

HOW TO SHAPE U.S. INFRASTRUCTURE POLICY



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HOW TO SHAPE U.S. INFRASTRUCTURE POLICY

There is wide-ranging agreement that our nation needs a serious, multi-faceted, and cohesive plan to build and update its existing infrastructure, from deciding the objectives of the investment through the delivery and maintenance of the selected projects. Financing is a crucial part of any infrastructure plan. Increasing financial constraints make it painfully obvious that infrastructure investment has to be based on long-term goals and planning, rather than short-term political cycles. This special report first looks at the reasons for infrastructure investment and then sets the stage for steps that are crucial for successful infrastructure projects. Particular attention is paid to ways to use existing funds more effectively and to increase participation by the private sector. The paper concludes with alternative methods for financing and funding the country's much needed infrastructure.

INTRODUCTION

Infrastructure in the United States has been under close scrutiny in recent years due to its inadequacy and poor performance. There is wide-ranging agreement that our nation needs a serious, multi-faceted, and cohesive plan to build and update the existing infrastructure, from deciding the objectives of the investment through the delivery and maintenance of those selected projects. After the recent passage of the Tax Cuts and Jobs Act of 2017 – the first major overhaul of the U.S. tax code in 30 years – various key players in the Administration, including the President, have indicated that infrastructure investment will be the next big item on the 2018 agenda.¹ In fact, an “Infrastructure Initiative” was one of the topics highlighted in the President’s 2018 Budget.²

Financing is a crucial part of any infrastructure plan. Historically, the majority of U.S. infrastructure has been financed by federal, state, and local governments.

However, nationwide, tightening budgets and growing deficits have put greater pressure on distributing scarce financial resources to answer economic needs and demands. Debt held by the public stood at 77 percent of GDP at the end of 2016 and is projected to grow to 87 percent in 2025.³ Anemic economic growth, flatlined productivity, and a rapidly aging population all suggest that there is no easy way out from under this increasing debt unless we reconsider how we finance and fund the various demands on our national budget. The same is true for the financial situation of our state and local economies.

A fact sheet prepared by the Office of Management and Budget raises questions about the role of the Federal Government in infrastructure investment, especially the funding of infrastructure projects: “...the Administration’s goal is to seek long-term reforms on how infrastructure projects are regulated, funded, delivered, and maintained. Providing more Federal funding, on its

own, is not the solution to our infrastructure challenges. Rather, we will work to fix underlying incentives, procedures, and policies to spur better infrastructure decisions and outcomes, across a range of sectors.”⁴

Motivated by increased noise around the issue and the Administration’s goal to reform the overall system of infrastructure, this paper first looks at the reasons for infrastructure investment and then sets the stage for steps that are crucial for successful infrastructure projects, especially ways to use existing funds more effectively and to increase participation by the private sector. The paper concludes with alternative methods for financing and funding the country’s much needed infrastructure.

WHY INFRASTRUCTURE INVESTMENT?

- **The U.S. Infrastructure is Crumbling:**

According to the American Society of Civil Engineers’ (ASCE) 2017 Infrastructure Report Card, the U.S. infrastructure is in need of significant investment that cannot be deferred any longer. In fact, according to the report, the overall U.S. infrastructure gets a grade of D+, which indicates a condition ranging from fair to poor and mostly below standard, with many elements approaching the end of their service lives. This means in many cases, problems can only be addressed with high cost rebuilds rather than via lower cost preservation techniques due to delay in responding to issues in a timely manner. Current projections forecast \$2.5 trillion of investment over the course of 10 years, \$2.0 trillion short of the amount needed to pull nation’s grade up and to maintain global competitiveness.⁵ **Table 1** shows the estimated funding gap for different types of infrastructure systems and highlights the need to rethink our national infrastructure strategy.

- **Sub-par Infrastructure is a Drag on the Economy:** Failing to undertake the investment needed to maintain and update the U.S. infrastructure also has important consequences for the overall U.S. economy. A well-functioning and updated infrastructure can affect the productivity of businesses and individuals in a variety of ways, such as lowering transportation costs, reducing

time spent on roads, increasing the reliability of our electricity supply, and providing clean water, etc. A 2016 study by ASCE showed that the investment gap could result in \$3.9 trillion in lost GDP by 2025 and 2.5 million fewer jobs in 2025.⁶ At the household level, the lost disposable income amounts to \$3,400 each year between 2016 and 2025.

In addition, prior research shows that increasing public investment spending by one percentage point of GDP increases the level of output by 0.4 percent in the same year and by 1.5 percent four years after the initial investment.⁷ According to the same report, these investments have a larger effect on the macroeconomic indicators of countries with a higher degree of public investment efficiency. There are also different multipliers or economic impacts based on which sector receives the infrastructure investment. For example, based on 2012 data, the U.S Bureau of Economic Analysis estimates that every \$1 spent in the construction sector generates an additional \$0.86 of economic activity.⁸

Given that increasing economic activity and creating jobs were major themes during the last election cycle as well as the first year of the Trump Administration, it is important to emphasize how public infrastructure investments have one of the highest effects on short-run GDP of any fiscal intervention.⁹ **Table 2** provides multipliers for various forms of government stimulus estimated by both the Council of Economic Advisers (CEA) and the Congressional Budget Office (CBO). Other research has emphasized long-run impacts: While a 1% increase in public capital stock would result in a higher level of private sector economic output by 0.083% in the short run, the long-run impact on private sector output would be 0.06%.¹⁰ These estimates are only for the private sector impact and the numbers would be higher if total economic output is evaluated. According to a report by the College of William & Mary, in the short run, a dollar spent

TABLE 1. CUMULATIVE INFRASTRUCTURE NEEDS BY SYSTEM BASED ON CURRENT TRENDS, EXTENDED TO 2025 (BILLIONS OF \$2015)

2016-2025 (10 YEARS) INFRASTRUCTURE SYSTEMS	TOTAL NEEDS	ESTIMATED FUNDING	FUNDING GAP
Surface Transportation ¹	\$2,042	\$941	\$1,101
Water/Wastewater Infrastructure ¹	\$150	\$45	\$105
Electricity ¹	\$934	\$757	\$177
Airports ¹	\$157	\$115	\$42
Inland Waterways & Marine Ports ¹	\$37	\$22	\$15
Dams ²	\$45	\$5.6	\$39.4
Hazardous & Solid Waste ³	\$7	\$4	\$3
Levees ⁴	\$80	\$10	\$70
Public Parks & Recreation ⁵	\$114.4	\$12.1	\$102.3
Rail ⁶	\$154.1	\$124.7	\$29.4
Schools ⁷	\$870	\$490	\$380
TOTALS	\$4,590	\$2,526	\$2,064

1 Data taken from ASCE’s Failure to Act: Closing the Infrastructure Investment Gap for America’s Economic Future (2016).
 2 Total needs are federal and non-federal high-hazard dams.
 3 Funding only includes publicly funded remediation, not funds from private sector.
 4 Total needs number based on discussions with the National Committee on Levee Safety.
 5 Does not include backlog and estimated spending for U.S. Army Corps of Engineers and city parks.
 6 Needs and funding estimates based on market projections and current investment trends.
 7 Data from State of Our Schools: America’s K–12 Facilities (2016). 21st Century School Fund, Inc., U.S. Green Building Council, Inc., and the National Council on Schools Facilities.
 *numbers may not add up due to rounding
Source: American Society of Civil Engineers, “2017 Infrastructure Card,” pg. 5, <https://www.infrastructurereportcard.org/wp-content/uploads/2017/04/2017-IRC-Executive-Summary-FINAL-FINAL.pdf>

on infrastructure construction produces roughly double the initial spending in ultimate economic output and, over a 20 year period, each dollar of public investment generates an accumulated \$3.21 of economic activity.¹¹ These numbers underline the significance of choosing long-lasting, high-quality projects in order to maximize the impact of each public dollar spent.

- **We Need to Increase the Resilience of our Infrastructure:** 2017 has been a painful reminder of how extreme weather events can destroy vital infrastructure and set back

the economies of affected areas. For example, according to experts at Stanford University, an updated stormwater management system could have lessened the economic impact of Hurricane Harvey in the Houston area.¹² The same is true for the distribution of electricity. Areas prone to high winds or severe storms could benefit from burying electricity distribution networks underground. Subpar or low-quality infrastructure not only devastates areas hit economically, it also threatens lives, increasing the overall cost to the economy.¹³

TABLE 2. ESTIMATED OUTPUT MULTIPLIERS FOR DIFFERENT TYPES OF STIMULUS

	CEA	CBO Low	CBO High
Public Investment Outlays ^a	1.5	0.5	2.5
State and Local Fiscal Relief	1.1	0.4	1.8
Income and Support Payments ^b	1.5	0.4	2.1
One-time Payments to Retirees	0.4	0.2	1
Tax Cuts to Individuals	0.8	0.3	1.5
Business Tax Incentives	0.1	0	0.4

Note: The CEA multipliers show the impact of a permanent change in the component of 1% of GDP after 6 quarters, or, equivalently, the cumulative impact of a one-time change of 1% of GDP over 6 quarters. The CBO multipliers show the cumulative impact of a one-time change of 1% of GDP over several quarters.

a. Includes transfer payments to state and local government for infrastructure and tax incentives to businesses directly tied to certain types of spending.

b. Includes such programs as unemployment compensation, COBRA and SNAP.

Source: National Economic Council and the President’s Council of Economic Advisers, “An Economic Analysis of Transportation Infrastructure Investment,” July 2014, pg. 12, https://obamawhitehouse.archives.gov/sites/default/files/docs/economic_analysis_of_transportation_investments.pdf

I. SETTING THE STAGE: STEPS FOR LONG-LIVED AND SUCCESSFUL INFRASTRUCTURE PROJECTS

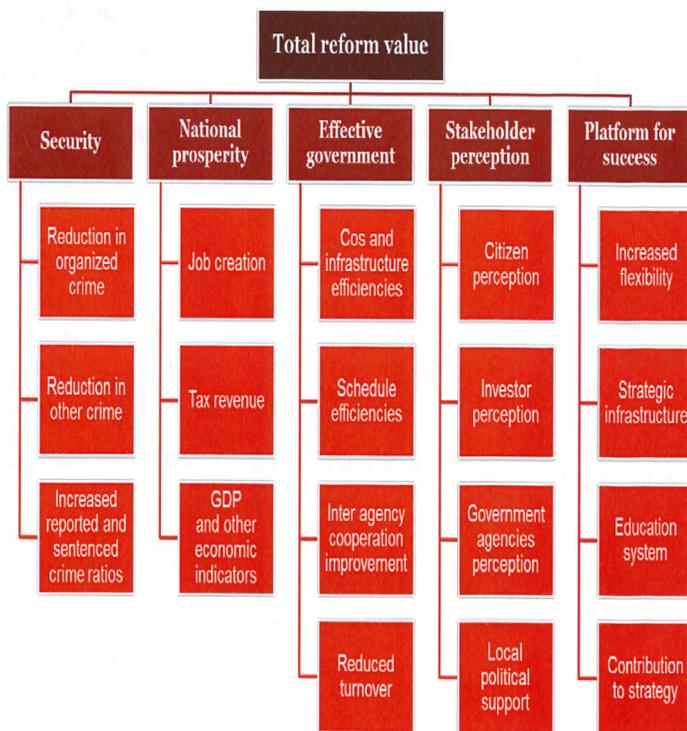
Increasing financial constraints make it painfully obvious that infrastructure investment has to be based on long-term goals and planning, rather than short-term political cycles. The problem is not unique to the United States. According to a recent McKinsey Global Institute Report, “On the whole, countries continue to invest in poorly conceived projects, take a long time to approve them, miss opportunities to innovate in how to deliver them and then don’t make the most of existing assets before opting to build expensive new capacity. In many

countries, the process of selecting, building, and operating infrastructure – and the governance systems that could force improvements – has not changed for the better in decades.”¹⁴ For example, after the 2008 recession, the U.S. used infrastructure spending as a stimulus to jolt the economy. However, only a small portion (\$27.5 billion) of the \$787 billion¹⁵ stimulus was spent on roads and bridges and these funds were largely focused on “shovel ready” projects “that put money to work quickly in the economy but were not necessarily the most likely to bring long-term economic, environmental and social benefits.”¹⁶

There are, however, opportunities to improve the system through an all-inclusive approach. Such an approach would require a methodical look at the problem from inception to delivery and management, as well as careful planning that brings together all parties involved in the process in a streamlined and efficient manner. The steps for a successful infrastructure investment program have been outlined by different organizations.¹⁷ The following list is largely based on a 2017 analysis by PwC and a 2013 report by McKinsey Global Institute:

1. **Identify the Needs and Expectations:** It is important to start infrastructure projects with clearly defined needs and goals. As stated by the McKinsey report, most of the time the investment

FIGURE 1. AN ILLUSTRATIVE STRUCTURE OF IMPORTANT GOVERNMENT FOCUS AREAS



Source: PwC, “Fiscal Stimulus through Infrastructure Investment: A Framework for Achieving Full Value,” February 2017, Figure 3, pg. 7. <https://www.pwc.com/us/en/capital-projects-infrastructure/publications/five-step-investment-framework.html>

undertaken does not address the defined needs or lacks in delivering the benefits envisioned. Multiple government agencies can be involved with the original project and they can have different priorities. **Figure 1** shows an example of a diverse list of “wishes,” some of which may be the result of a sense of urgency and a desire to act quickly.

Obviously, there will be trade-offs between different needs, associated benefits, and in many cases the speed in which the government wants to move on these projects. However, starting with a well-established framework can decrease inefficiencies and make the whole process much more transparent.

In June 2017, President Trump announced his infrastructure agenda with the goal of promoting job creation and U.S. economic growth.¹⁸ In order to accomplish these goals, the President envisions lowering the average permit time from 10 years¹⁹ to 2 years, incorporating private-sector capital and expertise into projects, increasing investment in rural infrastructure, investing in “transformative” projects that will change America’s approach to infrastructure, and introducing a workforce training initiative focused on skill-based apprenticeship education. These high-level goals established by the Administration will definitely require an updated infrastructure governance system.

According to the McKinsey report, updates in the infrastructure governance system could be achieved through:

- *Coordination between all related agencies to achieve the socioeconomic goals outlined by the infrastructure plan:* For example, in Singapore, the Urban Redevelopment Authority, Land Transport Authority, and Development Planning Committee work together to achieve

national priorities by developing plans, goals, and individual projects that are consistent with each other. To be successful, President Trump's ambitious infrastructure agenda will require close coordination between various agencies. For example, in line with one of the founding pillars of this agenda, the Administration issued multiple Executive Orders to encourage coordination, especially in the permitting process that is widely seen as the main cause of delays in U.S. infrastructure projects.²⁰

- *Separate Political and Technical Responsibilities:* For a well-functioning and accountable governance system, there needs to be a clear separation of political and technical responsibilities. According to the McKinsey report, while policymakers should set the overall goals and strategic direction of the plan (for example, whether to invest in urban transport or in rural connectivity), experts should decide the best and most effective way of achieving these goals as well as how to execute the projects that are selected. These should be based on sound scientific and market research, weighing multiple solutions taking a long-term approach, and encouraging competition. However, even with the independent nature of technical responsibilities, the resulting decisions should still be accountable to public and political leadership.
- *Effective Engagement between the Public and Private Sector:* In many infrastructure projects, the public sector sees the role of the private sector as financier, executor, and manager of assets. However, involving the private sector upfront in identifying the projects, as well as planning portfolios, could improve the overall outcome. For example, countries like Chile, South Africa, and Taiwan are develop-

ing frameworks that accommodate a growing number of unsolicited proposals and “typically include bonus opportunities or special procurement processes that reward the proposer for laying the groundwork. Creating a mechanism for the private sector to make proposals outside the customary bidding process has the potential to increase the quantity and quality of projects under consideration and foster greater interest, innovation, and competition among potential contractors.”²¹ It is also important to engage stakeholders effectively. This should be based on transparency – including easy access to information related to the costs, benefits, and effects of the project – education through public forums, and meaningful participation in the process by stakeholders. Along this process, it is imperative to communicate the importance of the long-term nature of such projects rather than focusing on short-term gains. This ensures that both the private and public sectors understand the need for high-quality projects that do not increase the financial burden on the public sector over the long run by using an appropriate evaluation system, which will be discussed below.

2. **Improve the Project Selection Process and Optimize Infrastructure Portfolios:** Once priorities are set, each project should be evaluated based on its cost and benefits in a consistent manner across different portfolios to enable comparison. As outlined by the PwC report, there are important steps to this process:
 - a. *Perform Multiple Scenario Analyses:* It is important for policymakers to evaluate various projects by incorporating multiple scenario analyses that factor in project delays, cost overruns, and other financial, political and legislative risks. These scenarios could be

instrumental in evaluating both ongoing and future projects and can be highly valuable in deciding how to proceed and correct course if one of these risks materializes.

- b. *Consider the Interdependencies within the Portfolio of Projects:* When analyzing the benefits of a project, it is important to consider not only its standalone benefits but also its impact on other potential investments in the portfolio. There could be a strategic fit between projects and synergies that could be translated into a benefit maximizing portfolio. For example, if evaluated alone, investment in a new data warehousing system that digitizes government data could be seen as not very beneficial since it does not create a net cash flow and it has few tangible benefits. However, if it is evaluated within the portfolio of projects, its impact on other projects within the portfolio, such as identifying needed infrastructure or catching tax fraud by enabling different data and analytics programs, is greatly amplified.

The same logic can be used in evaluating highway systems. Any highway management agency should integrate reconstruction and rehabilitation in the right proportion to improve the network conditions and most importantly to use the taxpayers' funds in the most efficient manner. Within rehabilitation, there are different approaches, or "mix of fixes" with different costs and life spans: Short term fixes are expected to last 2 to 10 years and they are considered preservation. Medium- to long-term fixes could have a life span of 10 to 40 years depending on the type of reconstruction activity. By analyzing the network of highways within the portfolio and staging all these activities correctly, "the life of the network is increased and the network's annual costs are

lowered because there are fewer pavements to rehabilitate each year."²²

- c. *Define Performance Targets and Define and Use the Right Metrics:* Based on the best available scientific and market information, agencies should set performance targets for projects in question. For example, this could include how long we expect a specific infrastructure project to last before it needs to be repaired or rehabilitated. This could be key to switch the focus to long-term performance that decreases the cost over the life span of a project. Furthermore, in order to have an accurate and uniform comparison between different sets of projects, it is important to define the right key performance indicators and translate them into common metrics.²³ A well-defined measurement process could be the key to an optimized spending portfolio.

One of the key methods that has gained prominence in recent years is the use of life cycle cost analysis (LCCA), a data-driven tool that provides a detailed accounting of the total costs of a project over its expected life.²⁴ Although tight budgets and political goals tend to put more prominence on upfront costs, a well-thought-out infrastructure project should take into account not only the construction of the project but also the maintenance and operation. Within the transportation sector, LCCA calculates upfront development, capital and financing costs, discounted operating and maintenance costs, and end-of-life costs associated with a specific asset or project. As stated by ASCE, LCCA can also factor in uncertainty, risk, and other elements including environmental and equity considerations. The application of LCCA includes but is not limited to:

- Helping to select the more cost-effective alternative to meet a project's objectives
- Within a specified project, evaluating a design requirement, such as pavement type
- Given the limited funding, prioritize projects based on overall cost differences
- Deciding the most cost-effective project implementation method
- Using LCCA in the project design process to iterate design options and evaluate trade-offs, such as environmental impacts vs cost and performance for different designs.

LCCA has been widely recognized as a tool that saves money over a projects' lifespan and is being used by several agencies with great success. For instance, the Port Authority of New York and New Jersey saved \$140 million over 40 years on an airport runway expansion project and \$100 million over 20 years on the George Washington Bridge Repair project.²⁵ In fact, after the success of these two projects, the use of LCCA was recommended throughout the agency, and a pilot program was developed for four projects at the cost of \$67,000 with a resulting cost savings of \$37 million.

Despite these success stories, the use of LCCA in the public sector, especially in the transportation sector, has been less than optimal.²⁶ **Box 1** summarizes a set of policy recommendations put forth by ASCE and the Eno Center for Transportation to increase the use of LCCA in infrastructure projects.

d. *Use Portfolio Optimization Tools:* Once the metrics are set, various portfolio optimization tools could be used to find the right combination of projects. With the advent of information technology and dissemination of data, some previous-

ly hard-to-find measures which would allow for the quantification of social, environmental, and job creation impacts are now publicly available. Obviously, a realistic cost estimate approach, factoring in potential risks such as delays and material cost escalation, should be an integral part of these calculations.

These optimization tools should also factor in existing projects and how to make the most of existing infrastructure assets through boosting asset utilization, optimizing maintenance planning, and expanding the use of demand-management measures. According to the McKinsey Global Institute Report, "for example, intelligent transportation systems for roads, rails, airports, and ports can double or triple the use of an asset – typically at a fraction of the cost of adding the equivalent in physical capacity."²⁷ Maintenance planning by factoring in LCCA could be key in finding the optimal balance between long-term renewal and short-term maintenance.

3. Plan Specifics of Selected Projects: Once the overall outline of projects have been decided, action starts with decisions on the bidding process. If the selection stage is properly undertaken, much of the general decisions on costs, schedule, delivery methods (public versus private), and the state of readiness have been undertaken. In this stage, these general decisions are shaped around specific projects and final decisions are made with respect to private finance participation, the bidding process, and monitoring. Setting clear guidance for each step of project from finalizing project design, to obtaining approvals and bringing projects to the market is important for the efficiency and productivity of these projects. Some projects may require longer timetables than others in terms of planning and contracting in the market. Portfolio optimization in the second stage carries greater value in these

BOX 1. RECOMMENDATIONS TO INCREASE THE USE OF LCCA IN PUBLIC SECTOR⁶⁰

The existing evidence points to the fact that taking a long-run view while evaluating infrastructure projects could save significant sums of money both at the federal and local levels during the life of a project. The following list of recommendations, for the federal, state and local levels, were put forth by ASCE and the Eno Center for Transportation to increase the use of LCCA in the public sector.

FEDERAL LEVEL RECOMMENDATIONS:

- **Tie Funding to Performance:** The U.S. Department of Transportation (USDOT) should have greater authority to hold the grantees accountable to performance standards that will reward the states that make most cost-effective decisions. This incentive system would encourage states to take a long-term view and use tools such as LCCA while decision-making.
- **Launch a Discretionary Grant Program Targeted Toward Asset Management:** In order to incentivize a better asset management system, Congress could introduce a new competitive discretionary grant program separating the funding set for asset management.
- **Use an LCCA-Driven Cost Effectiveness Ranking to Inform the Statewide Transportation Improvement Program (STIP) and the Transportation Improvement Program (TIP):** Congress should direct states to use data-driven, transparent project ranking methods to inform decision makers about the return on investment of alternative projects and to prioritize the selection of the projects with the greatest returns.
- **Improve Data Resources:** One of the greatest barriers to the use of LCCA is the lack of consistent data. This barrier could be overcome with the creation of data collection standards and the expansion of data retention policies.

- **Fund a Development Course for LCCA Leaders:** USDOT should look into development of periodic, low-cost courses to train state and local officials in the application of LCCA through educating decision makers on how to compare data over time, how to manage and incorporate risk, and how to implement and maintain an agency-wide program with the use of strong economic analysis skills.

STATE AND LOCAL LEVEL RECOMMENDATIONS:

- **Establish an LCCA Pilot Program:** A pilot LCCA program could be a significant first step to demonstrate how to ensure manageable implementation as well as to demonstrate the utility of the process.
- **Introduce State-Level Legislation:** In order to bring certainty in a changing political environment, legislatively tying funding to the result of a LCCA and other economic analysis would bring longevity to the programs. This could be done through cooperation between state legislatures and USDOT.
- **Dedicate Funding for Workforce Development:** Lack of understanding on how to incorporate LCCA in the decision making process has been highlighted in agency surveys. Developing training programs for staff and executives through dedicated funding could help overcome this hurdle.
- **Partner with the Private Sector:** Through partnership with the private sector, the public sector can benefit from the private sector's expertise with the use of LCCA, as well as their tendency to innovate new approaches to project design.

cases, especially if political pressure is pushing for quick action. Such large projects could be complemented with number of faster, high-impact projects, such as key repair, upgrade, and maintenance projects.

The **bidding process** carries significant importance in terms of lowering potential costs. Establishing a market discipline and opening up projects to competition from different and innovative technologies, as well as competing materials, could help achieve more efficient and cost-effective proposals. Today, many agencies have procurement policies that effectively limit competition by continuously relying on one type of material or existing technologies. However, some agencies such as the U.S. Department of Agriculture have embraced maximum open and free competition as outlined by an internal memo dated March 16, 2002: “The Department’s Rural Utilities Service (RUS) expects the owner and the design engineer to be open to reasonable alternatives during the facility planning and design process. Contractors, manufacturers, and suppliers with acceptable equipment and materials should have a chance to participate in the project. Once the facility requirements have been established that assures good quality, the goal is to construct the project at the best price for the system and the taxpayer.”²⁸ The Federal Highway Administration also issued a Pavement Type Selection Policy Statement

in 1981 to provide the public with acceptable highway service at a minimal annual or life cycle cost while permitting maximum flexibility. The intention of the policy was “taking advantage of fluctuating material prices while not compromising good design and pavement management practices.”²⁹ The best procurement practices not only stretch the limited funds available, they also encourage innovation through competition. (See **Box 2** for the importance of bidding and other policy recommendations on pavement selection as an example).

4. **Execute:** Once all the decisions are made, a careful execution of the projects should not be neglected. In many cases, the public sector has more experience in administration than oversight and could face many unexpected obstacles. In order to successfully manage these risks, the PwC report proposes the establishment of a project management office, with experts on environmental, financial and technical issues who would continuously evaluate the progression of the project: Is it on schedule? Does it meet budget and design expectations?

The policy recommendations above are important not only to set the stage for a successful infrastructure plan, but also have important implications for attracting much needed private capital by giving certainty to the private sector.



BOX 2: HOW SETTING THE STAGE RIGHT COULD IMPROVE INFRASTRUCTURE PROJECT OUTCOMES: A CLOSER LOOK AT ROADWAYS AND PAVEMENT MANAGEMENT

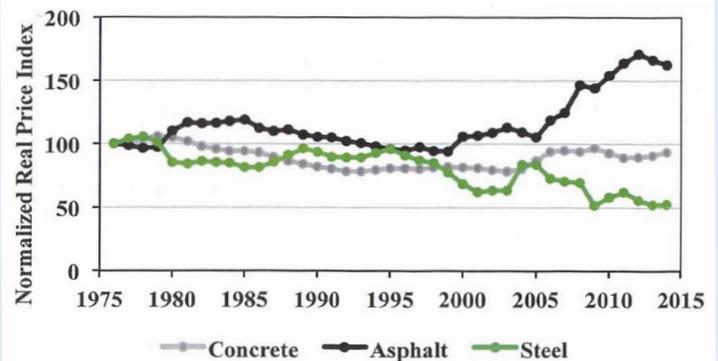
Since roadways and pavement are a major part of U.S. infrastructure spending, considerable cost saving could be achieved through applying some of the best practices or policy recommendations that were put forth in this paper. Not only the original construction costs but also future maintenance and operation costs and their impact on various economic and social indicators should be factored in when projects are designed and selected. If a project that has a low initial cost ends up requiring frequent future repairs, this will also have implications in terms of traffic congestion during repairs, fuel wasted, and possibly more repair costs for the vehicles, in addition to the impact on government budgets.

A proper LCCA should factor in all these aspects and uncertainties beyond pavement deterioration. Some form of LCCA has been used in the transportation decision-making process in the U.S. However, its use could be improved considerably, including changes that could enhance the selection process and could, in turn, stretch infrastructure funds even further. Some ideas that are being discussed are:

- *Improve LCCA's Cost Estimating Practices:* Using LCCA cost analysis has inherent uncertainties due to projects' long lives. For example, factoring in future price changes for materials could change the decision or the choice of material to be used in project construction. Currently, LCCA analysis generally assumes that the growth in future price of inputs follows the general rate of inflation for all goods and services in the economy. However, according to **Figure 2.1** put together by MIT CSHub,⁶¹ using data from the Bureau of Labor Statistics, inflation in construction materials differs significantly from the general inflation rate.

MIT CSHub in collaboration with Colorado Department of Transportation⁶² looked at whether incorporating alternative methods of projecting paving

FIGURE 2.1 HISTORICAL REAL PRICES OF CONCRETE, ASPHALT, AND STEEL SINCE 1976*



* A price of 100 matches the consumer price index.

Source: MIT Concrete Sustainability Hub, "Material Price Projections for Pavement Life Cycle Cost Analysis," March 2016.

material prices could improve existing modeling. The results showed that using material-specific projections improved the accuracy of LCCA. These improved estimates can also impact the allocation of DOT resources.

- *Conduct Multiple Scenario Analysis with Probabilistic Inputs to Factor in Various Uncertainties:* Due to the complexity of the modelling, many state Departments of Transportation (DOTs) use static values for the majority of their model inputs, rather than using probabilistic inputs. However, considerable research is needed to figure out how changes in these inputs could impact LCCA and which variables make a difference in project selection. Another analysis by MIT CSHub applied this probabilistic approach to 32 scenarios that vary in terms of location, traffic conditions, design life, analysis period, and maintenance schedule in order to identify what drives the differences between scenarios for alternative construction materials. The results suggest that for cement-based material the initial bid cost is the

major source of uncertainty while, for asphalt, other factors such as pavement degradation play an important role in creating uncertainty. These exercises are important to help refine the modeling process and to gather data in order to give the states more information for their decision making.

Some states, in collaboration with researchers, have begun looking into these important issues. For example, in collaboration with Minnesota DOT, MIT⁶³ applied this probabilistic LCCA framework which factors in the cost of material uncertainties for different sizes of projects to show the importance of economies of scale (a one-mile pavement project versus 6.3 miles). The analysis showed that in general, asphalt sections had the advantage of low initial cost, however they accrued greater maintenance costs over the 35 year analysis period. The size of the project also shows the importance of economies of scale: while the LCCA cost for asphalt selection is lower for smaller scale projects, concrete has an advantage in larger projects.

In addition to updating the LCCA modelling, research shows that improvements in competition in terms of opening up the market to various materials could be instrumental not only in bringing down costs, but also in encouraging innovation. Research by James W. Mack, Leif Wathne and Feng Mu,⁶⁴ looks at data put together by Oman Systems, which compiles construction cost data from web posting of bids data, for 45 states from the mid-1990s to 2000s. Their results highlight some important points:

- Many states rely heavily on only one type of material for their pavement needs.
- There is a clear trend toward lower unit prices for both asphalt and concrete when the share of pavement spending for asphalt versus concrete decreases from 100 percent to 60%.
- Price variability in unit prices for both materials decreases with increasing levels of competition.
- States that diversify their pavement “portfolio” get a bigger bang for their buck than states that rely on only one type of material. (See Table 2.1).

The importance of competition has also been highlighted by another MIT study that shows that if a state were to sustain more competitive pavement spending for multiple years, it could, for example, expect to pay a lower unit price for concrete, one of the paving choices.⁶⁵ Validating the study by Mack et al. , a more recent MIT competition analysis,⁶⁶ shows how moving from an average of 5 percent state spending on concrete to higher levels could decrease paving unit prices in both asphalt and concrete (see Figure 2.2). The researchers highlighted that:

- The most influential factors driving concrete paving material bid prices are project size, followed by inter-industry competition, market size, and intra-industry competition.
- The most influential factors driving asphalt paving material bid prices are the market size, followed by inter-industry competition, intra-industry competition, and the presence of price-adjustment clauses, which are used primarily for asphalt paving prices.

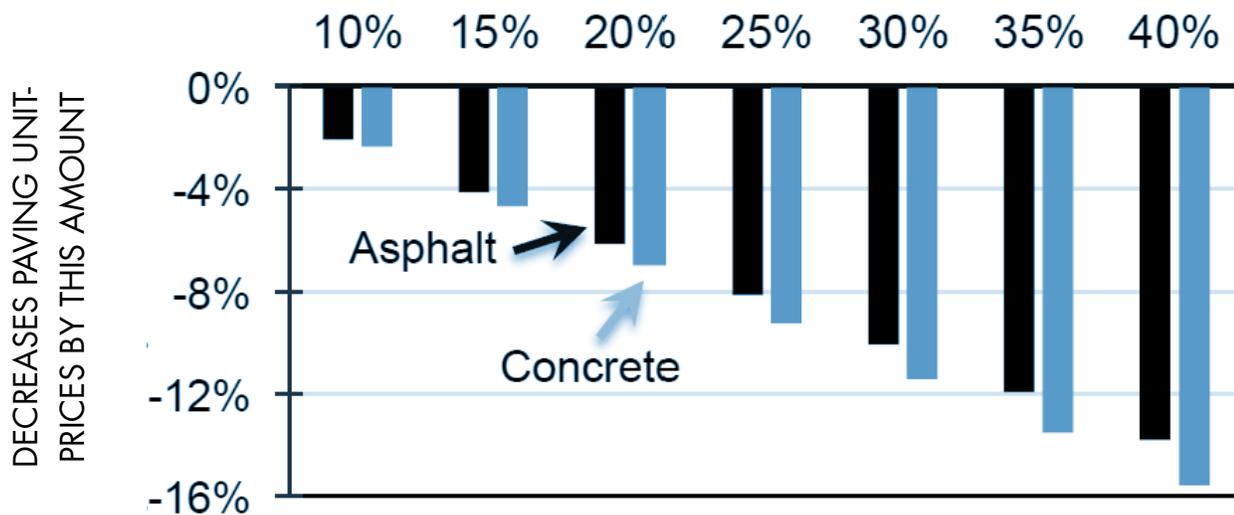
In order to encourage competition, many DOT agencies use the Alternate Pavement Bidding (APB) process under which two equivalent pavement designs are developed for a given project and the contractor decides which design to submit for his bid. Then LCCA is used to calculate the total cost of ownership to pick the project with lower cost. This process has not only increased the number of bids for pavement design projects, it has also resulted in lower average bid estimates. **Table 2.2** shows the compilation of cost savings associated with using APB and LCCA at the state level. Despite the fact that developing a second set of plans could involve additional costs, the overall savings outweighs these costs.⁶⁷ However, cost savings associated with APB and LCCA still requires long-term, persistent thinking. It is important to create a system that signals to bidders that agencies are serious about competition, even encouraging bids from out of state contractors to entice industries that have been excluded from contracts over the years. The cost savings should be thought as a long term goal, not an overnight achievement.

TABLE 2.1 BREAK-EVEN ANALYSIS FOR \$200 MILLION PER YEAR BUDGET FOR PAVEMENTS

INVESTMENT TOTAL (\$M)	CONCRETE MARKET SHARE	EXPEND. ON ASPHALT (\$ M)	ASPHALT UNIT PRICE (\$)	TONS OF ASPHALT	EXPEND. ON CONCRETE (\$M)	CONCRETE UNIT PRICE (\$)	SQUARE YARDS CONCRETE
\$200	0%	\$200	\$78.72	2,540,650	\$ -	\$63.71	-
\$200	5%	\$190	\$78.72	2,413,618	\$10	\$63.71	156,961
\$200	10%	\$180	\$78.72	2,286,585	\$20	\$63.71	313,922
\$200	30%	\$140	\$61.85	2,263,541	\$60	\$31.94	1,878,522
\$200	35%	\$130	\$61.85	2,101,859	\$70	\$31.94	2,191,609
\$200	40%	\$120	\$61.85	1,940,178	\$80	\$31.94	2,504,696

Source: James W. Mack, Leif G. Wathne and Feng Mu, "Improving Network Investment Results by Implementing Competition and Asset Management in the Pavement Type Selection Process," Proceedings of the 11th International Conference on Concrete Pavements, August 2016, San Antonio Texas.

FIGURE 2.2 IMPACT OF INCREASING AVERAGE STATE SPENDING OF 5% ON CONCRETE TO HIGHER LEVELS



Source: MIT Concrete Sustainability Hub, "Measuring the Impact of Competition on Paving Material Prices," Research Brief, November 2017.

TABLE 2.2 AGENCY SAVINGS FROM COMPETITION DUE TO LCCA AND ALTERNATE PAVEMENT BIDDING PRACTICES

STATE	DESCRIPTION
Indiana (Duncan & Holtz, 2013)	<ul style="list-style-type: none"> • Used on 64 projects • On 26 projects evaluated between 2009 and 2011, APB saved the state \$13M in initial costs and an estimated \$93.4M in Life Cycle Costs
Kentucky (Looney, 2013)	<ul style="list-style-type: none"> • Used on 44 projects, with a documented savings of \$148M • 32 of the 44 projects had both asphalt and concrete bidders, with only two being awarded to concrete - highlighting the incredible savings potential of increased competition
Louisiana (Temple, 2010)	<ul style="list-style-type: none"> • Used APB on 47 projects between 2001 and 2009. Cost savings on these 47 projects is \$120M
Missouri (Ahlvers, 2009)	<ul style="list-style-type: none"> • Used on 124 projects through July 2009. APB yielded a 10% decrease in unit costs for both asphalt and concrete
Ohio (Faulkner, 2010)	<ul style="list-style-type: none"> • Used on more than 10 projects. An industry study of five projects let in 2009 documented a savings of \$58M.
West Virginia (Hall, 2010)	<ul style="list-style-type: none"> • WV has used APB on 13 projects. On their six most recent projects, the state has documented a savings of \$16.4M
New York (Bid results, 2013)	<ul style="list-style-type: none"> • Used on first project in in December 2013. The cost savings was between \$1.3 to \$2.6M vs. costs on non-APB projects
Michigan (MDOT, 2001)	<ul style="list-style-type: none"> • On Michigan's first APB project, the low bid was nearly \$3M less than the engineer's estimate. After considering costs incurred in developing & implementing the APB process for the first time, the net savings was over \$2M
Ontario (Fung, 2006; OMOT, 2012)	<ul style="list-style-type: none"> • Used on 6 projects between 2000-2006. Total savings were \$28.5M when comparing the lowest concrete vs. the lowest asphalt bids • In April 2012, the Ontario Ministry of Transportation extended AD/AB to its arterial, non-freeway roads
<p>Source: James W. Mack, Leif G. Wathne and Feng Mu, "Improving Network Investment Results by Implementing Competition and Asset Management in the Pavement Type Selection Process," <i>Proceedings of the 11th International Conference on Concrete Pavements, August 2016, San Antonio Texas. Replicated Table 2, pg. 6.</i></p>	

II. FINANCING U.S. INFRASTRUCTURE

It is important to distinguish between funding sources and financing within the context of infrastructure investment. According to a Deloitte study,³⁰ these are defined as:

- **Funding:** The revenue or public spending that pays for the development and ongoing maintenance of an asset or service and the repayment of its financing. It's the money that doesn't have to be "paid back." The Highway Trust Fund is an example of the dedicated funding for highways and mass transit in the U.S. (See Box 3)
- **Financing:** The structure and related instruments used to leverage or securitize future funding sources. It's the money that's borrowed to build the project, and it's paid back from the funding sources.

Infrastructure in the U.S. is funded by a combination of tax revenues (federal grants and loans, state and local expenditures, and municipal bonds) and user fees (tolls, fees, and charges generated by enterprise systems like toll roads and water and sewer systems).

Historically in the U.S. almost all road and water infrastructure has been supplied by the public sector. According to a recent Congressional Budget Office report, total federal, state, and local government spending on transportation and water infrastructure was \$416 billion in 2014.³¹ Most of that spending (\$320 billion) was financed by state and local governments. However, over time, when adjusted for inflation, real public spending on transportation and water infrastructure fell by 5 percent between 2003 and 2014. Over this period, the decline was entirely the result of reductions in capital purchases, such as the construction and rehabilitation of highways. On the other hand, the operation and maintenance of infrastructure continued to grow.

As mentioned in the previous sections, in order to reverse the underinvestment trend in infrastructure and create a competitive infrastructure network, we need to expand the sources of investment and use funds, regardless of their source, as effectively as possible.

With that goal in mind, for example, in 2014 President Obama announced the Build America Investment Initiative, which instructed the Secretaries of the Treasury and Transportation to lead a working group to analyze how to increase public and private sector cooperation in infrastructure investment.

Even though certain infrastructure networks are primarily provided by the public sector, there are certain segments of the network that are financed by the private sector. For example, three-fourths of U.S. households are serviced by private investor-owned electric utilities whose rates are regulated by public utility commissions. Landline and cellular telecommunications networks, interstate oil and natural gas pipelines, and the railroad freight industry are privately owned and operated.³² The ownership of various infrastructure assets varies by country. For example, in Canada and Europe, there are privately managed highways. In U.K., all of the urban water supply infrastructure is owned by the private sector.

However, even for infrastructure projects that are traditionally owned by the public sector in the U.S., state and local governments often obtain private debt financing through municipal bond markets or have entered into public-private partnerships to provide financing and/or manage infrastructure. In this section, we will look into how these alternative financing sources are being used, how they impact each other, and how we can expand the role of private financing in infrastructure projects.

- **Municipal Bonds:**

A municipal bond is a bond issued by state and local government generally to finance public projects. The U.S. has the largest municipal bond market in the world, partly due to the fact that interest on municipal bonds has been exempt from federal taxation since the introduction of federal income tax in 1913. In addition to the federal government, the state that issues the bond also excludes the interest from state income tax. There has been discussions about the cost of municipal bonds to the federal government. It is one of the largest tax expenditures and it is expected to cost \$617 billion over the next 10 years.³³

BOX 3. HIGHWAY TRUST FUND: LOOKING FOR A SOLUTION

The Highway Trust Fund (HTF) finances most federal government spending for highways and mass transit. It is funded primarily by transportation related taxes (taxes on gasoline and diesel and sales taxes on certain tires, trucks and trailers). Before 2008, tax revenues were sufficient to sustain the outlays of the HTF. Since 2008, Congress has sustained highway spending by transferring \$143 billion of general revenues to the fund, including \$70 billion in 2016 as a result of legislation enacted at the end of 2015.⁶⁸ Unless the status quo changes, Congress will again have to transfer general funds to the HTF in 2020.

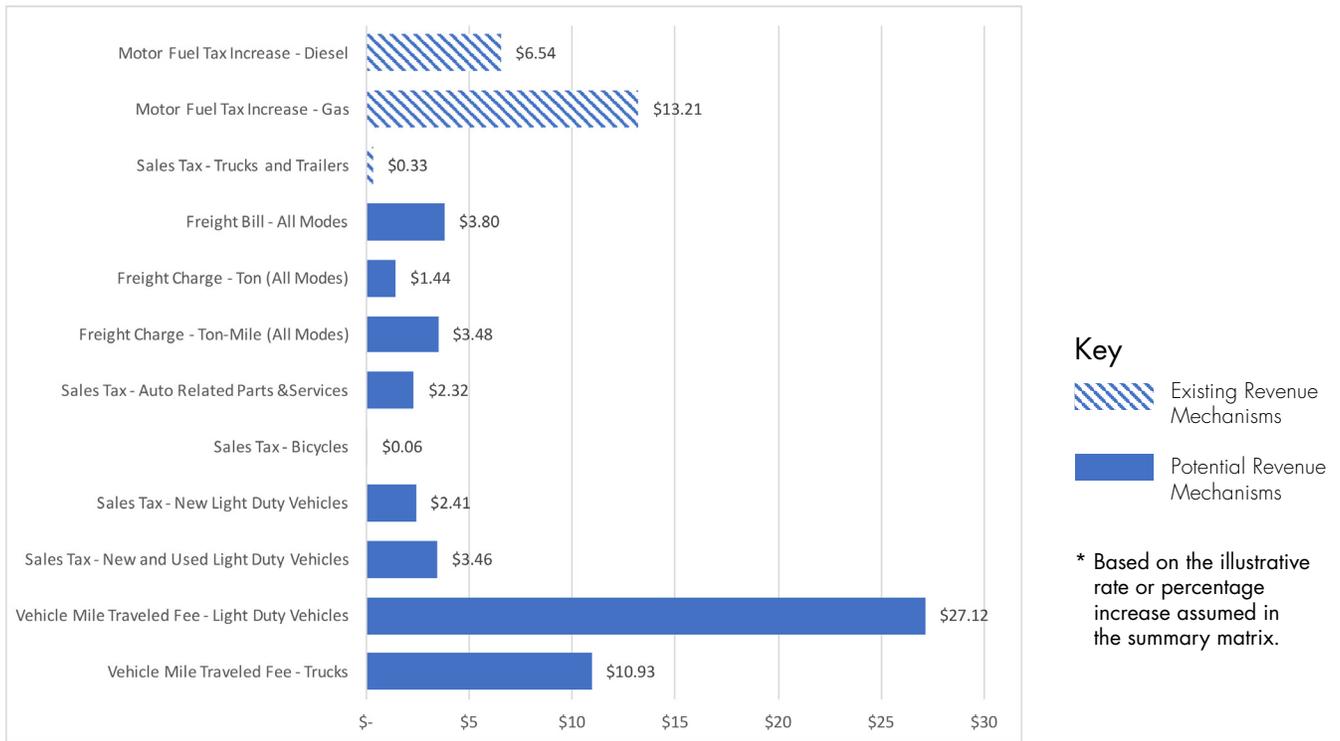
The downward trend in HTF revenues has lead policy-makers to consider alternative solutions to the problem. Table 3.1 and Figure 3.1 show an example of revenue options for various policy proposals prepared by the American Association of State Highway and Transportation Officials.⁶⁹ According to one policy option analyzed, a national sales tax on gasoline of 5.5 percent would have raised \$24 billion in 2014. **Some of the proposals that have been widely discussed are:**

- **Fuel Tax Increase:** Proposals include raising the current federal tax on gasoline from 18.4 cents a gallon and diesel from 24.4 cents per gallon, as well as indexing the tax rate for inflation.
- **Freight Charge:** This could either take the form of a tax based on tonnage (or tonnage per mile) or another tax that is based on the value of the service.
- **Vehicle Miles Traveled Tax (VMT):** With the rise of fuel efficient vehicles, the sales tax on fuel no longer fully reflects the use of infrastructure. A VMT could be based on the total number of miles traveled. Privacy issues frequently voiced by opponents of this policy can be overcome by setting a virtual rate based on total vehicles miles traveled annually.
- **Sales Tax:** In order to increase the contribution of users to HTF who do not currently participate at all or participate at a lower amount, taxes on bicycles, electric and hybrid vehicles, trucks and trailers could be increased.

TABLE 3.1 ILLUSTRATIVE SURFACE TRANSPORTATION REVENUE OPTIONS

EXISTING REVENUE MECHANISMS		
	Rate or Percent Increase	Definition of Mechanism/Increase
Motor Fuel Tax Increase - Diesel	15 ¢	¢/gal increase in current rate
Motor Fuel Tax Increase - Gas	10 ¢	¢/gal increase in current rate
Sales Tax - Trucks and Trailers	10%	Increase in current revenues, structure not defined
POTENTIAL REVENUE MECHANISMS		
	Rate or Percent Increase	Definition of Mechanism/Increase
Freight Bill - All Modes	0.5%	Percent of gross freight revenues
Freight Charge - Ton (All Modes)	10 ¢	¢/ton of domestic shipment
Freight Charge - Ton-Mile (All Modes)	0.1 ¢	¢/ton - mile of domestic shipment
Sales Tax - Auto Related Parts & Services	1%	Percent of Sales
Sales Tax - Bicycles	1%	Percent of Sales
Sales Tax - New Light Duty Vehicles	1%	Percent of Sales
Sales Tax - New and Used Light Duty Vehicles	1%	Percent of Sales
Vehicle Mile Traveled Fee - Light Duty Vehicles	1 ¢	¢/light duty vehicle mile traveled on all roads
Vehicle Mile Traveled Fee - Trucks	4 ¢	¢/truck mile traveled on all roads

FIGURE 3.1. SURFACE TRANSPORTATION REVENUE OPTIONS: ILLUSTRATIVE ANNUAL ESTIMATED YIELDS (\$ IN BILLIONS)*



Source: American Association of State Highway and Transportation Officials, "Matrix of Illustrative Surface Transportation Revenue Options," 2015, <http://downloads.transportation.org/TranspoRevenueMatrix2014.pdf>



Some studies have suggested that replacing the tax exemption with a direct subsidy to states could be more efficient.³⁴ However, these suggestions are often opposed due to budget concerns and the worry that future budget cuts could lead to a reduction or elimination of these subsidies.

Other studies suggest that the cost of municipal bonds may be overstated since investors have other options with similar tax preferences. According to a literature review by Poterba and Vertugo, the cost is about 0.5 to 0.66 of the tax expenditure estimates based on a simple substitution with taxable bonds.³⁵

According to the most recent data and analysis, state and local governments issued \$470 billion of municipal bonds in 2016, which was 2 percent less than in 2005.³⁶ According to the same analysis, new bond issuance (rather than restructuring or refinancing existing debt) fell 25 percent between 2005 and 2016. This decline is larger than the decrease in state and local capital spending over the same period, which indicates that other financing sources are now being used to complement traditional financing through municipal bonds.

Despite their tax advantage, municipal bonds have limitations. Use of municipal bonds could limit private-sector participation in public infrastructure assets financed by tax exempt bonds.³⁷ They also place significant limits on the use of private-sector maintenance and operation contracts. In 2009, the federal government introduced taxable municipal bonds through the American Recovery and Reinvestment Act. Build America Bonds provided a direct subsidy to the bond issuer equal to 35 percent of the Bond's interest cost. This was considered an effective complement to tax-exempt bonds since it expanded the investor base to include private pension funds and investors with lower effective tax rates. However, this program expired in December 2010.

The Tax Cuts and Jobs Act of 2017 raises some concerns about municipal bonds among tax experts. The sharp decrease of corporate tax rate from 35 to 21 percent is expected to make these financial instruments less attractive for banks, credit unions, property and casualty insurance companies, and life insurance companies

which currently hold 28 percent of the total outstanding municipal debt.³⁸ In addition, capping the State and Local Income Tax deduction "could be negative from a credit perspective, as states and local governments could face political challenges to increasing state tax rates. Additionally, residents in higher-tax states could see their disposable incomes decline, potentially reducing economic activity."³⁹

- **Public Private Partnership:**

Public Private Partnership (PPP) is an agreement between a public agency and private-sector companies through which firms can be involved with the design, building, financing, operation, and maintenance of an infrastructure project.⁴⁰ For example, the Department of Transportation (DOT) defines PPP as "contractual agreements between a public agency and a private entity that allow for greater participation in the delivery of a transportation project."⁴¹ According to a U.S. Department of Treasury paper, "When a PPP transfers risks to the private sector that it can manage more cost effectively, it creates value for taxpayers by lowering long-term project costs, improving the quality of services, or both."⁴² In many cases, the private sector recoups its costs through user fees.

According to DOT, there are potential advantages and limitation of PPP. These are:⁴³

- *Potential Advantages:*
 - May accelerate delivery
 - May enable a longer-term view of asset management
 - May provide access to additional capital
 - May reduce public cost and/or debt requirements
- *Potential Limitations:*
 - Requires considerable administrative cost and time to develop, analyze, procure, and monitor

TABLE 3. ALTERNATIVE COMPENSATION MODELS FOR PUBLIC PRIVATE PARTNERSHIPS

MODEL	EXPLANATION
Toll Concession	Private partner takes on project in exchange for receiving tolls. Public sector usually limits rate of toll increase in some way.
Shadow Toll Concession	Private partner receives payment for each vehicle that uses the facility. Sometimes payment is adjusted based on safety, congestion, or pre-established floors and ceilings.
Availability Payment	Private partner receives payment based on availability of the facility at a specified performance level.
<p>Source: U.S. Department of Transportation Federal Highway Administration Center for Innovative Finance Support, “Quick Facts: Public Private Partnerships” https://www.fhwa.dot.gov/ipd/fact_sheets/p3.aspx</p>	

- Although PPP can offer access to capital, they do not provide States with new revenue; in fact PPP need a revenue stream to work.
- May not be the most cost-effective or appropriate procurement model for projects if the public sector can deliver better value without PPP.

There are various payment models for PPPs. **Table 3** shows a sample prepared by DOT.

In addition to the potential advantages outlined by DOT, private sector involvement in infrastructure projects could bring additional revenues to public budgets by increasing the tax base through increasing the amount of property. According to a Bipartisan Policy Center (BPC) report, “For instance, Tennessee American Water, a subsidiary of American Water Works Company, Inc., has one of the top five taxable assessed values in Chattanooga, where it owns and operates the water utility. Had that utility remained in public hands, those taxes would not have been assessed.”⁴⁴

While PPP is prominent in other countries, its share of U.S. infrastructure spending has been small. Between 2007 and 2013, \$22.7 billion of public and private funds were invested in PPP transportation projects,

which represents just two percent of the overall capital investment in U.S. highways over the same time period.⁴⁵ In contrast, over the past fifteen years, the U.K. committed an average of \$6 billion annually from PPPs, while China recently released new directives governing PPP investments that are expected to launch more than 1,000 PPP projects worth \$318 billion.⁴⁶

Historically, the existence of a well-developed tax exempt municipal bond market, which is not an option in many other countries, has been seen as one of the obstacles to PPP development in the U.S. However, in recent years, PPPs have also increased their use of other forms of tax exempt bonds,⁴⁷ known as qualified private activity bonds. If certain facilities and activities are deemed to serve the general public, Congress recognizes and subsidizes their financing through exemption of the interest on the bond even if the facility is owned and managed privately. The increase in PPP use of these instruments is the result of a number of factors:⁴⁸

- PPP projects that are financed by private entities have traditionally used alternative funding sources such as bank loans, lines of credit, private equity and corporate debt. These funding sources are usually more expensive due to their higher borrowing costs.

- The Federal Transportation Infrastructure Finance and Innovation Act (TIFIA) loan program, which has helped finance more than \$81 billion in investment, requires senior debt to have an investment grade⁴⁹ credit rating. “This helps make tax exempt debt attractive because of the strong demand in the municipal market for investment grade securities.”⁵⁰

Overall, U.S. PPP projects typically use a combination of private debt and equity, TIFIA loans, qualified private activity bonds, and government funds. Some of these instruments that have particular importance are:

- *TIFIA* is a loan program that was created in 1998 by Congress to provide long-term flexible financing to highway, transit, intercity passenger facilities, freight rail and freight transfer facilities. The goal of TIFIA is to help with the funding gap on particular projects and it provides subordinated loans which can account for no more than 33% of a project’s funding. The program aims to attract private and other non-governmental financing by providing supplemental capital, which leverages federal dollars. Historically, and based on the most current estimates, \$1 of TIFIA program funds will support a TIFIA loan of \$14, and could potentially result in infrastructure investment of \$40.⁵¹ An example of a project financed with TIFIA could be: “The private sector developer/operator may provide a “down payment” of equity, of perhaps 20% of the project cost. Senior debt, in the form of investment grade toll revenue bonds, might cover 30% to 40%. With a TIFIA loan taking care of another 25% to 33%, conventional state/federal highway funds would cover the remaining 10% to 20%.”⁵² The increased use of TIFIA by PPP shows the success of the program.

- The Railroad Rehabilitation and Improvement Financing Program (RRIF) is another loan program created by Congress to offer long-term, low-cost loans to railroad operators to help them finance improvements to infrastructure and equipment. According to a recent Congressional Research Service Report,⁵³ since 2000, the RRIF program has made 36 loans totaling \$5.2 billion. However, the program is intended to operate at no cost to the government.

- Qualified Private Activity Bonds are tax exempt bonds that are issued by state or local governments. They are intended to finance projects that primarily benefit private entities. Since the program’s inception in 1968, the number of eligible private activities has increased from 12 to 22.⁵⁴

Table 4 shows these eligible activities. In addition to restrictions on the type of activities that are eligible, there are annual state-level volume caps on these loans. These restrictions are due to concerns that were discussed by the Joint Tax Committee in 1986:⁵⁵

- the bonds represent “an inefficient allocation of capital”;
- the bonds “increase the cost of financing traditional governmental activities”;
- the bonds allow “higher-income persons to avoid taxes by means of tax-exempt investments”; and
- the bonds contribute to “mounting [federal] revenue losses.”

Despite the threat of repeal by the House GOP tax plan, the Tax Cuts and Jobs Act of 2017 preserved the tax-exempt private activity bonds.

TABLE 4. QUALIFIED PRIVATE ACTIVITIES

INTERNAL REVENUE CODE SECTION	TYPE OF PRIVATE ACTIVITY (ITALICIZED ACTIVITIES MUST BE OWNED BY THE ISSUING GOVERNMENT TO QUALIFY)	SUBJECT TO VOLUME CAP	YEAR ESTABLISHED
Sec. 142	Exempt facility bonds		
Sec. 142(c)	Airports	No	1968
Sec. 142(c)	Docks and wharves	No	1968
Sec. 142(c)	Mass commuting facilities	Yes	1981
Sec. 142(e)	Water furnishing facilities	Yes	1968
Sec. 142(a)(5)	Sewage facilities	Yes	1968
Sec. 142(a)(6)	Solid waste disposal facilities	Yes/Noa	1968
Sec. 142(d)	Qualified residential rental projects	Yesb	1968
Sec. 142(f)	Local electric energy or gas furnishing facility	Yes	1968
Sec. 142(g)	Local district heating and cooling facilities	Yes	1982
Sec. 142(h)	Qualified hazardous waste facilities	Yes	1986
Sec. 142(l)	High-speed intercity rail facilities	Yesc	1988
Sec. 142(j)	Environmental enhancements of hydroelectric generating facilities	No	1992
Sec. 142(k)	Qualified public educational facilities	Nod	2001
Sec. 142(l)	Qualified green building and sustainable design projects	Nod	2005
Sec. 142(m)	Qualified highway and surface freight transfer facilities	Nod	2005
Sec. 1400U-3	Recovery zone facility bonds	Nod	2009
Sec. 143	Mortgage revenue bonds		
Sec. 143(a)	Qualified mortgage bond	Yesb	1968
Sec. 143(b)	Qualified veterans' mortgage bond	No	1968
Sec. 143(a)	Qualified mortgage bond	Yesb	1968
Sec. 143(b)	Qualified veterans' mortgage bond	No	1968
Sec. 144(a)	Qualified small issue bond	Yes	1968
Sec. 144(b)	Qualified student loan bond	Yes	1976
Sec. 144(c)	Qualified redevelopment bond	Yes	1968
Sec. 145	Qualified 501(c)(3) bond	No	1968

a. Exempt from the cap if governmentally owned. Subject to the cap if privately owned.
 b. Bonds for residential rental projects and mortgages were allocated an additional \$11 billion for 2008 that can be carried forward through 2010 by the Housing Assistance Tax Act of 2008.
 c. 25% of the bond issue is included in the cap. If the facility is owned by a governmental unit, no cap allocation is required. In addition, if the facility is not governmentally owned, to qualify for tax-exempt status, the owner must elect not to claim any depreciation deductions or investment tax credits with respect to the property financed with the bonds.
 d. Educational facility bonds are subject to a separate state cap: the greater of \$10 per capita or \$5 million. Green building bonds are subject to a national aggregate amount of \$2 billion through the expiration of the program, scheduled for October 1, 2009. Highway bonds are subject to the following annual issuance limits: \$130 million in 2005; \$750 million each year for 2006 through 2009; \$1.87 billion in 2010; and \$2 billion each year for 2011 through 2015, zero thereafter. Recovery zone facility bonds are subject to a separate cap of \$15 billion.

Source: Congressional Research Service, "Private Activity Bonds: An Introduction," March 30, 2016, https://www.everycrsreport.com/files/20160330_RL31457_d2b66a3a84896985c646b06f03bcdebcc9dad790.pdf

III. HOW TO INCREASE THE SHARE OF PPP IN THE U.S.

As mentioned in previous sections, infrastructure investment has to be based on long-term goals and planning rather than short-term political cycles. Many of the remedies outlined under the “Setting the Stage” section would give confidence and certainty to private-sector partners, especially for the projects that require long-term commitment. However, according to research by Tsilas and Brashares, it is hard to compare the U.S. experience in this field with reasonably successful PPP projects overseas “given the relative autonomy of state and local governments in the U.S. and significantly different tax rules and subsidies provided in other international countries.”⁵⁶

One area that could be helpful in increasing PPP’s share in infrastructure projects is introducing legislation that enables its uptake. According to U.S. Treasury report, “one of the most significant obstacles to developing the PPP market in the U.S. is a patchwork of legal environments and different procurement practices across states.”⁵⁷ This leads to increased uncertainty and transaction costs. In addition, since there is no streamlined process between states, knowledge is not necessarily

transferable and there is less incentive to become a sophisticated investor. In addition, the states that do have legislation have degrees of difference in the effectiveness in supporting PPPs. **Figure 2** shows the legislative landscape by state in 2014.

According to the same U.S. Treasury report, in addition to broad PPP enabling legislation, the program also needs to include:

- A legal framework that is flexible enough to give investors a guide about how to exit the project to deploy funds to an alternative investment.
- Clear definition of the terms of exit for a private investor as well as the transfer of ownership to a new investor or the sale of shares to a secondary specialist equity fund.

In addition to legislative improvements, alternative federal financing strategies could also increase the appetite for private involvement in the process. These include the creation of national or state infrastructure banks and the development of new types of bonds, like the Build

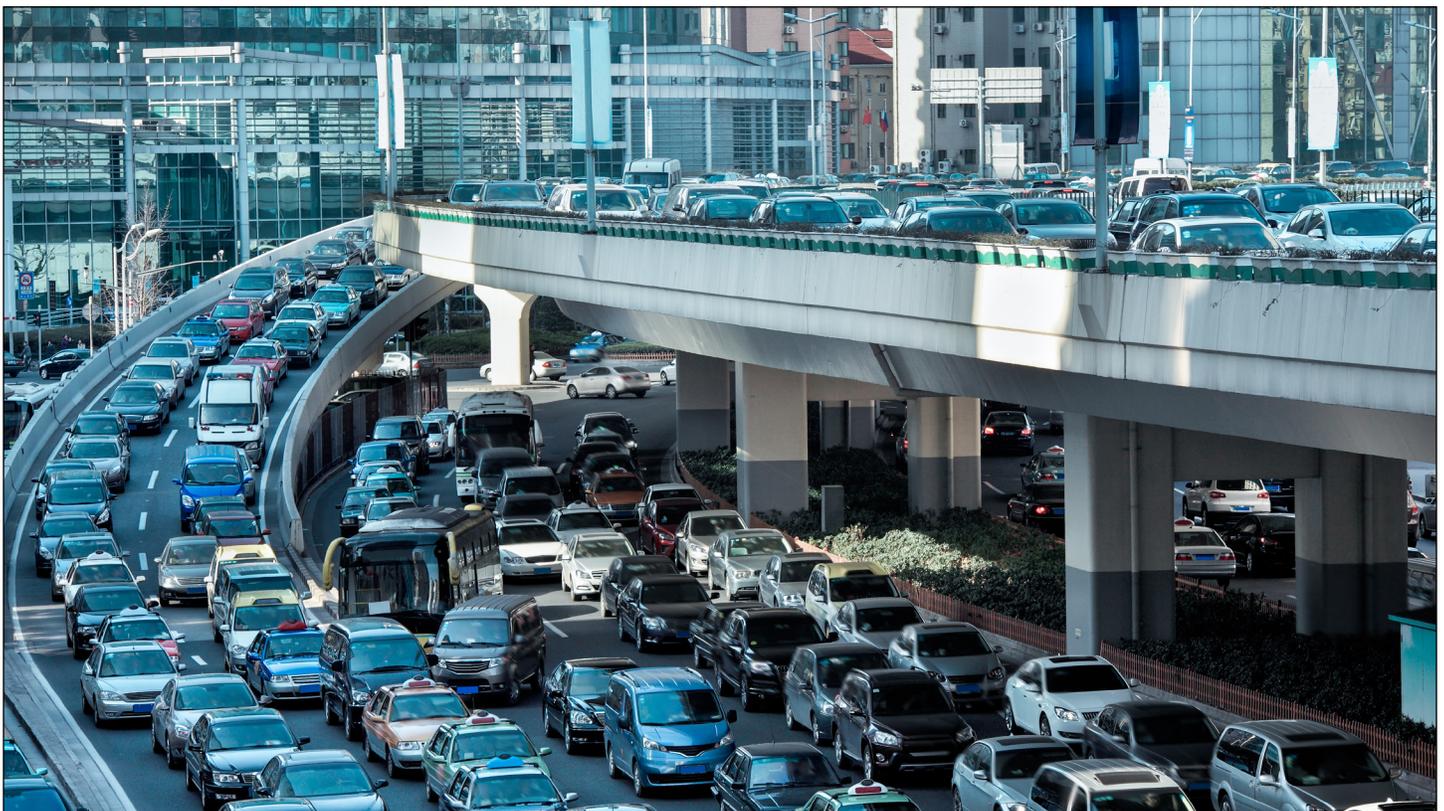
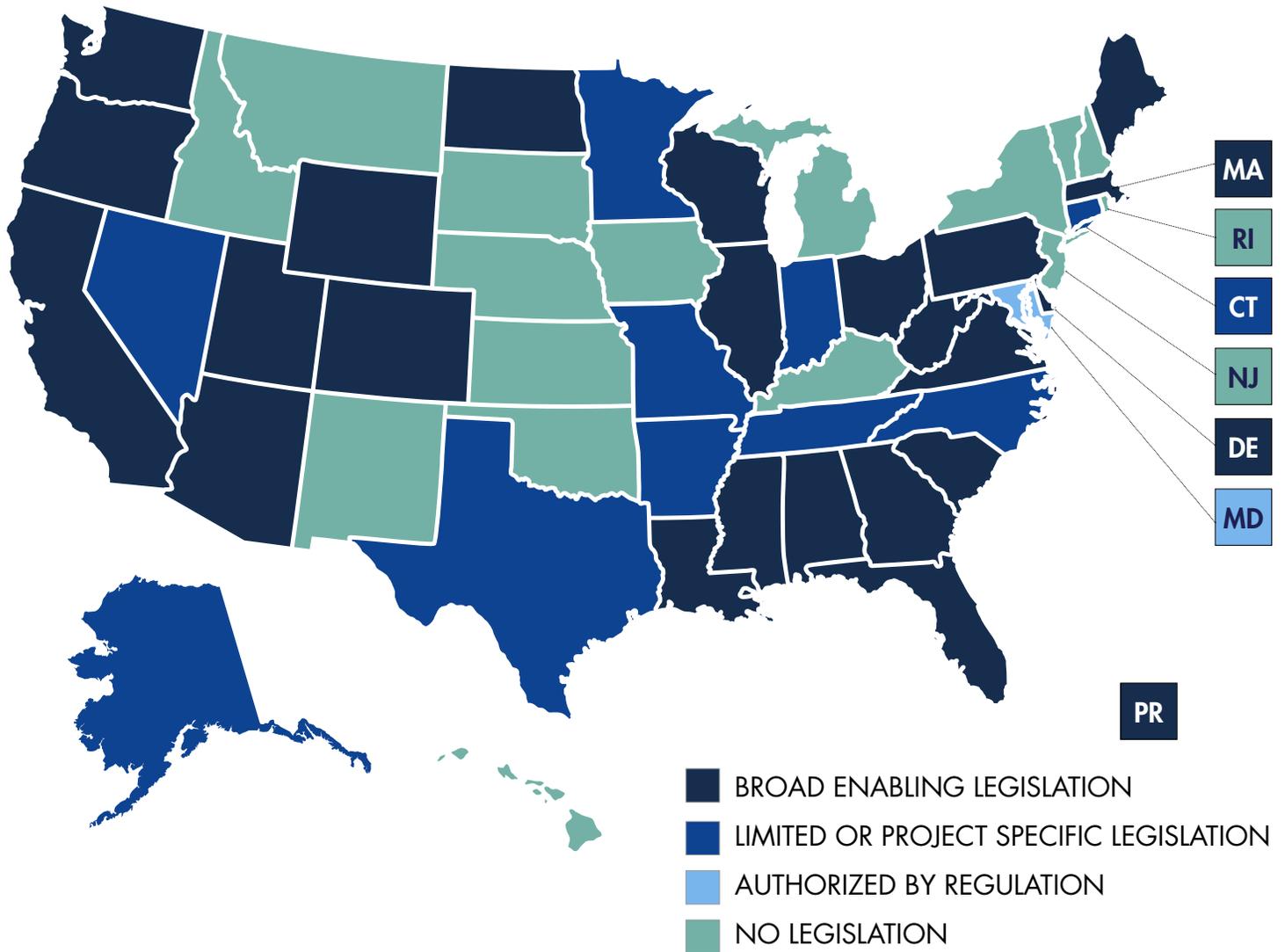


FIGURE 2. STATES WITH TRANSPORTATION PPP ENABLING LEGISLATION AS OF FEBRUARY 2014



Source: Office of Economic Policy, U.S. Department of Treasury, "Expanding our Nation's Infrastructure through Innovative Financing," 2014, [Source Link](#)

America Bonds. For example, the previous proposals regarding creation of a national infrastructure bank envisioned the bank having a limited access to budgetary funds and it would operate through extension of various forms of government guarantees.

BPC also suggests to broaden use of existing investment vehicles such as Real Estate Investment Trusts (REITs) and Master Limited Partnerships (MLPs) by allowing them to invest in infrastructure assets. REITs and MLPs are business structures used to enhance investment in

real property and assets, and they have tax advantages granted by the government (taxed only at the level of individual shareholder). However, they have strictly defined boundaries. For example, REITs have limitations as to what income they can earn and still qualify as a REIT: dividends, interest, and rents from real property and gains from sale or disposition of certain assets. This definition could be extended to include alternative sources of revenue such as tolls or availability payments.⁵⁸ It is also important to look for ways to attract the already available large pool of private capital to infra-

structure investment. There are number of investors currently not a significant part of U.S. infrastructure market. Due to their tax-exempt status, domestic and global pension funds, university endowments, personal trusts and sovereign wealth funds have little incentive to invest in municipal bonds. According to S&P Global estimates, these investors have \$90 trillion of capital, but hold less than 1 percent of their total assets in infrastructure investments.⁵⁹ However, the long-term nature of infrastructure assets should be a natural fit for these investors, who also vie for long-term investment options. By reforming the system using the suggestions above – such as introducing long-term thinking into project planning and execution and dissemination of good data for evaluating projects – we could decrease the risks and increase transparency, which could be key to attracting private investment.

CONCLUSION

There has been a bipartisan consensus on the need to invest in U.S. infrastructure, not only to improve the condition of existing assets but also to help economic growth by increasing productive capacity and creating jobs, thereby increasing the competitiveness of the nation. However, this requires an improved framework that identifies the goals and priorities of the nation and provides a structure that has clear guidelines on how to decide on an infrastructure portfolio that reaches these goals. If the government sets the right framework, the financing of these projects could be an attractive investment opportunity for the private sector. This could be an effective way of delivering certain projects better, faster, and at a lower cost. With our spiraling debt, reframing our infrastructure puzzle is an opportunity the country cannot miss.

ENDNOTES

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