

Revitalizing America

Engaging civic capital **for US infrastructure**



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Dear Reader,

In the days following the 2016 presidential election, UBS commissioned one of our *Investor Watch* surveys of investors and business owners in order to gauge their sentiments about the country's prospects and priorities. We found a high degree of confidence, optimism for near-term economic growth and a strong desire for the new administration to quickly begin making progress on important issues. Among the areas of focus at the top of business owners' wish lists was increased investment in America's infrastructure.

Perhaps more so than any other policy area, infrastructure investment requires foresight, patience, bipartisanship and cross-sector partnership. There are also few issues that have the same potential to impact every single American. Our ability to safely and quickly transport ourselves and our goods; to efficiently generate and deliver energy; to ensure a safe, clean and reliable water supply; and to extend the benefits of high-bandwidth broadband to all corners of our country—these are all essential if we are to continue improving our nation's productivity and competitiveness.

This working paper, the latest in our *Revitalizing America* series of reports, assesses the state of our built environment today and surfaces some of the more effective ways policymakers might work together and with multi-sector stakeholders to address our most pressing needs. UBS has deep experience financing major initiatives, so this paper focuses on perhaps the biggest challenge facing our country's aging and inadequate infrastructure—how to pay for the next wave of modernization.

In a time when public resources are more constrained than ever, and competition for budgetary dollars is only increasing, traditional approaches to funding are insufficient. In the following pages, we explore how decision-makers can identify, incentivize and mobilize various sources of capital to reduce costs and accelerate long-overdue investments. By aggregating civic capital from a variety of sources—including the nearly \$100 trillion in American household net worth—and clearing policy roadblocks to allow for fast-tracking of critically important projects, government can establish a system in which a broad range of new and under-utilized investors will be willing to accept proportional risk in exchange for compelling returns.

Our goal is to help inform substantive discussions about the profound infrastructure gaps facing our country, and to provide suggestions about how to transition from conversation to action.

Thank you for taking the time to read the paper and to engage on this important topic.



Tom Naratil
President Wealth Management Americas and President Americas
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Foreword

Introduction

There is no question that the United States suffers from massive infrastructure challenges. These structural deficiencies are putting Americans at a competitive disadvantage.



It will require a substantial investment to modernize our nation's infrastructure, but the cost of inaction—in terms of economic growth and household incomes—is even larger. Leaders from both political parties have put forth a call to action, but the task is too great for government to tackle alone. Therefore, we will need to embrace a more inclusive approach to capital, and a reprioritization of public policy.

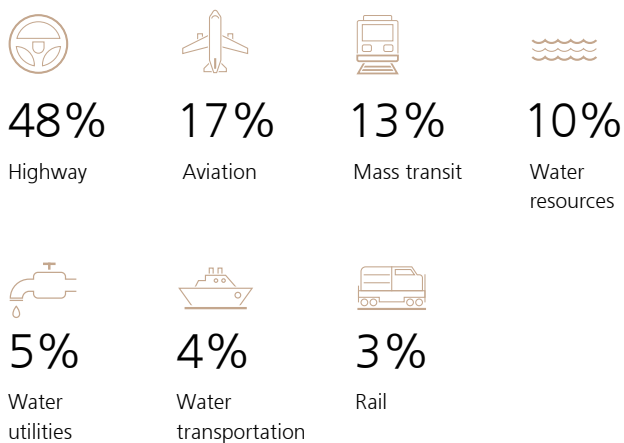
Our infrastructure needs are real, and daunting: experts estimate the cost to modernize our infrastructure will be in the trillions over the next several years, but the federal government spends less than 3% of its annual budget on meeting infrastructure requirements. This is supplemented by state and local funds, but public infrastructure expenditures remain insufficient, and have fallen significantly in real terms despite growing needs.

The result is highways choked with traffic, antiquated airports, vulnerable water systems, fragile electric grids, and older, inefficient ports. Unmaintained infrastructure makes it harder to move goods, slowing down our economy. Crowded highways mean more pollution, less time spent with family, and a lower quality of life. And as we've seen recently in Flint, MI, and elsewhere, antiquated infrastructure poses a danger to the health and safety of American citizens.

Added to this challenge are the new infrastructure demands of the 21st century. The "bar" for competing in the global economy has been raised, and we need to invest to make sure that every American can clear this higher hurdle. High-speed internet access is a prerequisite for full participation in the modern economy, but affordable broadband access remains out of reach for many Americans.

Transportation projects constitute most of the federal government's infrastructure investment

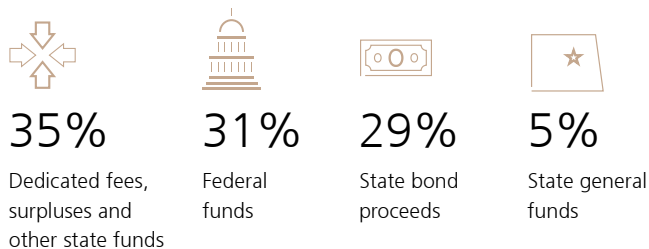
Share of federal infrastructure expenditure by type, 2014



Source: Congressional Budget Office, American Action Forum, UBS.

State dollars and borrowing pay for most infrastructure projects

Sources of state funding for infrastructure, 2014



Note: The National Association of State Budget Officers capital spending data includes the costs of new construction, purchases of buildings and major equipment, and major repairs and improvements.

Source: National Association of State Budget Officers State Expenditure Report, UBS.

Underneath these challenges lies an even larger opportunity: a chance to accelerate economic growth, improve mobility, and reinvigorate American innovation and entrepreneurship.

It will take trillions of dollars to rebuild our nation's infrastructure, and the reality is that public funds will not be enough to get us there. In this paper, we outline an alternative approach to financing these improvements and investments. In order to meet those challenges, we need a new national commitment to innovation: innovation in both our policymaking and in our approach to capital.

Private financing can fill the gap between our country's infrastructure needs and our limited public resources. Public-private partnerships ease the financial burden on governments for construction and maintenance of public facilities and allow for groundbreaking private financing options that place more risk on private entities, but also raise the incentives to succeed.

Private investors—individuals, institutions, funds and others—will be a critical element of any large-scale infrastructure proposal. Many experts believe that public financing would only make up about one-third of the needed capital for a trillion-dollar package.

But we can unlock private investment in infrastructure through creative approaches to public policy including, changes to our tax code and improvements to our regulatory and permitting process. We should also consider commonsense solutions, such as a coordination of infrastructure projects to promote synergies and efficiencies.

These policy changes will spur even more private capital solutions to our infrastructure financing needs, easing budgetary pressures on the federal government and meeting America's challenges to grow our economy.

We need innovation in our policy and in our approach to capital since public resources will not be enough. We explore the infrastructure challenges the country faces; the sources of civic capital that can be leveraged to improve our infrastructure; and the policy approach necessary to unlock that capital and unleash a new era of prosperity.

Rethinking infrastructure



Brick-and-mortar projects will always be an essential element of our nation's infrastructure, and a necessary strategy for supporting public life.

Improvements to America's roads, airports, seaports, and electric grid are clearly warranted, and will help stimulate economic activity. But, as the nature of public life has evolved, so must the definition of public works. In the modern era, Americans need more than basic physical infrastructure to participate in society. To encompass the full range of public works projects, beyond traditional brick-and-mortar infrastructure, we prefer the term "public purpose."

Consider the digital divide, where limited access to technology inhibits the education of children from less-affluent families. Every child deserves an equal chance to succeed and should not be denied the opportunity to access new information and communication applications. The impact of unequal internet access and inadequate education investment may not be immediately obvious but may hamper our economic growth a decade or two from now.

Sidewalk Labs, Alphabet Inc.'s urban innovation subsidiary, is accepting the challenge by replacing New York City pay phones with 7,500 kiosks offering free Wi-Fi service and charging ports. The upload and download speeds are exceptionally fast and, over time, will provide more convenient internet access to underprivileged communities.

The preservation and protection of our natural resources is another aspect of infrastructure that often fails to garner much attention. Whether it's the protection of valuable wetlands to reduce the damage caused by storm surges, or planting trees in city landscapes to reduce the prevalence of urban heat islands, the nation's natural resources can supplement traditional engineering projects to enhance the quality of life. These types of unconventional infrastructure investments are likely to be more important over time. They also will attract more capital from impact funds focused on environmentally sustainable projects.

Assessing the need

Every four years, the American Society of Civil Engineers (ASCE) assesses the quality of US public works, assigning a letter grade based on physical condition and highlighting areas of deficiency.

As a nation, our infrastructure receives barely passing grades.¹ It is often described, with some validity, as antiquated, dilapidated, and inefficient. Addressing these deficiencies is a costly endeavor—the ASCE estimates that the US faces a \$1.4 trillion investment gap over the next decade, having funded only 56% of the total cost of modernizing the nation’s infrastructure.² This large deficit is intimidating, but pales in comparison to the societal cost of inaction. Infrastructure deficiencies, if left unaddressed, could incur a steep economic toll over the next decade, with \$7 trillion lost business sales, \$3.96 trillion lost GDP, and 2.5 million lost jobs.³ For the average American household, an unfilled investment gap means losing \$3,400 in annual disposable income.⁴

Total public spending on infrastructure totaled \$416 billion in 2014. The federal government spent \$96 billion, representing only 2.7% of the 2014 budget.⁵ On an inflation-adjusted basis, federal spending on infrastructure peaked 60 years ago in conjunction with the creation of the interstate highway system. Federal highway spending has stabilized but remains 21% lower in real terms than it was just fifteen years ago.⁶



The construction and rehabilitation of public works must be a national priority. Traditional techniques of financing infrastructure, including the provision of federal grants, should be supplemented by the use of what we refer to as “civic capital.” Public-private partnerships have been successful in accelerating the completion of public works and can shift the risk of timely completion from the public sector to private investors. Expanding the use of tax-advantaged private activity bonds will accelerate the rate of investment in major undertakings. The use of tax credits to rehabilitate and reclaim urban brownfields will promote economic development.

As the United States spends more on national defense and on entitlements to support an aging population, public infrastructure allocations will face even greater competition for funding. Conventional techniques to finance infrastructure are no longer sufficient. To meet this national challenge, we will need to leverage the full breadth of our nation’s resources, mobilizing capital from America’s robust private sector and accumulated household wealth.

Establishing priorities

America's airports



\$88 billion

The total investment gap at airports through 2040 is now expected to be \$88 billion; \$42 billion through 2025 and an additional \$46 billion from 2026 through 2040.

In a country as vast as the United States, air travel is an essential mode of transportation. Major commercial airports are the critical links upon which most passenger travel depends.

Air traffic over the past three decades has increased by roughly 5% per year despite periodic oil shocks, security concerns, and economic recessions. The Federal Aviation Administration expects a 36% increase by 2036, with the number of annual passenger enplanements exceeding 1.2 billion.

Almost all air travel either originates or concludes in one of our nation's 100 largest metropolitan areas. However, the concentration of air travel is even higher than that figure would suggest. The 60 busiest airports in the country accommodate 88% of all commercial travelers. Logic would suggest that these airports receive an equivalent share of federal financial assistance. Instead, they received only 27% of airport improvement program grants in fiscal year 2015.⁷ The distortion is attributable to a variety of factors, including restrictions on the use of such grants inside terminal buildings and mandatory allocations to general aviation facilities and smaller airports with less patronage.

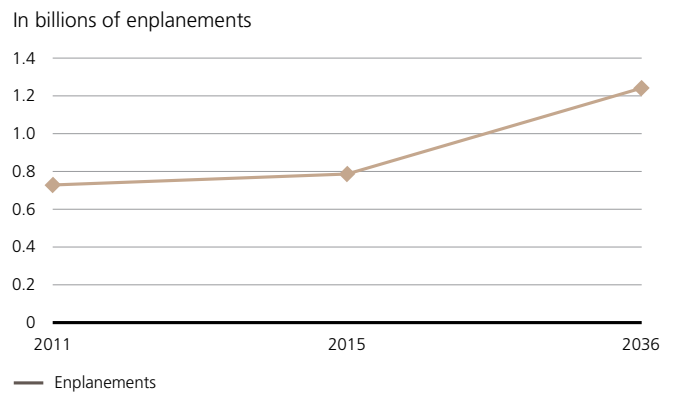
Private sector participation in US airport operations is not a novel concept. Privately-owned and operated airlines, after all, constitute a commercial airport's major source of revenue. Routine operations, ranging from jet fuel delivery to concessions to terminal maintenance, have been delegated to private companies for decades. Rental car companies on airport property compete fiercely for business, offering incentives and perquisites to loyal customers. However, the delegation of responsibility for inclusive management of integrated airport operations has been more difficult to achieve.

The public sector has been reluctant to relinquish responsibility for overall management despite widespread criticism of the antiquated facilities at many of our international gateways. Unlike facilities in Canada and Europe, which are usually owned by national governments, airports in the US are predominantly owned by local governments and regional authorities. The disparate ownership across America introduces a degree of parochialism into airport operations and allows the dominant airline in each city to exert a substantial degree of influence.



Congress authorized the US Airport Privatization Pilot Program in 1996. Only two major commercial airports have been leased to private managers since the program was established, and one of those facilities subsequently reverted back to public ownership.⁸ The failure of the pilot program to attract much interest owes much to the disincentives built into the process. For example, the obligation to discharge outstanding tax-exempt debt upon the execution of a long-term lease raises the cost of capital for interested bidders. Future federal grants-in-aid are also reduced for privatized airports, regardless of the importance of those capital improvements to the national aviation system. Lengthy permitting delays and the need to obtain prior approval from two-thirds of the airlines operating at the airport, and two-thirds of the annual landed weight, introduce a degree of uncertainty that chokes off private capital.

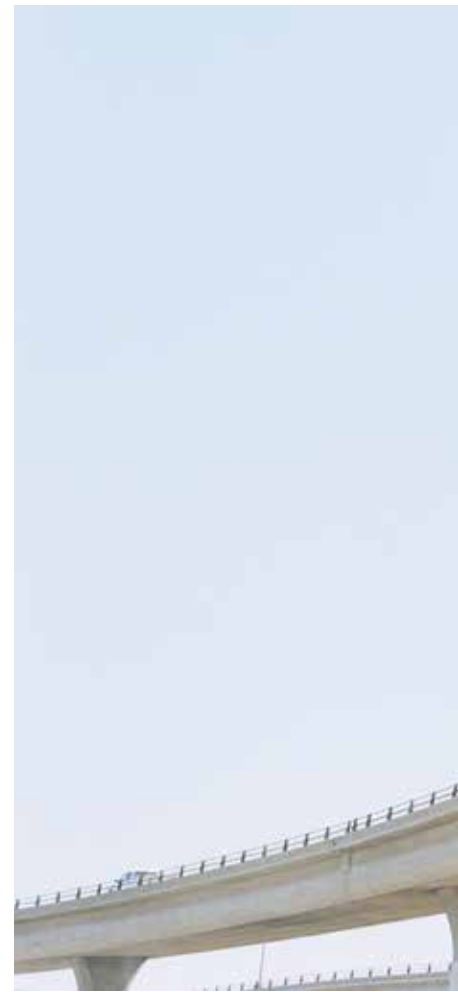
Total enplanements are expected to rise 36% by 2036



Source: American Society of Civil Engineers, UBS.

Surface transportation

On an inflation-adjusted basis, federal spending on infrastructure peaked 60 years ago in conjunction with the creation of the interstate highway system.



6.9 billion hours

Across 470 urban areas, there were a total of 6.9 billion vehicle-hours of delay on roads due to congestion in 2014.

The US population is expected to grow by 0.7% per annum for the next 30 years. Net overall growth in vehicle miles traveled (VMT) is forecast to increase over time at an only slightly lower rate of 0.6% per year. The net result: more congestion.

There were 6.9 billion vehicle-hours of delay across America in 2014 due to traffic bottlenecks. Congestion alone is estimated to waste 3.1 billion gallons of gasoline every year, spewing pollutants into the atmosphere and reducing worker productivity.⁹ According to a recent study by the Colorado Department of Transportation, driving on the state's deficient roads will cost motorists \$6.8 billion every year in the form of higher vehicle operating costs and traffic accidents.¹⁰



Unfortunately, federal highway funding is not directly correlated to usage. Traffic per lane-mile has increased more rapidly on urban interstates than on any other class of highway. However, spending on our most heavily used roads was substantially less than on our lightly-traveled rural highways.¹¹ The news regarding our nation's bridges is marginally better, as the number considered structurally deficient was reduced to 10% in 2014. But that still leaves 66,000 bridges that are structurally deficient. The average American bridge is 43 years old, with only a 50-year service life.¹²

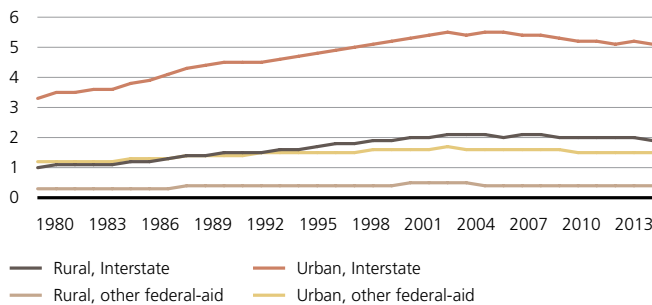
Each federal dollar spent on improving America's infrastructure needs to be more productive. The revenue dedicated to the Highway Trust Fund has been insufficient to pay for highway improvements since 2008. Federal gas tax revenue has declined on an inflation-adjusted basis as vehicles have become more fuel efficient, and now covers only half of roadway maintenance costs.¹³ As a result, lawmakers have been obliged to transfer up to \$143 billion to the fund over time.¹⁴ The Budget Control Act of 2011 placed caps on discretionary funding for non-defense programs, exacerbating the decline in federal aid for surface transportation projects. State and local government funding has failed to make up the difference left by the decline in federal spending, down 5% from its peak in 2003.¹⁵

Fortunately, through the Fixing America’s Surface Transportation (FAST) Act, there has been a consolidation of smaller programs under the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU), which target specialized programs like the Safe Routes to School Program, or the Denali Access System Program. This has led to greater flexibility for state and local governments directing the federal funds they receive. But the system continues to allocate funding based on mode of transportation, allocating around four times more funding to highways than to mass transit.¹⁶ This inflexibility structurally underfunds an important solution for reducing congestion in metropolitan areas, where 80% of Americans live. Urbanization is driving more mass transit usage—over the last decade, transit passenger vehicle-miles traveled (VMT) have increased 18%, outpacing population (9%) and highway VMT growth (5%).¹⁷

Traffic congestion and spending, by type of highway

Traffic congestion has been greater on urban Interstates than any other class of highway

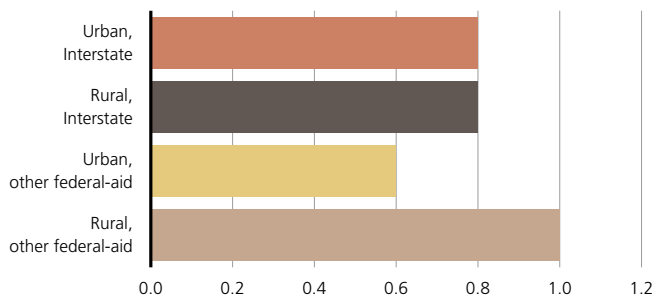
Highway congestion, Millions of annual vehicle-miles traveled per lane-mile



Source: Congressional Budget Office, UBS.

Yet, spending to expand capacity per vehicle-mile traveled (VMT) is greater for lightly traveled highways

Spending to expand capacity per VMT in 2013, in cents, 2014 dollars





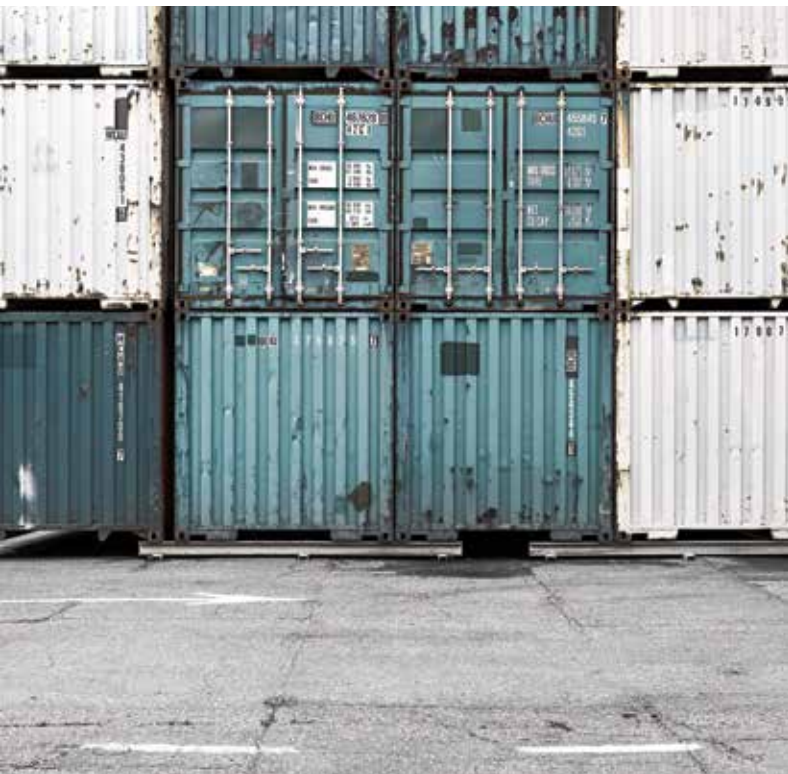
Transit systems are concentrated in old industrial metro areas, but are under-developed in recently urbanized areas, because funding allocations have discouraged states and localities from building new mass transit systems in response to demographic changes.

Technology offers another avenue for solving transit deficiencies. Shared transportation (car-sharing, ride-sharing, and bike-sharing) is an increasingly important complement to traditional transportation modes, offering potential savings for both commuters and taxpayers. Public transit agencies should consider shared modes as a supplement to scheduled transit capacity. This mode can also provide a cost-effective solution for “first-last mile” transportation gaps in underserved areas and for enhancing public paratransit services. In addition to being used to replace personal car use, ridesharing utilization trends indicate that it is already supplementing limited public transit availability at night and on weekends.¹⁸

Autonomous driving technology offers the potential to drastically amplify the benefits of shared transportation. An MIT study indicated that shared-autonomous vehicles could service Singapore’s transportation needs with 60% fewer cars.¹⁹ In addition to the direct economic benefits from increased safety and lower transportation costs, self-driving vehicles would likely lead to indirect benefits—especially for rural and suburban communities—through easier long-distance commutes, lower housing costs, and higher potential income and productivity. Broad adoption of shared-autonomous cars is likely still years away, but government policy can help accelerate and accommodate this trend by proactively incorporating “smart road” enhancements in road construction and maintenance projects to ensure that road markings and signs are easily visible to autonomous vehicles.

Maritime ports

A trucking company executive named Malcolm McLean transformed global trade in 1955 when he purchased a steamship company to haul his cargo-laden truck trailers between US ports.



The maiden voyage of the Ideal-X occurred one year later when the ship carried 58 truck trailers between New Jersey and Texas, launching the era of global container shipping.²⁰ Today, 90% of global trade is delivered over the oceans and two-thirds of that amount is contained in seaborne containers. The quantity of goods carried by container ships, the largest vessels on earth, was 1.69 billion metric tons by 2015.²¹ To put that in perspective, the average American consumer now relies upon the movement of 56 tons of cargo per year.²²

Maritime ports serve as the conduit through which the US exports raw material and finished goods to markets around the world. The US was responsible for \$3.7 trillion worth of trade in 2016, equivalent to one-fifth of GDP.²³ The largest container ports in the United States, Los Angeles and Long Beach, CA, accounted for 32% of US containerized cargo trade.²⁴ Although a relatively small number of ports accommodate most sea-borne trade, communities around the country have a vested interest in their efficient operations. While the top 10 metropolitan areas move 60% of all international goods by value, the vast majority of those goods—96%—moves on to other parts of the United States.²⁵



76%

of US exports by tonnage are transported by water through maritime ports for foreign markets.

42%

of exports by value are transported by water through maritime ports for foreign markets.

The United States trails its international competitors in terms of productivity. The speed at which a container ship can be berthed, unloaded, and returned to sea has an impact on a port's attractiveness to shipping companies. The concentration of activity in a relatively small number of ports raises the stakes and poses a challenge for American competitiveness. The most productive port in the US, as measured by the number of container moves per hour, is the Port of Baltimore with 71. The global leader is Japan's Port of Yokohama with 186.

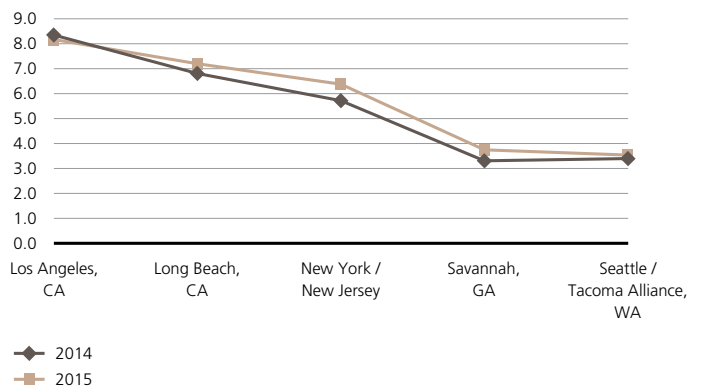
The landscape for maritime infrastructure is changing. With the freedom to export oil and the expansion of the Panama Canal, new demands will be placed on existing ports and inland waterways. The ASCE estimates an investment gap of \$43 billion through 2040, which would result in almost 1.2 million fewer jobs.

The widening of the Panama Canal has the potential to dramatically change trade dynamics, making port facilities on the Atlantic and Gulf coasts better positioned to compete with intermodal truck and rail shipments across the continent, and lowering prices

for the American consumer. Prior to the expansion, only 6% of the world's liquefied natural gas (LNG) tankers could take this route. Afterwards, it can now accommodate 90% of the fleet, and allows for much larger LNG tankers, with more than double the per-ship capacity. The result is a major trade route shift, with around 10% of East Asia container traffic moving from West Coast ports to the East Coast by 2020. This will lead to more traffic congestion as goods finish their journey by rail or truck.²⁶

The NY / NJ port experienced a 10.4% increase in containerized cargo, and is expected to grow even more with the expansion of the Panama Canal

In millions of twenty-foot equivalent units (TEUs)



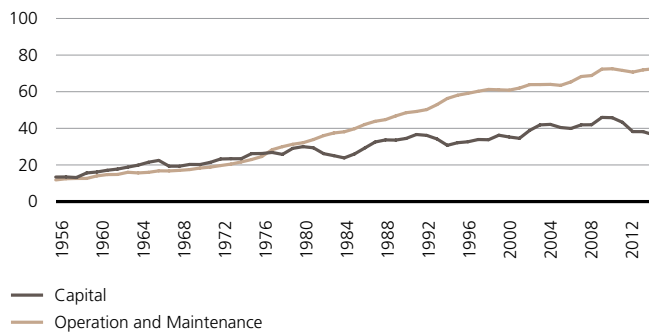
Source: US DOT, Federal Highway Administration, UBS.

Water utilities

Water covers more than three-quarters of the earth's surface but less than 1% is available for human use. Global consumption of potable water has tripled over the last 50 years in conjunction with population growth and urbanization, while supply remains constrained.

Public spending on operations and maintenance is rising faster than spending on capital infrastructure

In billions, 2014 dollars



Source: Congressional Budget Office, UBS.

The World Economic Forum identified the scarcity of potable water as the most critical risk to our planet, endangering the health of two-thirds of the human population.²⁷ The Office of the US Director of National Intelligence has concluded that the availability of fresh water around the world will not be able to meet demand, absent more effective management of water resources.

The United States is better positioned than many nations, but it is still exposed to the deleterious effects of drought, pollution, and aging infrastructure. The collapse of the water system in Flint, MI, is a siren call to policy makers that few public projects are as essential to citizens as safe and reliable drinking water. There are approximately 51,000 community water utilities across America, which together process 38 billion gallons of water per day for household use.²⁸ Together, they deliver 100 gallons per person per day through one million miles of pipelines and conveyances.²⁹ The construction and maintenance of this vast network is not cheap.

 900 billion gallons

of untreated sewage is discharged into public waterways each year and into our drinking water.



The Congressional Budget Office reports that spending at all levels of government for water and wastewater improvements has exceeded \$2.2 trillion over the past 60 years. However, total spending peaked in 2010 and subsequently declined by 8% as state and local governments wrestled with the fallout from the financial crisis. And yet, due to a gradual transition from grants to subsidized loans, states and local governments now account for 96% of investment dollars devoted to water utilities.³⁰ The net effect is an increase in the amount of money devoted to operations and maintenance, and a corresponding reduction in the amounts allocated for new capital construction.

Fortunately, the Clean Water Act, as amended, provides financial support for state revolving fund programs (SRFs). The SRFs throughout the US provide loans for eligible projects that improve drinking water quality and to construct and maintain wastewater treatment

facilities. Congress took another important step when it passed the Water Infrastructure Finance and Innovation Act (WIFIA). WIFIA provides long-term loans for regionally important clean water projects. It is awarded through a competitive process and may be supplemented with other state revolving funds. The Environmental Protection Agency (EPA) estimates that current budget authority may finance more than \$2 billion in water infrastructure investment.

Public-private partnerships have been an underutilized alternative model for the water sector for a variety of reasons. Notwithstanding the collapse of the water utility in Flint and the challenges facing the Puerto Rico Aqueduct and Sewer Authority, most other large municipal water systems have reasonably good access to the capital markets. Tax-exempt bonds reduce the utilities' cost of capital substantially.

The digital divide

Broadband internet access has become a precondition for full participation in advanced economies.

According to the Federal Communications Commission (FCC), in order to originate and receive high-quality telecommunications, Americans must have access to fixed and mobile broadband service that meets recommended speed thresholds (download speeds exceeding 25 Mbps and upload speeds faster than 3 Mbps).³¹ Today, 34 million Americans fall short of this “advanced telecommunications capability” standard.³²

Economically disadvantaged communities are at the greatest risk. While urban Americans face only a 4% shortfall in connectivity, 39% of rural Americans and 41% of Americans living on tribal lands fail to meet these thresholds.³³

A lack of broadband access leaves many Americans and small businesses at a significant disadvantage when attempting to compete in the 21st century economy, and it can also restrict access or increase the cost of other services. According to a 2015 Pew Research Center survey, 69% of Americans indicate that not having a home high-speed internet connection would be a “major disadvantage” to finding a job, getting health information, completing online banking transactions, or accessing other key information.³⁴

In areas where the US falls behind other developed nations in broadband access, it is primarily due to cost, speed, and availability. Approximately 38% of households without broadband access cite cost and availability as



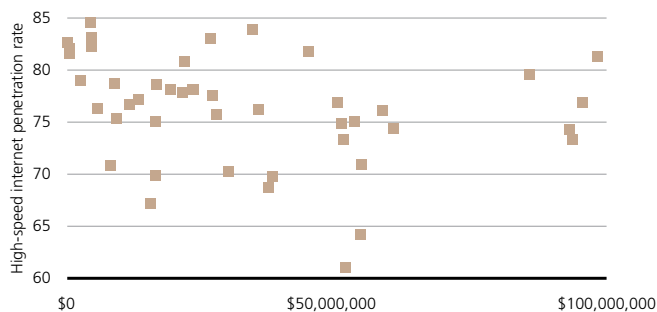
reasons for not having the service.³⁵ A global study found that the United States ranks 26th of 40 countries in download speed, 27th of 33 in cost per unit of speed, and 23rd of 33 in affordability.³⁶

Improved broadband access can significantly boost entrepreneurship, economic growth, and promote economic mobility. A study of 33 Organisation for Economic Cooperation and Development (OECD) countries concluded that doubling the broadband speed for an economy increases GDP by 0.3%.³⁷ A household survey showed that gaining 4 Mbps of broadband increases annual household income by \$2,100.³⁸ Improved connectivity fosters innovation, and society gains indirectly from social networking effects and enhanced access to education opportunities. Telemedicine and telecommuting are improved. High-speed, low-latency broadband can also enable various smart technologies that more broadly increase efficiencies.

The telecommunication and cable industry is already heavily engaged in US capital investment, having invested over \$48 billion—more than any other industry—in 2015.³⁹ These investments are responsible for the nation’s steady improvements in broadband access. To help direct more of this capital toward

Connect America Fund support has been directed towards narrowing the “Digital Divide”

High-speed internet penetration rates and Connect America Fund Phase II support dollars, in USD, by state



Source: FCC, UBS.



69% of Americans

According to a 2015 Pew Research Center survey, 69% of Americans indicated that not having a home high-speed internet connection would be a “major disadvantage” to finding a job, getting health information, completing online banking transactions, or accessing other key information.

building access in rural communities, where fiber connection costs are higher but the incremental socioeconomic impact of investment is also greater, the government has established multiple programs.

The largest, Connect America Fund (CAF), has pledged \$1.5 billion to subsidize \$9 billion of industry investment into projects that build, or improve, network infrastructure in underserved areas.⁴⁰ However, these funds were made available only to projects providing a minimum threshold of 10 Mbps download / 1 Mbps upload, below the new “advanced telecommunications capability” standard (25 Mbps / 3 Mbps).⁴¹ The FCC should consider thinking proactively in future phases of CAF funding by targeting projects that exceed the existing minimum, in order to reflect the fact that technology innovations will require increasingly faster speeds, lower latency, and higher bandwidth.

Fortunately, where conventional infrastructure projects show signs of capital misallocation, broadband infrastructure policies and spending have been properly focused on addressing the digital divide and providing access to underserved communities. However, the ongoing challenge calls for a redoubled effort to accelerate the pace of improvement.

The smart grid

America's energy system undertakes the herculean task of generating and delivering over four trillion kilowatt-hours (kWh) of electricity each year. This system developed incrementally over more than a century, and its deficiencies are growing larger and more costly.

According to the Department of Energy (DOE), approximately 4.7% of energy produced is lost each year due to power grid inefficiencies.⁴² The amount is equivalent to the fuel consumption and greenhouse gas emissions of over 50 million cars and represents a loss of \$195 billion per year.^{43,44} In addition to being vulnerable to attack, the system is also prone to an increasing number of blackouts and brownouts. Each year, the US experiences hundreds of "significant power interruptions" that cost businesses around \$150 billion in annual lost productivity.⁴⁵

"Smart grid" technology offers the opportunity to address these shortfalls in efficiency, reliability, and security by decentralizing energy generation, distribution, and storage. This approach enhances the ability to monitor and dynamically direct capacity to meet consumption needs, and supplements base load energy production through more energy-efficient solutions. The federal government does not need to underwrite all of the costs associated with these innovations, but does play a key role in building the general framework for market-based solutions. The most important first step is to work with the utility industry to set standards for smart grid design and implementation.

Energy storage is a prime example of how a dynamic "smart grid" can improve the system's reliability and flexibility. Storage solutions tackle deficiencies in the energy system by allowing for an increased share of renewable energy production, balancing centralized and decentralized electricity generation, and supplementing demand response approaches. According to the DOE, planned and installed energy storage capacity is currently 193.2 GW globally and 32.0 GW in the US, representing about 2% of energy generation.⁴⁶

While there are many sources of growth for energy storage, Battery Electric Vehicles (BEVs) represent a unique opportunity. Because BEVs naturally follow energy consumption (i.e., workers commuting to and from work), they are well-suited for addressing the "peak load" problem. Using "vehicle-to-grid" (V2G) technology, the stored energy in idle BEVs can be used to reduce "peak load" on the electric grid. Cars are parked and idle about 95% of their lifetime, and V2G is a market-based solution that offers incentives to BEV owners to supply energy during peak hours and pull energy during off-peak hours. In addition, distributing energy through BEVs can enhance the gains from other smart grid technologies, and reduce transmission costs.





As the BEV fleet grows, it will provide an additional (and growing) cushion of energy capacity for the grid, supplementing renewables and reducing the need for “peaking” power plants that are geared at meeting the on-peak hours for both urban and suburban areas. With a dynamic V2G and “smart grid” approach, this growing capacity can be harnessed to meet increasing electricity demand.

We estimate that electric vehicle production (mostly BEVs) will reach a global volume of 9.7 million vehicles per year by 2025 (9.2% of global sales).⁴⁷ BEV economics (through either cheaper batteries or more expensive gasoline) will be the predominant driver of adoption speed. Although breakthrough technologies could accelerate cost reductions, we already expect battery costs to fall 36% by 2021, bringing BEVs to cost parity with internal combustion vehicles (ICVs) in Europe by 2021.

While US market adoption will likely be slower due to lower gas prices (we estimate that electric vehicles will represent only 3% of US sales in 2025), this still puts the American BEV fleet at 3 million vehicles within 10 years.⁴⁸ We believe this could have major implications for energy

storage, even under the conservative estimate that only one-third of the BEV fleet’s 186 million kWh capacity is available to the grid on a daily basis. This would add a staggering 22 GW (70%) to the current annual energy storage capacity, dramatically enhancing the ability to meet peak energy demand.⁴⁹ Without taking steps now to move toward a “smart grid” approach, the growth of BEVs would actually cause further strain.



9.7 million

We estimate that electric vehicle (EV) production (mostly BEVs) will reach a global volume of 9.7 million vehicles per year by 2025 (9.2% of global sales).

Sourcing capital

Most of our existing national infrastructure has been financed through traditional methods, with heavy reliance on direct federal, state, and local expenditures. But given severe budget constraints, due in large part to an aging population and already high tax burdens, government will be unable to play the same dominant role going forward. This means that other forms of capital that originate largely from the private sector must now also be mobilized to meet the future infrastructure needs of our society. Determining the best way to engage non-traditional sources of infrastructure funding represents both the biggest challenge and the greatest opportunity for this generation of policymakers.

Public capital

As we've already noted, federal, state, and local government have historically been the principal source of funding for public infrastructure projects.



For example, while the federal government financed the construction of our interstate highway system, state and local governments took a leading role in the construction of secondary roads and the installation of water treatment and distribution systems. Meanwhile, our electric grid was built by regulated utilities and public power agencies. Borrowing at all levels of government was necessary to finance these expenditures. The Federal government issued Treasury securities, while state and local governments issued municipal bonds.

Of the \$18.2 trillion in government infrastructure spending from 1956 to 2014, roughly 27% was funded through the federal government. The remaining 73% was funded by state and local governments.⁵⁰ These investments have been made possible through a combination of federal and state resources, including federal grants, state revolving loan funds, and municipal bonds. These funding sources have proven to be highly cost-effective and should remain in the toolbox for projects that are necessary but difficult to delegate to the private sector. But they are no longer sufficient—or ideally suited—to meet all of the nation's diverse and growing needs. Mobilizing American household net worth, which totals over \$95.6 trillion, can reduce the public debt burden.⁵¹

Public-private partnerships

P3s

Public-private partnerships (P3s) are contractual agreements between the private sector and state or local governments.

We expect entitlement programs and defense expenditures to constitute a larger share of the federal budget in the years ahead. As these costs increase, the ability to devote federal revenue to other discretionary programs will become more challenging.

With fewer federal funds available for public works, US government spending will need to focus on areas where social benefits far outweigh the available return on investment, and generally preclude the use of private capital. For the remaining opportunities, which offer a balance of social and capital benefits, the nation will be well-served by employing the full breadth of resources—including private capital—to make the necessary investments to build, maintain, repair, and replace the nation's civic capital.

Just as private capital can be an effective complement or supplement to direct government expenditures, it can also be leveraged to absorb some of the risks associated with project design and construction. In return for such investments, and the corresponding risk that must be assumed, private investors deserve to receive a reasonable rate of return. This concept is not new; investor-owned utilities across the country have operated privately to provide an essential public service for a

century. Around the world, the private sector has been contracted to build and operate individual projects, ranging from toll roads to airport terminals to water treatment and delivery. Europe, Canada, and Australia have been leaders in this movement to leverage the operational expertise of private contractors to deliver high quality services to their citizens.

P3s are contractual agreements between the private sector and state or local governments. This arrangement provides for greater private sector participation than usual in the construction, maintenance, and management of a public facility. The private sector partner is responsible for activities historically undertaken by the government and bears a financial risk if the project fails to provide a minimally acceptable standard of service. Conversely, if the facility is built and managed efficiently, the private sector partner is normally permitted to seek a reasonable return on its invested capital.



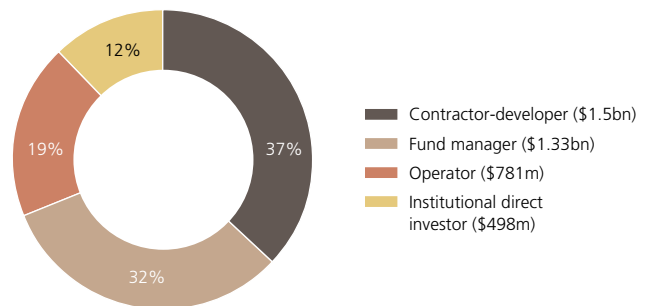


The allocation of risk is an important consideration in the execution of any P3 project. The equity participant and its financiers must absorb some risk, whether related to design, construction, or operation. If properly structured, the P3s reduce the risk to the government entity and shifts it to the private sector, which retains a powerful incentive to succeed.

The long-term lease of the Indiana Toll Road to a private consortium is a case in point. After paying \$3.8 billion to the State of Indiana for the privilege of operating the toll road, traffic failed to meet expectations and the private operator filed for bankruptcy protection. The State of Indiana retained the proceeds from the sale of the concession to operate the road. A subsequent operator assumed the lease and agreed to invest another \$260 million into toll road maintenance. The media attention may not have been particularly welcome but Indiana taxpayers and toll road patrons were protected.

Institutional direct investors represent the smallest contributors to the P3 market in the US

In % of USD, 2008-2013



Source: InfraAmericas, UBS.

Private capital

Federal largesse, civic engagement through philanthropic activities, and a robust municipal bond market have historically been the three pillars upon which America's infrastructure funding rests.

While federal financial assistance through subsidized loan programs will be an essential component in the next decade, concerns over the size of the deficit is likely to persist. State and local governments also are likely to face challenges as they wrestle with rising pension liabilities, limiting their ability to make new investments that would raise their bonded debt burdens.

America's households have been the dominant purchaser of tax-exempt municipal bonds for three decades. They are expected to remain so in the years ahead but their participation can extend beyond investments in state and local securities. Volunteerism and philanthropy have always been a defining trait of Americans. In Alexis de Tocqueville's study of our then-young nation, he observed that this tendency was a natural extension of American democracy.

"In the United States, as soon as several inhabitants have taken an opinion or an idea they wish to promote in society... From that moment, they are no longer isolated but have become a power seen from afar whose activities serve as an example and whose words are heeded."

ALEXIS DE TOCQUEVILLE, *DEMOCRACY IN AMERICA*, 1835

Charitable gifts are a natural manifestation of the American ideals of resourcefulness, equal opportunity, and participation. As a nation, we have always found ways to respond to national challenges through collective action. Ever since "voluntary associations" were established in the early days of our Republic, philanthropy has evolved into a vibrant ecosystem of different charitable organizations. In addition to donating time, talent, and other resources to serve causes and peoples around the world, Americans now give over \$1 billion a day to charity.⁵² In fact, the US ranks highest in terms of individual charitable giving—at approximately 1.4% of GDP, contributing nearly twice as much as the next-highest country.⁵³

Over the years, we have developed new ways of promoting philanthropy, such as tax credits and deductions, in recognition of its contribution to the public good. In order to leverage individual contributions for a larger impact, we have also developed a broad range of gifting vehicles and organizations, from private foundations and charitable organizations to donor advised funds.

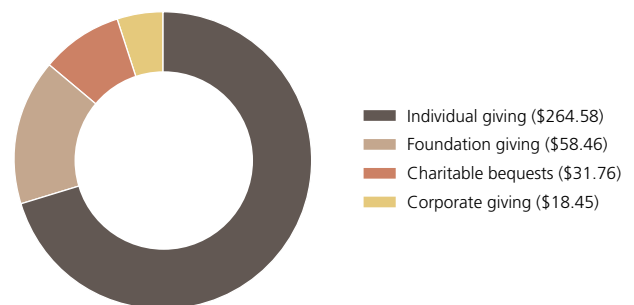


But our nation's civic commitments go beyond philanthropy, and these institutions are increasingly seeking opportunities to promote social benefits through private capital investment. In recent years, this has been exemplified by the burgeoning demand for sustainable investments, environmental finance, and impact investing. In total, the market for these and other forms of social finance already exceeds \$21 trillion globally.⁵⁴ Conventional impact investing is targeted to human suffering (poverty, hunger, and disease). Their track record of success suggests that there is a clear opportunity to tackle the challenge of funding investments that are needed for the public welfare.

To harvest this growing base of capital, and other investment communities around the globe, we envision a multi-pronged approach. Each potential source of capital has a unique set of investment objectives, regulatory requirements, and time horizons. In order to maximize the resources available to fund our nation's civic capital, it will be important to identify opportunities that tailor projects to account for these investors' objectives and hurdles. It will also be essential to consider mechanisms for applying leverage (through government guarantees, tax preferences, or matched spending) in order to expand the impact of each dollar invested.

Over 80% of philanthropic capital comes directly from individuals through donations or bequests

2015 charitable giving in the US, in billions



Source: UBS, Giving USA 2016: The Annual Report on Philanthropy for the Year 2015

1.4% of GDP

amount of US individual charitable giving is nearly twice as much as the next-highest country.

Private and external sources of capital

The table below reflects some of the primary sources of private and “external” sources of capital that can potentially be leveraged to address at least a portion of the nation’s future infrastructure needs.

Investor	Description	Total assets available*
Individuals / Households		
High Net Worth & Ultra High Net Worth Investors	— Investment strategies vary, but these investors have access to illiquid vehicles, such as private equity, and have sufficient net worth to create endowments and foundations	\$42.6 trillion (of \$95.6 trillion total household wealth) ⁵⁵
Family Offices	— Investment strategies vary — Investments may be mission-oriented or guided by risk/return — Risk tolerance also varies, but only 4% of North American family offices are invested conservatively	\$1.7 trillion—61% of which are now active or expect to be active in impact investing ^{56,57}
Institutional		
Pension Funds	— Wide range of internal staff expertise — Fiduciary board of directors typically sets risk tolerance and desired rate of return — Desire to match investment returns to long-term liabilities	\$7.8 trillion—only about 1% is earmarked to infrastructure ⁵⁸
Insurance Companies	— Invest mostly in bonds, common stock, and first-lien mortgages — Tend to invest conservatively — Desire to match returns to liabilities — Subject to government regulation	\$1.4 trillion—about 1.9% is allotted to infrastructure ⁵⁹
Endowments	— Donations to non-profit groups — Able to invest in alternative assets (including infrastructure) — Have varying rules regarding investment, withdrawal, and fund usage policy	\$348 billion, with 4.3% going to infrastructure investments ⁶⁰
Foundations	— Generally seek competitive financial returns — Investments can be mission-oriented investments, program related investments, or in the form of grants ⁶¹	\$865 billion—heavy civic capital investment, but little traditional infrastructure ⁶²
Environmental, Social, and Governance Considerations and Impact Investing Funds	— Professionally managed strategies: registered investment companies, alternative investment vehicles, community investing institutions, and separately managed accounts — Guided by a range of motivations; most assets are managed according to ESG factors ⁶³ — Factors are incorporated to manage institutional investors’ risk and to fulfill their fiduciary duty ⁶⁴ — Have varying rules regarding investment, withdrawal, and fund usage policy	\$21 trillion globally, and \$8.7 trillion in the United States ^{65,66}
Infrastructure Funds	— Professionally managed private equity strategies, managing assets for pensions, sovereign wealth funds, and other institutional clients — Invests in individual infrastructure deals,—average deal size of \$364 million, but 52% of deals are smaller than \$100 million ⁶⁷ — Funds generally have 10-year investment time-frames, and generally target 2-3% excess returns over public equity markets in order to earn their “illiquidity premium” — Gains may be subject to carried interest taxation	\$373 billion (46% of which is focused on North America) ⁶⁸
Sovereign Wealth Funds		
	— Investment funds owned by governments, funded by foreign exchange assets and reserves — Have exhibited prior interest in the infrastructure asset class	\$6.3 trillion, with 14% currently allocated to infrastructure ^{69,70}

*Note: Due to the nature of this data, there may be overlap in asset totals.

Policy considerations

Reduce permitting delays

By their very nature, infrastructure projects are time-consuming and complex investments of effort and capital.



Delays in the commencement of a project are a common complaint from private sector participants. Some delays cannot be avoided, as public hearings are an essential component of American democracy. But delays due to the absence of a unified permitting authority are far more difficult to justify. Sequential and duplicative review by multiple government agencies is a significant disincentive to private sector participation and must be addressed.

A recent review by the Bipartisan Policy Center illustrated the challenge. Major infrastructure projects require 59 different permits and reviews from a dozen separate agencies before construction can commence.⁷¹ No surprise, then, that the US recently ranked 39th among all nations in the World Bank index measuring the difficulty associated with processing construction permits.⁷² The past two presidential administrations have acknowledged the obstacles posed by permitting delays, prompting Congress to pass the Federal Permitting Improvement Act in 2016. President Trump took another step forward with his recent executive order on expediting environmental reviews.⁷³ The designation of high priority projects for expedited review should be expanded to encompass a broader set of projects beyond those with national significance.



59

different permits and reviews are required from a dozen separate agencies before construction can commence on major infrastructure projects.

Expand tax-advantaged investments

The cost of capital for state and local governments varies based upon a variety of factors. The ratings assigned to municipal debt obligations are a primary determinant, of course, but so is market demand for these securities.



The Internal Revenue Code imposes various restrictions on the sale of bonds secured by private sector participants—relaxing these constraints would promote investment from private capital.

Private activity bonds are issued by a public agency on behalf of a private project. Some of these bonds are deemed to be “qualified” and thereby exempt from federal income tax. A federally-mandated volume cap is allocated to each state, thereby restricting the number of bonds that may be sold on a tax-exempt basis. An aggregate increase in the volume cap and a more lenient approach to carrying over unused capacity beyond three years would reduce the cost of capital for private sector investments in public infrastructure.

The elimination of restrictions on the use of proceeds from the privatization of public assets would also enhance the attractiveness of public-private partnerships. The proceeds from the sale or lease of public assets currently are used to discharge existing tax exempt debt, among other purposes, raising the cost of capital for private sector participants. By allowing such debt to remain in place, the cost of privatizing assets would decline, allowing the public sector to impose more rigorous performance standards or raising the amount of money offered for the right to manage public infrastructure.

The Tax Reform Act of 1986 reduced the incentive of commercial banks to buy municipal bonds. By eliminating the ability of banks to deduct the interest cost incurred to carry an inventory of municipal bonds, the pool of potential buyers was reduced. An exception was made for “qualified tax-exempt obligations,” where the annual amount of bonds issued by a government was small. The net effect was to favor smaller local governments, preserving their access to the tax-exempt market but reducing the available capital for major projects. Raising the bank-qualified threshold for bond issues that initially fund infrastructure, or simply reverting to the incentives that existed before 1986, would promote investment by banks in infrastructure. Lastly, consideration should also be given to extending tax-advantages to equity investments as well. This would allow access to a much broader pool of investment capital.

Incentivize private capital



Cut the red tape

Mandate an accelerated review process for projects of “national significance.” Identify one lead agency for each project with responsibility for coordinating all permitting among federal agencies. Eliminate sequential permitting requirement.



Ease obstacles to private sector investment

Increase the maximum size of bank qualified bonds issued for new money infrastructure investments. Raise the volume caps for private activity bonds. Allow proceeds from privatization to be used on other infrastructure projects with tangential benefits to project operations.



Improve Federal-State coordination

A partnership between the FCC and states, through the Federal-State Joint Boards, is vital to ensuring that minimum standards (service availability, affordability, reliability, quality, public safety, and privacy) are being adopted and defined on a federal level, but with states’ input.



Remove unnecessary conditions

Remove conditions that intend to promote some other type of perceived utility, but otherwise detract from core focus of the project.



Foster community-driven solutions

Encourage the use of public benefit corporations to sponsor the repair and restoration of public spaces.



Coordinate infrastructure projects

Encourage cost synergies by identifying grants and programs where fiber optic cable can be installed alongside road construction and repair, or in conjunction with other infrastructure projects such as water and electrical grid installation.



Engage private wealth

Establish a national infrastructure fund for a limited number of projects of “national significance” that would offer tax advantages to individuals who make investments.



Broaden private engagement in mass transit

Promote public bidding for private sector operation of municipal bus routes and construction of light rail lines on public rights-of-way.



Revisit Build America Bonds

Allow state and local governments to issue taxable bonds and receive an annual federal subsidy toward the payment of debt service. Protect the subsidy from future sequestration. Promote the bonds to overseas investors.

Next steps

Assessing the needs, establishing the priorities, and identifying the funding sources for future infrastructure projects are necessary but not sufficient steps for driving innovation, raising productivity and improving living conditions.

Elected officials, policymakers, business leaders, civic leaders and investors will need to work jointly in determining the most effective way of leveraging civic capital for optimum impact.



Important policy considerations

How will these different infrastructure needs be prioritized?

Which projects are best funded through traditional public channels?

Which projects lend themselves best to the leveraging of private capital?

How can we most effectively engage and utilize private sources of capital?

What specific criteria should be avoided to allow for private capital to be efficiently deployed?

What outcome is being optimized through each of these projects and initiatives?



Too often in the past, the inability to address these basic questions has led to a misallocation of capital, a muddling of the public purpose, a tendency to “overreach” beyond the original mission mandate and an inability to tap into non-traditional sources of capital. To effectively engage civic capital however, there will need to be clearly defined goals, concrete deliverables, effective measures of success and tangible payoffs for investors.

We are under no illusions regarding the difficulties associated with introducing unconventional approaches to infrastructure investments. Generations of learned behavior about both what is—and what is not—possible will now need to be challenged. Entrenched special interests will no doubt feel threatened and likely push back hard against any new approaches that threaten the status quo. Bureaucracies tend to have an organic aversion to any type of change—especially when it is on such a large scale and with such critical stakes.

Care must also be taken to ensure that the terms of new initiatives to engage private capital are structured to maximize effectiveness without unfairly enriching a narrow sub-set of society. Incentives must reward the risk of committing capital, but safeguards must also be put in place to avoid the perception of windfall profits at the expense of the public purpose.

But none of these challenges are acceptable excuses for not trying. If the United States is to remain a vibrant, dynamic, robust, and innovative economy that provides both for the needs and aspirations of its citizens, then such efforts are not only fiscally sensible, they are also morally essential.

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- ⁷³ USA, White House, Executive Order Expediting Environmental Reviews and Approvals for High Priority Infrastructure Projects, 27 January, 2017, <https://www.whitehouse.gov/the-press-office/2017/01/24/executive-order-expediting-environmental-reviews-and-approvals-high>.

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