In response to the Great Recession, Congress authorized state and local governments to issue taxable bonds called Build America Bonds (BABs), in which the federal government paid a 35 percent interest subsidy to the issuer. The U.S. Treasury Department estimated that state

and local governments issued 2,275 separate BABs issues, which financed over \$181 billion in infrastructure projects.⁹⁵ The BAB program expired at the end of 2010.

Taxable bonds with a federal subsidy provision offer a number of advantages. They can attract investors, such as pension funds, that do not benefit from the tax-exempt status of traditional municipal bonds. These types of bonds can be a more cost-effective type of subsidy than tax-exempt bonds, in which a portion of the federal subsidy results in savings to individuals with high incomes.⁹⁶ This type of bond program also could increase transparency since it would be subject to the annual federal appropriations process. However, being part of the annual appropriations process could result in more uncertainty, along with the possibility of a decreased federal role compared to the long stable history of tax-exempt bonds.⁹⁷

The federal government currently administers a number of programs such as the state revolving fund (SRF) programs, WIFIA, the Transportation Infrastructure finance and Innovation Act (TIFIA) program, and the Railroad Rehabilitation and Improvement Financing (RRIF) program, that offer loans or loan guarantees for certain types of infrastructure projects. These programs allow state and local governments, and, in some cases, private firms, to obtain low-cost financing. Some projects also may qualify for tax-exempt private activity bonds (PABs).

Another option for providing low-cost financing would be to create a national infrastructure bank. The bank could operate as an independent government-owned corporation and use public seed funds, along with private capital, to make loans or loan guarantees for infrastructure projects. Advocates note this type of bank could decrease project costs, increase investment opportunities, decrease the impact of politics on project selection, increase incentives for private sector participation, and help facilitate regional and inter-jurisdictional projects.⁹⁸ Regional projects could help governments take advantage of economies of scale. The financing of bank projects could include requirements to fund maintenance reserve funds and to conduct periodic asset integrity inspections.⁹⁹

Expanding the Role of the Private Sector

President Trump's infrastructure plans calls for an explanation of the role of the private sector. This is in recognition that the private sector can play a role in the financing of infrastructure and can also offer other benefits.

Historically, the private sector has played an important role historically in the development of public infrastructure. Some of the earliest toll roads were built and operated by private firms. Most of the early rail construction was undertaken by private firms with financial assistance from the federal and state governments. Today, private companies own and operate the majority of infrastructure related to freight rail, telecommunications, and energy. These are areas that generally have sufficient demand, profits, and stability to attract private investors and operators.

In discussing the role of the private sector, it is important to distinguish “financing” versus “funding.” Financing refers to the means used to generate sufficient upfront cash to pay for an infrastructure project, while funding refers to the revenues that can be used to pay for the costs. Private firms may be willing to provide financing for public infrastructure, but there needs to be sufficient revenues, either generated from the infrastructure or some other source, to provide a return on private investments.

One option is to expand the use of private-public partnerships (P3s). Although there is no standard definition of a P3, the World Bank uses the following definition: “A long-term contract between a private party and a government entity, for providing a public asset or service, in which the private party bears significant risk and management responsibility and remuneration is linked to performance.”¹⁰⁰

P3s may be feasible for infrastructure projects that generate a revenue stream, such as water utilities, toll roads, and airports, but questions arise regarding how well P3s can work for non-revenue generating infrastructure and for smaller projects, which make-up the bulk of state and local capital spending.¹⁰¹ One possibility is to support P3s through revenue sources other than user charges related to a specific asset. A recent *New York Times* op-ed piece by former Secretary of Transportation, Mary Peters and her co-author, Samar Barend, noted that only eight of the 18 public-private transportation projects undertaken since 2010 transferred toll or revenue risk to the private sector. The other projects paid the private firms an availability payment for the use of the asset based on its condition and accessibility.¹⁰²

Peters and Barend identified successful public-private partnerships such as central terminal renovations at La Guardia Airport, expansion of Denver’s mass transit system, and construction of the PortMiami Tunnel. They also noted that public private partnerships can help rural areas, as demonstrated by a \$1 billion project to expand a California university that mainly serves rural students and a \$2 billion project in North Dakota to alleviate flooding.¹⁰³

P3s offer a number of potential advantages. They can lead to cost savings by shifting the risk of cost increases, delays, and revenue performance to private investors.¹⁰⁴ P3s also can include contract provisions that address the maintenance of the infrastructure. The use of a design-build approach, a type of P3 in which the same firm designs and constructs the road or facility, when used appropriately can decrease the time to complete a project, reduce the costs, and encourage more innovation in design and construction.¹⁰⁵

However, care must be taken to preserve the public interest when undertaking P3s.¹⁰⁶ This is an area in which the federal and state governments could address through the establishment of centralized units to assist in the development and negotiation of P3 agreements. This already is occurring to an extent through entities such as the Federal Highway Administration Center for Innovative Finance Support, which conducts research and training and provides technical assistance related to P3s and other revenue options, such as PABs and TIFIA.¹⁰⁷ More progress along these lines would be beneficial.

Another means for expanding the private sector's role in infrastructure development is to offer tax incentives for public infrastructure investments. One proposal, which was advanced during the presidential election, calls for \$137 billion in federal tax credits for companies that finance transportation projects. Tax incentives has been used in low-income housing development and more recently for renewable energy projects. Critics of tax credits for infrastructure projects caution that tax credits may encourage private firms to pursue the most profitable infrastructure, which may not necessarily be the most needed infrastructure. They also note that the tax credits may end up being used for infrastructure projects that would have been undertaken in the absence of tax credits.¹⁰⁸

Overall, finding sufficient revenues to finance infrastructure needs and expanding the role of the private sector present challenges, but also opportunities.

CONCLUSION

Public infrastructure plays a critical role in the nation's economy, as well as the daily lives of individuals. The nation's approach to the provision of infrastructure is a complex array of different types of providers, including federal, state, and local governments, as well as private companies, as well as different financing mechanisms. As illustrated in the discussion of historical massive investments in infrastructure, a significant amount of planning, collaboration, and public support is needed for the undertaking of infrastructure improvements.

As the nation seeks to develop an infrastructure plan for the future, it will be important to recognize the importance of existing infrastructure. The government has invested huge amounts of funds into existing highways, water systems, and other public facilities. These infrastructure and structures need to be maintained. Although it is politically appealing to finance the newest and latest infrastructure technologies and to invest in new infrastructure, this needs to be balanced with the critical need to maintain existing infrastructure.

One of the biggest challenges will be rallying support for sufficient funding of infrastructure maintenance and improvements. When infrastructure is functioning well, people may take it for granted. They may not know that infrastructure maintenance has been deferred. Therefore, it is incumbent on government leaders to undertake efforts to better educate the public on the importance and costs of infrastructure investments and the need to finance these investments.

Drawing on the expertise and resources of the private sector can be advantageous, but private firms are motivated by profits and will seek a return on their investments. So while the private sector needs to play an important role in the future investment in infrastructure, it is not going to solve the funding challenges.

Ultimately, the public needs to understand that providing funding for public infrastructure is an investment in the future. This will help support and grow the economy and have a positive impact on the daily lives of people.

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³¹ Leighninger, 2007, p. 99.

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³³ Leighninger, 2007, p. 82.

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⁷⁵ Rosen, 1996, p. 2.

⁷⁶ ASCE, *2017 Report Card*.

⁷⁷ The Congressional Budget Office (2016) also found that the overall net benefits could be increased by re-allocating a portion of the federal highway funds from rural to urban areas.

⁷⁸ Michael Pagano, 2011. *Funding and Investing in Infrastructure*. Washington, D.C.: Urban Institute, 2011. <http://www.urban.org/sites/default/files/publication/24996/412481-Funding-and-Investing-in-Infrastructure.PDF> accessed August 21, 2017.

⁷⁹ Federal Highway Administration, *Highway History*. <https://www.fhwa.dot.gov/interstate/faq.cfm#question1> accessed July 15, 2017.

⁸⁰ A survey conducted by the U.S. Environmental Protection Agency indicates that public water systems need to invest \$384 billion in infrastructure improvements over the next 20 years, or about \$19 billion per year, to comply with federal safe drinking water regulations and to ensure safe tap water. During the five-year period 2012-2016, Congress appropriated an average of \$910 million annually for the Drinking Water State Revolving Fund program.

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⁸² ASCE, *2017 Infrastructure Report Card – Wastewater*.

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⁸⁹ In a review of 28 polls that asked about a mileage tax, The Mineta Transportation Institute found that none of the polls found the majority of respondents supported the tax and only five had support above 40%. In a survey conducted by the Mineta Transportation Institute annually over the period 2011-2015, support for a 1-cent flat mileage tax has ranged from 19% (2013 and 2014) to 24% (2015), However, there was increased support of the mileage-tax to 44% in 2015 if the rate varied depending on the level of pollution emitted by a vehicle (Weinstein and Nixon 2015). Weinstein, Asha and Hilary Nixon. 2015. *What do Americans Think About Federal Tax Options to Support Public Transit, Highways, and Local Streets and Roads? Results from Year Six of a National Survey*. Report 12-51. San Jose, CA: Mineta Transportation Institute at San Jose University. <http://transweb.sjsu.edu/PDFs/research/1428-road-tax-public-opinion-poll-2015.pdf> accessed August 26, 2017.

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