

**THE ECONOMIC BENEFITS OF HIGHWAY
INFRASTRUCTURE INVESTMENT AND
ACCELERATED PROJECT DELIVERY**

HEARING
BEFORE THE
COMMITTEE ON
ENVIRONMENT AND PUBLIC WORKS
UNITED STATES SENATE
ONE HUNDRED SIXTEENTH CONGRESS

FIRST SESSION

MARCH 6, 2019

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COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS

ONE HUNDRED SIXTEENTH CONGRESS
FIRST SESSION

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THE ECONOMIC BENEFITS OF HIGHWAY INFRASTRUCTURE INVESTMENT AND ACCELERATED PROJECT DELIVERY

WEDNESDAY, MARCH 6, 2019

U.S. SENATE,
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS,
Washington, DC.

U.S. SENATE Committee on Environment and Public Works
Washington, DC.

The committee met, pursuant to notice, at 10:05 a.m. in room 406, Dirksen Senate Building, Hon. John Barrasso (chairman of the committee) presiding.

Present: Senators Barrasso, Inhofe, Capito, Braun, Rounds, Sullivan, Boozman, Ernst, Carper, Cardin, Whitehouse, Booker, and Van Hollen.

OPENING STATEMENT OF HON. JOHN BARRASSO, U.S. SENATOR FROM THE STATE OF WYOMING

Senator BARRASSO. I call this hearing to order. Today, we will discuss the economic benefits of highway infrastructure, and ways we can accelerate project delivery.

It is no secret that our economy relies heavily on the well-being of our Nation's roads and bridges. In 2015, the U.S. transportation system moved a daily average of about 49 million tons of freight that was worth more than \$52 billion. Annually, that is around 18 billion tons of freight valued at over \$19 trillion and these numbers are only going up.

According to the Department of Transportation, by 2045 our aging roads and bridges will carry an additional 4 billion tons of freight every year. Our Nation's highways must keep pace.

The authorization of Federal highway funding will expire in September of next year. The Congressional Budget Office projects that the Highway Trust Fund will become insolvent sometime in 2021. It is essential that Congress invests in our infrastructure and specifically our surface transportation.

That is why we must pass a multi-year reauthorization of the highway funding bill that is on time and fiscally responsible. If Congress fails to act, States and local governments will not have the funding certainty they need to plan and deliver vital infrastructure projects for the American people. Our highways, our roads and our bridges would struggle to keep pace with our growing economy.

Last November, we kicked off the process with a hearing to gather stakeholder input. In January, we held a hearing to consider the

nomination of Nicole Nason to be Administrator of the Federal Highway Administration. One week later, we favorably reported her nomination out of committee and to the floor.

The Federal Highway Administration will need a strong Administrator to work with Congress on the development and implementation of highway infrastructure legislation. It has been now over a month since we reported her from this committee. As with so many of the President Trump's nominees, the process is taking too long. We need Ms. Nason confirmed and in office.

Last month, Ranking Member Carper and I began asking Senate offices for their priorities for a highway infrastructure bill. As this bipartisan process continues, we must find ways to increase the effectiveness of Federal investment, so communities can feel the economic benefits faster.

Maintaining the Federal highway program's current approach of distributing funds to the States by formula is key. Using the formula-based approach expedites the delivery of infrastructure spending. It is an approach that works and should be continued.

Another way to make Federal highway dollars more effective is to speed up project delivery, which I believe can be done without sacrificing environmental safeguards. As States and towns wait to get permits and approvals from Washington, valuable time is wasted and costs for projects go up.

It should not take years to permit projects that take only months to complete. In order to truly benefit the economy, highway infrastructure legislation must address the needs of rural America, as well as urban America.

Rural roads are vital to bringing raw materials and products from the heartland to the coasts. We all buy and use goods that are transported on our Nation's highways through rural States and communities.

Federal highways like I-80 run coast to coast, bringing these goods and services across America. This includes the stretch of I-80 that runs through my home State of Wyoming. We must maintain and improve the highways that crisscross our rural States to keep vital arteries of national commerce open.

Our transportation infrastructure provides a firm foundation for our economy. As we will hear today, better highways, roads and bridges across America strengthens that foundation. I look forward to working together in a bipartisan way to pass a highway infrastructure bill that will deliver real economic benefits for the American people.

I would now like to recognize Ranking Member Carper for his remarks.

**OPENING STATEMENT OF HON. THOMAS R. CARPER,
U.S. SENATOR FROM THE STATE OF DELAWARE**

Senator CARPER. Thank you for recognizing me, Mr. Chairman. We welcome our witnesses.

Before I give an opening statement, you mentioned Nicole Nason, who has been nominated and I think is a very good nominee for Federal Highway Administrator. Last month, we submitted some questions for the record. We are waiting for her to finish those and soon as we have those responses, I suspect we will move forward

quickly. I will be happy to work with you and move that nomination. We need to get her into her job.

There used to be a Governor from Ohio named Jim Rhodes. I was a Navy midshipman at Ohio State in the late 1960's. He was Governor for 8 years. He sat out for 8 years and ran again. He was Governor for 8 years. He sat out and then he ran again and he almost did it again.

It was pretty amazing, but when he would give his State of the State address, he would mention the word jobs a whole lot. The folks in the reporting pool actually would take dibs on how many times he was going to say it. He would say jobs 30 or 40 times in one speech.

Not just because of that, but I have always been focused on jobs and how to create jobs. In our business, we do not create jobs, as you know. We create a nurturing environment for job creation. A big part of that is the ability to get people and goods where they need to go when they need to go. This is an important hearing with that in mind.

People ask me what I like most about my job. I say, I like getting things done. They say, you must be really frustrated. Some days, I am. In this committee, we actually do get things done. We are looking forward to building on what we did last year, water infrastructure. We are looking forward to doing something equally substantial on surface transportation this year.

I think as we work to achieve that goal, I believe we have to acknowledge three important facts. One of those is the No. 1 way to accelerate projects, quite simply, is to pay for them. Second, while the level of investment is critical, we also need new thinking as to how we invest and which innovative solutions will truly improve outcomes.

Third, perhaps most important, the benefits of highway infrastructure investment will be impeded, if not downright nullified, if we do not address the threats of climate change and extreme weather events that are increasingly disrupting our Nation's transportation system.

Let me speak first about project delivery and funding. Today, over 95 percent of highway projects are categorically excluded from review under the National Environmental Policy Act, NEPA. I will say that again, over 95 percent of highway projects are categorically excluded from review under the National Environmental Policy Act, NEPA.

Moreover, the highway bill passed out of this committee in 2005 had 10 environmental streamlining provisions for highway projects, the highway bill in 2012 had 23 environmental streamlining provisions for highway projects, and the highway bill in 2015 had 18 streamlining provisions for highway projects, and an additional 10 environmental streamlining provisions for large infrastructure projects.

While I will consider all ideas fairly, as I always do, let me be absolutely clear: I will not support legislation that weakens environmental protections in the name of accelerating transportation project delivery. Sometimes it seems that the focus on cutting environmental protections is a way to avoid talking about the 800-pound gorilla in the room, which is our funding shortfall. We have

a deficit in the Highway Trust Fund that is \$13 billion per year, and growing.

Despite spending more than we collect, we still are not spending enough to make a dent in the \$800 billion backlog of investments needed to merely improve our highways and bridges. We also need to look beyond the total level of investment, and think about the transportation goals we are trying to achieve. For instance, despite increasing spending every year, our safety outcomes continue to be dismal, with more than 37,000 Americans killed on our roads last year, a lot of them were pedestrians.

As we begin to work on the surface transportation bill, we are looking for opportunities to address these challenges and support a new vision for a 21st century transportation system. One critical element of that vision is addressing the global emergency of climate change. The transportation sector is now our Nation's largest contributor of greenhouse gas emissions. The bulk of it these days comes from cars, trucks and vans. To reduce those emissions, Federal policy can, and should, encourage the purchase of electric or alternative fuel vehicles through tax policy, as well as through funding for fueling and charging infrastructure.

Finally, we must ensure that we are planning and designing transportation systems that are sustainable and resilient to increasingly severe weather and extreme weather events. Nearly 2 years ago, the Rocky Mountain Institute published a report that said installing electric vehicle charging infrastructure should be, "an urgent priority in all States and major municipalities. The time to act is now." I agree.

Later today, I will introduce the Clean Corridors Act of 2019. This legislation would provide grants for the installment of electric vehicle charging infrastructure and hydrogen fueling infrastructure along the National Highway System. Even better yet, this legislation will help us in our efforts to put the United States back in the driver's seat of the world's clean energy economy, while creating green manufacturing jobs here at home.

I am confident we can pass this bill, as well as surface transportation reauthorization into law. If we are able to address climate change, encourage innovation and produce a sustainable source of funding, let me repeat that last one, produce a sustainable source of funding, then we will have achieved a great victory for the American people.

I think we can, and I am very much hopeful that we will.

Thank you so much. Welcome.

Senator BARRASSO. Thank you very much, Senator Carper.

We have three witnesses who are here to testify. We welcome all of you. We have Patrick McKenna, Vice President, American Association of State Highway and Transportation Officials and Director of the Missouri Department of Transportation.

We have Steven Demetriou, Chairman and CEO of Jacobs Engineering Group, testifying on behalf of the Business Roundtable Infrastructure Committee.

We also have Michael Replogle, the Deputy Commissioner for Policy for the New York City Department of Transportation.

I welcome all of you. I would like to remind you that your full written testimony will be made a part of the official hearing record.

Please keep your statements to 5 minutes so we may have time for questions. We look forward to hearing from you.

Mr. McKenna, please begin.

STATEMENT OF PATRICK McKENNA, VICE PRESIDENT, AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS AND DIRECTOR OF THE MISSOURI DEPARTMENT OF TRANSPORTATION

Mr. McKENNA. Chairman Barrasso, Ranking Member Carper, and members of the committee, thank you for the opportunity to discuss the benefits to our citizens from infrastructure investments and speedy project delivery.

My name is Patrick McKenna. I serve as Director of the Missouri Department of Transportation and Vice President of the American Association of State Highway and Transportation Officials.

Today it is my honor to testify on behalf of the great State of Missouri and AASHTO, which represents the transportation departments of all 50 States, Washington, DC, and Puerto Rico. We spent the past century building our Nation's transportation infrastructure. Once a model of innovation, achievement and progress, our current transportation system is in dire need of attention and investment.

Our focus today must be on restoring our network of interstates, roads and bridges to useful condition, ensuring they provide safe and reliable service to the American people. Looking forward, we must seek and implement innovation to operate the transportation system more safely, reliably and with less environmental and community impact. AASHTO and its member DOTs welcome discussions related to an infrastructure initiative and the reauthorization of the Federal surface transportation bill.

As this committee continues its work, please consider the tangible benefits of improving our highways both in the short and long term; the importance of the formula-based highway apportionments to States; and accelerating project delivery and improving our environment through assignment of Federal authorities to States. State DOTs appreciate your leadership in passing the FAST Act in 2015. Prior to the FAST Act, there was Federal funding instability and Missouri was in the difficult financial position of considering abandoning maintenance on 26,000 of our 34,000 miles of roadways.

Since passage of the FAST Act, Missouri has increased our capital budget by \$3 billion over 5 years. We live in a market-based economy where the supply and demand for goods and services are typically determined through very clear price signals. You know exactly what a gallon of milk costs and what you pay for electricity.

Unfortunately, for use of the transportation system, there are no similar price signals. The place to start this conversation is to recognize we need to do a better job communicating both the costs and benefits related to the uses of our transportation system.

The Federal Highway Administration estimates that each dollar spent on road and bridge improvements results in a benefit of \$5.20 from reduced vehicle and system operating costs and reduced emissions from improved traffic flow. Perhaps most importantly, according to a Federal Highway Administration study, \$100 million

spent on highway safety improvements will save 145 lives over a 10-year period.

To demonstrate the purpose and urgency of transportation investment and the call to action for Congress, please consider a single bridge in central Missouri, the Rocheport Bridge. The bridge is 60 years old and needs to be replaced.

MoDOT has programmed only \$14 million for rehabilitation as the only option due to funding constraints. Replacement is estimated to cost well over \$200 million. Traffic models predict that rehabilitation would close lanes on InterState 70 for seven to 9 months with three-to 8-hour backups.

Commercial traffic traveling over the Rocheport Bridge touches every part of the continental U.S. within 72 hours. This bridge demonstrates the nationally impactful nature of strategic investment in seemingly local transportation assets. I would be remiss if I did not raise the issue of the \$7.6 billion rescission of unobligated highway contract authority to take effect on July 1, 2020 and urge its elimination.

Progress has been made toward the goal of streamlining environmental reviews for transportation projects. However, the environmental process is still too long and costly. The most persistent difficulties arise from interaction among NEPA and other Federal environmental laws.

Several States are participating in the NEPA Assignment Program made available to all States in MAP-21. Changes that will make this program both more efficient and attractive to interested States include simplifying the assignment application and audit process, allowing States in this program to be solely responsible for the development of their policies so long as Federal laws and the USDOT requirements and guidance are met, and adding NEPA assignment authority to Title 49.

Another streamlining measure is to authorize any Federal agency to apply a categorical exclusion that has been adopted by any other Federal agency which would make CEs interchangeable among all Federal agencies. No matter what we might think, we cannot streamline our way into providing a safe and sound transportation system. We cannot cut our way to buying steel, concrete, asphalt, equipment and labor. We must work together to move transportation funding and policy in the direction of providing safety, service and stability to all.

Thank you again for the honor and opportunity to testify today. I am happy to answer any questions.

[The prepared statement of Mr. McKenna follows:]



TESTIMONY OF

Patrick K. McKenna

Vice President, American Association of State Highway and
Transportation Officials
Director, Missouri Department of Transportation

REGARDING

**The Economic Benefits of Highway
Infrastructure Investment and Accelerated
Project Delivery**

BEFORE THE

**Committee on Environment and Public Works of the
United States Senate**

ON

Wednesday, March 6, 2019

American Association of State Highway and Transportation Officials
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INTRODUCTION

Chairman Barrasso, Ranking Member Carper, and Members of the Committee, thank you for the opportunity to provide the perspective of the nation's state departments of transportation on the benefits our citizens reap from infrastructure investments and speedy project delivery.

My name is Patrick McKenna, and I serve as Director of the Missouri Department of Transportation (MoDOT), and Vice President of the American Association of State Highway and Transportation Officials (AASHTO). Today it is my honor to testify on behalf of the great State of Missouri and AASHTO, which represents the transportation departments of all 50 States, Washington, DC, and Puerto Rico.

I was appointed to my position by the Missouri Highways and Transportation Commission in December 2015. In this role, I'm responsible for overseeing all operations for the department. Prior to my current role, I served as deputy commissioner of the New Hampshire Department of Transportation.

I appear before you today very near to where I spent 13 years of my career as a staffer with the Secretary of the United States Senate. I am grateful for those years that enhanced my interest in public service and instilled in me a deep respect and admiration for this institution and for the work you perform and the sacrifices you make carrying out your constitutional duties on behalf of the American people.

My hope today is that we can continue the robust discussion on how we can best deliver transportation projects that both make the best use of limited taxpayer dollars and protect our precious natural resources. I believe these two objectives can be met if we work together toward these ends and approach them with a sense of purpose and urgency and a reflection on the past, present and future.

We spent the past century building our nation's transportation infrastructure. Once a model of innovation, achievement and progress, our current transportation system is dire need of attention and investment. Our focus today must be on restoring our network of interstates, roads and bridges to useful condition, ensuring they provide safe and reliable service to the end users – the American people. Looking forward, our next steps must be to seek and implement innovation to operate the transportation system more safely, reliably and with less environmental and community impact.

Let us look beyond the tangible products and technical aspects of our projects – such as steel, concrete and equipment - to the ultimate purpose behind our work and that is the people we serve. Transportation investment is about moving people and goods safely and efficiently and providing a high quality of life. That is why, in Missouri, we work to deliver resourceful and effective transportation projects under the umbrella of three guiding principles: safety, service and stability.

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Director, Missouri Department of Transportation

Every project we tackle must have the goal of making the movement of goods and services safer for all involved. That means we must look to technology, such as automated and connected vehicles, to make travel safer. We must consider smart routes as worthy of investment and examine ways we can enhance incident response tools and techniques.

Service means reliability and mobility for our nation's travelers. As such, it's imperative that we look at our processes, projects and products to ensure they are providing efficient and effective movement of goods and service. We must look beyond traditional project delivery means and methods to provide the transportation options to our customers.

Stability requires a broad consideration of the impacts of delivering transportation projects, especially as to how our work impacts the environment around us. In Missouri, we strive to do all we can to minimize the footprint of our work. Like many other organizations, MoDOT uses recycled shingles, tires, asphalt and other materials to deliver the best pavement with cost — and the environment — in mind. In fact, from 2007 to 2018, we saved \$298 million through recycling.

Stability also means economic development and jobs. In Missouri, we are fortunate to have a leader who has recognized the value of infrastructure on the current and future well-being of its citizens. From the moment he took office, Governor Mike Parson espoused two main goals: workforce development and infrastructure improvement. Most recently, he has proposed a bridge bonding package that would allow us to repair and replace 250 state bridges — bridges that are already programmed in the state construction program.

If successful, the bonding effort not only would fix a significant number of bridges in our state, but would also free up \$350 million that would allow us to perform additional critical infrastructure work in Missouri. This bonding package represents the key benefits to stability - economic development and jobs, guiding forces for transportation investment.

AASHTO and its member DOTs, like many in the transportation industry, welcome the current discussions related to an infrastructure initiative and the reauthorization of the federal surface transportation bill. As part of these discussions, it is timely to highlight the importance of federal highway infrastructure investments and the steps that can be taken to further accelerate the delivery of those projects. As this Committee continues to develop infrastructure legislation, I would like to emphasize the following issues:

- The need to make a stronger value proposition to the public for investing in highway transportation infrastructure;
- Tangible benefits of improving our highways both in the short- and long-term;
- Importance of the formula-based highway apportionments to states benefiting all corners of our nation;
- Accelerating project delivery and improving our environment through assignment of federal authorities to states and encouraging innovation.

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Director, Missouri Department of Transportation

ECONOMIC BENEFITS OF HIGHWAY INVESTMENT

First, let me express appreciation to you on behalf of the state DOTs for your leadership, along with your Senate and House colleagues on partner committees, in shepherding the Fixing America's Surface Transportation (FAST) Act in December 2015. Prior to the FAST Act, there was federal funding instability and Missouri was in the difficult financial position of considering abandoning maintenance on 26,000 of our 34,000 miles of roadways. Since the passage of the FAST Act, Missouri has taken on more financial risk as a state, and increased our capital budget by \$3 billion over five years.

The FAST Act carries forward the federal government's Constitutional directive to invest in transportation as one of its core responsibilities. Yet at the same time, we see ample evidence for ever-growing transportation investment needs from growing population, aging infrastructure stock, and rapid deployment of new technology. According to the US Department of Transportation's (USDOT) *2015 Conditions and Performance Report* to Congress, highway and bridge backlog reached \$836 billion, breaking down into \$420 billion for highways, \$123 billion for bridges, \$167 billion for system expansion, and \$126 billion for system enhancement.

That being said, these are numbers that are hard to grasp due to their sheer magnitude. We live in a market-based economy where the supply and demand for goods and services are typically determined through very clear price signals. You know exactly what a gallon of milk costs, how much a new car will be, and how much you'll be charged for a haircut. Unfortunately, for provision and use of transportation infrastructure, there are no similar price signals to users of the system in terms of how much they are asked to pay, and what they get in return.

In the past, AASHTO has commissioned man-on-the-street interviews asking how much the typical vehicle pays in terms of state and federal gas taxes per year—and the response ranged from around \$1,000 all the way up to \$7,000. The correct answer is \$313 per year, or \$26 per month per vehicle assuming 12,000 miles driven and fuel efficiency of 20 mpg. This compares to \$160 for electricity and gas, \$161 for cell phone, and \$124 for cable and internet accessories per month. I believe the value provided by our nation's transportation network is well worth the contributions being asked from system users, especially compared to other monthly utility and service fees.

The place to start this conversation, though, is to recognize that we in the transportation industry need to do a better job of making the value proposition for transportation investment, by more clearly communicating both the cost and benefits related to the use of our transportation system. And in Missouri, that is exactly where we've started our public conversation.

When I came to MoDOT, I found as I traveled around the state that elected officials, stakeholders and the general public had pervasive misconceptions about our transportation system, how it was funded and how we spent the funds we received. We decided a concerted

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Director, Missouri Department of Transportation

educational process was needed to take a complicated subject and explain it as simply as possible in layman's terms.

A multi-disciplinary team spent six months on the effort, and in the fall of 2016, produced our first Citizen's Guide to Transportation Funding in Missouri. The guide takes the complex issues of the state's transportation revenue, expenditures, system condition and unfunded needs and explains them in clear and easy-to-understand terms with the goal of educating and informing Missourians on the current status and future direction of their transportation system. It has proven to be a very valuable piece in telling our story.

We've updated it each year since, and it has helped to break down the old perceptions and to advance the discussion of a need for additional investment in transportation infrastructure.

Now, along with several companion pieces, the Citizen's Guide is legislatively required to be the core of our annual report to the Missouri General Assembly.

Though certainly significant, benefits from investment in highway transportation infrastructure go well beyond short-term construction jobs created. A well-performing transportation network allows businesses to manage inventories and move goods more cheaply, access a variety of suppliers and markets for their products, and get employees reliably to work. American families benefit both as consumers from lower priced goods and as workers by gaining better access to jobs.

The Federal Highway Administration (FHWA) estimates that each dollar spent on road, highway and bridge improvements results in an average benefit of \$5.20 in the form of reduced vehicle maintenance costs, reduced delays, reduced fuel consumption, improved safety, reduced road and bridge maintenance costs, and reduced emissions as a result of improved traffic flow. Perhaps most importantly, according to an FHWA study, \$100 million spent on highway safety improvements will save 145 lives over a 10-year period.

In Missouri, examples of rate-of-return investments made in the state include:

- Every dollar invested in transportation in Missouri results in \$2.5 to \$4 of new economic activity depending on the type of projects we are able to complete. When long-term federal funding is known and predictable, our project planning enables system improvements that bring higher returns. When federal funding is unpredictable, we focus on projects with single year completions that yield less long term economic benefits.
- Missouri has more than 1,000 miles of the Mississippi and Missouri Rivers bordering and bisecting our state. Some \$12.5 billion in cargo travels up and down those waterways each year. A little investment in ports can spur a great deal of private investment. For example, in the past 5 years, \$15.5 million in state investment in ports has led to \$2.4 billion in state and local tax revenue. Missouri public ports support nearly 290,000 jobs annually, \$15.7 billion in labor income and \$100.6 billion in economic activity.

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Director, Missouri Department of Transportation

- Missouri has 122 public-use airports that generate \$11 billion in annual economic activity.
- Missouri's cost-share program enables us to leverage contributions from local communities with state funds to advance projects of regional importance. Since the program's inception, more than \$450 million in state participation has led to the delivery of more than \$1 billion in projects.
- Missouri has utilized innovative procurement such as design-build and delivered more than \$1 billion in projects.

When we as a nation make significant investments in our transportation infrastructure, it generates a multi-decade return on that investment to all sectors of the economy in the form of improved productivity and quality of life. The current fiscal environment does not require a rapid deployment of public dollars to resuscitate the national and global economy like what we saw in 2008. Rather, right now is the opportune time to secure our economic future for the long-term based on a thorough modernization of the public capital stock in our transportation system. As such, the federal investment—whether through an infrastructure plan or FAST Act reauthorization—must focus on programs and projects that generate the most benefits through the entire lifecycle of the asset, rather than mandating short spending deadlines which will lead to less efficient use of taxpayer dollars due to project sponsors' inability to address longer-term needs.

To demonstrate the purpose and urgency of transportation investment and the call to action for Congress, please consider a single bridge in central Missouri – the Rocheport Bridge. The transportation challenge and engineering need for the Rocheport Bridge is simple – the bridge is 60 years old, and with rehabilitation (for a fourth time), it will last only 10 more years and then it must be replaced. MoDOT has programmed only \$14 million for the fourth rehabilitation in 2020 as the only option, due to funding constraints. Replacement is estimated to cost well over \$200 million. Rehabilitation, however, is not preferred and has several negative economic and operational consequences. Traffic models predict that rehabilitation would close lanes for seven to nine months with three- to eight-hour backups (some 25 miles long) depending on the extent and number of incidents on any given day. Commuters, and industries that rely on just-in-time suppliers and workers, will suffer irreparable financial losses and state's ability to attract new industry will be negatively impacted. These delays are unacceptable on a corridor that serves as the main artery through the nation's heartland. Also, Rocheport Bridge is located just 11 miles west of Columbia - home to the region's only Level 1 Trauma Center and the University of Missouri, Columbia – the State's flagship university.

Rehabilitation also puts construction crews and drivers at risk. **Traffic delays and increased risk during rehabilitation are estimated to cost the public more than the cost of a new bridge.** From a national and regional point of view, the need translates into uninterrupted economic prosperity. The Rocheport Bridge, quite literally, links Kansas City and St. Louis to each other and to the rest of the United States. **Any** delay at Rocheport Bridge negatively impacts the regional and national economy. For example, Ford's Kansas City auto manufacturing plant,

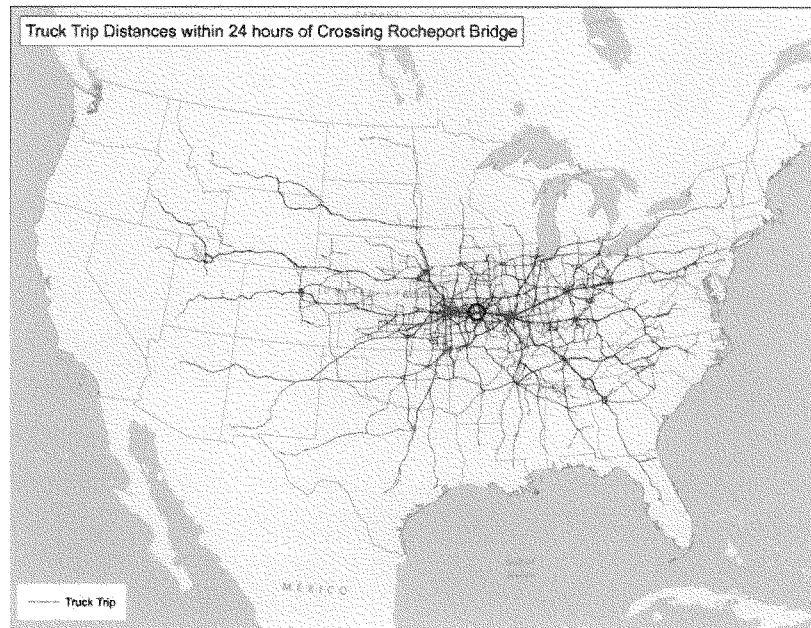
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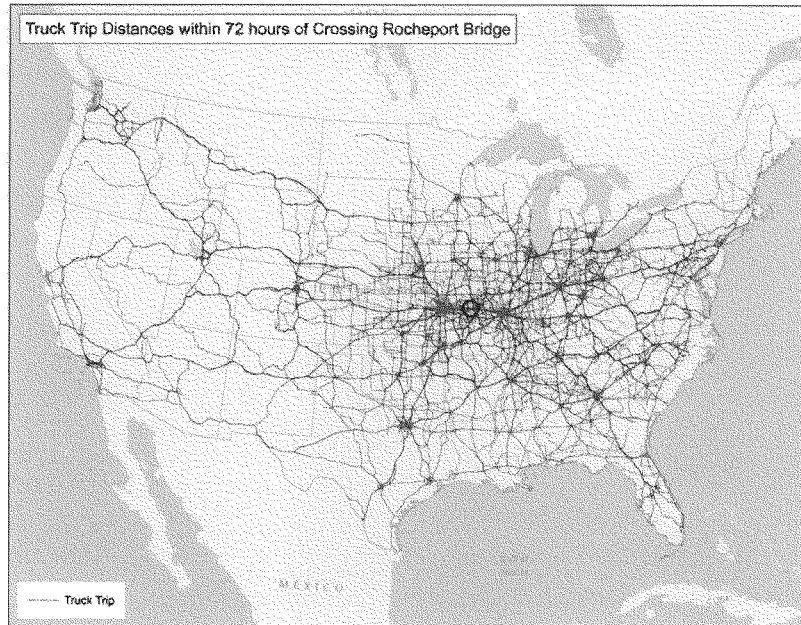
which produces the F-150 and Transit Van, is the largest Ford plant in the world, based on units produced. With this volume, the need for uninterrupted suppliers is crucial.

Below are images created at MoDOT's request by the American Transportation Research Institute (ATRI), which was formerly affiliated with the American Trucking Association (ATA).

These images use probe data from GPS, cell phone, and Bluetooth devices associated with commercial motor vehicles to outline travel patterns for trucks that use the Rocheport Bridge in both eastbound and westbound directions. This "select link" analysis depicts Rocheport at the center of national freight flows using the bridge on a 24-, and 72-hour basis.



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Vice President, American Association of State Highway and Transportation Officials
Director, Missouri Department of Transportation



These graphics demonstrate the nationally impactful nature of strategic investment in seemingly local transportation assets. We are more connected now than ever before by our infrastructure and we must rise to the challenge to renew and revitalize this national asset.

To further build on the solid foundation of our current federal surface transportation policy, we believe that it is now time for all transportation stakeholders—led by Congress and the President—to begin work on reauthorizing the FAST Act, and to ensure a smooth transition upon the FAST Act’s expiration on September 30, 2020, without the need for disruptive extensions of the program. Under the direction of AASHTO’s Transportation Policy Forum that I chair, the state DOTs last year initiated an extensive 18-month effort to develop and adopt reauthorization policy recommendations by October of this year. It is a bottom-up process, where we are currently in the process of gathering expert input from our wide range of technical committees and councils comprising leaders from all state DOTs. We’re also seeking our industry partners’ input during this process prior to our formal adoption in October in order to maximize the inclusivity of perspectives in our policy recommendations to come.

Testimony of **Patrick K. McKenna**
 Vice President, American Association of State Highway and Transportation Officials
 Director, Missouri Department of Transportation

As FAST Act reauthorization gets under way, we urge the Committee to recognize that federal funds should continue to be provided through the existing formula-based program structure directly to states rather than looking at untested new approaches that will require more time and oversight. For over one hundred years, we as a nation have enjoyed the fruits of the federal government's highly successful partnership with state DOTs to build and maintain our surface transportation system. That partnership should be continued and strengthened in any new federal transportation legislation.

The Federal-aid Road Act of 1916 established the foundation of a federally-funded, state-administered highway program that was—and still very much is—well-suited to a growing and geographically diverse nation like ours. Under this model, federal investment in all modes of transportation have allowed states and their local partners to fund a wide range of projects that serve the interest of the nation as a whole. The federal formula program's inherent flexibility defers project selection and investment decision-making to state and local governments based on extensive public input from local communities and businesses to address their needs and ensure goods get access to a larger market than ever before.

Putting the formula program that built the Interstate Highway System and the National Highway System—the backbone of our national network of roads and bridges that drive our national economy—to work as the linchpin of the next surface transportation legislation represents the optimal approach to serve all corners of our country, improving mobility and quality of life in urban, suburban, and rural areas.

I would be remiss if I didn't raise the issue of the \$7.6 billion rescission of unobligated highway contract authority to take effect on July 1, 2020, as a means to bring the spending baseline back to pre-FAST Act levels on paper. Unfortunately, the contract authority rescission is a budgetary artifice that at best impedes the flexibility of state DOTs to meet their individual infrastructure needs by disrupting transportation planning and timely delivery of projects; and at worst, the cumulative effect of rescissions—with over \$22 billion enacted since 2002—can wipe out the entire balance of contract authority held by states which will lead to hard funding cuts to federal dollars authorized under the FAST Act.

Testimony of **Patrick K. McKenna**

Vice President, American Association of State Highway and Transportation Officials
Director, Missouri Department of Transportation

ACCELERATING PROJECT DELIVERY TO IMPROVE MOBILITY AND PROTECT THE ENVIRONMENT

Over the past decade, significant progress has been made toward the goal of streamlining environmental reviews for transportation projects. This progress has been spurred by streamlining measures enacted in the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU), Moving Ahead for Progress in the 21st Century Act (MAP-21), and the FAST Act. But even with this progress, the environmental process still takes too long and is unduly costly and delay-prone. Some of the most persistent difficulties arise from the interaction among the National Environmental Policy Act (NEPA) and other federal environmental laws. To achieve further streamlining, focus must be paid to not only making continued improvement in the NEPA process itself, but also in making the NEPA process work more efficiently with other federal requirements, all while remaining responsible stewards of taxpayer resources and both human and natural environments.

AASHTO believes that tremendous benefit can be unleashed by assigning decision-making authorities traditionally assumed by the federal government to those states that both desire them and are willing to be held responsible. Currently, Alaska, California, Florida, Ohio, Texas, and Utah are participating in the NEPA assignment program made available to all states in MAP-21. Based on our collective experience, specific changes that will make this program both more efficient and attractive to interested states include:

- Simplifying the assignment application and audit processes;
- Allowing states to assume all of the responsibilities of the USDOT with respect to engineering and other activities related to environmental review, consultation, permitting or other action required under any federal environmental law for project review or approval,
- Allowing states in this program to be solely responsible for the development of their policies, guidance and procedures so long as federal laws and the USDOT requirements and guidance are met,
- Removing the pre-condition for a state to have taken on NEPA assignment for highways prior to being able to take on NEPA assignment for rail and transit projects, and
- Adding NEPA assignment authority to Title 49 to allow states to assume the federal NEPA responsibilities of any USDOT modal administration.

Beyond NEPA, AASHTO has identified a number of touchpoints where states can make determinations in lieu of seeking FHWA approval, including federal funds obligation management, project agreements, right-of-way acquisition, preventive maintenance, repayment of preliminary engineering and right-of-way costs, and credits toward non-federal share, among many other possible areas of current federal oversight.

For states without NEPA assignment, USDOT and its modal administrations should be authorized to and enter into programmatic agreements under which state DOTs could take on increased responsibility for carrying out routine FHWA responsibilities during the NEPA process.

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It would be far more efficient to allow the state DOT to carry out routine interagency coordination tasks, while maintaining regular communication with USDOT. USDOT would retain responsibility for all final decisions, while maximizing the opportunity for state DOTs acting under USDOT oversight to carry out the procedures leading up to those final decisions. This increased efficiency would also free up USDOT's limited staff resources to focus on issues such as a program oversight and major project decisions.

A recent and highly illustrative example from Missouri is the U.S. Route 54 Mississippi River Bridge replacement. To enable the bridge replacement, this project proposed to fill the "notch" in a federally authorized levee. A provision of the Section 408 permission process requires a written statement from the non-federal sponsor, in this case a levee district, endorsing the proposed alteration. To offset the hydraulic impact of filling the "notch", MoDOT along with the Illinois Department of Transportation committed to provide an opening under the bridge that would convey a 500-year flood event without raising the flood levels. MoDOT eventually negotiated with the levee district to reach agreement on the design flood frequency as proposed.

Without the letter of permission from the levee district, the United States Army Corp of Engineers will not grant the Section 408 permission (the approval process to ensure any alteration proposed will not be injurious to the public interest and will not affect the Corp project's ability to meet its authorized purpose), and subsequently won't issue the Section 404 permit associated with the Clean Water Act.

MoDOT met with representatives from the levee district numerous times in an attempt to resolve the issues, because the cost of additional conveyance would result in a longer bridge and would make it financially difficult to replace. While MoDOT managed to avoid project delays in this case, the letting was very close to being delayed, a delay which could have jeopardized receipt of a federal grant, which could have cancelled the project. MoDOT's suggested solution to address this problem would be for the Corp not to allow the letter of permission from the entity that has an interest in the federal levee to wholly dictate whether the applicant can complete the Section 408 permission process. The letter of permission should be a consideration in the Corp's decision making process, but it should not be the item that ultimately determines the permission can be issued.

Another streamlining measure is to authorize any federal agency to apply a categorical exclusion (CE) that has been adopted by any other federal agency, which would make CEs interchangeable among all federal agencies. For example, the Corps could apply a CE from FHWA's CE list. Under current NEPA regulations, each federal agency adopts its own list of CEs applicable to actions that the agency carries out. If multiple federal agency approvals are needed for the same project, and only one agency has an applicable CE, then that agency can issue as CE, but the other federal agencies must prepare an Environmental Assessment, slowing down the process unnecessarily. While an existing law allows any USDOT agency to use any other USDOT's agency's CE, this authority has two important limitations: (1) applies only to

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multimodal projects, and (2) it does not apply to agencies outside the USDOT. Allowing CEs to be interchangeable between federal agencies could significantly streamline project delivery.

In addition, although there are still improvements to be made within the NEPA process, a great deal of project delivery delay arises from the interaction with NEPA and other federal environmental laws, each with their own distinct procedures and requirements. Streamlining the NEPA process alone will not be successful without also streamlining compliance with the other federal environmental laws. To make the NEPA process work more smoothly with other substantive environmental requirements, USDOT and its modal administrations, along with state DOTs, should work with Federal environmental agencies to develop programmatic approaches to streamline environmental processes. Programmatic agreements greatly reduce the time and cost needed to meet environmental requirements, without changing the underlying environmental standards that projects must meet. Programmatic approaches have been used to help streamline many environmental requirements, but development of these agreements requires time and resources. To ensure success in developing programmatic agreements, Federal resources should be dedicated to this effort.

Finally, to foster the development and testing of new, innovative practices and approaches aimed at expediting project delivery while maintaining environmental protections, we ask Congress to consider establishing a project delivery innovation program. Thanks to the states' partnership with FHWA, we're making a great case for such a program by testing out the concept through Special Experimental Project—or SEP-16—which seeks proposals for delegation of various FHWA responsibilities directly to States.

There is a wide range of potential applications if SEP-16 criteria can be met. Some possible examples include:

- States approving modifications to Stewardship and Oversight agreements without preapproval by FHWA, subject to FHWA's ongoing oversight of the State's compliance with federal requirements;
- States taking the full responsibility for approving a new or modified access point on the Interstate System, and;
- States developing a definition for "high risk" Interstate projects that allows States to assume the full range of responsibilities for these efforts.

In addition, we're continuing to work with states to build on assignment of authorities related to environmental review, consultation, and permitting. Some additional assignment opportunities could exist for floodplain and noise policy determinations.

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I want to emphasize that building on this type of flexibility in a full-fledged project delivery innovation program must include appropriate safeguards to ensure adherence to federal environmental policy goals. For example, all federal agencies required to consult on a project would need to agree to the inclusion of the project in the pilot program, consulting resource agencies would need to determine that equal or improved environmental outcomes would be achieved, and no agency would be allowed to override or modify requirements that fall within another agency's authority. A program of this scale would require new legislative authority for federal transportation and regulatory agencies to allow them to modify their own requirements to develop innovative practices that streamline project delivery and achieve positive environmental outcomes.

CONCLUSION

State DOTs remain committed to assisting Congress in the development of strategies to ensure long-term economic growth and enhanced quality of life through robust multimodal transportation investments. Just last week, hundreds of State DOT leaders from all corners of our country were only a couple of blocks away attending AASHTO's 2019 Washington Briefing. Over four days of productive discussions, many of my colleagues were on Capitol Hill meeting with their respective Congressional delegations. As they did then, and as I do again now, AASHTO and the State DOTs will continue advocating for the reaffirmation of a strong federal-state partnership to address our surface transportation investment needs.

I'd like to leave you with what I believe is a critical consequence to inaction when it comes to investing in highway infrastructure and accelerating project delivery. No matter what we might think, we cannot streamline our way into providing a safe and sound transportation system. We can't cut our way to buying steel, concrete, asphalt, equipment and labor. We must work together to move transportation policy in the direction of providing safety, service and stability for all.

Thank you again for the honor and opportunity to testify today, and I am happy to answer any questions.

Senate Committee on Environment and Public Works
Hearing entitled, “The Economic Benefits of Highway Infrastructure Investment and Accelerated Project Delivery”
March 6, 2019
Questions for the Record for Mr. McKenna

Senator Whitehouse:

1. **Innovative Materials:** The National Academies of Sciences recently finalized a report titled, “Performance of Bridges That Received Funding under the Innovative Bridge Research and Construction Program.”

The report, which was included at my direction in the FAST Act, evaluated projects funded under the Innovative Bridge Research and Construction Program. This program provided grants between 1999 to 2005, but has since been defunded. The Academies’ report found that using advanced materials and technologies can reduce construction costs, construction time, and traffic congestion. It also found that structures using advanced materials are more resilient to natural disasters. The report recommends that Congress reestablish grant programs that would fund projects using innovative materials.

- a. Do you agree that any infrastructure bill should include provisions that will encourage the use of innovative materials that are more durable and resistant to corrosion than traditional materials?

Yes, it is important that any infrastructure bill include provisions to encourage the use of innovative materials for not only bridges, but other material as well. The use of new innovative materials can make a bridge last longer, signs appear brighter from a longer distance, or traffic signals operate more efficiently. Innovative materials can improve safety, reduce cost, and increase the overall life of the nation’s surface transportation infrastructure. Specific to bridges, AASHTO agrees with conclusion of the National Academies of Science report that using advanced materials and technologies does reduce cost and construction time resulting in less impact to the traveling public.

In Missouri, under the Innovative Bridge Research and Construction Program, we focused our efforts at improving bridge deck condition and deterioration resulting from the annual use of chlorides during winter conditions. We tested the use of stainless steel and carbon fiber reinforced materials and found good results, but limited supply and excessive pricing. We had success in testing and practical implementation with the use of epoxy coated steel rebar in bridge decks. The use of epoxy coated rebar has become standard practice and will result in longer lasting bridge decks and great system performance.

Perhaps a more expansive view beyond materials innovation should be a renewed call to invest in research across the spectrum of transportation. In Missouri, just

this past week, the Missouri Highways and Transportation Commission authorized the creation of a joint research venture with the University of Missouri System in Columbia, Kansas City, Rolla and St. Louis. The newly formed Missouri Center for Transportation Innovation (MCTI) is intended to:

- *Identify, conduct and disseminate transportation research*
- *Complete practical, timely and implementable research*
- *Implement innovative technologies*
- *Produce future transportation engineers*

MCTI will utilize existing research and laboratory facilities and promote an atmosphere that develops faculty and staff at the University System and Missouri DOT.

Part of the success of the MCTI and for that matter, national efforts to increase innovative material, process and construction tools and techniques will rely on federal funding participation with new funding, rather than a redirection of existing funds. Grant programs that further restrict existing funding create additional problems at the state DOT's who are trying to patch an aging interstate network. Properly funded, actionable research is a vital and pressing need.

- b. Do you agree that Congress should follow the Academies' recommendation and provide grant funding for projects that use innovative materials?

For full disclosure, I currently sit on the Executive Committee of the Academies' Transportation Research Board and favor this recommendation. However, any new product or material being produced and marketed towards state DOTs may come with it a higher cost and more risk. Due to the litigious nature of our current society and in some states, little statutory limitation of that liability, many state DOT's are forced into risk mitigation strategies. Programs and statutory assistance to reduce or mitigate a risk association with a new product or material is generally acceptable. Grant opportunities, like the one offered through the Innovative Bridge Research and Construction Program, is a way to mitigate the risk associated with using a new product or material. A similar approach was used for the second Strategic Highway Research Program (SHRP2) that provided grants to state DOTs to use innovative bridge designs and construction material.

Generally speaking, these types of grant programs are very useful in providing incentives to state DOTs, and other infrastructure owners and operators, to use innovative materials. To that end, AASHTO is supportive of the Academies' recommendation that:

"A new federal incentive grant program for innovative bridge technology could continue the success of IBRC in accelerating the adoption of proven technologies that have not yet gained wide acceptance and also contribute to

advancing less-developed technologies, by supporting state highway agency bridge projects that were coordinated as elements of research and evaluation studies.”

However, I will repeat my previous statement that any federal incentive grant program bring new funding, rather than a redirection of existing funds. Grant programs that further restrict existing funding create additional problems at the state DOT's who are trying to patch an aging interstate network.

2. Climate Preparedness: Rhode Island's Coastal Resources Management Council is planning for upwards of nine feet of sea level rise by 2100. To prepare for this much water overtaking our shores, we need to protect evacuation routes from flooding, reinforce bridges that are exposed to corrosive saltwater and storms, and consider moving or elevating coastal roadways. These improvements are essential if my state and others along the coasts have any chance of surviving the changes coming our way over the next 50 or 100 years.

These resiliency improvements will also go a long way in bolstering the coastal real estate market, which according to the First Street foundation, has already seen \$15.8 billion in lost home value due to sea level rise and flooding in the 15 East Coast states and Mississippi and Alabama along the Gulf.

- a. How should climate change considerations and sea level rise projections be incorporated in the local, state, and federal transportation planning processes?

Rest assured, storm frequency, severity and duration along with repeat cycles of damage to infrastructure and challenges to communities is not solely a coastal issue, but a national issue. In Missouri in the past three years and currently as I write this response, we have seen severe weather and flooding events in each of the past three years that have required the closure, cleanup and repair of over 300 roadways and other vital infrastructure such as flood control levees, water treatment facilities and private property. These impacts have been particularly damaging to the agricultural industry in the Midwest.

In the FAST Act, new requirements were created for the statewide and metropolitan transportation planning processes to consider projects and strategies to improve the resilience and reliability of the transportation system.

The FAST Act also created the Nationally Significant Freight and Highway Projects (NSFHP) program - established to support nationally and regionally significant freight and highway projects that achieve a range of program goals including the enhancement of the resiliency of critical highway infrastructure.

Additionally, MAP-21 codified a requirement for state DOTs to develop and implement a risk-based Transportation Asset Management Plan. Risks were considered anything that affects the condition of National Highway System (NHS) pavements and bridges and the performance of the NHS, including risks associated with current and future environmental conditions (such as extreme weather events, climate change, and seismic activity).

AASHTO members believe these provisions in current law provide the appropriate guidance and requirements related to state DOT planning for climate change, risk and resiliency challenges.

However, we would like to recommend Congress examine the current federal Emergency Relief (ER) Program in order to provide states with the flexibility to

use ER funds to increase the resilience of a replacement project to future hazards. Allowing ER funds to be used for actions outside of the right-of-way and/or for other strategies that improve the resilience of the damaged asset and/or facility would be a helpful step to improve the planning, mitigation and preparation for future climate and weather events.

Building requirements for states to address resiliency into new construction projects without addressing the core funding issues of the Highway Trust Fund will lead to reduced overall infrastructure condition as increased costs of new construction and replacement projects will limit construction in areas less prone to flooding.

- b. Do you agree that it is irresponsible to ignore this loss in value to our coastal assets as we harden our infrastructure for sea-level rise?

We understand Congress's interest in ensuring we develop as resilient a transportation system as possible to make sure our physical stock is able to adapt and respond to changing conditions – AASHTO members have the same interest as well. As the CEOs of state Departments of Transportation, it is our responsibility to effectively manage our transportation systems to meet the various challenges we face everyday.

To that end, AASHTO runs the Resilient and Sustainable Transportation Systems Technical Assistance Program. This is a voluntary pooled-fund program that provides timely information, tools, and technical assistance to AASHTO members in meeting the difficult challenges that arise related to climate change, energy efficiency, energy security, infrastructure adaptation, alternative vehicles and fuels, and other relevant topics. This program is a critical resource for state DOTs to address climate change and energy issues, while also providing the information needed to engage in and influence policy dialogue on resiliency at the federal level.

3. Electric Vehicle Corridors: According to Inside EVs, sales for electric vehicles increased by 81% in 2018, and sales for electric vehicles is predicted to continue to grow at a rapid pace. As you know, in 2015 Congress passed legislation as part of the FAST Act to establish a national alternative fuels corridor program, so drivers have a better understanding of where to find alternative fuel charging station and refueling stations. The agency you would head is now in the process of implementing that legislation, and attempting to establish a national network of alternative fueling and charging infrastructure along national highway system corridors.
 - a. Beyond the work that USDOT is already doing in this space, what else can the agency do to stimulate deployment of electric vehicle infrastructure?
 - b. What can USDOT do to reduce regulatory roadblocks to increase the nation's electric vehicle infrastructure?
 - c. What can Congress do in the next highway bill to continue to expand our nation's electric vehicle infrastructure?

State departments of transportation are not only owners and operators of key transportation assets, but also conscientious and responsible stewards of the natural and built environment. Expanding the nation's alternative fuel vehicle infrastructure could further encourage the use of alternative fuel vehicles, like electric vehicles, that produce zero emissions. Encouraging the installation of electric vehicle infrastructure could help to reduce vehicle emissions and improve air quality. To this end, AASHTO supports the Clean Corridor Act of 2019, proposed by Senator Carper in March 2019, that would establish a grant program to strategically deploy electric vehicle charging infrastructure and hydrogen fueling infrastructure along designated alternative fuel corridors that will be accessible to all drivers of zero emission vehicles. These types of targeted grant programs if properly funded could be useful to help mitigate the risk associated with the deployment of new and non-traditional infrastructure like electrical vehicle charging hardware.

4. Bicycle and Pedestrian Safety: I continue to be concerned by our nation's rate of bicycle and pedestrian deaths, which now make up more than 18% of all traffic fatalities and are at their highest level since 1990. While we are making progress in improving transportation safety overall, we are unfortunately heading in the wrong direction for people walking and biking. The Governors Highway Safety Association found that an estimated 50 percent of pedestrian deaths occur on state or US highways and interstates. Congress has attempted to prioritize this issue for state departments of transportation by requiring new safety goals for people walking and biking.
 - a. How should Congress address bicycle and pedestrian safety in the next highway authorization?

AASHTO members are also concerned with this trend in bicycle and pedestrian safety. To that end, two years ago, AASHTO undertook a comprehensive review of its entire committee structure to ensure that the needs of its members were being met. Two years ago, AASHTO created a Council on Active Transportation to take a comprehensive look at transportation safety issues.

All 52 AASHTO member departments are represented on the Council- most states have two or three members. The diverse backgrounds and differing roles within the DOTs of the Council members (CEOs, planners, chief engineers, designers, bike/ped coordinators) show the value the state DOTs place on this topic and also enables the Council to have a broad multidisciplinary view of active transportation.

One area of concern relates to a provision in the FAST Act that revised the definition of a Highway Safety Improvement Project. The change effectively restricts funding under the Highway Safety Improvement Program (HSIP) eligibility to only 28 strategies, activities or projects listed in the legislation, eliminating the ability to use HSIP funds for public awareness and education efforts, infrastructure and infrastructure-related equipment to support emergency services, and enforcement of traffic safety laws that are identified in a state's Strategic Highway Safety Plan (SHSP). SHSP's are a multidisciplinary approach to reducing highway fatalities and serious injuries on all public roads – including for users of the roadway such as bicyclists and pedestrians. The lack of flexibility in safety project selection in the HSIP program, particularly non-infrastructure related activities, stifles innovative safety improvements.

AASHTO members believe state DOTs should be able to utilize HSIP funds to address the safety priorities established as part of a state's Strategic Highway Safety Plan. Therefore, AASHTO recommends that Congress allow a portion of HSIP funds to be used for education and other behavioral programs. Addressing the behavioral aspects of driver, bicycle and pedestrian safety may be some of the highest returns of any investment.

In Missouri, we have created a public campaign called, Buckle-Up-Phone-Down with the intent of addressing behavior and safe conduct during use of the transportation

network. An affinity campaign has been created with many high school students taking the BUPD Challenge. A link to the campaign is below:

<http://www2.modot.org/BuckleUpPhoneDown/>

A great video reference is included below:

<http://www2.modot.org/buckleupphonedown/gallery/index.html>

Creatively engaging the public to encourage everyone to take personal responsibility for safe behavior is a winning formula. Please consider enabling more creative and flexible use of existing HSIP funds.

- b. Which programs in the FAST Act have been the most beneficial for bicycle and pedestrian safety?

The Highway Safety Improvement Program (HSIP) has been a very effective tool for state DOTs and other transportation stakeholders to address roadway safety priorities. However, the FAST Act restricts state DOTs from using all manner of solutions to help reduce bicycle and pedestrian injuries and fatalities. The FAST Act precludes the use of HSIP funds for education, enforcement, safety research, or emergency medical service safety programs that could be beneficial and requires all HSIP funds to be used for roadway safety infrastructure. AASHTO members believe state DOTs should be able to utilize HSIP funds to address the safety priorities established as part of a state's Strategic Highway Safety Plan. As mentioned above, AASHTO recommends that Congress allow a portion of HSIP funds to be used for public awareness and education efforts, infrastructure and infrastructure-related equipment to support emergency services, and enforcement of traffic safety laws.

Senator BARRASSO. Thank you so very much, Mr. McKenna.
Mr. DEMETRIOU.

**STATEMENT OF STEVEN DEMETRIOU, CHAIRMAN AND CEO OF
JACOBS ENGINEERING GROUP, ON BEHALF OF THE BUSI-
NESS ROUNDTABLE INFRASTRUCTURE COMMITTEE**

Mr. DEMETRIOU. Good morning, Chairman Barrasso, Ranking Member Carper and members of the committee. Thank you for inviting me to testify on the economic benefits of infrastructure investment.

At Jacobs, the 80,000-person professional services firm that I lead, we are working every day throughout the United States and around the world to solve complex infrastructure challenges, transform government and business operations, and, very importantly, to enhance communities.

I am here on behalf of the Business Roundtable, an association of CEOs of American leading companies working to promote a thriving U.S. economy and expanded opportunity for all Americans. At the Business Roundtable, we believe that infrastructure is critical to a modern, competitive economy. Appropriate investment in infrastructure creates near-term and long-lasting benefits.

At Jacobs, we have seen these benefits, in fact, firsthand right here in Washington, DC. with the \$390 million 11th Street Bridges Project over the Anacostia River. Jacobs led the environmental and preliminary design work for these bridges crossing the southeast, southwest and Anacostia freeways.

For decades, drivers were forced onto neighborhood streets to compensate for missing links between these highways. This restricted movement to local workplaces, schools and stores and discouraged economic development. Ultimately, the completion of this project improved traffic flows, connected communities, triggered billions of dollars of private investment in mixed-use development and resulted in new jobs, enhanced social and economic growth on a local and regional level.

For decades, America set the global standard when it came to transformative infrastructure. Yet, while the benefits were clearly tangible, our national commitment to investing in infrastructure has more recently diminished.

As a business leader, it concerns me that the U.S. spends a smaller share of GDP of infrastructure than all but two G7 countries. From 2003 to 2017, U.S. public infrastructure spending fell by a staggering 80 percent.

Forty-four percent of America's major roads are in poor or mediocre condition. Twenty-three percent of our bridges are either structurally deficient or functionally obsolete. Because of inadequate infrastructure, American businesses incur nearly \$27 billion in extra transportation costs each year.

Business Roundtable recently completed a study that quantifies the benefits of returning our infrastructure to a State of good repair and expanding it to meet the demands of a growing economy. Let me highlight a few key findings.

First, every \$1 invested in infrastructure can return roughly \$3.70 in additional economic growth over 20 years. Think about that for a moment, a four to one ratio representing an extraor-

dinary return on investment. The additional infrastructure investment will create 1.1 million new jobs over the next decade and boost wages. The average American household will gain \$1,400 in disposable income every year for an increase of more than \$28,000 over 20 years.

Investing in infrastructure will increase real GDP by nearly \$6 trillion over the next two decades. Every State will experience positive impacts on employment, household incomes and economic growth. This will also deliver benefits across economic sectors from farming, insurance, mining, to manufacturing. This is why it is so important to increase investment in Federal trust funds, especially the Highway Trust Fund where additional revenue is needed just to keep the fund solvent at current baseline spending levels, excluding critical future needs.

In addition to infrastructure funding, we must also streamline the permitting process. Although the Business Roundtable study did not examine the effects of permitting reform, we know that red tape increases project costs and delays. Streamlining the regulatory process is essential.

A great recent example of successfully streamlining the permitting process is the I-25 Gap Project in Colorado which connects Denver and Colorado Springs, the State's two largest employment centers. The project used permitting reforms, including the FAST Act, among others, to achieve an unprecedented delivery schedule, completing the long-range planning process through NEPA to the start of construction in less than 2 years.

This is why Business Roundtable supports the Administration's One Federal Decision policy. It encourages you to codify the 2-year deadline to reach a single decision on all proposed infrastructure projects.

Finally, we also need to modernize America's infrastructure through adaptive technology and innovation. At Jacobs, we are providing the value of new technologies for transportation infrastructure every day. In fact, we are working with Los Angeles County to pilot connected vehicle technologies that would reduce traffic congestion along an interState corridor that is crucial to international trade. In another example, we are partnering with Florida's Turnpike Enterprise and Florida Polytechnic University to create a test facility to demonstrate the resiliency of driverless vehicles in simulated conditions of rain, fog and smoke.

The need for action is clear. The benefits are profound. An investment in infrastructure is an investment in the future. Business Roundtable is committed to working with Congress to advance policies that will modernize U.S. infrastructure to support economic growth and expand opportunities for all Americans.

Thank you, Mr. Chairman, for the opportunity to testify. I look forward to your questions.

[The prepared statement of Mr. Demetriou follows:]

Prepared Statement of Steve Demetriou
Chair and Chief Executive Officer, Jacobs Engineering Group Inc.
Member of the Business Roundtable Infrastructure Committee
“The Economic Benefits of Highway Infrastructure Investment and Accelerated Project Delivery”
Before the U.S. Senate Committee on Environment and Public Works
Wednesday, March 6, 2019

Good morning, Chairman Barrasso, Ranking Member Carper and Members of the Senate Committee on Environment and Public Works. I am Steve Demetriou, Chair and Chief Executive Officer of Jacobs. Thank you for inviting me to testify on behalf of Business Roundtable regarding the economic benefits of infrastructure investment.

Jacobs is a public company headquartered in Dallas, Texas. Our more than 80,000 employees work throughout the United States and around the world to solve complex engineering and infrastructure challenges, with a focus on transforming government and business operations and communities to make them more connected, accessible and sustainable.

I am also a member of the Infrastructure Committee at Business Roundtable, an association of Chief Executive Officers (CEOs) of America’s leading companies working to promote a thriving U.S. economy and expanded opportunity for all Americans through sound public policy. These CEO members lead companies that employ more than 15 million people, generate more than \$7 trillion in annual revenues and invest nearly \$147 billion annually in research and development. Business Roundtable CEOs represent major employers in every state and are responsible for creating quality jobs with good wages across the country.

As a group, we believe that infrastructure is a critical component of a modern, competitive economy. The member companies of Business Roundtable rely on safe, reliable, efficient and world-class infrastructure for our continued success. To that end, Business Roundtable supports infrastructure policies that are economically sound, oriented toward the long-term and designed to deliver maximum benefit to stakeholders.

My testimony outlines the case for a strong reinvestment in infrastructure. I am particularly excited to share the results of a new economic study from Business Roundtable, *“Delivering for America: The macroeconomic impacts of reinvesting in America’s infrastructure systems,”* which quantifies the benefits of taking action on infrastructure for American families, workers and businesses.

Why infrastructure is important to the economy

Modern transportation infrastructure – through the safe, reliable, efficient movement of people and goods by road, rail, air and water – drives regional and worldwide commerce. Appropriate investment in infrastructure, creates near-term and long-lasting employment opportunities, increases efficiency for our company’s employees and customers, improves accessibility to goods and services and opens up people’s ability to access education, employment and other services.

At Jacobs, we've seen what kind of impact a modern transportation infrastructure can have on a community through our work on complex infrastructure projects around the world.

An example of this impact took place not far from this hearing room, the \$390 million 11th Street Bridges over the Anacostia River, were by far, the District Department of Transportation's largest construction project of its kind – and one that illustrates the profound impact that transformative infrastructure has on the lives of Americans. Jacobs led the environmental and preliminary design work for the pair of one-way bridges crossing the Anacostia Freeway (I-295 and DC-295) and the Southeast/Southwest Freeway (I-695).

This critical project replaced aging infrastructure, eliminated spillover freeway traffic into already distressed neighborhoods, connected communities and provided a foundation for billions of dollars of private investment that resulted in new jobs and enhanced social and economic growth on a local and regional level.

Action on Infrastructure is Long Overdue

Taking a step back for a moment, let us consider the foundational role that infrastructure plays in the American economy. Thousands of roads and bridges, airports, water systems, dams and levees, ports and urban transit systems form the infrastructure that sustains and unites America from coast to coast, connecting us to opportunities that drive a modern, competitive and dynamic economy. Infrastructure is also a critical catalyst for American innovation that powers our social and economic progress. For American households, high-quality, highly functioning infrastructure enables cleaner, safer, more reliable transportation, while reducing prices for everyday goods and improving quality of life. Streamlined commutes help employees and students get to work and school on time, and more importantly, get them home faster to be with their families.

For many decades, America set the global standard when it came to transformative infrastructure projects. However, over time, our national commitment to investing in infrastructure diminished, and the condition of many of our infrastructure systems eroded. From 2003 to 2017, public spending on infrastructure in the U.S. fell by a staggering eight percent.ⁱ As a business leader whose largest number of employees live and work in the U.S., it concerns me that our public investment lags behind our global competitors. The U.S. spends a smaller share of GDP on infrastructure than all but two G7 countries, Italy and Germany.ⁱⁱ Simply put: our country's investment in public infrastructure has failed to keep pace with the innovation and growth taking place around the world.

There is a widening gap between our growing infrastructure-related needs and our level of investment. This gap threatens the quality, reliability and safety of our national infrastructure. I would like to share some facts for this committee to consider:

- 44 percent of America's major roads are in poor or mediocre condition;ⁱⁱⁱ
- 23 percent of bridges in the national highway system are either structurally deficient or functionally obsolete;^{iv} and

- In 2016, there were 144,000 hours of lock shutdowns along U.S. waterways because of maintenance and unexpected delays.^v

From congested roads to crumbling bridges, America's outdated infrastructure systems slow daily commutes, hamper the flow of goods and services and increase costs for businesses and households, for example:

- Congestion on major urban roadways costs the average American commuter \$960 every year,^{vi} and
- American businesses nationwide incur nearly \$27 billion in additional transportation costs annually because of inadequate infrastructure.^{vii}

Action is long overdue. A problem of this scale and urgency requires bold leadership in Congress, to focus significant and sustained investment on restoring America's standard of infrastructure excellence.

America needs secure, reliable funding and financing models to move projects forward. At Jacobs, we can tell you from experience that the projects that are fully funded are the ones that tend to get completed ahead of schedule.

Shifting the Conversation from the Costs of Inaction to the Benefits of Action

While the costs of inaction have been well-documented, with many reports demonstrating the urgent need for investment, few have articulated and quantified the potential benefits of right-sizing U.S. investment in infrastructure. To lead the way toward a modern, dynamic and prosperous U.S. economy, we need a full understanding of the problems we must solve and what we stand to gain by doing so.

For instance, shoring up the Highway Trust Fund is a critical area of focus. A recent Eno Center for Transportation study notes that additional revenue would be needed just to keep the fund solvent for the next decade at current baseline spending levels—not addressing future needs.

In partnership with the Interindustry Forecasting Project at the University of Maryland, Business Roundtable recently completed a macroeconomic modeling study that quantifies the long-term economic benefits of right-sizing infrastructure investment. This report answers a critical question: *What are the economic dividends associated with not only returning our infrastructure to a "State of Good Repair", but also improving and expanding it to meet the demands of a growing economy?*

The study estimates the economic impacts of increased investment in surface transportation, aviation, water and wastewater, water resources and water transportation. Increased investment in these areas would return America's infrastructure to a state of good repair, expand capacity to meet future demand and fund innovative solutions to future infrastructure challenges. The investment would come from a mix of federal, state, local, and private sources.

Due both to the government's unique role in surface transportation funding and the significant need, surface transportation is the largest component of this investment package, comprising more than 60 percent of the total value dedicated to our nation's highways, roads and bridges.

Here are five key findings from the study:

1. Every \$1 Invested in Infrastructure Returns \$3.70 to the U.S. Economy

The study demonstrates that investing in infrastructure would pay for itself several times over. Every additional \$1 invested in infrastructure delivers roughly \$3.70 in additional economic growth over 20 years. Think about that for a moment; nearly a 4-to-1 ratio, representing an extraordinary return on investment, especially when considering that the benefits would continue to compound far beyond a two-decade time horizon.

2. An Investment in Infrastructure is an Investment in More Jobs and Higher Incomes for American Workers

The study highlights that investing in infrastructure would not only create *more* jobs, but *better* jobs for American workers. Specifically, it would create 1.1 million additional new jobs over the next decade, with increasing wages over the long term. In fact, the average American household would gain an additional \$1,400 in disposable income every year for 20 years. These benefits are tangible, meaningful and long-term.

3. An Investment in Infrastructure Would Spur Economic Growth and Private Investment

Investing in infrastructure would also amplify growth in the overall economy. Such an investment would boost real gross domestic product (GDP) by \$5.9 trillion over 20 years. Importantly, extra infrastructure spending would also catalyze additional private investment. Building modernized and expanded infrastructure systems would jumpstart U.S. business productivity, spurring \$1.9 trillion in additional investment by private businesses over 20 years derived from fewer delays, lower unnecessary costs and improved efficiency.

4. An Investment in Infrastructure Would Benefit All 50 States and All Corners of the Economy

Based on our analysis, investing in infrastructure would deliver benefits for all 50 states, from Wyoming to Delaware, by boosting productivity in every corner of the country. Every single state would experience positive impacts on employment, household incomes, and economic growth.

This investment would also boost productivity and create broad-based benefits across virtually every sector of the economy, from farming and mining to manufacturing and insurance. Intuitively, significant benefits would occur in sectors directly associated with our nation's highways and surface transportation systems, but the gains in productivity would also translate into broad-based growth for American businesses.

5. An Investment in Infrastructure is an Investment in the Future

The key benefit of infrastructure investment is the improved productivity that comes from better roads, deeper ports, increasingly efficient air travel and other structural enhancements. Compounded over time, these benefits would drive meaningful and sustained economic growth. In effect, improved infrastructure tightens the gears of the U.S. economy.

More than anything, an investment in infrastructure is an investment in the future of the U.S. While there are many ways to create jobs and stimulate the economy in the short run, the benefits typically fade over time. The enduring benefit of infrastructure investment is not only that it provides clear and tangible returns in community development, but that it also sets off a ripple effect attracting additional, local investments in commercial, residential and educational hubs connected by multimodal transportation networks. This isn't just about delivering benefits in the short term. This is about reinvesting in the foundation of our economy to be more competitive for the foreseeable future.

Let's take another example from my own company's experience, Jacobs was part of a team that delivered two new bridges over the Ohio River in Louisville in a very short period of time. The East End Crossing closed a gap on the 265/841 beltway and the Downtown Crossing doubled the capacity of the existing bridges, while relieving traffic in downtown Louisville. The net effect of the \$1.5 billion project on both Jeffersonville Indiana and Louisville Kentucky in terms of economic impact has been significant, proven by the expansion of the Port of Indiana and by the increased distribution speed for UPS from its Louisville base. Additional long-term economic growth will continue in both Indiana and Kentucky as a result of the now free-flowing North/South connections for decades to come.

Streamlining Permitting is One Key to Success

By setting a high priority on the nation's transportation, water, and energy infrastructure needs and revising existing policy to better and more quickly enable project implementation, available funds can be leveraged to accelerate infrastructure development and, as a result, economic growth. Although the Business Roundtable study focused on the benefits of investment and did not examine the effects of regulatory reform, the CEOs of Business Roundtable know from first-hand experience that regulatory barriers can increase project costs and delay project delivery, ultimately holding back the economic benefits from investment. While regulatory reform holds promise for streamlining delivery, best practices such as disciplined project management, integrated delivery, proactive communications between stakeholders, leveraging new tools and technology, and developing creative funding packages are all necessary to fully realize and complement the benefits of streamlined regulatory policies and procedures.

One example of better, faster results stemming from a streamlined process is the Elgin-O'Hare West Bypass project in Illinois. This \$3 billion project near Chicago O'Hare International Airport involves construction of more efficiently aligned highway segments that will accommodate transit as well as bike and pedestrian facilities while maintaining compatibility with the O'Hare Modernization Program. Jacobs delivered environmental studies and permits for the Illinois DOT and the Illinois Tollway following an innovative and integrated transportation, environmental, and financial planning process tailored to clearly define the project and position it for implementation.

A key to success and acceleration of the environmental and permitting process was early, ongoing coordination with regulatory agencies – and the commitment of those agencies to stay involved throughout the process. Continuous and collaborative agency involvement ensured a clear understanding of the environmental issues by all parties, facilitated timely development of appropriate solutions, shortened interim review times, and ultimately resulted in a Record of Decision months ahead of schedule – all while maintaining the integrity and rigor of the environmental process. The ultimate benefit is increased productivity through a more efficient local transportation system.

One more example I would like to highlight is the Colorado Department of Transportation's I-25 Gap project to expand an 18-mile, rural section of I-25 to connect Colorado's two largest cities and employment centers – Denver and Colorado Springs – and improve travel time reliability, driver safety, and incident management through one of Colorado's most important highway stretches.

The \$350 million project deployed innovations to accelerate delivery by using many Federal Highway Administration initiatives from permitting reforms included in the FAST Act, and recent implementation of these reforms and other programs by the previous and current administrations. The result was an unprecedented delivery schedule: completing the long-range planning process through NEPA to the start of construction in less than 2 years – and realizing the resulting safety and economic benefit of improved connectivity between Colorado's business centers sooner.

Based on the benefits of these examples and many more, Business Roundtable supports policies that further streamline the review and permitting process for projects to keep development costs down and accelerate project delivery while maintaining environmental stewardship. We support the Administration's One Federal Decision policy and encourage you to codify the two-year deadline for the federal government to reach a decision on a given proposed infrastructure project.

Charting a Path Forward

The CEO members of Business Roundtable can attest to the urgency and necessity of robust infrastructure investment, as well as the importance of a bold plan that reimagines and rebuilds America's infrastructure for the 21st century.

At Jacobs, we are proving the value of smart technologies, digital intelligence and data analytics to conceive and deliver more scalable, efficient infrastructure systems across different modes of transportation, including connected vehicle systems, and solutions that draw from various data platforms—from highway and transit systems to cell phones—to mobilize transport for people and goods within and between cities.

In fact, Jacobs is working with the Los Angeles County Metropolitan Transportation Authority to pilot connected vehicle technologies that would reduce traffic and air congestion along an 18-mile stretch of the I-710 South Corridor which is crucial to international trade. Jacobs is also partnering with Florida's Turnpike Enterprise and Florida Polytechnic University to create an approximately \$160 million test facility for driverless vehicles on a 475-acre site where we can simulate conditions like rain, fog and smoke.

In conclusion, the need for action on our nation's infrastructure is clear, and the potential benefits are profound and long-lasting. Business Roundtable is committed to seizing this window of opportunity to unlock the long-term benefits of infrastructure. We stand ready to work with the members of this committee to advance policies that will modernize U.S. infrastructure to support economic growth and expand opportunities for all Americans.

Thank you, Mr. Chairman and Members of the Committee for the opportunity to testify. I look forward to your questions.

Appendix: About the “Delivering for America” infrastructure modeling study

The full report, including assumptions, detailed national and state-level results, and the detailed policy scenario can be viewed online at: brt.org/delivering-for-america.

Business Roundtable partnered with the University of Maryland Inforum modeling group to conduct a macroeconomic modeling study of the impact of increasing infrastructure investment on the U.S. economy. The model is a fully dynamic, general-equilibrium model of the U.S. economy that captures the impacts and feedback loops of increased infrastructure investment across all sectors of the economy. The policy scenario, which specifies spending amounts by infrastructure system and funding source, sector-specific productivity estimates associated with improved infrastructure served as the core inputs to the model.

ⁱ Congressional Budget Office, “Public Spending on Transportation and Water Infrastructure, 1956-2017”, October 2018, p. 3.

ⁱⁱ Congressional Research Service, “Economic Impact of Infrastructure Investment,” January 2018, p. 8.

ⁱⁱⁱ TRIP, “Key Facts about America’s Surface Transportation System and Federal Funding,” May 2017, p. 2.

^{iv} U.S. Department of Transportation, Bureau of Transportation Statistics, “Transportation Statistics Annual Report 2017,” 2017, p. 1-6.

^v U.S. Department of Transportation, Bureau of Transportation Statistics, “Transportation Statistics Annual Report 2017,” 2017, p. 4-1.

^{vi} Texas A&M Transportation Institute, INRIX, “2015 Urban Mobility Scorecard,” August 2015, p. 5.

^{vii} The White House, “An Economic Analysis of Transportation Infrastructure Investment,” July 2014, p. 2.



Steve Demetriou
Chair & CEO

May 29, 2019

The Honorable John Barrasso
Chairman
Senate Committee on Environment
and Public Works
410 Dirksen Senate Office Building
Washington, DC 20510

The Honorable Tom Carper
Ranking Member
Senate Committee on Environment
and Public Works
410 Dirksen Senate Office Building
Washington, DC 20510

Dear Chairman Barrasso and Ranking Member Carper:

Thank you for the opportunity to testify before the Senate Committee on Environment and Public Works on March 6, 2019. It was an honor to do so.

I am writing in response to your letter of May 15, 2019 regarding the Senators' follow-up questions. I have addressed each question below. Please do not hesitate to reach out to me with additional questions.

Answers to Questions from Senator Whitehouse:

Question 1. Innovative Materials: *The National Academies of Sciences recently finalized a report titled, "Performance of Bridges That Received Funding under the Innovative Bridge Research and Construction Program."*

The report, which was included at my direction in the FAST Act, evaluated projects funded under the Innovative Bridge Research and Construction Program. This program provided grants between 1999 to 2005 but has since been defunded. The Academies' report found that using advanced materials and technologies can reduce construction costs, construction time, and traffic congestion. It also found that structures using advanced materials are more resilient to natural disasters. The report recommends that Congress reestablish grant programs that would fund projects using innovative materials.

a. Do you agree that any infrastructure bill should include provisions that will encourage the use of innovative materials that are more durable and resistant to corrosion than traditional materials?

b. Do you agree that Congress should follow the Academies' recommendation and provide grant funding for projects that use innovative materials?

My response: At Jacobs we are always looking for innovative methods and materials to help provide cost-effective and sustainable infrastructure for our public and private-sector clients. In fact, Jacobs helped to lead a study for the American Association of State Highway and Transportation Officials (AASHTO) on use of innovative materials called the Strategic Highway Research Program 2, or "SHRP2."

While Jacobs would need to review specific legislative language, we would generally support a provision in a surface transportation reauthorization that would increase research funding at the

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federal level and encourage the use of innovative materials. We firmly believe in solutions that lead towards additional research and implementation, but do not restrict our engineers, planners and designers to any one pre-determined material. We would also generally agree with the recommendation that sufficient federal grant funding would be beneficial to those projects using innovative materials that are more durable and corrosion resistant.

Question 2. Climate Preparedness: *Rhode Island's Coastal Resources Management Council is planning for upwards of nine feet of sea level rise by 2100. To prepare for this much water overtaking our shores, we need to protect evacuation routes from flooding, reinforce bridges that are exposed to corrosive saltwater and storms, and consider moving or elevating coastal roadways. These improvements are essential if my state and others along the coasts have any chance of surviving the changes coming our way over the next 50 or 100 years.*

These resiliency improvements will also go a long way in bolstering the coastal real estate market, which according to the First Street foundation, has already seen \$15.8 billion in lost home value due to sea level rise and flooding in the 15 East Coast states and Mississippi and Alabama along the Gulf.

- a. How should climate change considerations and sea level rise projections be incorporated in the local, state, and federal transportation planning processes?*
- b. Do you agree that it is irresponsible to ignore this loss in value to our coastal assets as we harden our infrastructure for sea-level rise?*

My response:

We understand that climate change continues to intensify the challenges facing critical infrastructure around the world and we support local, state and federal policymakers addressing these issues through the planning processes in a way that drives innovation and options, without restricting which options remain open to planners, designers and engineers.

Further, Jacobs believes that federal policymakers should strive towards increasing the utilization of renewable energy sources, such as wind and solar power. As a leading company in designing renewable energy solutions for both public and private sector clients, Jacobs understands that the solution can and should benefit both the environment and the American economy. The US has advantages that we can capitalize on to further develop a diverse portfolio of options for communities in every part of the country. We believe the Congress can work with the engineering industry and other critical sectors to mitigate climate change and drive a greener economy. At Jacobs, we pride ourselves on developing solutions to evolving complex problems like coastal resiliency. For example, our work includes managing the City of Miami Beach's Integrated Water Management Plan, which battles sea level rise, as well as our work as the Program Manager for the estimated \$5 billion San Francisco Seawall Program to address the City's vulnerability to increased sea level rise, seismic risk and more frequent storm events.

Question 3. Electric Vehicle Corridors: *According to Inside EVs, sales for electric vehicles increased by 81% in 2018, and sales for electric vehicles is predicted to continue to grow at a rapid pace. As you know, in 2015 Congress passed legislation as part of the FAST Act to establish a national alternative fuels corridor program, so drivers have a better understanding of where to find alternative fuel charging station and refueling stations. The agency you would head is now in the process of implementing that legislation and attempting to establish a national network of alternative fueling and charging infrastructure along national highway system corridors.*

a. Beyond the work that USDOT is already doing in this space, what else can the agency do to stimulate deployment of electric vehicle infrastructure?

b. What can USDOT do to reduce regulatory roadblocks to increase the nation's electric vehicle infrastructure?

c. What can Congress do in the next highway bill to continue to expand our nation's electric vehicle infrastructure?

My response: According to the US Department of Energy, the sale of plug-in electric vehicles in the U.S. has quadrupled between 2012 and 2017. It clearly shows no sign of abating and our transportation clients, particularly state departments of transportation, must grapple with the changing needs of the driving public and the ensuing changes to their asset management plans.

This changing need for electric vehicles will unquestionably drive an increase in the accompanying charging infrastructure. Because the question for policymakers is how to pay for this new charging infrastructure when traditional needs are not receding, the USDOT should look to funding and financing solutions. We suggest a full review of federal and state regulatory roadblocks preventing electric charging station public-private partnerships. There are revenue opportunities that should be explored; this would allow private funding to deliver many of the necessary charging stations while more of the federal taxpayer dollars continue to be spent on high-priority freight corridors, major bridge projects, urban transit, and projects of national significance.

As you know, there is a desperate need for revenue at the federal level (the end of the FAST Act will produce a \$176 billion Highway Trust Fund shortfall) and it is critical that electric vehicles pay their fair share. It is therefore important that a portion of revenues gained from charging stations are deposited into the Highway Trust Fund. We know this is not the path to solvency on its own, but instead one small piece of the puzzle that will create a balanced and just "user pays" system.

In addition, regarding question 3c we believe that flexibility is crucial; giving local stakeholders the ability to make the decisions in their long-term plans is an important consideration for federal policymakers.

Question 4. Bicycle and Pedestrian Safety: *I continue to be concerned by our nation's rate of bicycle and pedestrian deaths, which now make up more than 18% of all traffic fatalities and are at their highest level since 1990. While we are making progress in improving transportation safety overall, we are unfortunately heading in the wrong direction for people walking and biking. The Governors Highway Safety Association found that an estimated 50 percent of pedestrian deaths occur on state or US highways and interstates. Congress has attempted to prioritize this issue for state departments of transportation by requiring new safety goals for people walking and biking.*

a. How should Congress address bicycle and pedestrian safety in the next highway authorization?

b. Which programs in the FAST Act have been the most beneficial for bicycle and pedestrian safety?

My response: Jacobs knows that safety is everyone's responsibility; we all have a role in keeping pedestrians and bicyclists safe on our roadways. A strong commitment to safety is a foundational element of Jacobs' culture. We believe the wellbeing of our people is fundamental to our success and we are focused on consistently delivering an injury-free environment for every employee and those around us.

Jacobs strongly supports federal policymakers addressing these projects and programs in the next surface transportation authorization in a way that provides increased funding options for state departments of transportation, but also while maintaining maximum flexibility.

At Jacobs, our transportation safety engineers and designers have worked on pedestrian and bicycle projects around the nation. Just a few miles from the US Capitol Building is the transformative Anacostia Waterfront Initiative, a series of projects that modernized DC's waterfront. We proudly served as the Program Manager on this effort, which included 15 major project components, about half of which contained major bike and pedestrian safety upgrades. While safety is always the biggest driver, we also know that bike and pedestrian projects also help to connect local economies. This was the case on the I-270 North Corridor project, for which the Missouri Department of Transportation hired us to create safer access for citizens on a busy urban bridge, but which also allowed for bifurcated communities to connect and thrive.

Again, I appreciated the opportunity to appear before the Committee, and I look forward to working with you as the Committee and the Senate address America's pressing infrastructure needs.

Sincerely,



Steve Demetriou
Chair and Chief Executive Officer
Jacobs

Senator BARRASSO. Thank you so very much for your testimony.
Mr. REPLOGLE.

STATEMENT OF MICHAEL REPLOGLE, DEPUTY COMMISSIONER FOR POLICY, NEW YORK CITY DEPARTMENT OF TRANSPORTATION

Mr. REPLOGLE. Good morning, Chairman Barrasso, Ranking Member Carper, and members of the committee.

On behalf of Mayor Bill de Blasio and DOT Commissioner Polly Trottenberg, thank you for inviting me here to share our perspective on how Federal transportation investment could better support sustainable development across America drawing lessons from New York's experience.

We urge Congress to boost Federal funding for transportation infrastructure and to increase public transportation capital investment grants while ensuring competitive grant programs like BUILD are not largely directed away from urban areas. We urge support for new flexible funding for safety initiatives, for the redesign of streets to accommodate multiple travel options, and to safeguard transportation assets against extreme weather.

New York has been a U.S. lab for many of these approaches. Our officials realized 40 years ago that we could not solve congestion or support economic growth by continuing to expand New York City highways.

Since then, we have focused on improving highway operations, maintenance, management and safety, improving subways and commuter rail and investing in strategic transit expansions. This was not only smart economic policy. By relying on multimodal systems, we also slashed traffic fatalities, air pollution and greenhouse gas emissions.

Key to New York's success has been a focus on making it more attractive to walk, bike and take public transportation. We have begun to cut excessive traffic speeds, enhance enforcement and strengthen safety ethics. This has led to remarkable accomplishments other communities could learn from.

Since 2013, U.S. pedestrian deaths are up 30 percent and overall traffic deaths are up 13 percent. In New York City, on the other hand, we have cut both of these by more than one-third to the lowest levels in a century.

My testimony outlines multiple steps Congress should take to improve traffic safety, including allocating funds directly to local governments and metropolitan planning organizations for traffic safety activities.

Turning to climate change, the transportation sector's carbon footprint is substantial and growing, over 28 percent of total U.S. greenhouse gas emissions. New York City recognizes global climate change as an existential threat and is taking action by cutting emissions.

The City is investing over \$10 million in fast charging hubs. We are expanding our fleet of 1,300 electric municipal vehicles. We are partnering with utilities and the tech industry to develop solutions to take electric vehicle charging to scale.

Congress should take a number of steps to address climate change. Halt the phase-out of Federal tax credits that incentivize

the purchase of electric vehicles. Support smart electric vehicle charging infrastructure. Ensure that Federal, State and local infrastructure investments are designed and evaluated to take account of the latest anticipated forecasts for sea level rise, rainfall and flooding. Restore and strengthen FHWA's recently rescinded greenhouse gas rule that was designed to support State and local cooperation on climate mitigation plans to avoid wasting taxpayer dollars.

Last, I want to address project delivery. While Federal support for our investments is essential, federally funded transportation projects do often take longer to complete due to requirements administered by multiple agencies under dozens of statutes.

Expedited delivery need not and should not undermine important environmental safeguards and protections. A good first step would be to enhance local authority by increasing Federal funding directly available to cities.

FHWA should adopt a direct aid model that resembles the FTA process by granting self certification and delegation of design authority directly to localities; streamline permitting and reviews by developing concurrent permit processing guidelines; require States and large localities to develop programmatic agreements between relevant State, Federal and local resource and transportation agencies to cover routine permitting for common activities with triggers for more in-depth review where warranted.

While I have highlighted a number of policy ideas just now, my written testimony offers additional details on the initiatives mentioned here today.

In conclusion, this Congress has an exciting opportunity to rethink how the Federal Government supports the massive infrastructure needs of cities and other communities across the Country. I appreciate the opportunity to speak with you today regarding New York City's views and I am happy to answer any questions.

Thank you.

[The prepared statement of Mr. Replogle follows:]

TESTIMONY OF MICHAEL REPLOGLE
DEPUTY COMMISSIONER FOR POLICY,
NEW YORK CITY DEPARTMENT OF TRANSPORTATION
BEFORE THE SENATE COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS
ON INFRASTRUCTURE INVESTMENT
MARCH 6, 2019

New York City is the nation's largest and densest city, with a growing population of 8.6 million, within a region of 25 million accounting for 8 percent of U.S. GDP. The New York City Department of Transportation has an annual budget of \$3.5 billion and nearly 5,500 employees, larger than most other U.S. transportation agencies.

We are responsible for the operation and maintenance of most of the City's surface transportation network, including 6,000 miles of urban roadways, 111 miles of bus lanes, 12,000 miles of sidewalks, 13,000 signalized intersections, and 800 bridges and tunnels, many well over 100 years old. We operate the Staten Island Ferry around the clock. We are growing our network of 1,200 miles of bike lanes and expanding the Western Hemisphere's largest bike-sharing system from 12,000 to 40,000 bikes.

New York City has done some remarkable things in recent years. While U.S. road traffic deaths are up 13 percent since 2013, we've cut these by 33 percent, the lowest since 1910. Since 2013, pedestrian deaths are up 30 percent nationwide and down 38 percent in our City. Hundreds of people are alive today and tens of thousands are uninjured by road crashes thanks to New York City's Vision Zero program, which can be adapted nearly everywhere.

Since 1980, New York City added 1.5 million residents -- roughly the population of Phoenix - and 1 million jobs without highway system expansion. Instead, we grew the share of trips by sustainable travel modes -- walking, cycling, and public transportation - from three out of five trips in the mid-1990s to two-thirds today. This was smart economic policy that left us with a robust growing economy, the envy of many. But it also has helped us to significantly reduce traffic fatalities, air pollution, and greenhouse gas (GHG) emissions.

Despite our size, we share many common challenges with other major cities. We have a shared interest in ensuring federal infrastructure policy enhances local control and fosters opportunities to advance urban mobility, safety, asset management, environmental sustainability, and resiliency. And we join with most cities across America in imploring Congress to take urgent actions to address the growing crises of climate change and income inequality, which sound transportation policy and investments can help address.

I want to talk today about how federal transportation and environmental policy could better support sustainable urban and metropolitan development across America and draw lessons from New York City's experience, focusing on five key areas:

- Federal transportation investments and policies that most often yield net positive long-term economic, social, and environmental benefits;
- Steps to reduce the terrible death toll on America's streets and highways;
- How federal transportation policy can ensure state and local governments provide information on greenhouse gas (GHG) emissions and mitigation options;
- What steps are needed to streamline project delivery so urgent sustainability challenges can be addressed in the most cost-effective and expeditious manner.

I hope hearing about the experience of New York City will prove useful as the Senate deliberates on how best to adjust federal policy and funding opportunities and incentives to better support sound infrastructure policy and investment decisions advancing sustainable economic and social development.

1. Ensuring Infrastructure Legislation Boosts America's Metropolitan Economies

We urge Congress to increase federal funding for transportation infrastructure. There is ample evidence of long-term U.S. underinvestment in many elements of the transportation system. But it is vitally important for Congress to also ensure that increased transportation spending is directed at supporting productive long-term investment and system management. Congress needs to ensure that adequate funding flows to the complex intermodal systems that make America's metropolitan areas successful economic engines for the nation.

Specifically, we urge Congress to increase public transportation Capital Investment Grants, and take steps to ensure that competitive grant programs like BUILD are not largely directed away from urban areas. And rather than allocating more funding solely to existing formula programs, we urge new support and flexible funding for state and local traffic safety initiatives, for the redesign of our streets to accommodate multiple travel options, and for efforts to safeguard transportation assets against extreme weather.

Congress should consider using eligibilities and match requirements to incentivize adoption of transportation plans, programs, and projects designed to reduce GHG emissions, lower pedestrian and bicyclist fatalities, and improve connectivity and access for low-income communities. Federal-aid highway and transit funding should be made more flexible when used as part of an adopted plan with measurable targets and benchmarks related to these performance elements. States that fail to meet certain benchmarks might be required to reprioritize projects.

Congress should ensure transportation legislation promotes better consideration by state and local governments and regional planning bodies of the triple bottom line economic, social and environmental benefits and costs of transportation plans, programs, and investments. Funding programs, incentives, and requirements should be aligned to foster not just large projects, but also to expedite consideration of investment programs that improve safety of incomplete streets and highways that do not now include needed safe and efficient accommodation of buses, pedestrians, and cyclists in built-up areas. For us, infrastructure investment should strive to move people and goods most safely and efficiently, rather than focusing narrowly on moving vehicles as quickly as possible.

It is well established that infrastructure investment, including transportation infrastructure, is a critical economic driver and usually reaps significant dividends. Moody's estimated that, as of the beginning of 2015, after a number of years of economic recovery, an additional dollar of infrastructure investment would increase GDP by \$0.86.¹ Research by the International Monetary Fund in various advanced economies found an increase of 1 percentage

¹ The Center on Budget and Policy Priorities, "It's Time for States to Invest in Infrastructure," <https://www.cbpp.org/research/state-budget-and-tax/its-time-for-states-to-invest-in-infrastructure>

point of GDP in investment spending on quality projects raises the level of output by about 0.4 percent in the same year and by 1.5 percent four years after the increase.²

Yet, not all transportation investments yield similar benefits. Various studies have shown that transportation state-of-good repair and operational modernization, along with improved system management often generate more positive cost-benefit outputs compared to major capacity expansion investments. It is important to consider whether investments will unlock significant strategic opportunities for more sustainable transit-oriented regional economic and community development and shifts towards more sustainable patterns of mobility.

Will investments help reduce vehicle miles of travel per capita, lower GHG emissions, and improve safety? Will they increase equity of access to jobs, education, and other opportunities for residents of low-income communities? Or will they lock-in unsustainable mobility patterns for years to come or become stranded investments in a world where climate mitigation and adaptation are increasingly imperative? These are questions that should be considered in the transportation planning and programming process by various levels of government and federal policy should encourage this.

New York City has been a U.S. laboratory for many of these approaches. City and State officials realized 40 years ago that we could not solve congestion or support economic growth by continuing to expand New York City highways. Since then, we have focused mostly on improving the operations, maintenance, management, and safety of highways, improving maintenance and operations of subways and commuter rail, and making a few important strategic transit system expansions, such as the recently opened Second Avenue Subway and the 7 Train extension to support the Hudson Yards redevelopment. This was not only smart economic policy. It also helped New York City to significantly reduce traffic fatalities, air pollution, and greenhouse gas (GHG) emissions.

New York City, with its thriving economy, continues to attract more visitors, workers, and residents than ever before. Last year we saw 62 million tourist visits alone, and we are also experiencing a citywide construction boom. We've seen many more for-hire vehicles cruising

² International Monetary Fund, "Is it time for an Infrastructure Push: The Macroeconomic Effects of Public Investment," *World Economic Outlook*, Oct 2014, <https://www.imf.org/en/News/Articles/2015/09/28/04/53/sores093014a>

without passengers in our most congested areas. Home delivery services are adding more freight to our roadways than ever before. Our subways, streets, and sidewalks are overflowing, and NYC DOT is challenged with trying to make all these moving components operate safely and harmoniously in cooperation with the MTA, which runs our subway and bus system with over 8 million trips per day.

New York City and other metropolitan regions across America need greater federal investment to support modernization of complex multimodal transportation networks, especially for costly projects of regional significance, such as the Gateway tunnel under the Hudson River and the Port Authority Bus Terminal Reconstruction, which underpin major elements of the northeastern United States' economy.

2. Tackling Urban Congestion: FHV's, Subways, Buses, Bikes

One of the challenges facing city, metropolitan, state, and federal transportation policy makers is the rapid transformation of surface transportation technology. As information and communication systems are increasingly integrated into transportation, new mobility modes, including bike sharing, e-scooter sharing, car-sharing, and app-based For-Hire Vehicles (FHV's, also sometimes known as Transportation Network Providers, or TNCs) are rapidly taking on a larger role in urban transport.

Growth of FHV services has been explosive. According to an analysis by Bruce Schaller, a former NYC DOT and TLC official, FHV's transported 2.6 billion passengers in 2017, a 37 percent increase from 1.90 billion in 2016. Combined U.S. FHV and taxi ridership has likely surpassed local bus ridership in the U.S. in the past several months. Surveys show 60 percent of TNC users in large, dense cities would have taken public transportation, walked, biked or not made the trip if TNCs had not been available for the trip, while 40 percent would have used a taxi or their own vehicle.

While app-based FHV's contribute valuable new mobility options and expand access for their users, unless managed, recent research shows these services may threaten sustainable urban transportation. They appear to be having a particularly adverse impact on bus travel speeds. NYC DOT and the NYC Taxi and Limousine Commission (TLC) are working together to develop

more effective long-term strategies to reduce inefficiencies in the FHV sector that spur core congestion.

Federal policy should consider how FHVs and other kinds of microtransit might best become valuable extensions of – but not replacements for – fixed route public transit. This will require greater real-time and near-real-time data sharing between the private and public sector and increased local authority to regulate FHVs, as New York City is starting to do. To help cities effectively address the challenges of new mobility innovations, Congress should explore ways to encourage expanded collaborations between cities, states, and transportation mobility providers for bi-directional exchange of mobility data with appropriate safeguards for personally identifiable information and business confidentiality. Cities, as well as many members of the National Association of City Transportation Officials (NACTO), are working to develop such cooperation that could enable improved safety, reduced congestion, and more effective transportation planning and management for optimal system performance.

A key challenge for New York City is the financing of transport system modernization and expansion, which will require continued partnership with the federal government. New York City's goal is for four out of five trips to be made by these sustainable modes by 2050.³ To accomplish this, we need tens of billions of investment for local and regional public transportation, as well as countless improvements to sidewalks, bike paths, and pedestrian plazas, and sound policies to manage parking, curb and road space, with more priority for buses.

While new mobility modes get headline attention, subways still carry over 5.4 million passengers on the average weekday, 60 percent more than 30 years ago; buses still carry about 2.2 million passengers a day in New York City.⁴ In many corridors across the City, buses account for the majority of people moved but occupy a tiny fraction of the road space and are caught up in the congestion caused by single occupant vehicles that carry a minority of travelers. In response, we have continued to ramp up dedicated street space for bus services run by our partners at the MTA.

At the beginning of this year, the Mayor announced a new Bus Action Plan, along with an ambitious goal to improve average bus speeds by 25 percent, from 7.4 miles per hour to 9.0

³ New York City Mayor's Office, *New York City's Roadmap to 80x50*, 2016.

<https://www1.nyc.gov/site/sustainability/codes/80x50.page>

⁴ <http://web.mta.info/nyct/facts/ridership/>

miles per hour by the end of 2020. To achieve this increase, we will ramp up our pace of bus lane installation, introduce protected bus lanes, expand Transit Signal Priority to reduce the time our buses spend stopped at red lights, increase enforcement, and support the bus network with street redesigns. The FTA has supported some of this work previously with Capital Investment Grants, and we appreciate Congress intervening to preserve that program in the face of proposed cuts, and pressuring the current administration to execute grant agreements in a timely manner.

New Yorkers are also increasingly opting to navigate the City by bicycle. Bicycling is growing at faster rate than any other mode of transit, with annual growth of over eight percent in Midtown and nine percent on the East River Bridges. Daily cycling trips increased by 156 percent between 2006 and 2016. Bike projects are an important and low-cost safety improvement for all street users. On corridors with bicycle lanes, crashes involving pedestrians are 40 percent less deadly than other streets.

A significant amount of cycling occurs via the City's popular bike share program, Citi Bike. Since its launch in 2013, members have taken over 73 million trips. Currently, the system comprises 12,000 bikes at 750 stations and has over 150,000 active annual members. New York City plans to expand this system to 40,000 bikes by 2022. We are also pilot testing dockless shared bikes in several outer borough communities.

Congress can help support this essential form of mass transportation by making bike share memberships eligible for the same pretax benefits currently afforded to other modes of public transportation. Congress might also consider making bike share programs eligible for TIFIA financing.

3. Advancing Vision Zero: Ending Road Traffic Fatalities

A key element of New York's success at expanding use of sustainable transportation has been efforts to make it more attractive to walk, bike, and take public transportation. Since 2013, New York City has experienced a 33 percent decline in traffic fatalities, led by a 38 percent decline in pedestrian fatalities. In the same time period, traffic fatalities have risen 13 percent

across the United States as a whole, to over 37,000 per year.⁵ U.S. pedestrian fatalities in 2018 rose to 6,227, the highest since 1990.⁶ While total highway fatalities have fallen slightly in the past decade, pedestrian deaths have risen 35 percent.⁷ Excess vehicle speeds, the more widespread use of very large SUVs, distracted driving, and an increase in pedestrian travel all play a role in the adverse national traffic safety trends.

New York's traffic safety success is the product of strong mayoral leadership, inter-agency cooperation, data-driven policy, targeted investment, and efforts to bring about cultural change. This experience is one that can be adapted to other communities across the U.S. and world.

New York City has unique status among large United States cities, as fewer than half of households here own a motor vehicle. High pedestrian volumes lead to high exposure to motor vehicles, and the doubling of cycling in the last decade has presented new challenges and opportunities for street engineering. New York City was then a natural fit for an initiative that emphasized the safety of vulnerable road users and confronted assumptions about the primacy of drivers on city streets.

To ensure the plans for Vision Zero were comprehensive as well as equitable, Mayor de Blasio and Transportation Commissioner Polly Trottenberg insisted on a data-driven community engagement plan to create Pedestrian Safety Action Plans designating priority areas, corridors, and intersections based on pedestrians killed or seriously injured. Local communities were engaged through workshops and online portals through which residents could provide input on places in their neighborhoods that felt unsafe.

The first wave of street engineering interventions under Vision Zero focused on these priority areas. They became the proving grounds for signal re-timings aligned with a newly-

⁵ Traffic Safety Facts: Early Estimate of Motor Vehicle Traffic Fatalities for the First Half (Jan-June) of 2018, USDOT National Highway Traffic Safety Administration, <https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812629>

⁶ Pedestrian Traffic Fatalities by State: 2018 Preliminary Data, Governor's Highway Safety Association, <https://www.ghsa.org/resources/Pedestrians19>

⁷ Governor's Highway Safety Association, *Pedestrian Traffic Fatalities by State: 2018 Preliminary Data*, [ghsa.org/resources/Pedestrians19](https://www.ghsa.org/resources/Pedestrians19)

enacted 25 mph (40 kph) city-wide speed limit, the installation of leading pedestrian intervals (LPIs) that give people walking across the street a head-start before turning vehicles, and the creation of street geometry changes like curb extensions. Thanks to these interventions, pedestrian deaths and serious injuries declined over 30 percent at priority locations. In addition, four major arterial roads in the outer boroughs were designated “Vision Zero Great Streets” and were intensively redesigned. One of the four, Queens Boulevard, for years was known as “the Boulevard of Death,” with 18 pedestrians killed there in 1997 alone. After the start of reconstruction, three years passed without a pedestrian fatality, and this once-forbidding artery now hosts a well-used bicycle lane.

Both citywide policies and targeted interventions where they are needed most have made Vision Zero relevant to all New Yorkers. These included, lowering the default speed limit, dramatically increased enforcement of traffic laws, and additional authorization from the State government to use automated speed enforcement cameras in 140 school zones during limited times tied to school opening and closing hours. Tellingly, approximately 85 percent of serious crashes happen at times and places where State law now prohibits cameras’ use. Where cameras do operate, speeding summonses have fallen over 60 percent.

New York City has committed US \$1.6 billion through 2021 to Vision Zero initiatives including a \$25 million TIGER grant. In 2018, the City DOT installed more than 20 miles of protected bicycle lanes, implemented left turn traffic calming interventions at 113 intersections, activated 873 leading pedestrian intervals (LPIs), and completed 139 distinct safety improvement projects.

Congress should consider a number of steps to improve traffic safety in future legislation. It should expand eligibility of highway funding to be flexed to traffic safety initiatives and adjust matching requirements, for example, if these are part of a transportation plan designed to meet Vision Zero benchmarks. Congress should consider allocating funds directly to local governments and metropolitan planning organizations for traffic safety activities. Congress should do more to advance road safety with funding and policy changes. For example, the current prohibition on the use of federal aid highway funds for speed cameras, one of the most effective safety tools used by New York City, should be removed. Design standards and

practices should be revised to facilitate lowering of speed limits in built up areas, rather than setting speed limits based on the 85th percentile speed of traffic on roads.

The development of highly automated vehicles (HAVs) presents both a challenge and an opportunity to advance Vision Zero. National legislation should require HAVs to be designed and programmed to comply with traffic laws, except where necessary for safe and effective operation, and could require that HAVs demonstrate capacity to reliably recognize and safely interact with cyclists and pedestrians. The European Union is mandating that all motor vehicles sold starting with model year 2022 must have new mandatory safety technologies, including Intelligent Speed Assistance (ISA), automated braking, and pedestrian and cyclist recognition systems.⁸ European research and pilot programs suggest that overridable ISA alone could cut road traffic deaths by 20 percent while also reducing greenhouse gas emissions.⁹

Congress should require NHTSA to develop similar rules for the U.S. motor vehicle marketplace. Congress should mandate that Federal Motor Vehicle Safety Standards are developed for HAVs before full scale deployment on American roads and streets. Congress should also require FMVSS to account for the safety of persons both inside and outside of a vehicle, especially in light of the alarming continuing rise of pedestrian and cyclist fatalities on America's streets and highways.

4. Climate Change

The transportation sector's carbon footprint is substantial and growing. Transportation directly accounts for about 28 percent of total U.S. greenhouse gas emissions (predominantly CO₂) and this does not include significant additional indirect emissions related to the extraction and refining of fuel, the manufacture of vehicles, and the maintenance of supporting infrastructure, which if counted together would make the total emissions related to transportation

⁸ Reid Carlton, "All New Cars To Have Speed Limiters Fitted, Rules European Parliament," *Forbes*, February 27, 2019, <https://www.forbes.com/sites/carltonreid/2019/02/27/all-new-cars-to-have-speed-limiters-fitted-rules-european-parliament/#1ab6f351d145>.

⁹ European Transport Safety Council, *In-vehicle technology vital to tackling speeding in Europe*, February 18, 2019, <https://etsc.eu/in-vehicle-technology-vital-to-tackling-speeding-in-europe/>

about 40 percent. About 83 percent of direct transportation emissions are from on-road vehicles.¹⁰

Total transportation sector emissions rose 29 percent from 1990 to 2005, driven largely by increased vehicle miles of travel in road transport. With continued improvements in vehicle efficiency, sector emissions fell 9.7 percent from their 2005 peak by 2015. In recent years, sector emissions have been increasing, due largely to increased passenger-vehicle VMT.¹¹

Decarbonization of the transportation sector cannot be accomplished by technology changes alone. There is broad expert agreement that electrification of surface transportation must be part of a comprehensive strategy to address the climate change challenge. Automation of cars, trucks, and buses will have uncertain impacts on greenhouse emissions, but many believe that such technologies are likely to boost emissions unless there is strong and effective road user pricing and traffic management that encourages shared mobility, walking, cycling, and transit.

Transportation greenhouse gases from on-road sources can be reduced by improving vehicle efficiency (such as motor vehicle fuel economy standards and incentives for purchase and use of more efficient vehicles); switching to lower carbon fuels (such as electricity produced from low carbon sources); reducing the distance traveled by motor vehicles (through better urban planning, by substituting telecommunications for travel, by smarter logistics and supply chains, and switching travel to higher occupancy modes of travel); improving vehicle and transportation system operations (such as eco-driving, traffic calming, advanced traffic management); and improved construction and maintenance and agency operations.

State and local governments have considerable capacity to influence each of these elements and to reduce transportation greenhouse gas pollution, with substantial emission reduction potential as detailed by several recent studies. The 2007 Urban Land Institute Study, *Growing Cooler*,¹² for which I was an adviser, estimated that adopting efficient land use

¹⁰ Federal Highway Administration, *A Performance-Based Approach to Addressing Greenhouse Gas Emissions through Transportation Planning*, 2013, https://www.fhwa.dot.gov/environment/sustainability/energy/publications/ghg_planning/ghg_planning.pdf (page v).

¹¹ Ashley Lawson and Fatima Maria Ahmad, *Decarbonizing U.S. Transportation*, Center for Climate and Energy Solutions, July 2018, <https://www.c2es.org/document/decarbonizing-u-s-transportation/>

¹² Ewing, et al., *Growing Cooler*, Urban Land Institute, 2007.

strategies for a portion of new development could slow Vehicle Miles of Travel (VMT) growth by 12-18 percent in metropolitan areas, or 10-14 percent across the U.S. by 2050. The study concluded that this level of reduction is achievable with land use changes alone, excluding complementary measures such as transportation pricing or major expansions of transit. The study calculated potential transportation CO₂ savings of up to 38 percent under a comprehensive set of policies. Because a large share of the housing and buildings accommodating employment in 2050 will be constructed in the next 30 years, there are considerable opportunities to shape the long-term carbon footprint of development and resulting travel patterns through better coordination of planning, smarter incentives, and consideration of impacts prior to investment or development approval. Federal transportation legislation and investment could help support such activities.

The 2009 study, *Moving Cooler*,¹³ for which I was also an adviser and which was sponsored by the U.S. Department of Transportation, U.S. Environmental Protection Agency, Shell Oil, the American Public Transportation Association, the Urban Land Institute, Natural Resources Defense Council, Environmental Defense Fund, Intelligent Transportation Society of America, and other groups, looked at four dozen transportation investment and management strategies for their potential to reduce CO₂ emissions between now and 2050, considering costs of implementation, vehicle operating cost savings, and equity impacts. The study analyzed these strategies in half a dozen different “bundles” assuming in each a different focus and different levels and paces of implementation.

Moving Cooler concluded that various combinations of transportation investments, management strategies, pricing, and smart growth policies could produce significant GHG emission reductions in the United States. With the addition of sound transportation pricing policies, reductions of a third or more in annual GHG emissions could be achieved by 2050. The findings from this 2009 study remain valid, though the urgency of efforts to achieve these goals has increased, commending more concerted national action than before. In most of the scenarios examined, vehicle operating cost savings alone soon exceeded implementation costs, suggesting the potential for large positive consumer benefits. Pay-as-you-drive automobile insurance and road user charging or carbon taxes were found to multiply the CO₂ reduction potential of other

¹³ *Moving Cooler*, *supra* note 3.

effective strategies, such as improved public transport, walking, cycling, smart growth, and smart traffic management. Investments in highway capacity expansion and bottleneck alleviation were found to be the least effective elements to be included in long-term CO₂ reduction strategies due to induced traffic effects, although they could be bundled with other strategies that collectively reduce GHGs.

Similar evaluations of the greenhouse gas reduction potential for various transportation strategies have been performed for various states, metropolitan areas, and regions. For example, the opportunities to reduce greenhouse gas emissions from transportation in the Northeast and Mid-Atlantic region were well documented in a 2015 report by the Georgetown Climate Center commissioned by the Transportation and Climate Initiative (TCI), which is made up of 11 northeast and mid-Atlantic states and the District of Columbia.¹⁴ This study found that existing federal and state policies (including fuel economy standards that the Trump Administration is seeking to rollback) are likely to cut greenhouse gas emissions by 29 percent by 2030 in the region from 2011 levels. The study considered additional strategies that are readily available to state and local governments and found these could lead to reductions of greenhouse gas emissions from transportation of 31 to 40 percent below 2011 emissions levels by 2030 while yielding large public health improvements.

Adopting some of these greenhouse gas emission reduction strategies can require clearing administrative and political hurdles. Developing effective and tailored strategies and the analytical rationale for them requires an assessment of current emission levels as well as targets for reducing them. In that context, the FHWA's greenhouse gas analysis and reporting requirements, which the Trump Administration has sought to rescind, would enable informed decision-making by state and local officials in the northeast and mid-Atlantic and across the United States.

New York City recognizes that global climate change poses an existential threat to its economic and social viability and is taking action. We witnessed some of the early impacts of climate change on the New York City region during Hurricane Sandy in 2012, suffering billions

¹⁴ Pacyniak, Gabe, Kathryn Zyla, Vicki Arroyo, Matthew Goetz, Christopher Porter, David Jackson, *Reducing Greenhouse Gas Emissions from Transportation: Opportunities in the Northeast and Mid-Atlantic*, November 2015, Georgetown Climate Center, Washington, DC.

of dollars in damage from a combination of storm surge and rising sea level. Even prior to Hurricane Sandy, New York City was committed to achieving an 80 percent reduction by 2050 and a 40 percent reduction by 2030 in CO₂ emissions relative to a 2005 baseline, including proportional reductions from the transportation sector.

New York City, with the lowest transportation CO₂ per capita of any major U.S. city, has continued to reduce its transportation sector CO₂ in recent years, even while growing to a record 8.5 million residents, 4.2 million jobs, and nearly 60 million annual tourist visits. Between 2010 and 2015, the City added more than 370,000 new residents, 500,000 new jobs, and 10 million more annual tourist visits, accommodating these through added use of public transportation, walking, and cycling, with lower car use.

By giving greater priority to walking, cycling, and public transportation and cutting our city-wide speed limit to 25 MPH, the City has helped to improve traffic safety and sharply reduce greenhouse gas emissions and air pollution that harm public health. For example, New York City has heavily invested in the public transportation network. From 1982 to 2011, the Metropolitan Transportation Authority funded \$129 billion (in 2017-adjusted dollars) for state of good repair, system upgrades, and expansion initiatives, with a majority of these funds coming from New York City and city residents.¹⁵

The City is also encouraging low- and zero-emission vehicles through municipal fleet policies and development of expanded opportunities for electric vehicle charging. The Mayor has committed the City to expanding access to electric vehicles at a rapid clip. As part of the Administration's target for 20 percent of the motor vehicle registrations in New York City to be electric by 2025, the City is investing \$10 million to develop fast charging hubs with up to 20 chargers per site.

In addition, the City is cleaning up its fleet of vehicles across all city agencies. The City has nearly 500 electric vehicle chargers serving a rapidly growing fleet of 1,300 electric municipal vehicles. We also have a 900,000-gallon pilot of renewable diesel launching this year.

¹⁵ The Road Back: A Historic Review of the MTA Capital Program. The Permanent Citizens Advisory Committee to the MTA. May 2012. <http://www.pcac.org/wp-content/uploads/2014/09/The-Road-Back.pdf> (page i; pdf page 3).

Renewable diesel is the product of fats and vegetable oils, meaning that it is yet another way that we are reducing our dependency on fossil fuels.

We are also partnering with sectors outside of government. The NYCx Climate Action Challenge called on the tech industry to develop solutions for scaling electric vehicle (EV) charging infrastructure and help accelerate adoption of EVs citywide. It is our position that now is the wrong time to phase out critical tax credits to incentivize the purchase of electric vehicles, and we urge Congress to ensure they are preserved going forward. We also urge increased federal investment in transportation infrastructure that supports electric vehicles nationwide.

Congress should step up with substantial new funding and economic incentives for states, regions, and local governments and the private sector to invest in greenhouse gas mitigation, including smart electric vehicle charging infrastructure for cars, trucks, and buses. This should include funding for interstate charging networks so that EV drivers can be confident of finding charging points for most journeys across America.

Additional federal funding and incentives should be made available to support electrification of public sector fleet vehicles, such as school buses and transit buses. These investments will require changes to streets, bus depots, electric grids, and other complex integrated systems. Congress has a role in supporting more effective intermodal transportation planning to enable this important energy and mobility transition.

And critically, with any new infrastructure funding, Congress should ensure that federal, state, and local infrastructure investments are designed and evaluated to take account of the latest anticipated forecasts for sea level rise, rainfall and flood maps, heat island impacts, and other empirical research that underpins effective resiliency planning. Super storms like Hurricane Sandy are expected to only grow in frequency, and that single event has left New York City with billions in required infrastructure spending. From the rehabilitation of a major subway line connecting Brooklyn and Manhattan to the need to completely replace train tubes connecting New Jersey and Manhattan, our region is a case study for the essential resiliency investment communities across the country will require. Within our agency, we are undertaking a massive capital project to improve the resiliency of the Staten Island Ferry. Federal leadership and funding will be critical to effective adaptation planning and investment across the U.S.

Similarly, New York City strongly opposes the Trump Administration's efforts to roll back adopted more stringent fuel economy standards adopted by California and many other states under the Clean Air Act. We count on those standards to help us achieve our environmental and public health goals.

Because the transportation sector is now the largest source of greenhouse gas emissions in the United States, the federal government needs to help ensure federal aid recipients are taking this growing threat seriously. Currently, the opposite is happening. The Federal Highway Administration recently moved to repeal a rule that established a carbon pollution performance measure for the first time. New York City recognizes the need to do more to reduce greenhouse gas emissions from transportation, in collaboration with other jurisdictions in our metropolitan region. Access to reliable information on regional greenhouse gas pollution from transportation will help the City, region, and States consider the effectiveness of strategies to monitor and mitigate greenhouse gas pollution over time. The greenhouse gas measure established by the FHWA on January 18, 2017, would provide this vital information, which is why New York City supported its adoption.

Without the measure, it will be harder for New York City and other states, regions, and local governments to ensure consistency in the methods by which transportation sector greenhouse gas emissions are evaluated from area to area and across different evaluation frameworks. Such consistency is crucial to successful development of strategies for reducing emissions from transportation systems, since they cross multiple political boundaries.

As a result, the cost and time involved in doing transportation sector greenhouse gas analysis will be higher due to lack of standardization of assumptions and reporting methods, and will inhibit consideration of these impacts in the transportation planning and decision-making process.

This, in turn, will hamper timely consideration and implementation by state and local governments of a wide array of measures that are available to reduce greenhouse gas emissions. Instead, some state and local governments will make ill-advised decisions to invest in transportation projects that will increase vehicle miles traveled, yielding greater greenhouse gas emissions and adverse climate change impacts.

Other current measures of performance monitoring, such as congestion management or air quality conformity analysis, do not provide adequate substitutes for analysis of greenhouse gases. As discussed above, a greenhouse gas measure would provide vital information about the level of greenhouse gas emissions from the transportation sector and the effectiveness of strategies aimed at reducing those emissions. Further, while some strategies that cut congestion, such as reducing VMT, will also cut greenhouse gases and air pollution, other congestion cutting strategies, such as widening roads, can lead to increased driving and therefore increased greenhouse gases and air pollution.

Congress should restore and strengthen the FHWA's now rescinded greenhouse gas measure. Congress needs to step in to ensure that all levels of government have the information needed to ensure at a minimum transparency about the greenhouse gas impacts of transportation sector investments and policies. New rules should require state and local transportation agencies to adopt and report on progress for greenhouse gas reduction strategies, setting measurable goals and benchmarks for performance. This is vital to increasing consistency and effectiveness across transportation systems in adopting such strategies, and helping reduce climate change and other air pollution.

Federal transportation law already requires that certain objectives be accomplished, including minimizing transportation-related fuel consumption and air pollution¹⁶, but these requirements have not been enforced by U.S. DOT rulemaking. To effectively accomplish those objectives requires timely availability of information about the effects of state and regional transportation plans and programs on greenhouse gas emissions, using comparable metrics and analysis methods across states and regions. The FHWA's now revoked greenhouse gas regulation would provide that vital information.

There is no sound policy reason to stop collecting this data. Maybe some fear what the numbers are telling us. But burying our heads in the sand does not change reality, and does nothing to help make smarter policy and investment choices. We have little to lose and nothing to fear from a data-based approach to policymaking. Across the federal government, there is an understandable desire to learn from data and avoid wasting taxpayer dollars.

¹⁶ 23 U.S.C 134(a)(1), 23 U.S.C 134(c)(1) and 23 U.S.C. 135(a)(1).

5. Project Delivery Reform

We appreciate this Committee's focus on expediting project delivery. While federal support for our investments is essential, it is often the case that federally funded transportation projects take longer to complete, due to planning, design-procurement and implementation requirements administered by multiple agencies under dozens of statutes. Importantly, expedited delivery does not have to and should not mean undermining important environmental safeguards and protections.

A good first step would be to enhance local authority by increasing the federal funding that is directly available to cities. Direct access to funds helps critical safety, accessibility, and state of good repair projects that are responsive to local needs to get in the ground faster, cheaper, and with fewer redundant reviews than funds channeled through states. Additionally, project reviews by multiple agencies add months, or even years to projects, often with little to no substantive change. Streamlining permitting and reviews by developing concurrent permit processing guidelines will help deliver projects more efficiently. Increased use of tiered environmental and plan reviews and programmatic agreements can facilitate better consideration of alternatives within consolidated planning processes. These changes will promote a consistent and predictable process that leads to better outcomes. Active transportation networks should be eligible to undergo a systemic streamlined environmental review process to better account for cumulative impacts and benefits.

FHWA should also adopt a direct aid model that resembles the FTA process by granting 'self-certification' and delegation of design authority directly to cities. FTA provides funding to its grantees and allows them to implement projects quickly based on local conditions without any additional FTA approvals, as long as grantees certify that they are meeting the Federal requirements. FTA conducts reviews of the grantees work every three years to ensure that requirements were met as certified. The existing FHWA process delegates some responsibilities to the State, but not all, creating duplicative levels of review by both State and FHWA at multiple stages of project delivery. This adds months or years to project timelines.

Moreover, USDOT could require States and large cities to develop programmatic agreements between relevant State, Federal, and local resource and transportation agencies. These agreements would cover routine permitting from the Coast Guard, Army Corps of

Engineers, Environmental Protection Agency (EPA) and State for common activities, such as bridge projects, restriping, and sea wall reconstruction, and road maintenance, development of new bus lanes, bicycle lanes, and signalization. This will allow these activities to bypass time-consuming special processing as long as the project activities follow mutually agreed upon procedures to minimize unnecessary adverse impacts through routine mitigation and impact avoidance. These agreements should identify triggers for more in-depth project review where warranted.

6. **Conclusion**

This Congress has an exciting opportunity to rethink how the federal government supports the massive infrastructure needs of cities and other communities across the country. I appreciate the opportunity to speak with you today regarding New York City's priorities and am happy to answer any questions.

Senate Committee on Environment and Public Works
Hearing entitled, “*The Economic Benefits of Highway Infrastructure Investment and Accelerated Project Delivery*”
March 6, 2019
Questions for the Record for Mr. Replogle

Senator Whitehouse:

1. **Innovative Materials:** The National Academies of Sciences recently finalized a report titled, “Performance of Bridges That Received Funding under the Innovative Bridge Research and Construction Program.”

The report, which was included at my direction in the FAST Act, evaluated projects funded under the Innovative Bridge Research and Construction Program. This program provided grants between 1999 to 2005, but has since been defunded. The Academies’ report found that using advanced materials and technologies can reduce construction costs, construction time, and traffic congestion. It also found that structures using advanced materials are more resilient to natural disasters. The report recommends that Congress reestablish grant programs that would fund projects using innovative materials.

- a. Do you agree that any infrastructure bill should include provisions that will encourage the use of innovative materials that are more durable and resistant to corrosion than traditional materials?
- b. Do you agree that Congress should follow the Academies’ recommendation and provide grant funding for projects that use innovative materials?

The City of New York (the City) benefitted directly from this important grant program. In 2013, the City was awarded approximately \$350,000 to collaborate with the City University of New York on corrosion resistance approaches for the Annandale Road Bridge in Staten Island.

New York City DOT owns, operates and maintains 793 bridges and tunnels throughout the City and has planned capital expenditures of over \$9 billion to maintain these facilities. The agency has attempted to use materials such as fiberglass-reinforced polymer on its projects where feasible and continues to explore other methods for preventing or delaying corrosion. The City strongly supports the inclusion of incentives for the use of innovative materials in federal infrastructure legislation, including appropriating grant funding.

2. **Climate Preparedness:** Rhode Island’s Coastal Resources Management Council is planning for upwards of nine feet of sea level rise by 2100. To prepare for this much water overtaking our shores, we need to protect evacuation routes from flooding, reinforce bridges that are exposed to corrosive saltwater and storms, and consider moving or elevating coastal roadways. These improvements are essential if my state and others along the coasts have any chance of surviving the changes coming our way over the next 50 or 100 years.

These resiliency improvements will also go a long way in bolstering the coastal real estate market, which according to the First Street foundation, has already seen \$15.8 billion in lost home value due to sea level rise and flooding in the 15 East Coast states and Mississippi and Alabama along the Gulf.

- a. How should climate change considerations and sea level rise projections be incorporated in the local, state, and federal transportation planning processes?
- b. Do you agree that it is irresponsible to ignore this loss in value to our coastal assets as we harden our infrastructure for sea-level rise?

Climate science is now well understood, and projections from the International Panel on Climate Change and the National Climate Assessment outline increasing risks to communities resulting from anticipated sea level rise, extreme rains, and more heat waves. We cannot continue to look to past weather conditions to plan for the future. Building code and engineering standards as written today assume that the past 30, 50, or 100 years of weather give us insight into what the next century of weather will look like. Historic data alone is no longer a reliable proxy for future conditions. We have climate change projections of ever-increasing confidence available today, and those projections offer new practical applications.

At the federal level, in 2015, Executive Order 13690 provided guidance on how the use of forward-looking sea level rise data may be used in federal capital investments to improve the nation's resiliency. This EO established an important standard for using forward-looking data and provided an important foundation for the development of the City's resilient design policy. Unfortunately, EO 13690 was rescinded in 2017 and current federal guidance recommends the use of risk-informed decision making and adaptive learning. *See* Federal Highway Administration Order 5520 (2014) "Transportation System Preparedness and Resilience to Climate Change and Extreme Weather Events."

We believe it is important for more specific guidance such as that issued in EO 13690 be re-established. Using forward-looking climate data increases the resilience of our built environment, ensuring that assets constructed today serve Americans for decades to come, do not require additional maintenance costs, and are able to withstand the extremes of climate change. All federal investments in our country's transportation infrastructure should be designed to a resilient standard using forward-looking climate data.

The City recognizes the imperative of using forward-looking weather projections to supplement historic weather data, and that's why we've issued the Climate Resiliency Design Guidelines to change how the City designs and builds its infrastructure and buildings. The Guidelines identify the changes to existing design standards needed in the City, such as: identifying where design flood elevations need to be higher; assessing how much to expand storm water retention systems to manage extreme rain; and identifying which materials and mechanical systems need to be upgraded to better withstand extreme heat. Other government authorities are developing or have issued similar guidelines to ensure that infrastructure design is informed by the best available data on future climate hazards. We are pleased to hear that similar efforts are ongoing in Rhode Island.

We agree that the value of coastal transportation assets is not limited to their replacement cost; their outsized impact on the national economy must be considered as well. We strongly urge

Congress to invest in solutions that increase the resiliency of the national transportation network and account for future climate conditions as well as economic and demographic growth.

3. Electric Vehicle Corridors: According to Inside EVs, sales for electric vehicles increased by 81% in 2018, and sales for electric vehicles is predicted to continue to grow at a rapid pace. As you know, in 2015 Congress passed legislation as part of the FAST Act to establish a national alternative fuels corridor program, so drivers have a better understanding of where to find alternative fuel charging station and refueling stations. The agency you would head is now in the process of implementing that legislation, and attempting to establish a national network of alternative fueling and charging infrastructure along national highway system corridors.
 - a. Beyond the work that USDOT is already doing in this space, what else can the agency do to stimulate deployment of electric vehicle infrastructure?
 - b. What can USDOT do to reduce regulatory roadblocks to increase the nation's electric vehicle infrastructure?
 - c. What can Congress do in the next highway bill to continue to expand our nation's electric vehicle infrastructure?

The City is committed to dramatically increasing the number of electric vehicles (EVs) on its streets as part of the City's plan to reduce greenhouse gas emissions 80 percent by 2050. The City is currently electrifying its own light-duty vehicle fleet, with the goal of creating the largest electric fleet of any U.S. city. In addition, the City has set a goal that 20 percent of all new vehicle registrations will be electric by 2025. To support that goal, the City plans to install 120 level 2 EV chargers at curbside locations in partnership with Con Edison (the local utility) and is creating a network of up to 50 fast charging stations across the five boroughs. Because the City is a dense urban area where residential charging is difficult, the City will install both on-street Level 2 charging with a lower power draw and multi-hour charge time, and fast-charging stations which offer a gas-station experience at greater cost.

Additional federal support for charging infrastructure would accelerate adoption and increase the feasibility of fully-electric urban fleets. To support the increase in electricity demand, cities and utilities will also require help to upgrade power grids. And, at the vehicle level, aggressive fuel economy standards and extension of the federal tax credits for purchasing EVs would increase uptake and prompt utilities to deploy more charging infrastructure.

Congress should appropriate substantial new funding and economic incentives for states, regions, local governments, and the private sector to invest in greenhouse gas mitigation, including smart EV charging infrastructure for cars, trucks, and buses. This should include funding for designated corridors so that EV drivers can be confident of finding charging points for most journeys across America. Additional federal funding and incentives should be made available to support continued electrification of public sector fleet vehicles, such as school buses and transit buses. These investments will require changes to streets, bus depots, electric grids, and other complex integrated systems. Congress has a key role in supporting more effective intermodal transportation planning to enable this important energy and mobility transition.

4. Bicycle and Pedestrian Safety: I continue to be concerned by our nation's rate of bicycle and pedestrian deaths, which now make up more than 18% of all traffic fatalities and are at their highest level since 1990. While we are making progress in improving transportation safety overall, we are unfortunately heading in the wrong direction for people walking and biking. The Governors Highway Safety Association found that an estimated 50 percent of pedestrian deaths occur on state or US highways and interstates. Congress has attempted to prioritize this issue for state departments of transportation by requiring new safety goals for people walking and biking.
 - a. How should Congress address bicycle and pedestrian safety in the next highway authorization?
 - b. Which programs in the FAST Act have been the most beneficial for bicycle and pedestrian safety?

The City's Vision Zero program has been a great success in reducing traffic fatalities and serious injuries as a result of crucial safety-focused Street Improvement Projects (SIP) that have been implemented at key intersections and corridors with the highest crash data. These projects re-engineer intersections and corridors to improve safety for road users (pedestrians, cyclists and motorists) by implementing a range of traffic calming measures, including: increasing space for pedestrians and cyclists; narrowing travel lanes to reduce speeding; slowing left turns and removing dangerous turn conflicts; and simplifying complex intersections so they are easier to navigate.

In addition, the City has installed Leading Pedestrian Intervals (LPI) throughout the city, which dedicate 7 to 10 seconds at the start of the signal phase to allow pedestrians to cross before parallel traffic receives a green light, thereby making pedestrians more visible and reducing conflicts with motorists. We have also improved our crosswalk and street markings to increase visibility and safety for pedestrians and motorists.

The City's speed camera enforcement program, newly expanded by the New York State Legislature, has reduced dangerous speeding by over 60 percent in locations where we have installed the cameras, and injuries are likewise down 17 percent. As Vision Zero is a data-driven initiative, we have focused these interventions, as well as the installation of new signals, at locations where serious injury and fatality data indicate they are most needed.

As discussed in my testimony, Congress should consider a number of steps to improve traffic safety in future legislation. It should expand eligibility of highway funding to be flexed to traffic safety initiatives and adjust matching requirements, for example, if these are part of a transportation plan designed to meet Vision Zero benchmarks. Congress should also consider advancing new ways to allocate funds directly to local governments and metropolitan planning organizations for traffic safety engineering projects and initiatives.

We urge Congress to do the following:

- Authorize the use of direct aid agreements, pilot programs, and competitive performance-oriented grant programs, such as envisioned in the bi-partisan Vision Zero Act of 2017, H.R. 1266, which would fund both creation of Vision Zero plans and the implementation of those plans.
- Further advance road safety with funding, design standards and policy changes that are founded in data and which give priority to proven measures that improve safety.
- Require road projects funded with federal money to meet Complete Streets criteria as first proposed in the Safe Streets Act of 2013, H.R. 2468.
- Require states to allow local agencies' the use of their guidance of choice in road and street design rather than requiring adherence to the Green Book of the American Association of State Highway and Transportation Officials (AASHTO). The current prohibition on the use of federal aid highway funds for speed cameras, one of the most effective safety tools used by New York City, should be removed.
- Codify into statute the speeding-related safety recommendations of the National Transportation Safety Board by:

(1) Directing the U.S. Department of Transportation to complete actions called for in the 2014 Speed Management Plan, while publishing periodic progress updates;

(2) Directing the Federal Highway Administration to revise the Manual on Uniform Traffic Control Devices (MUTCD) to remove guidance that speed limits in speed zones should be within 5 mph of the 85th percentile speed, incorporate a safe-systems approach to protect vulnerable road users, and establish best practices around automated speed enforcement; and

(3) Directing the National Highway Traffic Safety Administration to identify speeding-related performance measures to be used by local law enforcement and collaborate with traffic safety stakeholders to inform additional crash data needs.

The last transportation authorization, the FAST Act, did continue some important initiatives on this front, including the Transportation Alternatives Program and Safe Routes to School. More broadly, the public transportation investments supported by the federal government often spur localities to address walkability and plan more complete streets. However, overall, the FAST Act has been accompanied by a huge spike in pedestrian fatalities nationally, as referenced in your question. Clearly, the crisis demands aggressive intervention from both Congress and USDOT.

Senator BARRASSO. I am grateful for the testimony of all of you. We are going to go to a round of questioning.

Senator Inhofe, I know you have a pressing matter so I would like to turn to you first.

Senator INHOFE. Thank you, Mr. Chairman, for allowing me to go out of turn.

I wanted to do it because there are two things I want to emphasize. You have done a pretty good job of emphasizing, Mr. Demetriou, but it is worth repeating.

You hear the word investments all the time. Every big spender around, every big spending program, you never hear the word spending, you never hear the word deficit. You just hear investments. A lot of time it is a phony characterization. However, in transportation, it is not. It is real.

In my State of Oklahoma, because of some massive improvements we have made in our transportation system, two of our communities, one, Durant and the other, Innova, are the direct beneficiaries as a result of what happened in the highway programs.

In those two communities, the companies are investing \$250 million in one and \$360 million in the other creating 300 new jobs in each location. The investment the Oklahoma Department of Transportation and the Federal Government has made improved these highways as a result of property tax, sales tax and all of that.

What I would like to get from you, Mr. McKenna and Mr. Demetriou, is any elaboration on this, very briefly, and what you see as a return on investment? We will start with you, Mr. McKenna.

Mr. MCKENNA. Thank you, Senator. That is a great question.

In Missouri, we actually track our capital program. We put, at present, about \$900 million per year into that program. We track and measure that with an economic study on each 5-year period.

We find when we are at that \$900 million to over \$1 billion level, we see returns of 4 to 1 in economic benefits. When we have instability of Federal funding and tighten down the types of projects we work on, we can see that drop to \$2 to \$2.50 per dollar invested.

Consider the changes between a short-term paving program or a long-term capital investment program, those returns are really stark. We have tracked that for over 20 years.

Senator INHOFE. I appreciate that very much.

Mr. Demetriou, you did cover this. Is there anything you wanted to add to what you have already said concerning return on investment?

Mr. MCKENNA. I think I stated that there was a tremendous return. Patrick just covered that as well. Hopefully, each of you has a fact sheet on your State that has been put together by the Business Roundtable.

Specifically for Oklahoma are the additional jobs you laid out, but more important are the benefits to the mining industry, finance, insurance and real estate industries which are important to your State. Each and every one of you has a similar fact sheet.

For me as a business leader, this is completely tied to what we do every day to drive investment and get a high return on that capital. It is clear that, from an infrastructure standpoint, that is what we are talking about.

Senator INHOFE. The second thing I would like to have you elaborate on a little bit has to do with streamlining. In the last two highway bills or transportation bills that we had, actually when I was chairing this committee, we concentrated on streamlining. It had not been done before.

I remember that Barbara Boxer at that time came around in a lot of areas where she did not agree initially but she changed her position. I think that streamlining has come a long way.

Mr. McKenna, you did not say too much about that. Tell me what your thoughts are on streamlining. Some people are saying we have already addressed that. We do not need to address it more. Why do we need to address it more in this bill?

Mr. MCKENNA. Thank you, Senator.

We do believe we are along the path. We have made significant progress in streamlining with a lot of coordination going on among and between Federal agencies. We are trying to mirror that at the State level between cabinet agencies in each State. The coordination efforts that are going on are substantial. We do believe that we still have progress to be made.

I want to make sure everyone realizes we are not suggesting we delve into the environmental issues themselves. We do not wish to negatively impact the environment, but we do think on a process standpoint, even in simple projects where we have categorical exclusions, that coordination can still be improved. We have more work to do. If we can shave, on average, 3 months off 95 percent of the projects we do, that is a substantial return for the taxpayer.

Senator INHOFE. That translates into more money for infrastructure.

Mr. MCKENNA. Yes, it does.

Senator INHOFE. Do you agree with that, Mr. Demetriou.

Mr. DEMETRIOU. Yes, I do. I really do encourage you to put into the law the Executive Orders putting the 2-year limit on the permitting process.

I also want to say there are great examples of projects recently applying the FAST Act, applying the deadlines, collaborating and cooperating with all the stakeholders ensuring government and environmental regulations are preserved. We are seeing opportunities to improve and shorten the timelines.

Senator INHOFE. I appreciate that very much.

Thank you, Mr. Chairman.

Senator BARRASSO. Thank you, Senator.

Senator CARPER.

Senator CARPER. Mike, how do you pronounce your last name?

Mr. REPLOGLE. It is Replogle.

Senator CARPER. Why?

Mr. REPLOGLE. Old Alsatian dialect. It means wine carrier.

Senator CARPER. The 800-pound gorilla in the room is always how to pay for this stuff. We all know we need to do it. A fellow named Earl Blumenauer who I think is from Oregon, talks about the purchasing power of the Federal gasoline and diesel. I think he is calling for five cent increases for 5 years and index it, going forward.

It reminds me a little of what George Voinovich and I suggested almost a decade ago to the Simpson-Bowles Commission when we

called for increases of four cents a year for 4 years and then to index. A lot of people said that was a pretty good idea. We never got around to doing it. We really did not have the kind of leadership we should have had from the executive branch. People were really reluctant here in this body to raise fees even for something we know we all need to do.

I was in a meeting with Senator Inhofe, Senator Barrasso and a number of our colleagues maybe 6 months ago at the White House, meeting with the President on infrastructure. He said, I am not going to give a big speech but let's listen here to all of you. What do you think we ought to do?

He turned to me first. I am sitting right across the table from him. I said, the 800-pound gorilla in the room is always how to pay for this stuff. I suggested what George Voinovich and I had suggested seven, eight or 9 years ago, four cents a year for 4 years. He cut me off. He said, that's not enough.

I looked at John Barrasso sitting right next to the President and I winked at him. He said, that's not enough. It should be 25 cents and it should be right now. I looked around the room and I think there were a few surprised people there. He came back to it again and again in the meeting which lasted over an hour.

That night I spoke on the phone with the Secretary of Transportation. I said was that just a warm-off or something he decided to throw out there as he sometimes does? She said, no, he's been talking about this for weeks, actually longer.

As an old Governor, I have always felt leadership is important, especially in doing difficult things. The President said he supports 25 cents right now on the gas and diesel tax and provides political cover for the Congress. He said, I know this is a hard thing for elected officials in the House and Senate to do, Democrats and Republicans. I will provide you that cover for that.

I said to the Secretary, was he serious about this? She said, he's been talking about it for quite a while.

I would suggest if we are serious about really doing something, I think Earl Blumenauer was on to an idea. I think George Voinovich and I had a pretty good idea. I think the President has a pretty good idea. What we need is the political courage to do it.

Not just that but can we find more ways to streamline and save some money through permitting reform? My guess is we probably can. Everything I do, I know I can do better.

How about the folks out there who use roads, highways and bridges and do not bring in anything? They are in electric vehicles, hydrogen-fueled vehicles. Shouldn't they have some obligation to maintain the roads they are driving on? I think so.

Let me ask you guys to react to what I have just said and laid out before you. Then I will ask some other questions. Mr. Replogle.

Mr. REPLOGLE. I think we clearly need more infrastructure investment here in America. I think we need to consider a diverse array of ways of achieving increased revenues, both through traditional means and new innovative means if we are to accomplish this. We need to make sure those funds are well targeted to the right kinds of investments.

Senator CARPER. We just opened a four-lane limited access highway called Route 301 which comes right out of the eastern side of

Maryland and comes through Delaware. It was always a two-lane road in Delaware with a lot of congestion, traffic lights and pollution.

We just converted it into a four-lane, limited access highway. It is a toll road with the largest loan from the Federal Government. It is a toll road and we are recovering the tolls to pay off the loan back to USDOT. That is another option.

Steven?

Mr. DEMETRIOU. Senator, I agree with what Michael said. There is no silver bullet. There needs to be a diverse array of public, State, local and private funding. The overlay is it really should be user-based. We have that in place today with the gas tax. Unfortunately, it is 25 years since we increased it. I think we have lost about 40 percent of the purchasing power.

We have vehicles out there that are more energy efficient, as you said, some even electric, not even paying the gas tax. We need to move to a mileage-based, user fee as quickly as possible. Initially, we should start with the increased gas tax and then move to a miles-based user fee. At Jacobs, we are working with many States and coalitions across the west coast and east coast to pilot these. I think we need to accelerate that to get to that ultimately.

Senator CARPER. Mr. McKenna, please.

Mr. MCKENNA. Thank you.

Senator CARPER. I would ask you to be brief and right to the point.

Mr. MCKENNA. Great points, and I agree the two primary issues we are facing are lost purchasing power from inflation over the last 20-plus years, and the rising fuel economy. We do have to address that. We do believe there are cost effective ways to do that through user fees today, adjusting those user fees to help that purchasing power.

Senator CARPER. Have you done anything in Missouri along these lines?

Mr. MCKENNA. We have made several attempts in that regard. We have constitutional prohibitions on legislative authority to increase revenues. The public has not agreed with us to date. We have not made as much progress as we would like.

We do have right now one of the alternatives to the fuel tax going through our legislature. It is actually a conversion of our registration fee to a mileage-based fee. The idea is to capture from all users relatively the same amount.

Whether you are paying gas and fuel tax or whether you have an all-electric vehicle or a hybrid, the idea is that we capture about \$30 a month from each of these users. We need to do that across whatever form of transportation you are using.

Senator CARPER. Thanks so much. Thanks, Mr. Chairman.

Senator BARRASSO. Thanks, Senator Carper.

Senator BRAUN.

Senator BRAUN. Thank you.

I come from the State, Indiana, where back in 2017 we were grappling with the same issues here. Being on Roads and Transportation there in Ways and Means, and a fiscal conservative, it was easy for us to do it. I spoke vehemently to increase the gas tax and diesel, and I own a trucking company, 10 cents a gallon on gas,

20 cents on diesel. It was in the context of a balanced budget that we do every year and cash balances.

I did not have the reservation of even increasing a user fee in the context of what I would call bad fiscal management here in general. I think that is the dilemma that we live here on the Federal level.

What I want to talk about mostly, though, and I agree with Senator Carper when he mentioned how do you pay for it, I think it is disingenuous to rely on an institution like we have here that is running trillion-dollar deficits, and \$22 trillion in debt. That would be infeasible anywhere else, if you are asking to get more revenue out of it, whether it is through transfer from the general budget or raising a user fee. I think we have to work on that in general before we really can do it with confidence that it is going to be there and sustainable.

We started experimenting with some other ideas. We had counties and cities constantly wanting more roads and bridges fixed within their domains, and had the nerve in that same year to throw out a program that had a 50 percent match. They griped about it, did not want to do it. It is oversubscribed now in the two or 3 years we have done it, because they had no capacity to do it. They found the way to do it. Cities and counties are going to have capacity to do stuff within a State. States have capacities to do more.

I think we cannot shy away from asking States that generally are in financially good shape, to do more. There is capital capacity there. Also, through public-private partnerships, there is even more probable capital capacity in that area. There are a lot of folks who do not like the idea of it.

I think we have to be enterprising. We cannot expect this to be solved because look how long it has been and we did not have the fortitude to do a user fee here. It would have been a lot easier 10 or 15 years ago when we had a balance sheet that would not argue against doing it.

I know in my State, Joe McGuinness, who is our Director of Transportation, is really enterprising. I want to mention one other thing we did. I authored the bill, could not find a model for it anywhere in the U.S. This was for cities and counties, locals, to initiate a road project and bring the State along to get engaged with it and put skin in the game. Here, it seems like you never talk about skin in the game. When you do it, things work better.

We teed-up that bill the same year that we did the long-term road funding. I can tell you in my home area, we have a road project we have talked about for 40 years that local industry is going to pay half of the EIS fee and we have shamed local governments into matching it, so we are on the board. We are getting something done. That is what it is going to take.

Mr. McKenna, you would be in the same space as Joe McGuinness was. He likes it. We were in a State legislature that did something. What do you think of the idea of asking cities and counties to do more within States and States carrying more of the burden because they are better able to do it?

Mr. McKenna. Senator, those are great comments and a great question.

In Missouri, we have a 15-year history of cost share with local communities. Those local communities, to the extent that they believe investment in the National Highway System that runs through their communities is valid and valuable, we do have them putting skin in the game. In fact, we have used \$450 million of State and Federal resources and actually produced \$1 billion worth of construction projects.

I would say that in a State like Missouri, where we have the seventh largest transportation network and are ranked 48th in terms of revenue per mile, we have been looking, on an enterprising basis, for any potential solution we can find on a project by project basis. All of these types of programmatic project-based approaches work. However, they do not solve the entire system base. There are tools in the toolbox that are vitally important and everyone should be seeking those. I do think DOTs around the Country and communities have been working together pretty hard to do so.

Senator BRAUN. Thank you.

In respect of time, I will yield. If there is a second round, I have another question.

Thank you.

Senator BARRASSO. Thank you, Senator Braun.

Senator WHITEHOUSE. Thank you, Mr. Chairman.

Thank you to the witnesses for coming. This is one of the areas where it is kind of fun to be on EPW. We work together and I think we can get a lot of things done. I wanted to flag a couple of issues I think are important as we go forward.

One is I want to add to the record a statement of the American Property Casualty Insurance Association made to the House Committee on Transportation and Infrastructure.

Senator BARRASSO. Without objection.

[The referenced information follows:]

United States House of Representatives**House Committee on Transportation and Infrastructure****“Examining How Federal Infrastructure Policy Could Help Mitigate and Adapt to Climate Change.”**

February 26, 2019

Statement of the American Property Casualty Insurance Association**Introduction**

The American Property Casualty Insurance Association (APCIA) respectfully submits this statement to the House Committee on Transportation and Infrastructure for its hearing entitled “Examining How Federal Infrastructure Policy Could Help Mitigate and Adapt to Climate Change.” Our testimony includes several suggestions for building a more resilient infrastructure in the United States and describes how the property and casualty insurance industry can help bridge the insurance gap to provide consumers and communities with stronger protections.

APCIA represents nearly 60 percent of the U.S. property casualty insurance and reinsurance market with the broadest cross-section of home, auto, and business insurers of any national trade association. APCIA members protect families, communities, and businesses in the U.S. and across the globe.

The United States federal government appropriated nearly \$140 billion for expenses related to the 2017 natural catastrophes – comprising almost 18 percent of last year’s fiscal deficit.¹ Globally, 2017 and 2018 were the costliest back-to-back years for weather disasters on record.² In the last two years, natural disasters caused near record economic losses in the United States. In 2017, our nation experienced the second greatest economic losses from hurricanes in our history and the greatest wildfire losses in 2017 and 2018.

Continued increases in federal spending on disaster relief is not financially sustainable. Federal infrastructure policy can play an essential role in mitigating natural disaster losses and helping consumers and communities become more resilient to changes in weather severity.

¹ The Hill, Niv Elis, October 14, 2018. (<https://thehill.com/policy/finance/411215-disasters-become-big-chunk-of-us-deficit>)

² AON: “Weather, Climate & Catastrophe Insight,” 2018 Report, Page1. (<http://thoughtleadership.aonbenfield.com/Documents/20190122-ab-if-annual-weather-climate-report-2018.pdf>)

Building a Resilient Infrastructure

APCIA stands ready to assist the Committee in crafting specific public policy solutions to improve the nation's infrastructure with the goals of protecting lives and property, reducing economic losses, limiting taxpayer expense, and making communities more resilient. To that end, we offer the following broad-based suggestions:

Encourage states, U.S. territories, communities, and tribes to adopt prudent, hazard-specific land use measures.

Adopt and enforce strong building codes and defensible space requirements for both new and existing property and construction to increase resilience to present and future risks.

Incorporate climate risk models and climate resilience standards into all public infrastructure projects.

Commit additional government funds for resilient infrastructure and retrofitting existing infrastructure in areas at risk.

Support and utilize research and targeted incentives (such as tax credits, loans, or grants) to promote effective loss mitigation, in order to reduce current and future risk to people, property, natural features, ecosystems, and critical infrastructure.

Share science-based information to better inform public policy and decision-making at all levels of government and commerce, including analyses of the benefits and costs of property mitigation measures.

Resilient infrastructure and smart development play a critical role in the reduction of American citizen's exposure to disasters and allow them to recover more quickly. If we make these investments on the front end, it will pay considerable dividends once a catastrophe strikes. The National Institute of Building Sciences recently issued the *Natural Hazard Mitigation Saves: 2018 Interim Report*. Generally, the report found a benefit cost ratio of "... \$6 for every \$1 spent through mitigation grants funded through select federal agencies."³ Importantly, the report also concluded that investment in mitigation could save hundreds lives and prevent one million non-fatal injuries.⁴

³ National Institute of Building Sciences, "Natural Hazard Mitigation Saves: 2018 Interim Report," (2018) Page 1. https://cdn.ymaws.com/www.nibs.org/resource/resmgr/mmc/NIBS_MSv2-2018_Interim-Report.pdf

⁴National Institute of Building Sciences, "Natural Hazard Mitigation Saves: 2018 Interim Report," (2018) Page 86. https://cdn.ymaws.com/www.nibs.org/resource/resmgr/mmc/NIBS_MSv2-2018_Interim-Report.pdf

Bridging the Insurance Gap

The property and casualty insurance industry is an essential part of our national emergency response apparatus. In the wake of 241 weather and climate disasters that each exceeded \$1 billion in damages/costs since 1980 property casualty insurers have consistently responded to help Americans financially recover. The total cost of these catastrophic events exceeds \$1.6 trillion.⁵ In 2017 alone, estimated insurance payments due to natural catastrophes in the U.S. topped \$78 billion in 2017, more than triple the \$23.8 billion total for 2016.⁶

These figures represent only half of the total economic losses suffered. In 2018, the U.S. experienced about \$92 billion in total damages and costs from natural disasters, with an estimated \$57 billion insured.⁷ As large as this insurance gap is, even this data hides the large scale of the insurance gap due to the larger-than-normal wildfire-related costs in 2018 and the more commonly purchased standard fire insurance policy. While there is no doubt that insurance payments have helped communities and individuals recover, the United States faces a considerable insurance gap, especially for other catastrophe perils like windstorm (hurricane), flood, and earthquake. That is, a great number of people remain underinsured or uninsured.

Property casualty insurers across the country are actively engaged in closing this insurance gap. Increasing take-up rates for catastrophe insurance is critically important if we really want to bend the curve in reducing costs and losses from natural catastrophes.

In addition to reducing the reliance on taxpayers or government assistance, the insurance mechanism provides several other benefits that will improve resiliency. These include:

- Reducing exposure in a changing world through actuarially-sound risk transfer, risk underwriting, risk awareness and risk management.
- Sending important financial signals about risk and a creating a financial incentive to reduce or mitigate risk through risk-based pricing
- Articulating a common message about levels of risk and vulnerability posed by extreme weather to more directly match insurance coverage to relative risk.

⁵ NOAA National Centers for Environmental Information (NCEI) U.S. Billion-Dollar Weather and Climate Disasters (2019). <https://www.ncdc.noaa.gov/billions/>

⁶ Insurance Information Institute, "Facts + Statistics: U.S. catastrophes." <https://www.iii.org/fact-statistic/facts-statistics-us-catastrophes>

⁷ AON: "Weather, Climate & Catastrophe Insight," 2018 Report, Page 38. (2018). <http://thoughtleadership.aonbenfield.com/Documents/20190122-ab-if-annual-weather-climate-report-2018.pdf>

In addition, the property casualty insurance sector can help to improve insurance literacy, raise awareness of climate risks, urge disaster planning and preparedness, and encourage wider purchase of insurance.

Conclusion

Making America more resilient to natural catastrophe events will take the combined efforts of government -federal, state, and local, communities, the private sector and individual property owners. Resilient infrastructure is an important component to build a national strategy to address this important issue. Property casualty insurers stand ready to assist the Committee in building a resilient infrastructure and helping communities recover quickly after disaster strikes, and APCIA thanks the Committee for holding this important hearing.

Senator WHITEHOUSE. They pointed out the importance of incorporating climate risk models and climate resilient standards into all public infrastructure projects and that it is not just designing and building resilient infrastructure, it is also retrofitting existing infrastructure in areas at risk. I think I see every head nodding about this.

It becomes particularly important for States like mine that are coastal where there is a lot of infrastructure along the coast, where we are at risk of losing transport capability to flooding. Highway 95, in the big rain-burst flooding of several years ago, actually closed because it was filled with water. Amtrak has been stopped because of flooding in Rhode Island and its railway along the Connecticut coast is a massive, massive potential liability. I think it is important that we pay attention to what the insurance industry, what the American Property Casualty Insurance Association is saying.

I also want to emphasize as we go forward the opportunities for better infrastructure, cheaper construction, more durable infrastructure and I think for a lot of our local States, economies through the increased use of new materials.

I would like to ask that a report called The Performance of Bridges that Receive Funding Under the Innovative Bridge Research and Construction Program by the National Academies of Science, Engineering and Medicine be added as an exhibit.

Senator BARRASSO. Without objection.

[The referenced information follows:]

Performance of Bridges That Received Funding Under the Innovative Bridge Research and Construction Program

Committee for the Study on Performance of Bridges

A Consensus Study Report of
The National Academies of
SCIENCES • ENGINEERING • MEDICINE



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PREFACE

The Transportation Research Board (TRB) formed the Committee for the Study on Performance of Bridges to analyze the performance of bridges that received funding in the federal Innovative Bridge Research and Construction (IBRC) program and to recommend to Congress how life-cycle costs of bridges could be reduced through use of innovative technologies. The U.S. Department of Transportation commissioned TRB to conduct the study, as it was directed by Congress in Section 1422 of the Fixing America's Surface Transportation (FAST) Act of 2015, Public Law 114-94. The IBRC program, created by Congress in 1998, provided grants to state highway agencies to cover costs associated with use of new materials and technologies in bridge construction and repair projects, as incentives for innovation in the agencies' practices.

The TRB committee included members with expertise in each of the major categories of materials and technologies that were demonstrated in the IBRC projects. Members' backgrounds included state highway administration, engineering research, and the construction and engineering design industries.

The committee heard presentations at its meetings from Sheila Duwadi, Federal Highway Administration; Thomas Harman, Federal Highway Administration; Dave White, American Composites Manufacturers Association; Karl Frank, National Steel Bridge Alliance; Reid Castrodale, National Concrete Bridge Council; and William R. Cox, National Concrete Bridge Council.

This report was reviewed in draft form by individuals chosen for their diverse perspectives and technical expertise. The purpose of this independent review is to provide candid and critical comments that will assist the National Academies in making each published report as sound as possible and to ensure that it meets the institutional standards for quality, objectivity, evidence, and responsiveness to the study charge. The review comments and draft manuscript remain confidential to protect the integrity of the deliberative process. The committee thanks the following individuals for their review of this report: Jamie Farris, Texas Department of Transportation, Austin; Douglas D. Gransberg, Iowa State University, Ames; Sandra Q. Larson, Stanley Consultants, Inc., Des Moines, IA; Gary J. Klein, Wiss, Janney, Elstner Associates, Inc., Northbrook, IL; Thomas P. Macioce, Pennsylvania Department of Transportation,

Harrisburg; John J. Myers, Missouri University of Science and Technology, Rolla; Henry G. Russell, Henry G. Russell, Inc., Glenview, IL; and Phillip Sauser, U.S. Army Corps of Engineers, St. Paul, MN.

Although the reviewers provided many constructive comments and suggestions, they were not asked to endorse the conclusions or recommendations of this report, nor did they see the final draft before its release. The review of this report was overseen by Maxine Savitz (National Academy of Engineering), Honeywell, Inc. (retired); and Chris T. Hendrickson (National Academy of Engineering), Carnegie Mellon University (emeritus). They were responsible for making certain that an independent examination of this report was carried out in accordance with the standards of the National Academies and that all review comments were carefully considered. Responsibility for the final content rests entirely with the authoring committee and the National Academies.

Joseph R. Morris managed the study, edited the report, and drafted sections of the report under the guidance of the committee and the supervision of Thomas Menzies, Director, Consensus and Advisory Studies Division. Glenn A. Washer, Professor in the Department of Civil and Environmental Engineering at the University of Missouri-Columbia, engaged by TRB as a consultant to the study, conducted the interviews with state highway agencies that are summarized in this report and compiled data on the IBRC projects. Karen Febey managed the report review process. Michael Covington assisted with meeting arrangements and communications with committee members.

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SUMMARY

The Innovative Bridge Research and Construction (IBRC) program, created by act of Congress in 1998, provided grants to state transportation departments as incentives for use of innovative materials and technologies in the construction and repair of highway bridges. The program awarded \$128.7 million to approximately 400 projects from 1999 to 2005. Materials used included fiber-reinforced polymer (FRP) composites, high-performance concrete (HPC), high-performance steel (HPS), and corrosion-resistant reinforcing bar (rebar). Projects also demonstrated accelerated bridge construction (ABC) techniques.

As directed by Congress, the U.S. Department of Transportation commissioned TRB to study the performance of the bridges that received funding in the IBRC program. TRB formed a committee charged with four tasks: analyze the performance of bridges that received funding in meeting the program's goals; analyze the utility of the materials and technologies used in IBRC projects in meeting needs for a sustainable and low life-cycle cost transportation system; recommend to Congress how life-cycle costs of bridges could be reduced through use of innovative technologies; and identify research needed to reduce bridge life-cycle costs.

To respond to the charge, the committee examined how the experience of the IBRC projects affected highway agency practices, in particular, whether the technologies used in the state's IBRC projects were incorporated in regular practice, and examined data on the performance of the IBRC bridges. The principal sources of information were interviews with the staffs of 10 state transportation agencies that participated in the program and records of the IBRC projects.

The first three chapters of the report summarize the committee's conclusions on the extent to which the IBRC projects met the goals of the program, the utility of the technologies, and opportunities to reduce life-cycle costs of bridges. The final chapter presents recommendations.

PERFORMANCE OF THE IBRC PROJECTS IN MEETING THE GOALS OF THE PROGRAM

The projects completed under the IBRC program contributed to fulfillment of at least five of the seven statutory goals of the program (see Box 1.1). The technologies used will reduce life-cycle costs. The data available on the IBRC projects does not contain the information needed to compare life-cycle costs of alternative technologies. Information is available from other sources on effects of IBRC technologies on life-cycle cost, but the evaluation record is incomplete, and economic comparisons are especially scarce. Nevertheless, based on the existing evidence, including information on the physical properties of the innovative materials used in IBRC projects, published cost comparisons, and acceptance of several of the IBRC technologies in state highway programs, the committee concludes that it is likely that the program contributed to the reduction of costs.

The IBRC technologies can reduce construction time and traffic congestion by reducing either the duration of construction or the frequency of construction and maintenance. Safety is improved particularly by shortening the frequency and duration of work zones, which reduced the risk of casualties to the public and to workers. Materials demonstrated in IBRC projects that can help bridges withstand natural disasters include HPC, HPS, and externally bonded FRP reinforcement. The experience that highway agencies gained in IBRC projects was a stimulus for the development of standards and specifications for some of the new technologies. Techniques to separate vehicles and pedestrians from rail traffic were not the primary objective of any IBRC project, although reducing construction cost and duration facilitates the elimination of grade crossings. Similarly, development of nondestructive evaluation techniques was not the primary focus of any project, but several projects included instrumentation to allow condition monitoring.

UTILITY OF THE IBRC TECHNOLOGIES

Certain applications in every category of IBRC technologies (HPC and other advanced concrete materials, FRP composites, corrosion control technologies, HPS, and ABC) showed high utility for reducing bridge life-cycle costs. Several have achieved general acceptance in state highway bridge programs (including

HPC, HPS, stainless steel rebar, and externally bonded FRP reinforcement). Others (including ABC and monitoring technology) could produce much greater savings if used more widely in appropriate applications. Some of the IBRC technologies (for example, FRP deck and superstructure elements) will require further development and evaluation before their correct use and full potential can be determined.

OPPORTUNITIES TO REDUCE LIFE-CYCLE COSTS OF BRIDGES THROUGH INNOVATION

The following conclusions concern the value of federal incentives for innovation, the role of highway agency practices in fostering cost-saving innovation, and specific technological opportunities.

Importance of Federal Incentives as Stimulus for Innovation in Highway Bridges

The funds provided by the IBRC program mitigated the risk of innovation and motivated use of new technologies. The greatest impact was through the incentive to apply technologies that were already developed and of proven benefit but not yet standard practice (advanced concrete materials, externally bonded FRP reinforcement, HPS, and ABC). The program was less successful at increasing application of technologies that were at earlier stages of development. The program lacked features that would be required to advance earlier-stage technologies toward implementation, in particular, planning to define and focus resources on objectives and a provision for monitoring and evaluation.

A new federal incentive grant program for innovative bridge technology could continue the success of IBRC in accelerating the adoption of proven technologies and also contribute to advancing less developed technologies by supporting state highway agency bridge projects that were coordinated as elements of research and evaluation studies.

Importance of Management and Evaluation Practices That Support Innovation

The methods that a highway agency uses to design, construct, and maintain bridges and manage its bridge network are the primary factors that determine success in controlling costs and maximizing the public benefits of bridge investments. Life-cycle cost analysis is necessary to evaluate technology that extends

the life of a structure or reduces the frequency of repair. A bridge management system that identifies maintenance and rehabilitation needs will highlight the value of cost-saving innovations for repairs or for avoiding the need for repairs. A new federal innovation incentive grant program could contribute to advancing highway management practices by providing data on the performance of alternative technologies and through support for highway agency trials of state-of-the-art management systems and evaluation methods.

Specific Technology Opportunities

The committee reviewed the status of the technologies demonstrated in the IBRC projects and innovations that have emerged since the program to identify opportunities to reduce life-cycle costs and improve bridge performance. These opportunities are listed in the final chapter of the report.

RECOMMENDATIONS

The recommendations of the committee concern three topics: a new federal program to provide incentives for innovation in bridge construction, research needs to develop and evaluate innovative approaches to reducing bridge costs, and other actions to encourage innovation.

New Federal Program to Provide Incentives for Innovation in Bridge Construction

Congress should create a new federal bridge innovation incentive program, administered by the Federal Highway Administration (FHWA), to advance the development and application of technologies for improving bridge performance and reducing life-cycle costs. The new federal program can be modeled on IBRC but should include the following features in order to improve on the results of the earlier program.

- **Program plan:** The program should be guided by a plan that defines the objectives, allocates funds in accord with the objectives, and specifies procedures for selecting projects. FHWA should develop the plan in consultation with the state highway agencies.

- **Definition of objectives:** Objectives should be defined with respect to (1) the technologies to be developed, (2) improvements in bridge performance to be obtained with each technology, and (3) the contribution of the program to advancing each technology. The objectives may include expanding use of proven technologies and developing or evaluating earlier stage technologies.
- **Recordkeeping:** FHWA should maintain comprehensive information on each grant awarded, through project completion and follow-up evaluation. Changes in the location, scope, or technologies involved in a project should be recorded.
- **Dissemination:** FHWA should arrange for dissemination of information on projects under way, assessments of completed projects, and monitoring results.
- **Monitoring performance of technologies:** The program should include funding and requirements for monitoring. Monitoring should be on two tracks: every project should be subject to a minimum standardized monitoring requirement; projects that have the objective of development or evaluation should have additional requirements, including a research design that specifies data collection.
- **Emphasis areas:** Emphasis areas for projects should be determined by the federal–state consultative planning process previously recommended. Emphasis areas recommended for consideration are listed in Chapter 5.

Research Needs

The U.S. Department of Transportation (USDOT) and the state departments of transportation should consider sponsoring research to develop and evaluate innovative approaches to reducing the costs of highway bridges, with the following objectives:

- Long-term monitoring of durability, performance, and costs of materials and technologies. Standard procedures for inspection of the materials could be developed in conjunction with monitoring studies.
- Optimized designs and standardization for advanced materials to maximize the cost savings attained

- Optimized design for ABC that takes full advantage of the economies attainable from prefabrication of bridge elements and systems.
- Development and validation of models for projecting service life and deterioration rates.
- New nondestructive bridge evaluation technologies and techniques.
- Development of new advanced materials and use of new materials in bridge construction.
- A program of research and technology transfer to determine the potential for greater use of and benefit from FRP materials in bridge construction. Such a program is outlined in Chapter 5.
- Methods of maintaining and updating existing infrastructure to accommodate truck platooning (operation of two or more trucks in a convoy with close spacing maintained by an advanced driver assistance system) and other upcoming transportation technologies.

Other Actions to Encourage Innovation

- Professional interchange: The state highway agencies should recognize the essential role of professional interactions for disseminating technical advances, support the establishment of opportunities for technical exchange, and support the participation of their engineers in these activities.
- Existing federal highway innovation programs: Congress should continue to provide funding and direction for the existing innovation programs administered by the FHWA Center for Accelerating Innovation. These programs have accelerated the adoption of new technology.

1. INTRODUCTION

The Innovative Bridge Research and Construction (IBRC) program was created by Congress in the 1998 Transportation Equity Act for the 21st Century (TEA-21). TEA-21 authorized the federal highway and transit programs for 1998 to 2003. (Continuing resolutions of Congress later extended the provisions of the Act, including IBRC, to 2005.) The purpose of IBRC was to demonstrate the application of innovative materials and technologies in the construction and repair of highway bridges. The program provided funding for part of the costs of approximately 400 projects from 1999 to 2005 (FHWA n.d.a, HDR 2013). Total funding made available by Congress under the program was \$128.7 million (as determined by authorized funding and annual obligation limitations imposed on the federal-aid highway program) (FHWA 2008, 7). Materials used included fiber-reinforced polymer (FRP) composites, high-performance steel (HPS), advanced concrete materials, and corrosion-resistant reinforcing bar (rebar). Projects also demonstrated accelerated bridge construction techniques.

Historically, technical innovation in materials and construction methods has allowed savings in construction and maintenance costs, improved durability and reliability, and extended the service life of highway infrastructure. However, highway agencies face obstacles to the adoption of innovations. Contracting and budgeting practices may disfavor designs with higher initial cost but lower life-cycle cost and designs that reduce user costs (resulting from delay and crash risk during construction) at the expense of higher agency costs. Contracting regulations can discourage use of proprietary materials or processes.¹ Early projects that use new technology can have higher costs because designers and contractors must learn how to use the new materials and methods and the lack of experience entails a risk of errors or disappointing results. Owners and the construction industry may resist change due to its inherent risks. The IBRC program provided an incentive for highway agencies to overcome these obstacles to gain the benefits of innovation.

¹ 23 CFR 635.411, known as the proprietary and patented products rule, prohibits state highway agencies from requiring use of a patented or proprietary material, specification, or process except in certain special circumstances.

As it was directed by Congress in Section 1422 of the FAST Act, the 2015 federal transportation authorization legislation, the U.S. Department of Transportation commissioned TRB to conduct a study of the performance of bridges that received funding through the IBRC program. To perform the study, TRB formed the Committee for the Study on Performance of Bridges, composed of engineers from universities, highway agencies, and industry with expertise in the materials and technologies that were employed in the bridges.

STUDY CHARGE

The committee's charge (see Box 1.1), which was specified by Congress in the FAST Act, asks it to undertake four tasks:

1. Analysis of the performance of bridges that received IBRC funding in meeting the goals of the program.
2. Analysis of the utility, compared to conventional materials and technologies, of the innovative materials and technologies used in IBRC projects in meeting needs for a sustainable and low life-cycle-cost transportation system.
3. Recommendations to Congress on how the installed and life-cycle costs of bridges could be reduced through the use of innovative materials and technologies.
4. A summary of any additional research that may be needed to further evaluate innovative approaches to reducing the installed and life-cycle costs of highway bridges.

The seven goals of the IBRC program, as defined in TEA-21, were to develop:

- Cost-effective, new, innovative materials for highway bridge applications.
- Methods for reducing maintenance and life-cycle costs of bridges.
- Construction techniques to increase safety and reduce construction time and traffic congestion.
- Design criteria for innovative products and materials.
- Techniques to separate vehicle and pedestrian traffic from railroad traffic.

- Structures that will withstand natural disasters.
- Nondestructive evaluation technologies and techniques.

SOURCES OF INFORMATION

A complete response to the committee's first task—determining whether the IBRC projects were successful in meeting the goals of the program—requires two kinds of evidence:

- Information about how the experience of the IBRC projects affected highway agency practices: whether the technologies used in the state's IBRC projects were incorporated in regular practice, whether experience with the IBRC projects influenced present use, and whether the IBRC experience stimulated development of standards and specifications for the technology.
- Data on the performance over time of the IBRC bridges, as evidence of the benefits of the IBRC technologies with respect to durability; construction, maintenance, and user costs; and service life.

Evidence from the IBRC projects and also from evaluations of other experience with the technologies used in the projects is relevant to the second task—analysis of the utility of the IBRC technologies compared with conventional methods.

The information available to the committee was incomplete. The IBRC program did not require highway agencies to conduct any special monitoring or evaluation of the performance of the bridges that received funding or to document the effect of new technology on life-cycle cost. Routine bridge inspections generally will not provide specific and detailed data on the performance of the features of the IBRC bridges that embody the new technology. Bridge construction that received IBRC funding occurred less than 20 years ago, an inadequate time span for a full comparison of the durability of IBRC and conventional materials. However, any cases in which a material performed well below expectations would be observable, and a robust monitoring program (that collected performance data beyond routine visual inspection) might have been able to detect any early differences in performance, for example, signs of deterioration of reinforcing materials in concrete.

Finally, schedule and budget constraints did not allow the committee to obtain current information on all IBRC bridges or to obtain condition information other than that readily available in bridge inspection records. The following subsections describe the sources the committee used to respond to its charge. The information from these sources is presented in later chapters.

FHWA Project Lists

The Federal Highway Administration (FHWA) provided the committee with a list of 324 projects that received IBRC funding, indicating the state, the innovative material or technology that qualified the project for the program, the general location of the project, a truncated description of the project, and an identifying project number (FHWA n.d.a). National Bridge Inventory numbers and exact locations were not recorded. This list appears to omit projects funded in the final year of the program, 2005. A second list provided by FHWA shows amounts of federal funds obligated and spent on each of 367 IBRC projects, identified by project numbers in a different format from those in the first list (FHWA n.d.b). A list compiled by HDR, Inc. (see the following section) includes 77 projects awarded funds in 2005; some of these may not have been carried out or may have been extensions of earlier projects. Because of the lack of a common system of project identification, it was not possible to consistently match projects across lists. Consequently, the committee did not have a complete and authoritative list of IBRC projects.

HDR Report

In 2013, an FHWA contractor compiled information for bridge projects that received funds from the IBRC program and from a similar program (Innovative Bridge Research and Deployment [IBRD] program) established in 2006 (HDR 2013). The contractor's report is based on information received from the state highway agencies that conducted projects in the two programs. It includes a two-page summary of each project for which information was received, including a brief project description, the innovative technology employed, IBRC or IBRD funds awarded, and the highway agency's identification of positive and negative results, obstacles to implementing the technology, lessons learned, and reuse of or plans to

reuse the technology in other projects. Assessments of results are qualitative in nature. No data on performance over time were collected. The report also includes case studies describing 30 projects in detail. The case studies do not contain performance information, although some results of laboratory testing of materials are reported. Four of the case studies include limited information on cost savings from the innovative technology, compared with conventional practice. Finally, HDR compiled a library of assessments of the projects that the states or others had carried out. Some highway agencies did not provide information for the HDR report.

State Interviews

TRB engaged a consultant to conduct interviews, under the direction of the committee, with state highway agency officials in 10 states that had been active participants in the IBRC program and had completed IBRC projects using diverse technologies (see Table 1.1). The interviews were to obtain information about the performance of the states' IBRC bridges and the influence of the states' experience participating in the IBRC on their subsequent use of the IBRC technologies.

The interview topics included the following:

- Topics relevant to the committee's first task (to analyze the performance of the IBRC bridges in meeting the program's goals):
 - Extent of use today of the technologies that were used in the state's IBRC projects.
 - Existence of specifications or standards for use of the technologies.
 - Reasons for not adopting technologies that were tried in the state's IBRC projects but are not in use today.
 - Influence of experience with the IBRC projects on present use (or nonuse) of the technologies.
 - Effect of training requirements on the state's decisions about adopting IBRC technologies.
 - Effect of availability of standards and specifications on use of the technologies.
- Topics relevant to the committee's second task (to analyze the utility of the IBRC technologies in meeting needs for a sustainable and low life-cycle-cost transportation system):

- Benefit of the IBRC technologies the state now uses, compared with previous practice.
- Results of quantitative evaluations of the benefits.
- Available data on performance and costs over time of the state's IBRC bridges.
- Topics relevant to the committee's third and fourth tasks (how life-cycle costs of bridges could be reduced through the use of innovative materials and technologies; research needed to further evaluate innovative technologies to reduce the installed and life-cycle costs of highway bridges):
 - Obstacles to the state's use of promising IBRC technologies and actions needed to overcome them.
 - Methods of identifying and evaluating innovations in the state's bridge program.
 - State officials' views on research needs to develop methods to reduce the costs of bridges.
 - State officials' views on the possible value of programs similar to IBRC in the future.

TABLE 1.1 Case Study States: IBRC Technologies Used and Grant Amounts Received

State	Number of IBRC Projects Employing Each Technology Category						Total Projects ^b	IBRC Grants Received (\$ millions)
	Concrete	FRP	Corrosion Control	HPS	ABC	Other ^a		
California	1	11		3		2	13	3.4
Iowa	6	8	1	1	2		16	3.4
Michigan	2	3	4				9	1.8
Missouri	5	5	3	2	1		16	2.1
New Hampshire	7	2	2	1	2		10	2.8
New York	3	14	3	2	3		21	2.9
Pennsylvania		7	2	2	1	1	13	2.6
Texas	2	5	4		5	2	18	4.3
Virginia	9	8	3				19	6.4
Washington	2	5	1	2	1		8	3.0

HPS: high-performance steel; FRP: fiber-reinforced polymer; ABC: accelerated bridge construction.

SOURCES: numbers of projects by technology—committee's classification of projects based on the FHWA (FHWA n.d.a) and HDR project lists (HDR 2013); grants received (HDR 2013).

^a Includes glue-laminated hardwood deck panels (PA), monitoring and instrumentation (CA), graffiti-resistant coating (TX), and a project for which complete information was not available (TX).

^b Some projects employed technologies in more than one category; therefore rows do not necessarily sum to the total number of projects in a state.

Views of Supplier Industry Representatives

The committee invited representatives from associations of the steel bridges, concrete bridges, and composite materials industries to comment on the committee's charge in presentations at a public

meeting. Specifically, the representatives were asked to comment, from the standpoint of their respective industries, on the success of the IBRC program in promoting innovation, the utility of the materials and technologies demonstrated in the IBRC projects, current opportunities to reduce the life-cycle cost of bridges through new technologies, and research needed to evaluate innovative approaches.

Published Evaluation Research

Most of the innovative materials and technologies in the IBRC projects are by now widely used, and evaluations have been published of their performance and costs in projects other than IBRC projects. To supplement the limited information available about the performance of the IBRC projects, the committee consulted published evaluations of the materials and technologies in other projects as a basis for conclusions on its second task, to analyze the utility of the IBRC materials and technologies compared with conventional methods. The committee also noted gaps in the published record of performance of some technologies.

AASHTO Survey

At the request of the committee, the American Association of State Highway and Transportation Officials (AASHTO) included two questions in its 2018 AASHTO Committee on Bridges and Structures Annual State Bridge Engineers Survey, sent to all state highway agencies. For each of the IBRC technologies, agencies were asked two questions: “Is the technology currently in use in your state?” and “Have you adopted special provisions or specifications related to this technology?” Responses were received from 40 states, although not all states answered all questions.

ORGANIZATION OF THE REPORT

In the remainder of this report, Chapter 2 describes the administration of the IBRC program and the projects that it funded. Chapter 3 describes state highway agencies’ experiences with the program, with respect to the impact of the program on their adoption of innovations in bridge construction. Chapter 4

summarizes the available information on the performance of the IBRC bridges and the utility of the IBRC materials and technologies. Chapter 5 presents the committee's conclusions on the performance of the IBRC projects in meeting the goals of the program, the utility of the IBRC technologies, and opportunities to reduce life-cycle costs with new technology; and recommendations on research needs and on federal actions to promote innovation in highway bridge construction.

Box 1.1

Study on Performance of Bridges

Statement of Task

An ad hoc committee will conduct a study on the performance of bridges that received funding under the innovative bridge research and construction program under section 503(b) of title 23, United States Code (as in effect on the day before the date of enactment of Public Law 109-59; 119 Stat. 1144) in meeting the goals of that program, which included:

- (1) the development of new, cost-effective, innovative materials for highway bridge applications;
- (2) the reduction of maintenance costs and life-cycle costs of bridges, including the costs of new construction, replacement, or rehabilitation of deficient bridges;
- (3) the development of construction techniques to increase safety and reduce construction time and traffic congestion;
- (4) the development of engineering design criteria for innovative products and materials for use in highway bridges and structures;
- (5) the development of cost-effective and innovative techniques to separate vehicle and pedestrian traffic from railroad traffic;
- (6) the development of highway bridges and structures that will withstand natural disasters, including alternative processes for the seismic retrofit of bridges; and
- (7) the development of new nondestructive bridge evaluation technologies and techniques.

The study will include:

- (1) an analysis of the performance of bridges that received funding under the program in meeting the goals described in items (1) through (7) above;
 - (2) an analysis of the utility, compared to conventional materials and technologies, of each of the innovative materials and technologies used in projects for bridges under the program in meeting the needs of the United States in 2015 and in the future for a sustainable and low life-cycle cost transportation system;
 - (3) recommendations to Congress on how the installed and life-cycle costs of bridges could be reduced through the use of innovative materials and technologies, including, as appropriate, any changes in the design and construction of bridges needed to maximize the cost reductions; and
 - (4) a summary of any additional research that may be needed to further evaluate innovative approaches to reducing the installed and life-cycle costs of highway bridges.
-

2. IBRC PROGRAM ADMINISTRATION: TECHNOLOGIES AND PROJECTS FUNDED

The following first section is a description of the administration of the IBRC program by FHWA. The second section describes the categories of innovative materials and technologies applied in the projects funded by the program and the composition of the program in terms of grant amounts and numbers of projects by technology category and by state.

LEGISLATION, FUNDING, AND ADMINISTRATION

The relevant paragraphs of TEA-21, Section 5103, the 1998 legislation that created the IBRC program, are reproduced in Appendix A. The legislation specifies the seven goals of the program (noted in Chapter 1), administrative procedures, and funding authorized.

IBRC was established as a discretionary grant program. FHWA issued an annual solicitation for applications for funding from state highway agencies. Applications were reviewed first by the FHWA division office in each state and then by a selection panel of FHWA headquarters staff from the Office of Bridge Technology and the Office of Infrastructure Research and Development. Projects were selected and grant amounts determined based on the criteria specified in the solicitation and in accordance with the law (FHWA 2005). FHWA issued the first solicitation for proposals for IBRC funding in July 1999. From the proposals received in response to the 1999 solicitation, it awarded grants totaling the combined amount Congress had authorized for 1998 and 1999.

The FHWA submission requirements for IBRC grant applications called for the following information (FHWA 2005, 3–4):

- Priority ranking of the project with respect to other projects for which the state was applying for IBRC funding.
- Location and description of the structure.
- The innovative material to be used in the project, the specific application of the material proposed, and an explanation of how the application would meet one or more of the IBRC program goals.

- Proposed letting date for the project.
- Estimated costs: cost of the entire project; cost of the innovative portion of the project, including associated preliminary engineering; and cost of proposed activities to monitor and document the performance of the innovative material application.
- Amount of IBRC funds requested.
- Commitment of other funds to the project.

FHWA informed the states that in selecting and evaluating the applications, priority for funding would be given to projects that (FHWA 2005):

- Met one or more of the goals of the program.
- Incorporated innovative materials that are readily available.
- Were ready for or near the construction phase.
- Had designs that are repeatable or have widespread application.
- Would leverage federal funds with other public or private resources.

States were discouraged from submitting applications for projects that duplicated the innovative material application of a previous IBRC project in the state.

FHWA also informed the states that “Because the concept of equity was important in the development of TEA-21, project selection will also consider national geographic distribution among all of the discretionary programs as well as congressional direction or guidance provided on specific projects or programs” (FHWA 2005).

Grants usually covered 100 percent of the cost of the innovative component of the project, as identified by the state in its application, up to a limit set by FHWA, which for the final year of the program was \$400,000. The limit was not absolute, and a few grants were larger than \$400,000 (FHWA 2005).

The proposal submission requirements refer to innovative materials, but not to innovative construction methods or to monitoring technology. However, in its guidance for FY 2005 applications,

FHWA encouraged proposals for projects demonstrating use of bridge components designed for rapid installation and projects incorporating innovative technology for bridge performance monitoring (FHWA 2005, 4). IBRC projects that incorporated accelerated bridge construction techniques became more frequent in the later years of the program. Nine projects that featured monitoring technology as a principal innovation were identified.

FHWA's *IBRC Summary Report* states that "IBRC grant awardees were encouraged to monitor projects and provide documentation and performance data during and following construction" (FHWA 2008, 3), and states could apply for federal IBRC funding for monitoring (that is, for data collection to evaluate performance of innovative features over time). However, the application did not require states to describe monitoring plans, and FHWA did not identify monitoring as a consideration in project selection.

Total funding authorized in federal law for the IBRC program, as restricted by obligation limitations imposed on the federal-aid highway program, was \$122 million for construction project grants and \$7 million for research grants in FY 1998 through 2005 (FHWA 2008, 7). FHWA awarded grants to states for the full amount provided (see Table 2.1). FHWA made the first awards in 1999.

TABLE 2.1 IBRC Grants by FY (FHWA 2008, 19)

FY	1998– 1999	2000	2001	2002	2003	2004	2005	Total
Grants awarded (\$ millions)	21.3	15.9	18.3	17.2	17.9	18.8	19.3	128.7

NOTE: Total amount includes approximately \$7 million in grants for research projects. The remainder was for construction projects.

The IBRC legislation required USDOT to "take such action as is necessary to ensure that the information and technology resulting from research conducted [with IBRC grants] ... is made available to State and local transportation departments and other interested parties" (TEA-21, Section 5103). FHWA interpreted this requirement to apply not only to the research grants under the program, but also to the construction grants that demonstrated the new technologies. FHWA created a website with program information, a resource library, and a database containing information on each project, including the innovative technologies used and bridge elements involved (FHWA 2008, 25–27). The website is no

longer available. Apparently, no readily accessible repository of information about the IBRC projects exists.

TECHNOLOGIES APPLIED IN THE IBRC PROJECTS

The FHWA rules for IBRC grant applications did not specify the innovative materials and technologies that would qualify for funding. Applicants could propose any material or technology and were to provide justification that the proposal met the goals of the program. The FHWA *Summary Report* contains a tabulation of the numbers of projects by 10 material categories, two “other innovative applications” categories, and an “other” category. FHWA also classified projects by the bridge element in which the material was applied (FHWA 2008, 24). The HDR review of the program classified projects by 11 technology categories (including a miscellaneous category) and 61 subcategories (HDR 2013, 665–729). The use of multiple innovative technologies in some individual projects complicates the classification of projects.

To organize its analysis of the success of the IBRC projects in meeting the program’s goals and the utility of the projects’ innovative materials and technologies, the committee classified those materials and technologies in 17 categories. These include three types of concrete, five applications of FRP materials, six corrosion control technologies, high performance steel, accelerated bridge construction, and monitoring and instrumentation technology (Table 2.2). Appendix B contains definitions of each of the technologies and examples of their use in IBRC projects.

TABLE 2.2 IBRC Projects, Grant Amounts, and States with Projects by Technology Category

IBRC Technology	Number of Projects Using the Technology	Total IBRC Grants (\$ millions)	Number of States with Projects
Concrete:		31	37
1. High-performance concrete (HPC)	81		
2. Self-consolidating concrete (SCC)	12		
3. Ultra-high performance concrete (UHPC)	4		
Fiber-reinforced polymers (FRP):		55	30
4. Externally bonded FRP reinforcement	41		23
5. FRP deck elements	65		23
6. FRP superstructure elements (beams or girders) and appurtenances (rails, dolphins, impact guards)	28		
7. FRP rebar			
8. FRP prestressing tendons (strand or bar)	29		
Corrosion control technologies: concrete reinforcement:		10	30
9. Low-chromium steel (ASTM A1035/1035M steel) rebar	19		
10. Galvanized rebar	2		
11. Stainless steel rebar (solid or clad)	29		
Other (epoxy-coated rebar)	2		
Corrosion control technologies: coating and anodes:		6	16
12. Metallizing	3		
13. Cathodic protection anodes and electrochemical chloride extraction	6		
14. Galvanic protection and other (paint systems, inert gas, Surtreat TPS, Al deck, deck overlay)	17		
15. High-performance steel (HPS)	48	15	30
16. Accelerated bridge construction (ABC)	30	7	12
17. Monitoring and instrumentation technology	9	3	8
All Projects		128.7	

Source: Committee estimates based on FHWA n.d.a and HDR 2013.

NOTE: Some projects employed more than one technology. In such cases the project is included in the project count for each of the technologies employed; therefore, sums of project counts across categories are not meaningful. Project counts and grant amounts for individual technology categories are estimates based on the incomplete project grant information available to the committee. In calculating the grant totals by technology category, grant amounts for multitechnology projects were divided equally among the technologies employed.

Project grants were awarded in all 50 states, Puerto Rico, and the District of Columbia (see Figure 2.1). Certain states, including several smaller states, were especially active in seeking participation in the program.

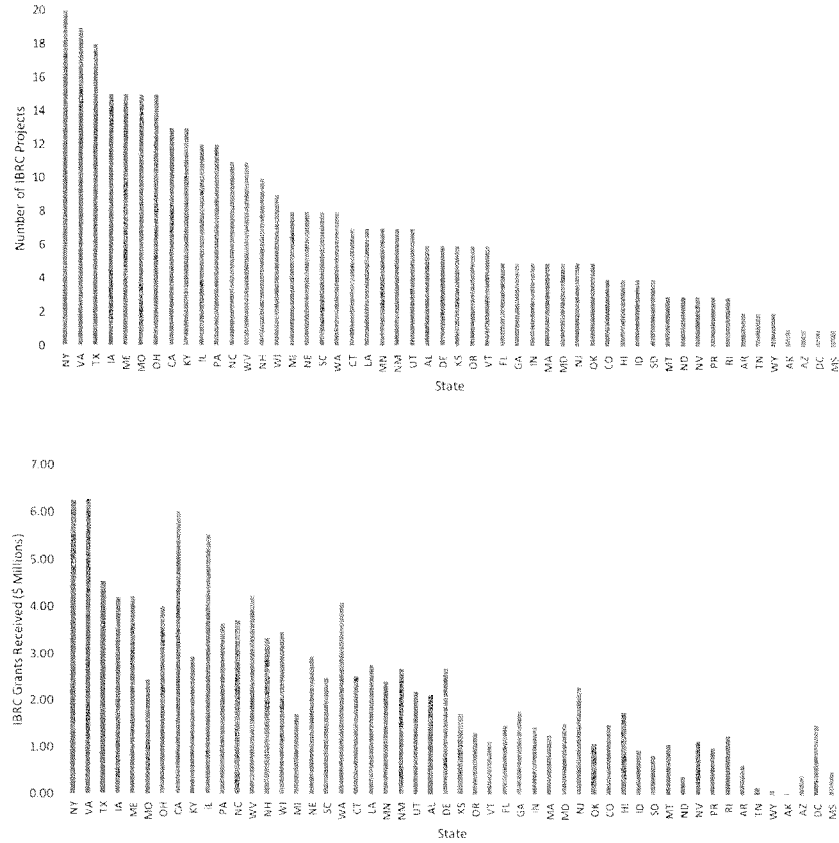


FIGURE 2.1 Number of IBRC projects and amount of grants received by state.

Sources: FHWA n.d.a; HDR 2013.

NOTE: Project counts and grant amounts are approximate, because project information available to the committee was incomplete.

3. HIGHWAY AGENCY EXPERIENCE WITH THE IBRC PROGRAM

The first section below describes the use today of the technologies that were used in the states' IBRC projects. The best indicator of the impact of the program is the extent to which the technologies demonstrated in IBRC projects have been adopted in general practice. The subsequent sections describe IBRC technologies that have not been adopted, the influence of the states' IBRC experiences on acceptance and use of the technologies, the influence of standards and specifications on adoption of new technologies, and the influence of training requirements.

EXTENT OF USE TODAY OF THE IBRC TECHNOLOGIES

Information on the extent of use of the IBRC technologies by state highway agencies today was obtained from two sources, the interviews with the state agencies selected as case studies and the 2018 survey of state highway agencies conducted by the AASHTO Committee on Bridges and Structures. The AASHTO survey requested essentially the same data as the interviews, but had a broader distribution to all 52 states and territories.

Table 3.1 is a summary of the responses from the states interviewed regarding their use of the IBRC technologies. (One of the 10 states did not respond to this question.) The table shows, for example, that all nine states that responded had implementation processes in place for HPC, SCC, and HPS, indicating that these technologies are fully implemented and are used regularly in appropriate situations, while most states are not using FRP deck elements (6 out of 9 states not using), FRP superstructure elements (7 of 9 not using), and FRP prestressing tendons (7 of 9 not using).

A similar inquiry was made of state bridge engineers through the AASHTO survey. The results of this survey, combined with information from two states interviewed who did not respond to the AASHTO survey, are shown in Table 3.2. Forty states responded to the AASHTO survey, although some respondents did not respond to every question. The table shows, for example, that close to 90 percent of respondents are using externally bonded FRP reinforcement (32 out of 37 states that responded to the question) and ABC (33 of 37), and that approximately two-thirds are using HPC (28 of 42), SCC (29 of

42), and HPS (26 of 37). Stainless steel rebar and cathodic protection anodes are each used by 61 percent of respondents (22 of 36).

Table 3.3 summarizes the data describing use of IBRC technologies from the AASHTO survey and the state interviews. In the table, the technologies are listed in order of the number of states indicating that the technology is in use. The column headed “Specifications or Standards Developed” shows the total number of states reporting that they have agency- or state-developed, AASHTO, or other specifications and standards. The following technologies have been adopted into regular practice by the majority of respondents (that is, the majority use the technology and have developed specifications or standards for it):

- ABC.
- Externally bonded FRP reinforcement.
- SCC.
- HPC.
- HPS.
- Stainless steel rebar.
- Cathodic protection anodes.

Neither the state interviews nor the AASHTO survey asked the states how frequently they used each technology, compared with alternatives. Thus, for example, among the states that reported using stainless steel rebar, the fraction of all rebar used that is stainless steel is not known.

TABLE 3.1 Present Use of IBRC Technologies, Case Study State Highway Agencies

Technology	Current Status of Technology			Special Provisions or Specifications			
	Not in Use	Developing Implementa- tion Processes	Implementa- tion Process in Place	Not Applicable	Agency- Developed	AASHTO	Other
Concrete							
HPC	0	0	100% (9/9)	0	89% (8/9)	11% (1/9)	0
SCC	0	0	100% (9/9)	0	100% (9/9)	0	0
UHPC	0	56% (5/9)	44% (4/9)	11% (1/9)	67% (6/9)	11% (1/9)	22% (2/9)
FRP							
Externally bonded FRP reinforcement	0	22% (2/9)	78% (7/9)	0	78% (7/9)	33% (3/9)	22% (2/9)
FRP deck elements	67% (6/9)	11% (1/9)	22% (2/9)	33% (3/9)	11% (1/9)	11% (1/9)	11% (1/9)
FRP superstructure elements	78% (7/9)	11% (1/9)	11% (1/9)	33% (3/9)	11% (1/9)	0	11% (1/9)
FRP rebar	33% (3/9)	33% (3/9)	33% (3/9)	33% (1/9)	22% (2/9)	33% (3/9)	22% (2/9)
FRP prestressing tendons (strand or bar)	78% (7/9)	0	22% (2/9)	44% (4/9)	22% (2/9)	0	11% (1/9)
Corrosion Control Technologies							
<i>Concrete reinforcement</i>							
Low-chromium steel rebar	11% (1/9)	22% (2/9)	67% (6/9)	0	44% (4/9)	56% (5/9)	11% (1/9)
Galvanized rebar	44% (4/9)	22% (2/9)	33% (3/9)	11% (1/9)	22% (2/9)	22% (2/9)	22% (2/9)
Stainless steel rebar (solid or clad)	22% (2/9)	11% (1/9)	67% (6/9)	11% (1/9)	56% (5/9)	33% (3/9)	22% (2/9)
<i>Coatings and Anodes</i>							
Metallizing	22% (2/9)	11% (1/9)	44% (4/9)	22% (2/9)	44% (4/9)	0	0
Cathodic protection anodes	11% (1/9)	22% (2/9)	67% (6/9)	0	67% (6/9)	0	0
Galvanic protection	22% (2/9)	11% (1/9)	67% (6/9)	11% (1/9)	56% (5/9)	11% (1/9)	11% (1/9)
Other IBRC Technologies							
HPS	0	0	100% (9/9)	0	44% (4/9)	56% (5/9)	11% (1/9)
ABC	0	11% (1/9)	89% (8/9)	0	100% (9/9)	22% (2/9)	11% (1/9)

TABLE 3.2 Present Use of IBRC Technologies, AASHTO Survey Respondents and Interviewed Highway Agencies

Technology Name	Currently Using Technology	Special Provisions or Specifications			
		Not Applicable	Agency/State-Developed	AASHTO	Other
Concrete					
HPC	67% (28/42)	18% (6/33)	73% (24/33)	3% (1/33)	6% (2/33)
SCC	69% (29/42)	23% (8/35)	71% (25/35)	3% (1/35)	3% (1/35)
UHPC	45% (19/42)	47% (15/32)	34% (11/32)	3% (1/32)	16% (5/32)
FRP					
Externally bonded FRP reinforcement	86% (32/37)	16% (5/31)	71% (22/31)	3% (1/31)	13% (4/31)
FRP deck elements	24% (9/37)	74% (23/31)	23% (7/31)	0	3% (1/31)
FRP superstructure elements	14% (5/37)	83% (25/30)	13% (4/30)	0	3% (1/30)
FRP rebar	46% (17/37)	52% (17/33)	33% (11/33)	12% (4/33)	3% (1/33)
FRP prestressing tendons (strand or bar)	16% (6/37)	84% (26/31)	10% (3/31)	3% (1/31)	3% (1/31)
Corrosion Control Technologies					
Low-chromium steel rebar	25% (9/36)	61% (19/31)	23% (7/31)	10% (3/31)	6% (2/31)
Galvanized rebar	25% (9/36)	62% (20/32)	31% (10/32)	3% (1/32)	3% (1/32)
Stainless steel rebar (solid or clad)	61% (22/36)	36% (12/33)	55% (18/33)	6% (2/33)	3% (1/33)
Metallizing	36% (13/36)	47% (15/32)	50% (16/32)	3% (1/32)	0
Cathodic protection anodes	61% (22/36)	45% (15/33)	52% (17/33)	0	3% (1/33)
Galvanic protection	42% (15/36)	52% (17/33)	42% (14/33)	3% (1/33)	3% (1/33)
Other IBRC Technologies					
HPS	70% (26/37)	24% (8/34)	32% (11/34)	41% (14/34)	6% (2/34)
ABC	89% (33/37)	11% (4/35)	69% (24/35)	11% (4/35)	11% (4/35)

NOTE: Tabulations include information from the AASHTO survey and from two interviewed state highway agencies that did not respond to the AASHTO survey.

SOURCE: AASHTO Committee on Bridges and Structures 2018 Annual State Bridge Engineers Survey and interviews with state highway agencies conducted for the committee.

Technologies that have been less widely adopted include UHPC and FRP rebar. The UHPC technology was developed toward the later stages of the IBRC program; research to further develop the technology has continued since that time. The Iowa Department of Transportation constructed the first UHPC bridge in the United States in 2005 with support from the IBRC program. The objectives of the project included advancing the state-of-the-art in concrete bridge construction technology, developing experience in using advanced materials, and developing recommended design procedures. The bridge was constructed as a 110-ft simple span bridge with a three-beam cross section. According to a state report on

the project, “The design of the beam was a challenge for the staff involved because of lack of approved specifications.” The investigators report that this issue was addressed with the assistance of standards developed in France and research completed at the Massachusetts Institute of Technology (Bierwagen and Abu-Hawash 2005, 8). This project illustrates that the UHPC technology was still new in the last years of the IBRC program. Nonetheless, nearly half of respondents (19 of 42) indicated current use of this technology, suggesting that implementation of the technology is progressing. The quantities and frequency of use of UHPC by these states were not determined in the survey or interviews.

The use of FRP rebar has not been as widespread as use of stainless steel rebar. Barriers to implementation indicated in the state interviews include unavailability of the material and challenges with the field application, including handling difficulties and inability to field-bend the FRP rebar. Respondents also noted that corrosion-resistant materials such as stainless steel and low-chromium steel rebar provide sufficient performance characteristics and have similar costs. As a result, there was not a clear benefit to using FRP rebar instead of the other technologies to balance the increased field implementation challenges. However, FRP rebar is being used in a significant number of states (17 of 37 responding).

TABLE 3.3 Summary of IBRC Technology Use by States

Technology	Currently Using Technology	Specifications or Standards Developed
ABC	89% (33/37)	91% (31/35)
Externally bonded FRP reinforcement	86% (32/37)	87% (27/31)
SCC	69% (29/42)	77% (27/35)
HPC	67% (28/42)	82% (27/33)
HPS	70% (26/37)	79% (27/34)
Stainless steel rebar (solid or clad)	61% (22/36)	64% (21/33)
Cathodic protection anodes	61% (22/36)	55% (18/33)
UHPC	45% (19/42)	53% (17/32)
FRP rebar	46% (17/37)	49% (16/33)
Galvanic protection	42% (15/36)	49% (16/33)
Metallizing	36% (13/36)	53% (17/32)
Low-chromium steel rebar	25% (9/36)	39% (12/31)
Galvanized rebar	25% (9/36)	38% (12/32)
FRP deck elements	24% (9/37)	26% (8/31)
FRP prestressing tendons (strand or bar)	16% (6/37)	16% (5/31)
FRP superstructure elements	14% (5/37)	17% (5/30)

SOURCE: AASHTO Committee on Bridges and Structures 2018 Annual State Bridge Engineers Survey and interviews with state highway agencies conducted for the committee.

IBRC TECHNOLOGIES THAT HAVE NOT BEEN GENERALLY ADOPTED

As Table 3.3 indicates, present use of galvanic protection, metallizing, low-chromium steel rebar, and galvanized rebar among the states is limited. It should be noted that the need for corrosion control technologies varies by region. Southern states generally have lower rates of corrosion due to the reduced need to use deicing chemicals that can cause accelerated rates of corrosion. Moreover, satisfactory experience with epoxy-coated rebar, together with adoption of stainless steel rebar for some applications in the majority of responding states, may diminish the need for other forms of corrosion-resistant rebar solutions.

FRP deck elements, FRP prestressing tendons (strand or bar), and FRP superstructure elements are the IBRC technologies used today by the smallest number of the responding states. According to the interviewed states, barriers to implementing these FRP technologies include:

- High cost of the material.
- Insufficient benefits to justify additional costs.
- Poor performance in some initial projects.
- Difficulty implementing technology in the field.
- Lack of an industrial base to provide qualified construction contractors and support for inspection and maintenance.
- Lack of available standards and design and materials specifications.

The interviews indicated that the most common reason that FRP decks and superstructure elements were not being implemented was that the benefits of these technologies did not justify the additional cost. Poor performance of the materials in the field was also identified as a reason that further implementation of the technology was not pursued. Examples provided included difficulty with maintaining a suitable driving surface on FRP deck sections, poor field performance due to detailing, and the lack of inspection and repair guidelines for these materials.

An example of a project from the IBRC program that used technologies that have not been widely adopted is the Rollins Road Bridge in New Hampshire, one of the interviewed states (Bell and Bowman 2007). This project included a bridge deck constructed with HPC and FRP grid reinforcing, as well as a structural health monitoring system installed during the time of construction. The monitoring system was used originally to verify the design assumptions and study the structural behavior of the deck, in particular the FRP grid reinforcing (Bell and Sipple 2010). The monitoring system was later used in load testing the bridge to verify the field performance of the new technology. The current NBI condition rating of the bridge deck of the Rollins Road Bridge is 7 (good). The bridge was constructed in 2000; the current

condition of the bridge deck is typical for a bridge with 18 years of service, indicating that there was not a performance problem with the deck's FRP grid reinforcing.

New Hampshire has not adopted into regular practice the FRP technology evaluated during the Rollins Road Bridge project. The barriers to implementation identified in the state interview included a lack of adequate standards and specifications, difficulty handling the material in the field, and high cost. Implementation of structural health monitoring has been very limited in the state due to its cost and limited utility for most common highway bridges, according to the interview. The HPC used in the Rollins Road Bridge has been adopted into regular practice. Adoption of HPC is generally motivated by the low permeability qualities of the material, which are believed to extend the service life of bridges.

It was also noted in the interviews that clad stainless steel rebar has not been adopted for use by selected states. Several of the interviewed states indicated that during planned IBRC projects that included clad stainless steel rebar, the material was unavailable and had to be replaced with an alternate material such as solid stainless steel rebar. It was additionally noted that the clad rebar is susceptible to exposure of the overlaid carbon steel core caused by damage to or cutting of the bars. Such exposure would significantly affect the corrosion resistance of the rebar, reducing the benefit of the technology.

INFLUENCE OF IBRC EXPERIENCE ON ACCEPTANCE AND USE

The interviewed states were asked how their experience with the IBRC projects influenced the use or nonuse of IBRC technologies. Generally, the interviews indicated that the IBRC program had an influence on the acceptance and use of the technologies included in the program. The means of influence included providing the motivation to try a new technology, mitigating the risk associated with new technologies, and assisting in the development of standards and specifications for new technologies. In several instances, an IBRC project was a state's first experience with a technology that the state eventually adopted as part of regular practice.

Interviewed states reported that the funding provided by the IBRC program motivated the trial of new technologies. For example, in Texas, where project decisions are generally made at the district level,

the availability of funding to support the implementation of a new technology helped convince the district to try a new technology.

Some states indicated that they had prior interest in a new technology, and that availability of IBRC funds was effective in accelerating implementation of the technology. An example identified by the Iowa Department of Transportation is the Mackey Bridge replacement project (120th Street over Squaw Creek in Boone County), an IBRC project that used ABC technology, including full-depth precast deck panels and precast superstructure and substructure components, all constructed with HPC. The bridge won the 2007 Precast/Prestressed Concrete Institute (PCI) Design Award for best owner-designed bridge. An article in a 2009 department publication that described the project reported: "ABC reduces construction time, minimizes traffic disruption, improves safety, reduces environmental impacts, enhances constructability, and improves quality and life-cycle costs." The article stated that "Iowa DOT officials used this research to determine the feasibility of using precast-concrete bridge components to accelerate construction for future projects in the state" and reported that the use of ABC was increasing, with several projects each year using the technique (Abu-Hawash et al. 2009, 8).

Interviewed states also reported that the funding provided by the IBRC program mitigated the risk of trying new technologies in the field, encouraging trials. Successful initial projects led to further use and implementation. For example, the success of a Virginia IBRC project constructed with lightweight HPC deck and girders (Ozyildirim and Gomez 2005) led to a recommendation for use of the technology for construction of decks and beams. As of 2016, the use of lightweight HPC is required for all bridge decks in Virginia state projects.

STANDARDS AND SPECIFICATIONS

It was the consensus of the interviewed states that lack of standards and specifications was generally a barrier to implementation of new technologies. It was noted that the development of standards and specifications requires field experience with the technology. However, there is sometimes a reluctance to try a new technology when standards and specifications are not yet developed. Institutional resistance to

exploring new technologies in the absence of standards and specifications was also identified as a barrier when existing practices are considered adequate.

It was noted by several states that IBRC funding provided the motivation and resources to develop the specifications necessary to conduct a trial for a new technology. In addition, IBRC trials served as a means of developing standards and specifications. Standards for welding procedures for HPS were developed by Pennsylvania. California developed FRP specifications before the initiation of the IBRC program, but experience gained through the state's IBRC projects contributed to improvement of the specifications. Iowa noted that several states had pooled funds to support the development of UHPC standards and specifications following the initial testing of the technology during the construction of a UHPC bridge in an Iowa IBRC project, as previously described.

It was also noted by several of the selected states that there is a willingness to try new technologies on an experimental basis without fully developed standards and specifications, if sufficient research and background information is available. Development of the supporting standards and specifications is required to move the technology from experimental use to practical implementation. Respondents also noted that industry and vendors sometimes assist with providing initial data for developing a specification.

Several states indicated that the funding from the IBRC program contributed to the research and testing needed to develop standards and specifications for new technologies. For example, California had several IBRC projects focused on constructing a bridge entirely from FRP materials. Although the construction of the bridge was never realized, California Department of Transportation personnel reported that the fundamental testing and development that occurred during the IBRC-funded projects contributed to the implementation of FRP technology.

A second example is the application of HPS in the state of Pennsylvania. According to the interviews, the IBRC program funding motivated the development of new welding procedures for using HPS (Kaufmann and Pense 2000). The Pennsylvania Department of Transportation subsequently constructed two bridges that used HPS with funding from the IBRC program. Today, the use of HPS is

commonplace, as indicated in Table 3.3, and the welding procedures developed during the research have been adopted nationwide.

Several states interviewed reported that IBRC projects provided the field experience necessary to validate and improve standards and specifications that were in the development stage. For example, the Bridge Street Bridge in Southfield, Michigan (MI-1999-02)² was constructed in 2001 with partial funding from the IBRC program. The bridge girders were reinforced using pretensioned FRP tendons and posttensioned FRP composite cable (Grace et al. 2002). The Bridge Street Bridge was the first concrete vehicular bridge constructed with FRP as its principal structural reinforcement. This project was awarded the Harry H. Edwards Industry Advancement Award by PCI. The overall project included an experimental effort aimed at developing and verifying design rules (Grace and Singh 2003; Grace et al. 2003). The project also included field testing to verify the in-situ performance of the technology. The project provided the opportunity to test standards and specifications that incorporated prestressed FRP reinforcement in bridge structures, which were under development, and led to further use of the technology based on the successful experience and the project's verification of the specifications and standards.

The state responses shown in Table 3.3 indicate that standards and specifications have been developed and adopted for those IBRC technologies that are commonly used today. For example, more than three-fourths of respondents indicated that there are specifications or standards developed for ABC, externally bonded FRP reinforcement, SCC, HPC, and HPS.

INFLUENCE OF TRAINING REQUIREMENTS

Responses in the state interviews indicated that training requirements had not been a significant barrier to implementing most of the IBRC technologies. Respondents noted that entirely new materials such as FRP required training to implement the technology in the field and that lack of training for these technologies

² Identification number assigned to the project by FHWA (FHWA n.d.a). The number indicates the state that received the award and the year in which funds were awarded.

had sometimes hindered implementation. New technologies that improved existing materials, such as HPC and SCC, required less training and training generally was not a barrier to implementing these materials.

It was reported that industry sources were sometimes used for training on FRP materials. However, because the materials were often unique to the supplier of the material, there was little opportunity to develop training regimes that could be broadly utilized. Conversely, industry sources assisted in providing training for materials such as HPC and SCC. For example, the Portland Cement Association has contributed to developing specifications and training for HPC, according to the interview respondents.

Several states reported that training of contractors was a challenge in implementing new technologies. Contractors had little experience with the new materials or processes. The consequences in some instances were poor construction quality or contractor resistance to including innovative technologies in construction bids due to the increased risk.

It was noted that in some cases, fabricators were motivated to implement some new technologies because of the potential to improve the quality and ease of fabrication (for example, SCC.)

4. PERFORMANCE OF THE IBRC BRIDGES: UTILITY OF THE IBRC TECHNOLOGIES

The following two sections present evidence relevant to the second task in the committee's charge: to analyze the utility, compared to conventional materials and technologies, of each of the innovative materials and technologies used in projects for bridges under the program in meeting needs for a sustainable and low life-cycle cost transportation system. The evidence comes from two types of sources: evaluations in the published engineering literature of the technologies used in IBRC projects and data from the 10 case-study state transportation departments on the performance of their IBRC bridges. The committee's conclusions on the utility of the IBRC technologies are presented in Chapter 5.

QUANTITATIVE EVALUATIONS OF THE BENEFITS OF IBRC TECHNOLOGIES

Most of the IBRC projects have not been systematically monitored for the purpose of evaluating the performance of the innovative technologies that they demonstrated. Therefore, the evidence available from the IBRC projects themselves on the value of the technologies is limited. However, many of the IBRC technologies are widely used, and evaluations have been published of their performance and costs in projects other than IBRC projects.

Summarized in the following section are selected published evaluations of in-service performance and life-cycle cost comparisons for the major categories of IBRC technologies: HPC, FRP composite materials, corrosion control technologies, HPS, and ABC. The committee did not conduct a comprehensive literature review of performance evaluations of the technologies. The studies cited are representative of the literature and provide a part of the basis for the committee's conclusions on the utility of the technologies.

The content of the studies reviewed suggests that overall, evaluation of the long-term performance of the IBRC technologies has been fragmentary. Life-cycle cost comparisons of innovative technologies are based on projections of future performance (that is, assuming that the innovative technology will perform as intended) rather than on actual past experience. Systematic long-term

monitoring of the durability of IBRC materials and technologies in bridge projects has rarely been conducted.

Advanced Concrete Materials

The IBRC technologies in this category are HPC, SCC, and UHPC.

HPC

HPC was developed under the first Strategic Highway Research Program (SHRP) implementation in the early to mid-1990s for use in all bridge elements (Halladay 1998). Concrete mixtures, concrete properties, research projects, girder fabrication, bridge construction, live-load tests, and specifications from 19 HPC bridges in 14 states were compiled in 2006 to document SHRP implementation (Russell et al. 2006).

High-strength HPC has been used successfully in bridge girders for many years. Although high-strength HPC has been used in some bridge decks and substructures, the preference for decks and substructures is typically to specify normal-strength HPC. This is because high compressive strength is typically not required in decks and substructures and the high cementitious content required for high strength can lead to an increased potential for cracking.

A synthesis of concrete bridge deck performance was conducted in 2004. Findings included that all HPC is not high-strength concrete and experience has shown that the use of high-strength concrete does not necessarily lead to a highly durable concrete or, conversely, a highly durable concrete is not necessarily a high-strength concrete. Research and practice show that designing for durability involves more than specifying compressive strength. The researcher identified parameters, based on current practice and research results, that enhance the performance of concrete decks. These include specified fly ash, silica fume, and ground-granulated blast furnace slag replacement as percentages of the total cementitious materials content; maximum water–cementitious materials ratio; maximum concrete permeability; and 6-ksi maximum concrete compressive strength. (Russell 2004, 13, 29).

In 2006 a life-cycle cost analysis was performed on two concrete highway bridge decks built in a corrosive environment using HPC and conventional concrete. The analysis showed an estimated service life of the HPC deck from 3 to 10 times the life of the conventional deck. In addition, the HPC deck was found to be more cost-effective than the conventional deck, with agency life-cycle cost about 40 to 45 percent lower and the user's life-cycle cost about a third the cost of the conventional deck (Daigle and Lounis 2006).

SCC

Extensive research in the past 20 years indicates important benefits from the use of SCC in bridge construction (Bailey et al. 2005; HDR 2012; Henault 2014; Ozyildirim 2008). In areas of the country where concrete suppliers and contractors were unfamiliar with SCC, there were some less than desirable outcomes. Yet experienced suppliers and contractors are consistently delivering structures with enhanced service life and life-cycle costs through the use of SCC.

UHPC

The enhanced durability of UHPC compared to conventional concrete is expected to result in structures with a longer service life and reduced maintenance needs compared to those constructed with conventional concrete, and thus reduced life-cycle costs. Piotrowski and Schmidt (2012) conducted a life-cycle cost analysis of two replacement methods for the Eder Bridge in Felsberg, Germany. One used precast UHPC box girders filled with lightweight concrete and the other used conventional prestressed concrete bridge girders. The UHPC bridge with the higher initial costs was predicted to have a lower life-cycle cost over 100 years. The 2013 FHWA UHPC state-of-the-art report found that research had not yet been conducted to demonstrate that cost savings from the greater durability of UHPC compared with conventional concrete will be sufficient to offset higher initial cost of the material and thus reduce life-cycle cost. The report recommended research on the cost-effectiveness of UHPC in various applications. (Russell and Graybeal 2013, 67-69).

FRP Composite Technology

The technologies in this category are externally bonded FRP reinforcement; FRP deck elements; FRP beams, girders, and appurtenances; FRP rebar; and FRP prestressing tendons (strand or bar).

A National Institute of Standards and Technology study used life-cycle cost comparisons of three FRP composite bridge deck designs and a conventional concrete deck to illustrate a proposed standard method for life-cycle cost evaluation of new materials and designs (Ehlen and Marshall 1996). The results indicated that “new technology introduction” costs, the extra time and labor required to design and monitor a project involving a new technology, could negate the long-term cost savings obtainable from FRP decks in initial projects, but once the new technology introduction costs are spread over several projects, they become negligible (Ehlen and Marshall 1996, 44–45). More recent investigations of FRP bridge deck panels (Hastak et al. 2004) and FRP bridge superstructure elements (Eamon et al. 2012) have concluded that life-cycle cost savings are to be expected, compared with conventional construction, because savings in operating costs and from longer lifetimes outweigh higher construction costs.

Theoretical and limited case study investigations have concluded that construction with FRP has higher initial cost than construction with conventional materials (Alampalli et al. 2002, Soroushian et al. 2001), partially because of material costs and partially because of the experimental nature of the product, although the use of the materials for a bridge superstructure offers an advantage of faster construction compared with concrete (Alampalli et al. 2002). Reports from the IBRC projects indicate that these theoretical studies on costs are substantiated, although in the case of FRP externally bonded reinforcement, there could be an immediate cost savings (Harichandran and Baiyasi, 2000).

Available field data are too limited to support estimates based on field experience of the comparative life-cycle costs of using FRP materials, either as rebar or decks during construction or in externally bonded reinforcement for repair.

Corrosion Control Technologies: Concrete Reinforcement

The technologies in this category include three types of concrete rebar: solid and clad stainless steel, low-chromium, and galvanized.

Coating reinforcement steel with epoxy became mainstream in the 1980s to extend the service lives of highway structures exposed to chlorides from deicing chemicals and spray and splash from saltwater. Research on epoxy coating suggests it can add 5 to 15 years of service life compared to the use of bare steel (Kahl 2007). Corrosion-resistant rebar materials are intended to add even more years of service life. The technologies in this category that were examined in the IBRC program include three types: low-chromium, galvanized, and solid and clad stainless steel rebar.

Some research results in the literature suggest the service life of reinforced concrete can be increased by the use of corrosion-resistant reinforcing steel. The Virginia Transportation Research Council (VTRC), which is affiliated with the Virginia Department of Transportation (VDOT), issued reports in 2007 and 2018 that examined the effect that cracks in bridge decks can have on chloride penetration and the onset of rebar corrosion (Balakurnaran et al. 2018). VTRC conducted a literature review and studied 37 highway bridge decks. Ten of the decks were older (built from 1968 to 1971) and built with uncoated rebar. The other 27 were built with epoxy-coated rebar from 1984 to 1991. Because all 37 decks predated VDOT's use of corrosion-resistant rebar (which began in the 2000s), the ability of rebar technologies to resist corrosion under different chloride exposures had to be modeled based on the study results.

Service life estimates from VTRC's modeling suggest that when decks have low to medium cracking frequencies, both low-chromium and stainless steel rebar offer good corrosion resistance. With medium crack frequencies, low-chromium steel rebar was estimated to resist corrosion for more than 50 years. However, with high crack frequencies that allow higher chloride diffusion under heavy use of deicing chemicals, the time to corrosion onset in low-chromium steel was estimated to be as soon as 30 years. In the case of stainless steel, both the frequency of cracking and degree of chloride diffusion through the cracks had little effect on corrosion rates, as service life was estimated to exceed 150 years

under all circumstances. The report concluded that because repairing cracks can be expensive, corrosion-resistant technologies such as low-chromium and stainless steel rebar can be cost-effective on a life-cycle basis under conditions of high chloride exposure.

VTTC prepared a 100-year life-cycle cost comparison of epoxy-coated rebar and the two types of corrosion-resistant rebar, as shown in Table 4.1. Based on its modeling and its life-cycle estimates—which assume a reduced need for crack sealing and overlays and patching of concrete decks with corrosion-resistant rebar—VTTC recommended that VDOT undertake follow-up validation studies of newer bridge decks built with low-chromium and stainless steel rebar.³

Another life-cycle cost comparison of low-chromium steel rebar was conducted by the Michigan Department of Transportation (Kahl 2007). The investigator concluded that low-chromium steel rebar exhibits corrosion resistance, higher yield strength, and a lower life-cycle cost than epoxy-coated rebar. The low-chromium steel rebar was estimated to provide an additional 12 years of service life over epoxy-coated rebar, which could justify its higher initial investment under some applications. The investigator concluded that low-chromium steel rebar may be justified on a life-cycle basis when applied on high-volume bridges where service disruptions from deck repairs can be very costly.

³ Table 4.1 shows undiscounted future expenditures. If future expenditures are discounted at a rate of 3 percent per year, the present values of the 100-year life cost including patching and user costs are \$560 per yd² for epoxy coated, \$426 for low-chromium, and \$483 for stainless steel. If expenditures are discounted at 0.6 percent, the 2018 rate specified by the Office of Management and Budget for discounting constant-dollar expenditures over periods of 30 years or longer in evaluations of federal government programs (OMB 2018), the present values are \$915 per yd² for epoxy coated, \$631 for low-chromium, and \$483 for stainless steel.

TABLE 4.1 Life-Cycle Cost Analysis of Epoxy-Coated and Corrosion-Resistant Rebar

Rebar Type	Epoxy-Coated	ASTM A1035 (low-chromium steel)	ASTM A955 (stainless steel)
Rebar cost, \$/lb	1.20	1.65	3.50
Rebar construction cost, \$/yd ²	72	99	210
Deck construction cost, \$/yd ²	345	372	483
Seal cracks in deck with ECR, \$/yd ²	45	-	-
Polymer overlay @ 20 years, \$/yd ²	60	-	-
Concrete overlay @ 40 years, \$/yd ²	150	-	-
Polymer overlay @ 50 years, \$/yd ²	-	60	-
Concrete overlay @ 70 years, \$/yd ²	150	150	-
100 year life cost, \$/yd²	750	582	483
Patch overlay @ 60 years, \$/yd ²	30	-	-
Patch overlay @ 90 years, \$/yd ²	30	30	-
100 year life cost including patching concrete overlays, \$/yd²	810	612	483
User cost for concrete overlay @ 40 year, \$/yd ²	150	-	-
User cost for concrete overlay @ 70 years, \$/yd ²	150	150	-
100 year life cost including patching concrete overlays and user costs for overlays, \$/yd²	1,110	762	483

Assumptions:

60 lb of reinforcement per yd² of deck.

Costs based on 2009 and 2010 (through August) bid tabs.

A4 concrete @ \$852.24 per cubic yard = 213.06 per yd.²

Mobilization for deck construction @ \$50.00 per yd.²

Saw cut grooves @ \$10.00 per yd.²

Cracks are linear and 9-ft apart = 1 ft of crack per yd² of deck @ \$45.36 per ft.

ASTM 1035 reinforcement time to corrosion is four times that of epoxy-coated rebar (ECR).

Solid stainless and stainless last more than 100 years.

User cost for polymer overlay and patching concrete overlay after 20 years is zero.

User cost for concrete overlay equals cost of overlay.

SOURCE: provided to the committee by Michael Sprinkel, Associate Director, VTRC.

Corrosion Control Technologies: Coating and Anodes

The main IBRC corrosion control technologies used in bridge repair are metallizing (coatings) and galvanic protection (sacrificial anodes). The use of metallizing and sacrificial anodes as forms of corrosion control for highway structures was pioneered in Florida in the 1980s to protect bridges in salt-laden marine environments prone to concrete deterioration from corroded reinforcement. Florida's applications and follow-on research have focused primarily on thermally-applied zinc coatings

(metallizing) and anode systems (jacketed and point-specific) using zinc and aluminum (Larson 2018; Troconis de Reincon et al. 2018). Florida's high environmental humidity and saltwater-exposed bridges made the anode technologies more effective. The reduced resistivity due to moisture in the concrete and the high rate of oxygen diffusion in the splash zone resulted in higher passivating effects of the cathodic currents. Florida also evaluated bridges that have metallizing systems and humectants, which are substances that assist in the retention of humidity at the interface of the concrete. Various types of humectants were studied. Lithium-salt-based ones were found to perform particularly well by keeping humidity high at the interface to enable a higher current in the zinc and more effective corrosion protection as a result.

Likewise, a study conducted in Australia evaluated sacrificial anodic protection systems as a corrosion control measure for bridge decks in coastal environments (Moore et al. 2012). As in Florida, the study indicated good success with sacrificial anodic systems, especially zinc strip anodes. It was noted that sacrificial anode systems were particularly cost-effective on smaller structures or application areas.

Florida's and Australia's metallizing and anodic technologies were essentially the same ones investigated in the IBRC program; however, their experience is primarily applicable to bridges in marine environments under high humidity conditions. Most of the applications in the IBRC program did not involve bridges in marine environments or bridges exposed to high levels of humidity. The literature contains few studies of these technologies when used outside marine environments. Because the principal application of coatings and anodes has been for the repair of concrete, the literature is also deplete of life-cycle studies of these technologies when building a new bridge or installing a new bridge deck over an existing superstructure.

HPS

Evidence of Field Performance

HPS has gained general acceptance. Approximately 500 HPS bridges have been constructed in 47 states since the first bridge project in 1997. Bridge owners are specifying HPS to build cost-effective structures

with improved strength, weldability, toughness, and corrosion resistance. The HPS-70W grade is classified as a weathering steel that is suitable for use in the unpainted condition. Assessments have been made to investigate the protective rust patina that forms to provide the corrosion resistance of the material. The assessments have included visual inspection and laboratory testing of physical samples. HPS girders that are designed, fabricated, and constructed according to state standards and national specifications have been performing very well (Barth and McConnell 2010; Wilson and Raff 2012; Wiss, Janney, Elstner Associates 2013).

Life-Cycle Cost Comparisons

A HPS bridge cost comparison was prepared by HDR Engineering and the University of Nebraska, Lincoln, and presented at the HPS Bridge Workshop on October 22, 2007. The study compared weight, girder depth, and cost of 49 girder configurations for a range of span lengths, girder spacing, and steel types. The weight savings for a typical bridge using the HPS 70W instead of the lower strength HPS 50W were in the range of 8 to 14 percent. The cost savings for a typical HPS 70W bridge were in the range of 2 to 9 percent factoring in the slightly higher cost of the HPS 70W material. The hybrid designs were the most economical when using HPS 70W on the most highly stressed plates in the girders and HPS 50W on the other plates (Power 2007). Additional cost savings can be realized when using HPS 70W in shipping and erection, foundations, and reduced approach fill heights.

ABC

Evidence of Field Performance

Although the use of ABC is recent relative to the anticipated design life of bridges, indications to date are that field performance is typically at least as good as conventional construction. A state with significant experience with and implementation of ABC is Utah. Although Utah did not have ABC projects funded by the IBRC program, the Utah Department of Transportation (UDOT) made ABC a common practice during the past decade and was the first state to do so. The state has built the largest population of bridges

constructed with ABC technologies in the country. The department published an extensive evaluation of the performance of Utah ABC projects through 2016 (UDOT 2016). The investigators visited 44 Utah bridges constructed with ABC components between 2003 and 2012, completed a cursory inspection of each, and determined general performance. ABC technologies evaluated included full-depth and partial-depth precast concrete deck panels, precast abutment elements, and prefabricated superstructure spans installed using self-propelled modular transporters or moved into place with lateral or longitudinal slides. Summary findings were that bridges built with ABC details similar to current UDOT standards were generally performing very well and that bridges that did not adhere to the standards were generally performing fairly.

A 2012 report of the National Cooperative Highway Research Program (NCHRP) Domestic Scan program *Best Practices Regarding Performance of ABC Connections in Bridges Subjected to Multihazard and Extreme Events* described investigations of ABC projects in eight states (Kapur et al. 2012). Findings included that ABC connections were generally perceived to perform the same as conventional connections over time.

Life-Cycle Cost Comparisons

The states vary in their approaches to evaluating life-cycle costs of ABC relative to conventional construction. Utah, the first state to move to ABC as a standard practice, does not compare costs of ABC with conventional bridge construction. Instead, the state prioritizes traffic mobility and estimates project costs based on project limitations. The state also focuses on reducing construction schedules, thereby lessening impacts to the traveling public, and minimizing total project costs. It uses ABC in all projects for which a reduction in total project cost (price plus time) can be achieved. For total project costs, Utah includes both direct construction costs and indirect costs such as maintenance and delay-related user costs. The state evaluates impacts to the public by considering maintenance of traffic, construction schedule, and project-specific critical features such as environmental and railroad constraints. The state uses its own ABC decision-making process (UDOT 2017, 20-3).

The Connecticut Department of Transportation (CTDOT) has also developed its own ABC decision process methodology (CTDOT 2017) to assess the viability of ABC technologies during the preliminary design phase of projects involving the replacement of bridge decks, superstructure spans, or entire bridges. The state's ABC Decision Matrix has been adopted as a bridge design standard practice in Connecticut. A User Guide explains the use of the ABC Decision Matrix worksheet and definitions of the input variables. The methodology determines the effect of ABC on the overall cost of the bridge, with overall cost including bid price, the cost of managing the project (construction engineering and inspection costs), and road user impacts. Preliminary road user impacts are assessed by estimating and comparing the road user delay time for conventional construction to a proposed ABC construction methodology. The ABC design methodology is strongly considered when the results of the worksheet analysis are favorable for ABC. Values of other parameters in the matrix may still lead to a favorable ABC rating and possible decision to use ABC in a project regardless of the level of road user impact. CTDOT has implemented this ABC evaluation process in more than 30 projects to date.

Table 4.2 shows an example of an application of the construction cost and user delay comparisons that are components of the Connecticut DOT methodology. The example is a comparison of ABC and conventional construction for replacement of a bridge on a state highway. In this case, it was estimated that ABC would have a lower construction cost than the conventional method and would save road users delay by reducing the duration of road closure from 90 days with conventional construction to 49 days with ABC.

TABLE 4.2 Example of a Comparison of ABC and Conventional Construction Cost (Fields and Heredia 2018, 19)

Project: Replacement of a bridge over a stream on a state highway

Project alternatives

Conventional construction method:	Integral bridge with precast abutments, wingwalls and beams; cast-in-place deck and parapets
ABC method:	Precast rigid frame, footings, and wingwalls

User Delay Impact Comparison

Average Daily Traffic (ADT):	4,100 vehicles per day
Delay time per vehicle during construction:	20.98 minutes

Construction impact duration:	
Conventional construction	90 days
ABC	49 days

Aggregate delay:	
(= ADT x [delay per vehicle] x duration):	
Conventional construction	5,376 person-days
ABC	2,927 person-days

User impact change with ABC:	-2,449 person-days
(negative indicates delay reduction with ABC)	

Construction Cost Comparison

Estimated conventional construction project cost:	\$2,624,000
Estimated premium for ABC:	-10%
(negative indicates ABC estimated to be less than conventional construction cost)	
Construction cost change with ABC:	-\$262,400

Estimated construction engineering and inspection (CE&I) costs per month:	\$23,563
Time difference with ABC:	-1 month
CE&I cost change with ABC:	-\$23,563

Summary

Construction cost change with ABC:	-\$262,400
CE&I cost change with ABC:	- 23,563
Net cost change with ABC:	-\$285,963

User impact change with ABC:	-2,449 person-days
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A set of decision making tools for use by highway agencies to quantitatively determine whether ABC would be beneficial for a specific project, compared with conventional construction, was developed in a 2011 project sponsored by FHWA and 8 state departments of transportation through the Transportation Pooled Fund Program (Doolen et al. 2011). The project included development of software and a user manual.

Other studies have documented the life-cycle cost advantages that ABC provides over conventional construction. For example, a 2017 case study of the M-100 over CN Railroad Bridge replacement project in Michigan showed that the economic impact of conventional construction on surrounding businesses was 16 times greater than the economic impact of ABC (Yavuz et al. 2017).

DATA FROM THE STATES ON PERFORMANCE OF THE IBRC BRIDGES

The 10 state highway agencies that were interviewed for this study provided information on the performance of bridges in their systems that were the sites of IBRC projects, including records of the most recent results of routine inspections of the bridges, as well as observations on performance in response to interview questions.

Historical inspection results were analyzed to determine if bridges that were the sites of IBRC projects exhibited accelerated or reduced rates of deterioration, as compared with experience and other analyses of NBI data (Nasrollahi and Washer 2015). NBI data from past inspections for the IBRC projects identified for each of the 10 interview states were obtained from the FHWA Long-Term Bridge Performance (LTBP) Program bridge portal. These data provide a component-level rating for the deck, superstructure, and substructure of the bridge on a rating scale that varies from 0 (Failed condition) to 9 (Excellent condition). The data include the most recent inspection results and historical inspection records. The period for which historical records were available varied by state and by bridge, from 35 years (1983 to 2017) to 7 years (2011 to 2017).

The data provided by the bridge portal were compared with the project descriptions in the FHWA IBRC database and inspection results provided by the interviewed states to identify inconsistencies. There

were a total of 121 IBRC projects in the interview states identified in the FHWA IBRC database. From these 121 projects, inspection records for 73 bridges were examined.

The data indicate that the deterioration pattern for these 73 bridges is typical of deterioration for all highway bridges. The average condition rating for the deck, superstructure, and substructure components of the bridges was 7.1, 7.3, and 7.1, respectively. A condition rating of 7 is considered “Good” condition.

The average condition rating for the deck components included in the study was 7.1, while the lowest condition rating for the deck components was 5 (Fair) for two bridges. However, examination of the historical record for one of the bridges showed that the rating was unchanged from 1998, indicating that the deck was not part of the IBRC project completed on that bridge. The FHWA IBRC database indicated that the IBRC-funded project consisted of FRP repairs to superstructure elements. The second bridge was an FRP glulam repair, according to the FHWA IBRC database. There were insufficient data available to determine if the IBRC technology was related to the low condition rating, and it was notable that the superstructure and substructure components were rated 5 (Fair) and 4 (Poor), respectively. These data indicate that the bridge overall had a high level of deterioration. The FRP glulam repair was likely applied to a deteriorated bridge to extend its service life, and therefore these data do not reflect the performance of the IBRC technology.

Several IBRC projects involved the simultaneous construction of a bridge deck using corrosion-resistant reinforcing paired with the construction of a bridge deck using conventional reinforcing. The two bridge decks were located on adjacent bridges, such that the structures were exposed to similar traffic levels and environmental conditions. For example, Missouri project MO 2000-01 included the construction of two decks on adjacent bridges. One deck was constructed using solid stainless steel rebar and the second was constructed using epoxy-coated rebar. The current condition rating for each bridge is 7 (Good). New Hampshire project NH-2002-01 featured a pair of bridge deck replacements for bridges carrying I-93 over a railway. One deck was constructed with low-chromium steel rebar and the second was constructed with epoxy-coated rebar. Both decks are currently rated an 8 (Very Good). A second

IBRC project in New Hampshire (NH-2002-02) consisted of twin bridge deck replacements with galvanized rebar in one deck and epoxy-coated rebar in the second deck. Both decks have current ratings of 8 (Very Good). These data illustrate that the IBRC technologies are performing in a similar manner to conventional technologies. It is not possible to predict future performance based on the available information.

To evaluate the overall performance of bridge decks constructed with IBRC technologies, the condition ratings were analyzed for 43 projects that included renovation or construction of decks. The historical condition ratings for the 43 decks starting from 2005, when the IBRC program ended, through the most recent available inspection year (2017) were tabulated and the average condition rating versus years elapsed since IBRC project construction was calculated. For comparison, average deck condition ratings were tabulated for a sample of 10 bridges in each of the same states that are less than 150 ft in length and were constructed in 1999. As shown in Figure 4.1, the average condition rating of the IBRC bridges was slightly over 8 (Very Good), 6 years after the IBRC project, and had diminished to 7 (Good) by 17 years after the project. In the figure, deterioration rates of the IBRC and non-IBRC bridges appear closely similar. A 17-year period is too short, compared with the intended service lives of the decks, to fully judge comparative performance of alternative technologies. However, the graph indicates that the available bridge rating data provide no indication of inferior or superior performance for the IBRC decks, compared with conventional construction.

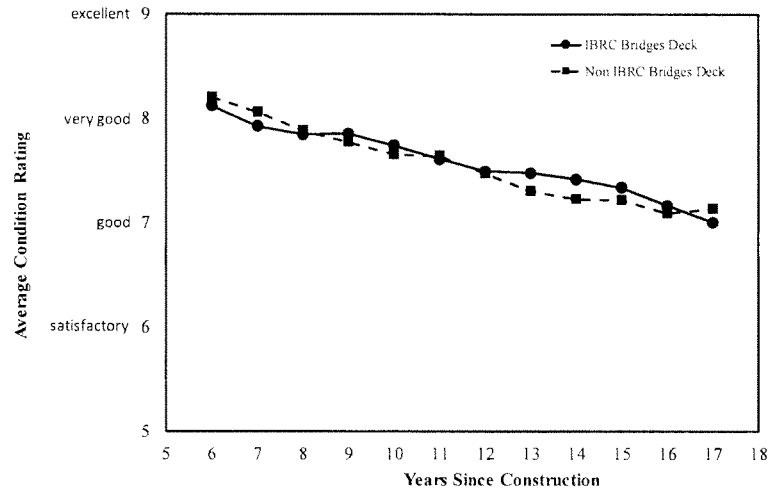


FIGURE 4.1 Average condition rating for bridge decks in IBRC bridge deck projects in interview states, compared with condition of decks in a sample of non-IBRC bridges in the states constructed in 1999. Sources: State highway agency bridge inspection reports, FHWA NBI database

The average condition rating for the superstructure, for the 73 IBRC bridges in the interview states for which inspection records were examined, was found to be 7.3. Six projects had a superstructure condition rating of 5 (Fair). These included the previously identified glulam project and two FRP deck projects in which the IBRC technology was not implemented on the superstructure component. Therefore, the relatively low superstructure condition rating for these three bridges cannot be ascribed to the IBRC technology.

Two of the bridges with superstructure condition rating 5 (Fair) were HPC projects involving bulb tee girders in Virginia. According to the interview with Virginia Department of Transportation staff, construction- and design-related problems with the bulb-tee girders resulted in the relatively low condition rating for the two bridges. The design of the bulb tee girders included a narrow web with inadequate space for longitudinal tendon ducts. The inadequate space resulted in longitudinal cracking

and spalling in the girder webs at the time of construction (Sprinkel and Balakumaran 2017). The state is no longer using that design today based on the experience from the IBRC program.

Finally, one project on a bridge with a present superstructure condition rating of 5 (Fair) was an externally bonded FRP reinforcement project to repair a superstructure that was deteriorated at the time of the project. Based on the historical inspection records, the superstructure component was also rated a 5 at the time of the IBRC program, and the rating was increased to a 6 during the time interval of 2006–2011. In other words, the externally bonded FRP reinforcement was used as a repair that improved the condition of the member. In summary, the inspection results for the superstructure component did not show any unusually rapid deterioration of bridges that appeared to be related to IBRC technologies or the IBRC program.

The substructure component had an average rating of 7.1. The lowest component ratings for the substructure were two bridges with a rating of 4 (Poor). This includes the previously mentioned glulam project and one other bridge in which the IBRC technology was an FRP deck and therefore the substructure condition is not related to any IBRC technology. There were four substructure components with a rating of 5 (Fair), two of which were externally bonded FRP reinforcement repair projects and two of which were projects involving superstructure elements. There was no evidence found that IBRC technologies involved in these projects were subject to accelerated deterioration.

Data were analyzed to determine the overall performance of corrosion-control technologies for reinforcing steel. This analysis considered solid and clad stainless steel rebar and low-chromium steel rebar used in the construction of decks. Ten projects were identified, and the average deck condition rating was found to be 7.2, with three decks rated an 8 (Very Good), six rated 7 (Good), and a single deck rated as a 6 (Satisfactory). The data were also analyzed to determine the current condition of elements formed from HPC. There were a total of 16 projects that used HPC. The average ratings for the superstructure, substructure, and deck were 7, 7.25, and 7.31, respectively.

Overall, the analysis indicated that based on the available data, bridges that were part of the IBRC program had typical deterioration patterns. It should be noted that the IBRC program was completed in

the time period of 1998–2005, and therefore components constructed or repaired during the program have been subjected to 13 to 20 years of service, which is a relatively short period of time for a bridge to deteriorate significantly, considering the minimum 75-year design life of bridges built today. Therefore, it is difficult to determine at this time if the use of the IBRC technologies is effectively extending the service life of bridges as compared with conventional technologies.

5. CONCLUSIONS AND RECOMMENDATIONS

The conclusions and recommendations in this chapter respond to the four tasks in the committee's

Statement of Task:

- Analysis of the performance of bridges that received IBRC funding in meeting the goals of the program.
- Analysis of the utility of the innovative materials and technologies used in IBRC projects in meeting needs for a sustainable and low life-cycle cost transportation system.
- Recommendations to Congress on how the installed and life-cycle costs of bridges could be reduced through the use of innovative materials and technologies, including, as appropriate, any changes in the design and construction of bridges needed to maximize the cost reductions.
- A summary of any additional research that may be needed to further evaluate innovative approaches to reducing the installed and life-cycle costs of highway bridges.

The first three sections in this chapter present the committee's conclusions on the extent to which the IBRC projects met the goals of the program, the utility of the technologies, and opportunities to reduce life-cycle costs of bridges through programs to foster innovation and through development and evaluation of specific technologies. The final section presents recommendations for federal and state actions to promote cost-saving innovation through an incentive grant program and through research.

PERFORMANCE OF THE IBRC PROJECTS IN MEETING THE GOALS OF THE PROGRAM

The legislatively defined goals of the IBRC program were:

1. Development of new, cost-effective, innovative materials for highway bridge applications.
2. Reduction of maintenance costs and life-cycle costs of bridges, including the costs of new construction, replacement, or rehabilitation of deficient bridges.
3. Development of construction techniques to increase safety and reduce construction time and traffic congestion.

4. Development of engineering design criteria for innovative products and materials for use in highway bridges and structures.
5. Development of cost-effective and innovative techniques to separate vehicle and pedestrian traffic from railroad traffic.
6. Development of highway bridges and structures that will withstand natural disasters, including alternative processes for the seismic retrofit of bridges.
7. Development of new nondestructive bridge evaluation technologies and techniques.

As described in the following section, the committee identified projects that were successful in advancing most of these goals, as well as projects that attempted to fulfill the goals but fell short. Some of the goals received little attention in the program.

1. Development of new, cost-effective, innovative materials for highway bridge applications

IBRC contributed most significantly to promoting the application for highway bridges of four innovative materials: advanced concrete materials, FRP composites, corrosion-resistant steel rebar, and HPS. These materials were available and in use in other applications before the IBRC program, but had been used rarely or not at all in highway bridges. Use of these materials probably would have grown in the absence of the program, but it is likely that the experience that the state highway agencies gained from IBRC projects substantially accelerated their adoption.

Advanced Concrete Materials

HPC for use in all bridge elements was developed under the first SHRP in the early 1990s (Halladay 1998). FHWA undertook a program in 1993 to promote use of HPC in highway bridges, which included a series of “showcase” workshops for bridge design and construction professionals and construction of demonstration bridges (Russell et al. 2006, 1). At the time of the first HPC showcase in Texas in 1996, six HPC bridges were under construction in the United States (FHWA 1996).

The IBRC program provided funding to approximately 81 HPC projects, 12 SCC projects, and 4 UHPC projects, located in 37 states. The program thus was instrumental in introducing states to the material and significantly advanced HPC implementation.

Use of HPC has become standard practice in most states today. Two-thirds of the states that responded to the AASHTO Committee on Bridges and Structures survey reported using HPC and SCC, with most following state-developed specifications. Nearly half of the states that responded reported using UHPC (see Table 3.3). The AASHTO survey did not determine the extent or characteristics of use of UHPC by these states.

FRP Composites

The feasibility of the use of FRP composites in construction of new bridges and rehabilitation of existing bridges was demonstrated in the 1980s and early 1990s in projects outside of the United States. By the 1990s, a few U.S. states were experimenting with this technology in bridge projects.

To compare U.S. polymer composite bridge technology with the state of the technology abroad, FHWA organized a tour of 23 project sites in Europe and Japan for U.S. government and industry representatives and researchers. The tour report concluded that U.S. composite bridge technology was not lagging behind the technology implemented in the visited countries, but that all countries lacked comprehensive design standards and specifications as well as programs for detailed long-term monitoring and evaluation (FHWA 1997). Also in response to the interest in FRP composite materials in the 1990s, AASHTO established Technical Committee T-6, Fiber Reinforced Polymer Composites, to develop specifications, standards, and guidance for bridge owners. The other IBRC technologies were advanced by existing AASHTO technical committees.

The initiation of the IBRC program in 1998 coincided with the growing interest in the technology. Trials of FRP materials were a major interest of IBRC participants. Approximately 161 projects in 30 states involving use of FRP materials received funding. These included 41 projects in 23

states that used externally bonded FRP reinforcement. More than 40 percent of IBRC grant funds went to projects that used FRP materials (see Table 2.2).

Today most state highway agencies use externally bonded FRP reinforcement and nearly half of those that responded to the 2018 AASHTO survey use FRP rebar. However, few of the states that responded to the survey use or have specifications for FRP deck elements, FRP superstructure elements, or FRP prestressing tendons (strand or bar) (see Table 3.3). Most states had little or no prior experience with these materials and IBRC helped fund large numbers of FRP applications in the majority of states. Therefore it is likely that the experience of the IBRC program influenced state practices today, including the popularity of externally bonded FRP reinforcement as well as the hesitance of many states to use the other FRP technologies.

Corrosion-Resistant Steel Rebar

To protect bridge deck reinforcement from corrosion, the standard practice for bridge deck construction for many years was to provide two levels of corrosion protection by using sufficient concrete cover and the use of epoxy-coated rebar. In the early 1990s, several state departments of transportation began research on alternative reinforcement materials to increase the service life of bridge decks. IBRC grants provided opportunities for states to evaluate alternative rebar materials.

Alternative metallic reinforcement materials used in IBRC projects were solid stainless steel and stainless steel clad rebar, low chromium steel rebar, and galvanized rebar. The IBRC program included approximately 51 projects that used these materials in 30 states. IBRC projects also used FRP rebar.

According to the AASHTO Committee on Bridges and Structures 2018 survey of state highway agencies, 22 states currently use stainless steel rebar in projects, with 9 states also indicating that they use both galvanized and low-chromium steel. Although standards and specifications are available for these materials, there may be some concerns about product availability in certain areas of the country and the initial cost of the products.

HPS

HPS for highway bridges was developed through a cooperative research program formed in 1994 by FHWA, the Office of Naval Research (ONR), and the American Iron and Steel Institute (AISI). The HPS Steering Committee was formed to guide the research and support adoption of HPS (Lwin 2002, 4). The first U.S. HPS highway bridge opened in December 1997 (FHWA 2002). By 2002, 30 HPS bridges were in service in 10 states (FHWA 2002); by 2003, 46 bridges in 14 states were in service and 65 were under construction in 17 states (Mistry 2003, 6). In 2018, about 500 HPS bridges are in service in 47 states (AISI 2018; SMDI 2017).

The creation of the IBRC program in 1998 was a timely complement to the FHWA—ONR—AISI initiative. The first five grants for HPS projects were awarded in 1999. From 1999 to 2005, 47 IBRC projects in 29 states demonstrated use of HPS in bridges. IBRC funding reinforced the government–industry initiative by providing an incentive for states to build HPS bridges, probably earlier than many would have done so without the program.

2. Reduction of maintenance costs and life-cycle costs of bridges, including the costs of new construction, replacement, or rehabilitation of deficient bridges

New technologies can reduce life-cycle costs in several ways: through reduced initial construction cost (provided the reduction is not offset by lost service life or higher maintenance costs), longer service life, lower maintenance costs, or lower user costs. As described in Chapter 4, the data available to the committee on the IBRC projects does not contain the information needed to compare life-cycle costs of alternative technologies. Direct comparison of life-cycle costs of two alternative technologies would require data on construction costs, maintenance and rehabilitation costs over a period of decades, and expected service lives, for bridges that use the alternative technologies and that are similar with respect to traffic and climate.

Examples of life-cycle cost comparisons from sources other than the IBRC projects are cited in Chapter 4. The available comparisons are projections that depend on assumptions about performance of

materials over long periods, rather than empirical observations of cost differences. Published studies cited in Chapter 4 provide evidence that HPC bridge decks, low-chromium and stainless steel rebar, HPS girders, and ABC reduce bridge life-cycle costs when used in appropriate applications. In most of these comparisons, cost savings from improved performance (or from reduced user costs in the case of ABC) are projected to offset somewhat higher highway agency initial construction costs, although initial cost savings in some applications are also reported. The evidence available from published studies is incomplete, and economic comparisons are especially scarce.

In spite of these limitations of the documented evidence on cost and field performance, the physical properties of certain of the IBRC technologies provide grounds for expecting that their use can provide life-cycle cost savings. In addition, the extent of acceptance that some of these technologies have gained with the state highway agencies in recent decades is evidence that the agencies are experiencing performance that provides savings or that they expect savings.

On the basis of these kinds of evidence--the physical properties of materials, published cost comparisons, and growing acceptance in state highway programs--the committee concludes that it is likely that the IBRC program contributed to the reduction of costs through promotion of use of the following materials:

- HPC: Use of HPC in bridge construction can reduce life-cycle cost because the durability of the material extends bridge service life and because of savings attainable in construction cost. Properties of HPC allow bridges to be constructed more quickly and with less material, compared with conventional concrete. For example, use of high-strength HPC allows for shallower girder cross sections, reducing the required height of approach spans and also reducing earthwork requirements. Alternatively, longer girders can be constructed with high-strength HPC, reducing the number of supports required.
- HPS: Use of HPS can reduce bridge construction costs because its greater strength allows the bridge to be constructed with less material, compared with construction that uses conventional materials.

Additional savings can be realized in transporting material, erection, constructing foundations, and earthwork.

- Corrosion-resistant steel rebar: Use of this material in bridge decks can reduce life-cycle cost by delaying rebar corrosion, thus extending service life. Avoiding deck repairs also avoids the user cost of delay during repair work.
- Externally bonded FRP reinforcement: This lightweight material is used for repairing bridges that have experienced deterioration or for strengthening bridges to increase their load-carrying capacity. Repairs can be carried out faster and at lower initial cost than with alternative technologies.

Use of new technologies other than materials can also reduce initial and maintenance costs and extend service life. Such technologies demonstrated in IBRC projects include ABC, cathodic protection systems to control corrosion, and monitoring and instrumentation.

ABC reduces life-cycle costs primarily by reducing user costs during construction (motorist delays at construction sites), and also reduces initial construction costs for some projects, although currently ABC projects typically have somewhat higher initial construction costs. In addition, the off-site or near-site fabrication of elements and systems away from traffic (and if elements are constructed in fabrication plants, also away from weather constraints), allows enhanced quality control that can improve material quality and product durability, thereby producing longer-lasting performance with reduced maintenance cost. Other benefits include reduced environmental impacts and improved site constructability. These multiple benefits result in reduced life-cycle costs for ABC projects.

Corrosion control reduces maintenance and rehabilitation needs and extends the service life of the bridge.

A properly designed monitoring program can reduce costs by alerting the highway agency to incipient problems, allowing more efficient planning of maintenance and rehabilitation. Long-term monitoring of performance is needed to verify cost savings from the IBRC technologies in highway bridge applications and to identify the applications in which the technologies are most beneficial. The bridge innovation program proposed below would provide an opportunity for monitoring and evaluation.

3. Development of construction techniques to increase safety and reduce construction time and traffic congestion

ABC is the most significant IBRC technology for reducing the duration of traffic disruptions necessitated by bridge construction. The motivation for most ABC projects is to reduce on-site construction time and traffic congestion. In addition, because ABC reduces the duration of highway work zones, it increases safety for construction crews and travelers. These time savings are achieved in large part through off-site or near-site fabrication of bridge elements (such as pier caps) and systems (such as superstructure spans), with quick on-site installation.

Use of materials demonstrated in IBRC projects can also reduce construction time and increase safety. Use of SCC in place of conventional concrete in appropriate applications (primarily for the purpose of improving consolidation and quality) can reduce concrete placement labor requirements, leading to improved work site safety and reduced construction time. Use of prefabricated FRP decks can reduce construction time. Use of more durable materials such as HPC reduces traffic delay over the life of the bridge by reducing the frequency of maintenance and extending the life of the deck and substructure. IBRC materials (in particular HPC and FRP) were used in the prefabricated elements of approximately three-quarters of the ABC IBRC projects for which details were available to the committee. With materials that reduce the cost of bridge strengthening and rehabilitation, such as externally bonded FRP reinforcement, states can afford to upgrade more load-restricted bridges, eliminating the user delay costs of load restrictions.

4. Development of engineering design criteria for innovative products and materials for use in highway bridges and structures

The majority of the states that responded to the AASHTO survey on IBRC technologies today have special provisions or specifications established for HPC, SCC, UHPC, externally bonded FRP reinforcement, stainless steel rebar, metallizing, cathodic protection, HPS, and ABC (see Table 3.3). The

timing of the IBRC program was a stimulus for developing standards, specifications, and other forms of guidance for the new bridge materials and technologies that were coming into use beginning in the 1990s.

New Hampshire's Mill Street Bridge in the town of Epping is an example of how IBRC projects supported the development of standards and specifications. The bridge was replaced in 2004 with an ABC bridge that included HPC elements, following a 2002 IBRC award. The abutment footing, abutment stem, and mechanical connector details developed in this project were the origin of the precast concrete cantilever abutment details included in the first edition of the Precast/Prestressed Concrete Institute Northeast's (PCINE's) *PCINE Guidelines for ABC Using Precast/Prestressed Concrete Components*. These guidelines were subsequently updated with additional research and have been implemented in the northeast region of the country (PCINE 2014). The updated details are also included in the FHWA ABC manual (Culmo 2011). Similarly, certain of the guidelines are included in the *AASHTO Guide Specifications for ABC Design and Construction* (AASHTO 2018).

In a similar case, IBRC program funding motivated the development of new welding procedures for HPS. The Pennsylvania Department of Transportation constructed two HPS bridges with IBRC funding. Welding procedures developed during the research for these projects have been adopted nationwide.

As previously described, IBRC was the catalyst that stimulated state interest in use of FRP for bridge construction. In response to that interest, AASHTO established a standing technical committee (T-6, Technical Committee on Fiber-Reinforced Composites) to develop specifications, standards, and guidance. AASHTO has adopted five guide specifications (AASHTO 2008, 2009, 2012a, 2012b, AASHTO 2018a) and a standard specification (AASHTO 2013) for design of bridges and bridge elements using FRP materials. The AASHTO Committee on Bridges and Structures continues to develop standards and specifications to support use of FRP. Inspection and evaluation of structures that use FRP is an area that remains in need of standards or guidance.

5. Development of cost-effective and innovative techniques to separate vehicle and pedestrian traffic from railroad traffic

No IBRC project for which the committee had information appears to have had development of innovative techniques for separation of pedestrian and vehicle traffic from railroad traffic as a primary objective.

Seven IBRC projects were identified in the project documentation available to the committee as involving construction or strengthening of highway overpasses over railroads. The technologies applied were FRP decks, FRP rebar, externally bonded FRP reinforcement, SCC girders, HPC in a deck and girders, and hybrid steel girders.

6. Development of highway bridges and structures that will withstand natural disasters, including alternative processes for the seismic retrofit of bridges

IBRC technologies valuable for the construction or retrofit of bridges to resist earthquakes and floods include HPC, externally bonded FRP reinforcement, and HPS. In one IBRC project, use of HPC allowed construction of a longer span, eliminating the need for a pier in a stream bed and reducing the risk of scour damage. Externally bonded FRP reinforcement is commonly used to strengthen existing bridges to reduce risk of disaster damage.

Six IBRC projects involved seismic retrofit or seismic protection on new bridges, according to the project documentation available to the committee. The technologies involved were installation of monitoring instrumentation for evaluation of the performance of seismic bearings, replacement of seismic bearings on an existing bridge, installation of seismic bearings on a new bridge, installation of instrumentation to monitor response to seismic loads on a new bridge, construction of an HPC deck slab on a new bridge to reduce dead load and thus ease design of the substructure to meet seismic load requirements, and replacement of a bridge using ABC in a high seismic area.

7. Development of new nondestructive bridge evaluation technologies and techniques

No IBRC project for which the committee had information appears to have had development of nondestructive evaluation techniques as a primary objective. The records available to the committee indicate eight projects that included installation of sensors on bridges for monitoring of stress, deformation, rate of rebar corrosion, scour, or chloride ingress. As was the case with ABC, the FHWA instructions to the states encouraged applications demonstrating monitoring only in the later years of the program. Costs of monitoring technologies have declined substantially in recent years, limiting the relevance of the IBRC experience.

Summary: Performance of the IBRC Projects in Meeting the Goals of the Program

The projects completed under the IBRC program contributed substantially to fulfillment of at least five of the program's goals. The program was primarily valuable for motivating state highway agencies nationwide to gain experience with several technologies that had reached an advanced stage of development but had not yet been adopted for highway bridge construction in the United States. However, the program's contributions could have been greater if it had stronger provisions for in-service evaluation of the technologies demonstrated and for dissemination of project results. Grant recipients were not required to systematically monitor the performance in service of the innovative components of their projects. Records of projects were not systematically maintained and cost implications of new technologies were not documented. Consequently, performance over time of the projects cannot readily be evaluated and opportunities are reduced for agencies to learn from the IBRC experiences of others.

UTILITY OF THE IBRC TECHNOLOGIES

The committee's Statement of Task asks it to analyze the utility, compared with conventional materials and technologies, of each of the innovative materials and technologies used in the IBRC projects in meeting the need for a sustainable and low life-cycle cost transportation system. The committee

considered that the materials and technologies that have greatest utility are those that provide substantial cost savings, are widely applicable, and are readily available to highway agencies.

Conclusions about the utility of the IBRC technologies are presented in the following section for three groups of technologies: technologies that have been proven to be highly useful for reducing life-cycle costs and are of broad applicability; promising technologies that are at an advanced stage of development and have been applied but are not yet generally accepted and may require additional research, evaluation, or standards and specifications development; and technologies at a less advanced stage of development or those for which the utility is still uncertain.

Technologies of Proven High Utility and Wide Applicability

The IBRC technologies in this group are HPC and other advanced concrete materials (SCC and UHPC), externally bonded FRP reinforcement, HPS, and ABC. The technologies in this group share the following characteristics:

- The life-cycle cost reductions achievable with the technology, compared with older alternative materials or methods, are generally recognized and have been demonstrated in a large number of projects. The forms of cost reduction are:
 - reduced initial construction costs (attainable with HPC, externally bonded FRP reinforcement, HPS, and ABC).
 - increased durability that extends service life and reduces maintenance and rehabilitation needs (HPC).
 - reduced user costs through faster construction or reduced maintenance frequency (ABC).
- The technology is readily accessible to highway agencies. Materials suppliers and experienced contractors are available. Standards, specifications, and guidelines are established; most states that responded to the AASHTO 2018 state bridge engineers survey have developed specifications or standards for their use (see Table 3.3).

- The technology has become fundamental to highway bridge construction (or is becoming so), with applicability in many kinds of projects throughout the United States. Each of the technologies is used today by the large majority of states that responded to the AASHTO state bridge engineers survey, with the exception of UHPC, a relatively new material (see Table 3.3).

Contributing to the application of these important technologies was a major accomplishment of the IBRC program. Efforts to apply the technologies to highway bridges were under way before the IBRC program began; however, the program accelerated their development and adoption. Applications of these technologies made up a large portion of the program in terms of funding, numbers of projects, and numbers of states with projects (see Table 2.2).

Promising Technologies at an Advanced Stage But Requiring Further Development or Demonstration

The IBRC technologies in this group are FRP (other than externally bonded FRP reinforcement) and corrosion-resistant concrete reinforcement (low-carbon chromium steel, galvanized steel, and stainless steel rebar). These technologies have demonstrated potential for reducing the life-cycle costs of bridges, but their application has been more limited than for the technologies in the first group.

Solid or clad stainless steel rebar was used in approximately 29 IBRC projects, and a majority of states that responded to the AASHTO bridge engineers survey reported that the material is in use and that they have specifications for the material today (see Tables 2.2 and 3.3). However, galvanized and low-chromium steel rebar were used in few projects and few states report using these materials today. Life-cycle cost estimates cited in Chapter 3 suggest that use of these materials in place of conventional materials would result in savings. Obstacles to their greater use may be initial cost, lack of availability, and lack of awareness of the potential benefits of these rebar materials. Promotion activities would increase awareness and could lead to increased use and increased availability.

Projects featuring use of FRP materials for a variety of applications made up a major portion of the IBRC program (see Table 2.2). Today, externally bonded FRP reinforcement is used by nearly all the

states that responded to the AASHTO 2018 bridge engineers survey, and FRP rebar is used by nearly half of them (see Table 3.3). However, FRP deck elements, used in approximately 65 IBRC projects in 23 states, are used in construction today in less than one-quarter of states that responded to the AASHTO survey. Similarly, FRP prestressing tendons (strand or bar) and FRP superstructure elements, both demonstrated in multiple IBRC projects, are little used today (see Table 3.3).

Obstacles to fully realizing the potential benefits of these FRP technologies have included lack of standards or specifications, higher cost or limited availability of materials, lack of evaluations that document benefits, highway agency and contractor inexperience, negative impressions formed by unsuccessful results in early trials, and unresolved technical problems. A program of research, evaluation, standards and specifications development, and technology transfer to determine appropriate applications and attain greater benefit from the use of FRP in bridge applications is outlined later in Chapter 5.

Promising Technologies at a Less Advanced Stage

The IBRC technologies in this group include monitoring and instrumentation and corrosion control technologies other than the corrosion-resistant concrete reinforcement materials (including cathodic protection anodes, galvanic protection, electrochemical chloride extraction, metallizing, paint systems, and deck coatings). These technologies are promising as means of reducing life-cycle costs and some of them may become increasingly important in the future. However, at the time of IBRC, they attracted little attention from the states, and few projects that used them were funded (see Table 2.2).

The utility of cathodic protection systems, electrochemical chloride extraction, galvanic protection, and metallizing is to extend the service life of existing structures. These techniques were not new at the time of IBRC. SHRP had developed and evaluated cathodic protection and electrochemical chloride extraction methods for steel-reinforced concrete bridges. Presumably, these technologies were not among the highest priorities of bridge engineers at the time of the IBRC program. Research to demonstrate performance over time may be necessary to gain greater acceptance for these technologies.

Metallizing technology has advanced since IBRC. AASHTO and the National Steel Bridge Alliance (NSBA) collaborated with industry to develop a specification for thermal spray coating for steel beams that was adopted in 2017 (AASHTO/NSBA 2017). The use of this specification will help standardize metallizing methods across the nation, thus helping to achieve quality and value in the application of metallic thermal sprayed coating systems.

Monitoring technology costs have declined and capabilities have increased since the time of the IBRC program. Opportunities for reducing bridge life-cycle costs through improvement and application of monitoring are identified later in this chapter.

Summary: Utility of the IBRC Technologies

Certain applications in every category of IBRC technologies (HPC and other advanced concrete materials, FRP composites, corrosion control technologies, HPS, and ABC) showed high utility in the IBRC program for reducing bridge life-cycle costs. Several have achieved general acceptance in state highway bridge programs (including HPC, HPS, stainless steel rebar, and externally bonded FRP reinforcement). Others (including ABC and monitoring technology) could produce much greater savings if used more widely. Certain of the IBRC technologies (for example, FRP deck and superstructure elements) remain promising but will require further development or more systematic evaluation before their optimum use and full potential can be determined.

OPPORTUNITIES TO REDUCE INSTALLED AND LIFE-CYCLE COSTS OF BRIDGES THROUGH INNOVATION

Conclusions are presented in the following section on three topics: the importance of federal incentives for innovation, the importance of highway agency asset management and evaluation practices in fostering cost-saving innovation, and specific technological opportunities to reduce the installed and life-cycle costs of highway bridges.

Importance of Federal Incentives as Stimulus for Innovation in Highway Bridges

As described in Chapter 3, the evidence is strong that the IBRC program increased the use of innovative technology in highway bridges nationwide. The funds provided by the program mitigated the risk of innovation and motivated the use of new technologies. The greatest impact was through providing incentives for highway agencies to apply technologies that were already well developed and of proven benefit but had not become standard practice (for example, HPC and HPS). The program was less successful at increasing the application of technologies that were at earlier stages of development (for example, nondestructive evaluation and FRP deck and superstructure elements). The structure of the IBRC program did not have the features that would be required to advance such technologies toward implementation: planning to define specific objectives, a process to allocate funds consistent with objectives, coordination across multiple projects, and provision for systematic monitoring and evaluation.

A new federal incentive grant program for innovative bridge technology could continue the success of IBRC in accelerating the adoption of proven technologies that have not yet gained wide acceptance and also contribute to advancing less-developed technologies, by supporting state highway agency bridge projects that were coordinated as elements of research and evaluation studies. Long-term monitoring of the performance and costs of new materials is an urgent evaluation research need that could be organized through a new federal grant program. The recommendations in this chapter include a proposal for the structure of such a program.

Importance of Management and Evaluation Practices That Support Innovation

The methods that a highway agency uses to design its bridges and manage its bridge system are the primary factors that determine the agency's success in controlling costs and maximizing the public benefits of bridge investments. A bridge management system that identifies maintenance and rehabilitation needs and helps optimize maintenance spending will highlight the value of cost-saving innovations for carrying out repairs or avoiding the need for repairs. Agencies that use life-cycle costing to compare bridge design alternatives and have bridge management systems to help guide maintenance

and rehabilitation decisions are more likely to recognize the benefits of innovative materials and technologies. Life-cycle cost analysis is necessary to evaluate technology that extends the service life of a structure or reduces the frequency of maintenance or rehabilitation, but has a higher initial cost than alternatives. Life-cycle costing that takes user costs into account is also necessary to assess the full value of technologies that reduce travel delays from construction and maintenance.

FHWA provides training courses, software, case studies, and an introductory guide for life-cycle cost analysis of highway projects, including bridges (FHWA 2017). NCHRP has produced a manual for bridge life-cycle cost analysis (Hawk 2003).

A new federal innovation incentive grant program could contribute in two ways to advancing highway agency management practices. First, the program could support projects that would provide data on the performance of alternative materials and technologies. Life-cycle costing is useful for guiding decisions only if reliable data on long term performance are available. Second, highway agency trials of state-of-the-art management systems and evaluation methods, or upgrades of existing systems, could be designated eligible projects to receive grants. Eligible practices would include asset management, life-cycle costing, and service life design. As with all projects in the innovation incentive grant program, projects involving management systems and evaluation methods would be required to include periodic reporting in a standard format of experience, costs, and benefits.

Specific Technology Opportunities to Reduce Installed and Life-Cycle Costs

The committee reviewed the status of the technologies demonstrated in the IBRC projects and innovations that have emerged since the program to identify opportunities to reduce installed and life-cycle costs and thereby improve bridge performance. These are described in the following section. The technologies are at various stages of development. Well-developed technologies may be in need of promotion to expand awareness and application. For less-developed technologies, the need may be research to fully develop the technology, standards and specifications development, or evaluation research to verify and demonstrate benefits.

The interviews with state highway agencies conducted for the committee identified a variety of obstacles that may slow or block highway agency adoption of a potentially cost-saving new technology:

- The technology may not yet be fully developed and technical problems remain to be resolved.
- The technology may have high cost because economies of scale have not yet been attained.
- Cost savings may not be sufficiently documented to justify a trial of the technology.
- Standards and specifications necessary for guiding use of the technology may be lacking.
- Agency or contractor staff may lack experience or training in the use of the technology.
- The agency does not regularly apply life-cycle cost as the basis for design decisions, and so a technology with higher initial cost than alternatives, offset by long-term savings, will not be accepted.

Technology emphasis areas in a new federal innovation incentive grant program could be chosen from the following technology opportunities. Such a program would select projects targeting the specific obstacles facing each technology to advance the technology toward full development and application.

Concrete

HPC was one of the most frequently used innovative materials in IBRC projects; 34 states received IBRC grants for projects featuring HPC, UHPC, or SCC. HPC is today in general use for highway bridges throughout the United States.

Opportunities exist to increase the benefits of these advanced concrete materials by developing designs and applications that take full advantage of their special properties:

- UHPC is being used for deck closure connections and is a promising material for use as an overlay. The material has essentially zero permeability and therefore prevents penetration of materials that cause corrosion of steel reinforcement.
- Adoption of design standards that optimize use of advanced concrete materials could allow lower-cost construction and lead to greater use of the innovative materials. Design standards in some cases do not take into account the improved performance characteristics of these materials. The consequence may be that structures designed according to the standards do not make the most economical use of

the material, or that the innovative material is not used because the cost of a design according to the standard would not be justifiable.

- Similarly, adoption of bridge rating standards that give proper credit for the properties of innovative materials would encourage appropriate use of the materials.
- SCC has not been used for bridge decks because of its high flowability property, although the material could be useful for decks on high capacity bridges. SCC has lower permeability than conventional concrete (Trezos et al. 2010) and thus could provide extended service life.

Technologies that have become of interest since the end of the IBRC program also hold promise for cost-saving applications. These include:

- Alternative cementitious materials to reduce the carbon footprint of cement manufacture. .
(Environmental costs may be regarded as components of life-cycle costs.)
- Fiber reinforcement in concrete decks to control cracking and increase durability.
- Use of high-strength steel reinforcement, particularly in earthquake-resistant concrete structures, and to reduce rebar congestion.
- Concrete-filled steel tubes, in which structural concrete is placed inside a structural steel shell.
Properly designed concrete-filled steel tubes are inherently stronger and stiffer than their conventional reinforced concrete counterparts; these are valuable qualities for bridges in seismically active regions on sites with soft liquefiable soils (Washington State Department of Transportation 2018, 7-101).

Steel

As with HPC, HPS was a frequently used material in IBRC projects and today is in general use by most state highway agencies for bridge applications. Current opportunities for achieving life-cycle cost savings through improved steel materials include the following:

- Development and adoption of design standards and practices that take full advantage of the properties of HPS.

- Evaluation of the performance of innovative applications of steel such as corrugated webs and folded plate girders.
- Development of design criteria and material specifications for tubular member design.
- Advancement of improved grades of stainless and conventional steel for bridge construction.
- Evaluation of shape memory alloys for use as prestressing materials in reinforced concrete structures and for strengthening existing structures (Shahverdi et al. 2018).
- Development of appropriate applications of weathering steel. A method for determining corrosion rate would aid in design of bridges with this material.

FRP and Other Composite Materials

FRP materials were the most common category of innovative material in the IBRC projects, with 161 projects in 30 states. Today, externally bonded FRP reinforcement is used by most state highway agencies and the use of FRP rebar in concrete bridge decks is growing. However, there is infrequent use of several other FRP applications demonstrated in IBRC projects, including FRP deck elements, FRP superstructure elements, and FRP prestressing tendons (strand or bar). The obstacles to greater use of FRP include initial cost, perceptions gained in early unsuccessful projects, lack of standards or guidance for inspection and evaluation of the materials, possible lack of awareness of existing AASHTO bridge specifications and guidelines for FRP, present limited availability of experienced fabricators (concomitant with the limited market for bridge elements), and incompleteness or inconsistency of available design and construction standards and specifications for certain applications.

Needs for advancing FRP applications include the following:

- Data on durability and service life.
- Filling gaps in existing standards, specifications, and guidelines for design, use, and inspection.
- Accumulation of more field experience in projects with systematic follow-up evaluation.

Properly designed projects in a new federal innovation incentive grant program could meet some of these needs.

Significant advancement has occurred in the standardization of glass fiber-reinforced polymer (GFRP) rebar, including development of a standard specification (ASTM International 2017). The AASHTO *LRFD Bridge Design Guide Specifications for GFRP Reinforced Concrete, Second Edition* (AASHTO 2018a) expands the use of GFRP rebar from the limitation to decks and rails imposed by the first Load and Resistance Factor Design (LRFD) guide edition to all appropriate elements of the bridge. A program of bridge deck construction with GFRP rebar is needed to determine whether the composites industry can consistently supply quality material to multiple projects.

A current NCHRP project⁴ is developing a GFRP tendon made up of one or more strands. Substructure applications for GFRP prestressing strands in foundation piling should be explored.

Bridge applications that use advanced materials such as engineered cementitious composites are under development. These advanced materials have properties that could potentially allow fundamental change, such as three-dimensional (3-D) printing, to current fabrication methods.

Corrosion Control

Projects that use corrosion-resistant concrete reinforcement materials were popular in IBRC, and two of the materials demonstrated in the program, stainless steel rebar and FRP rebar, are used in many states today. However, few IBRC projects featured cathodic protection, galvanic protection, or coatings for corrosion control, and the program appears to have had little impact on advancing these technologies. These latter technologies may hold great promise for extending the service life of existing bridges, but there is a lack of rigorous research documenting their benefits.

Galvanized steel for bridge superstructures is an existing technology that is not widely used but that may merit evaluation and trials to assess its potential.

⁴ NCHRP IDEA 20-30, Project 207, MILDGLASS: GFRP Strand for Resilient Mild Prestressed Concrete, <http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=4654>.

ABC

As FHWA encouraged applications for ABC projects late in the IBRC program, only about a dozen states received funding for projects that highlighted ABC as a primary innovation. Other projects included ABC practices, for example, FRP bridge deck projects in which the deck was fabricated offsite. Today, most states conduct ABC projects, but infrequently, and ABC generally is not regarded as a standard practice or considered as an option in most bridge projects.

Opportunities to increase cost savings from ABC include the following:

- Expanding use of ABC to all bridges for which the practice would be cost effective. If ABC were routinely evaluated as an option for all bridge projects on the basis of life-cycle cost, it is likely that it would be found to be beneficial in many more projects than those for which it is now used.
- Expanding use of life-cycle cost analysis, with inclusion of direct and indirect agency costs and with realistic accounting for user costs of construction delays, as the basis for comparing bridge design and construction alternatives.
- Developing bridge designs that take full advantage of the time-saving potential of prefabricated elements. Designs of prefabricated elements today are often based on designs of conventional cast-in-place structures.
- Expanding use in bridge construction of bridge move equipment (self-propelled modular transporters or lateral slides). Use of these technologies to move prefabricated systems minimizes traffic disruption.

Monitoring and Evaluation

Methods and applications for monitoring and evaluation of bridges did not receive emphasis in the IBRC program. Important opportunities exist to reduce bridge life-cycle costs by improving evaluation and monitoring. The following are examples:

- Advancement of building information modeling (BIM) for bridges and structures as a framework for maintaining and sharing data during design and construction and throughout the service life of the bridge.
- Integration of data from weight-in-motion installations with the NBI data system to measure the relationship of traffic to deterioration and to support improved estimates of service life and replacement needs.
- Artificial intelligence applications to make full use of bridge monitoring and evaluation data in bridge management systems to guide maintenance and rehabilitation decisions.
- Application of low-cost, low-maintenance sensors for detecting the initiation of reinforcing steel corrosion.
- Use of unmanned aerial vehicles to increase the efficiency of bridge inspections.
- Development and application of improved nondestructive bridge evaluation technologies and techniques to allow for more precise and reliable assessment of bridge performance.
- Use of visualization, 3-D modeling, and virtual reality technologies in ABC and conventional projects.
- Methods for maintaining and updating current infrastructure to be more effectively used with upcoming new transportation technologies, such as autonomous vehicle, web base sensing, and communication technologies, and real-time traffic data.

RECOMMENDATIONS

Recommendations of the committee are presented in the following section on three topics: a new federal program to provide incentives for innovation in bridge construction, research needs to develop and evaluate innovative approaches to reducing the installed and life-cycle costs of highway bridges, and other actions to encourage innovation to reduce life-cycle costs of bridges.

New Federal Program to Provide Incentives for Innovation in Bridge Construction

The preceding section described numerous technologies, at various stages of development, that hold promise for improving bridge performance and reducing life-cycle cost. However, most require further development, evaluation, or promotion to increase awareness of their potential among bridge owners. Congress should create a new federal bridge innovation incentive program, administered by FHWA, to advance such technologies and to promote their use in U.S. highways.

As was stated at the beginning of this chapter, the IBRC program increased use of cost-saving innovative technology in U.S. highway bridges, but had limited impact in advancing technologies at earlier stages of development toward application. The new federal program can be modeled on IBRC, but with features to improve on the results of the earlier program. The new program should incorporate the provisions described in the following paragraphs.

Program Plan

The program should be guided by a plan that defines the objectives, allocates funds in accordance with the objectives, and specifies procedures that FHWA will follow for selecting projects that contribute to the objectives. The plan should specify the division of funds between projects for which the primary objective is to gain widespread use of proven technologies and projects for development and evaluation of earlier-stage technologies.

The terms of grants in the program should allow states adequate time for project development and flexibility in implementing technologies (for example, the possibility of substituting sites for a project). This flexibility was an important feature of the IBRC program. The grant program should award funds early in the project process, so that the availability of funds is known when decisions on the scope of work are being made and there is sufficient time to provide information and preparation to the project team and contractors.

FHWA should develop the plan in consultation with the state highway agencies. Advice should be solicited from industry and from researchers.

Definition of Objectives

Objectives for the program should be specifically defined with respect to (1) the technologies to be developed, demonstrated, or evaluated; (2) the specific improvements in bridge performance to be obtained with each technology; and (3) the contribution of the projects funded in the program to advancing each technology. The objective for a particular technology will depend on its state of development. For technologies of proven value that are not yet generally adopted, the objective may be to expand use by providing incentives for states to gain experience with them. For technologies at earlier stages, the objective may be to conduct trials to develop or evaluate the technology or to support standards and specifications development.

Recordkeeping

FHWA should have in place at the beginning of the program a project recordkeeping system that maintains comprehensive, current, and accurate information on each grant awarded. The record should include the location and NBI number of each involved bridge, a detailed description of the full scope of the project of which the grant-funded activities or features are a part, data on funds awarded and expended and total project costs, and a description of monitoring and evaluation provisions. The record system should track projects through completion and through follow-up evaluation activities. The record system should record any changes in the location, scope, or technologies involved in a project made after award of a grant.

Dissemination

FHWA should establish, at the initiation of the program, arrangements to disseminate to highway agencies, researchers, and the public information on projects under way, assessments of completed projects, and data and results from long-term monitoring.

Monitoring Performance of Technologies

For all technologies that require long-term monitoring for evaluation, the program should include funding and specific standard requirements for monitoring. FHWA should maintain a repository of monitoring data from projects in the program. Monitoring should follow two tracks:

- Every project that receives a grant (including projects for which the primary objective is to promote wider use of proven technologies) should be subject to a minimum standardized monitoring and reporting requirement, appropriate for the specific technology demonstrated in the project, for a period of years after the completion of the construction phase of the project. Required data collection would be simple and practical.
- Projects for which the objective is development, testing, or evaluation of a technology should have additional requirements, including an evaluation research design that specifies data collection. These projects may involve installation of monitoring technology. Requirements may include monitoring the performance of control bridges for comparison purposes. Grant amounts for projects with primary research or evaluation objectives would cover data collection costs.

Evaluations conducted in conjunction with bridge projects funded by the program would be complementary to FHWA's LTBP Program. The two programs would not duplicate efforts, because the proposed program would concentrate on evaluating a specific group of innovative materials and technologies that would be unlikely to receive focused attention in the LTBP Program.

Emphasis Areas

Emphasis areas for project selection should be determined by the federal–state consultative process previously recommended. The committee recommends that consideration be given to the following areas:

- Projects that contribute to development and evaluation of designs, standards, and specifications that take full advantage of the performance qualities of advanced materials.

- ABC projects that allow highway agencies to gain experience with technologies for bridge system moves in addition to bridge element installations such as prefabricated substructures.
- FRP projects that are coordinated with a program of FRP evaluation research, such as the research program recommended in the following section.
- Projects with provision for systematic long-term monitoring of the performance of materials and technologies.
- Projects to develop and evaluate corrosion control methods for existing structures.
- Projects to determine the circumstances that warrant installation of structural health monitoring instrumentation in new and existing bridges.
- Projects to develop, demonstrate, or evaluate management systems and decision tools that support cost-saving innovation, including bridge management systems, life-cycle cost assessment, and service life design

Research Needs

USDOT and the state departments of transportation should consider sponsoring research with the objectives identified in the following section, which address the development and evaluation of innovative approaches to reducing the installed and life-cycle costs of highway bridges. Research projects on these topics should have sharply defined problem statements and objectives and valid research designs. These research projects could be carried out in conjunction with projects funded by the federal innovation incentive grant program previously recommended; that is, construction, rehabilitation, or monitoring projects that receive grants could be planned as experiments or as data sources for purposes of the research. Research on these topics could also be conducted independently of the incentive grant program.

The recommended research objectives are:

- Development and validation of models for projecting service life and deterioration rates for use in bridge management and life-cycle cost analysis.

- Long-term monitoring of the durability, performance, and costs of materials and technologies.
Highway agencies will hesitate to adopt unfamiliar but potentially cost-saving technologies without strong evidence of performance over time. If bridge owners waited for results of long-term monitoring evaluations before deciding whether to adopt a technology, innovation would be greatly slowed. Evidence from laboratory measurements and accelerated testing, the experience of construction of early projects, and short-term monitoring (e.g., 4 to 10 years) of the performance of early projects can identify technologies that are likely to provide long-term cost savings. Data from long-term monitoring are necessary to validate expectations and to determine the practices that maximize the benefits of the new technology. Evidence of long-term performance is especially important to justify a technology with higher initial cost than alternatives in a life-cycle costs comparison. Systematic long-term performance data are lacking or inadequate for the materials demonstrated in the IBRC program. Standard procedures for inspecting the materials could be developed in conjunction with monitoring studies.
- New nondestructive bridge evaluation technologies and techniques: Improved capability for quantitative measurement of bridge condition and for efficient inspection of bridges will allow highway agencies to choose maintenance, rehabilitation, and replacement strategies that reduce the life-cycle costs of their bridges. The information from evaluations will also lead to design improvements that reduce life-cycle cost.
- Optimized designs and standardization for materials: Development is needed of designs and design standards that maximize the cost savings attained from advanced materials and that specify use of these materials in applications for which their properties are most valuable. Bridge rating standards are needed that properly account for the performance of these materials.
- Development of advanced materials such as engineered cementitious composites for bridge elements and optimization of their use in bridge applications.

- Optimized design for ABC: Design methods are needed that take full advantage of the economies attainable from prefabrication of bridge elements and systems. A NCHRP report on research to develop the ABC design and construction guide specifications that were subsequently adopted by AASHTO lists more than 30 ABC knowledge gaps and identifies research needed to fill certain gaps (Culmo et al. 2017, 25–48).
- Methods of maintaining and updating existing infrastructure to accommodate truck platooning (operation of two or more trucks in a convoy with close spacing maintained by an advanced driver assistance system) and other upcoming transportation technologies.

These research objectives parallel certain of the objectives previously suggested for the proposed new federal innovation incentive grant program. Problem statements for specific research projects could be developed as part of the planning for the grant program.

FRP Bridge Applications Evaluation

Use of FRP composites in bridges was a major emphasis area of the IBRC program. Externally bonded FRP reinforcement and FRP rebar, two applications demonstrated in IBRC projects, have gained substantial use by highway agencies. However, FRP deck elements, superstructure elements, and prestressing tendons (strand or bar), which together were demonstrated in more than 100 IBRC projects, are used by few states today, according to the 2018 AASHTO state bridge engineers survey. Apparently, the experience of the IBRC program either did not resolve uncertainties about the performance and appropriate applications of these technologies or did not overcome highway agencies' resistance to change.

FHWA, in cooperation with the state highway agencies, could determine the potential for greater use and benefit from FRP materials in bridge construction through a research and technology transfer program that includes the activities listed in the following section. FHWA and the states should consider undertaking such a program in light of their overall innovation objectives and available resources.

- Develop a material qualification and certification program that identifies suitable FRP materials for bridge construction.
- Conduct material durability studies and create a materials database that is accessible to highway agencies and engineering professionals to enable improved quality and safe designs and construction.
- Conduct demonstration projects to collect cost and long-term performance data for cost-benefit and life-cycle cost analysis, and develop a material cost database to support analyses.
- Harmonize and refine the currently available AASHTO FRP specifications and guides to ensure their consistency and uniformity among each other.
- Conduct trial design and construction projects to test ease of use and reasonableness of the standards and specifications. Projects should take place in several states and involve several bridge engineering firms.
- Develop inspection, repair, and rating procedures for bridge components and systems that use FRP materials consistent with standard practice for concrete, steel, and timber bridges.
- Conduct education and training programs that provide bridge structural design, bridge maintenance and inspection, and bridge materials research and test engineers in the federal and state governments and the private sector with knowledge, tools, and techniques for the effective use of these materials.

These activities could be organized as an emphasis area within the innovation incentive grant program previously recommended.

Other Actions to Encourage Innovation

Professional Interchange

In the interviews conducted for this study, state highway agency staff emphasized that interaction with engineers in other states is a key source of information about innovations and commonly influences decisions to try new technology. Interactions occur at professional events organized by AASHTO and others as well as informally. Interactions in regional working groups established to promote technical

interchange can lead to cooperation in developing standards and specifications. State engineers identified the Bridge Preservation Partnerships, supported by the AASHTO Transportation System Preservation Technical Services Program, as an effective resource for technical interchange. Opportunities for highway agency engineers to interact with researchers and with industry representatives are also valuable.

Virtual meetings via the Internet are becoming increasingly effective tools for technology transfer of innovative products. However, person-to-person events continue to be the most effective means for streamlining the successful implementation of innovation. Project demonstration showcases allow potential users to come together to witness firsthand a new product being built in the field. Showcases include presentations by the experts who designed, fabricated, and constructed a bridge that incorporates the focus innovation, followed by a tour of the bridge, preferably during its construction. Potential users not only hear about the new technology, but also talk with the experts and see it being implemented in the field.

The state highway agencies should recognize the essential role of professional interactions among engineers for the dissemination of technical advances, support the establishment of activities that provide opportunities for technical exchange, and support participation of their engineers in these activities.

Existing Federal Highway Innovation Programs

Congress should continue to provide funding and direction in future federal aid program authorizations for the existing innovation programs administered by the FHWA Center for Accelerating Innovation. These programs are important in encouraging state highway agencies to use innovative technologies and methods and have accelerated the process of adoption. The new bridge innovation incentive program previously recommended is not intended as a substitute for the existing programs.

Dissemination and Implementation of Research Results

All federal highway research and innovation programs should incorporate formal provisions and sufficient resources for implementation, dissemination, and long-term monitoring of in-service

performance of new technologies. Strengthening federal implementation activities will greatly magnify the value of research. State highway agencies hesitate to implement new technologies without evidence of performance.

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APPENDIX A
TEA-21 SECTION 5103 (PART) (JUNE 9, 1998): INNOVATIVE BRIDGE RESEARCH AND CONSTRUCTION PROGRAM

Public Law 105-178
 105th Congress
 An Act

To authorize funds for Federal-aid highways, highway safety programs, and transit programs, and for other purposes.

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SECTION 1. SHORT TITLE; TABLE OF CONTENTS.

(a) Short Title.—This Act may be cited as the “Transportation Equity Act for the 21st Century.”

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SEC. 5103. TECHNOLOGY DEPLOYMENT.

Chapter 5 of title 23, United States Code (as added by section 5101 of this title), is amended by adding at the end the following:

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“(b) Innovative Bridge Research and Construction Program.—

“(1) In general.—The Secretary shall establish and carry out a program to demonstrate the application of innovative material technology in the construction of bridges and other structures.

“(2) Goals.—The goals of the program shall include—

“(A) the development of new, cost-effective innovative material highway bridge applications;

“(B) the reduction of maintenance costs and life-cycle costs of bridges, including the costs of new construction, replacement, or rehabilitation of deficient bridges;

“(C) the development of construction techniques to increase safety and reduce construction time and traffic congestion;

“(D) the development of engineering design criteria for innovative products and materials for use in highway bridges and structures;

“(E) the development of cost-effective and innovative techniques to separate vehicle and pedestrian traffic from railroad traffic;

“(F) the development of highway bridges and structures that will withstand natural disasters, including alternative processes for the seismic retrofit of bridges; and

“(G) the development of new nondestructive bridge evaluation technologies and techniques.

“(3) Grants, cooperative agreements, and contracts.—

“(A) In general.—Under the program, the Secretary shall make grants to, and enter into cooperative agreements and contracts with—

“(i) States, other Federal agencies, universities and colleges, private sector entities, and nonprofit organizations to pay the Federal share of the cost of research, development, and technology transfer concerning innovative materials; and

“(ii) States to pay the Federal share of the cost of repair, rehabilitation, replacement, and new construction of bridges or structures that demonstrate the application of innovative materials.

“(B) Applications.—To receive a grant under this subsection, an entity described in subparagraph (A) shall submit an application to the Secretary. The application shall be in such form and contain such information as the Secretary may require. The Secretary shall select and approve the applications based on whether the project that is the subject of the grant meets the goals of the program described in paragraph (2).

“(4) Technology and information transfer.—The Secretary shall take such action as is necessary to ensure that the information and technology resulting from research conducted under paragraph (3) is made available to State and local transportation departments and other interested parties as specified by the Secretary.

“(5) Federal share.—The Federal share of the cost of a project under this section shall be determined by the Secretary.”

APPENDIX B**DEFINITIONS AND INTENDED BENEFITS OF IBRC TECHNOLOGIES**

The Committee classified the innovative materials and other technologies used in the Innovative Bridge Research and Construction (IBRC) projects in 17 categories (see Box B.1). Definitions of each technology are presented in the following section, along with explanations of the intended benefits of applying the technologies in bridge construction and examples of IBRC projects that demonstrated the technology.

Box B.1
IBRC Technology Categories
Concrete:

1. High-performance concrete (HPC)
2. Self-consolidating concrete (SCC)
3. Ultra-high performance concrete (UHPC)

Fiber reinforced polymers (FRP):

4. Externally bonded FRP reinforcement
5. FRP deck elements
6. FRP superstructure elements
7. FRP rebar
8. FRP prestressing tendons (strand or bar)

Corrosion control technologies: concrete reinforcement:

9. Low-chromium steel (ASTM A1035/1035M steel) rebar
10. Galvanized rebar
11. Stainless steel rebar (solid or clad)

Corrosion control technologies: coating and anodes:

12. Metallizing
13. Cathodic protection anodes and electrochemical chloride extraction
14. Galvanic protection and other corrosion control technologies

Other IBRC technologies:

15. High-performance steel (HPS gr 50, 70)
 16. Accelerated bridge construction (ABC) technologies, methods, or procedures
 17. Monitoring and instrumentation technology
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CONCRETE

1. High-Performance Concrete (HPC)*Definition*

HPC is designed to add strength and durability to bridge elements. The mix design includes supplementary cementitious materials (for example, fly ash, silica fume, ground-granulated blast furnace slag) for a concrete with low permeability that slows or stops the ingress of chlorides that can corrode steel reinforcement. HPC may include the use of high-range water-reducing admixtures for a low water-to-cementitious materials ratio to achieve higher strength while maintaining workability and finishability. Higher-strength HPC is typically used in bridge girders. Normal-strength HPC is typically used in bridge decks and substructures because of its enhanced durability.

Intended Benefits

The use of HPC is intended to extend the service life of the bridge by reducing cracking and permeability. Use of the material also promises benefits during bridge construction and element fabrication. The use of HPC for precast prestressed girders is typically associated with high early concrete compressive strength. The ability of HPC to achieve high strengths at early ages can lead to faster turnover of precasting beds, and thus allow for increased production. High final concrete compressive strengths in conjunction with additional reinforcement in precast prestressed girders can also enable wider girder spacings and longer span lengths, potentially eliminating or reducing the number of piers and reducing the number of girders per span. These capabilities can lead to savings in construction costs and time. HPC can also allow for shallower girder cross sections that reduce the required height of approach spans or increase underpass clearances with savings in earthwork. By replacing a percentage of the cement, the supplementary cementitious materials used in HPC can lower the cost of the concrete mix and reduce the project's carbon footprint.

Example Projects

In the IBRC program, HPC was used in girders, decks, superstructure spans, abutments, piers, and overlays. Two examples are:

- The Church Street South Extension Bridge in New Haven, Connecticut (CT-2000-1). The bridge, which provides a direct link between downtown New Haven and the Long Wharf and waterfront areas, was constructed with an 8.25-in.-thick cast-in-place HPC deck, which was also reinforced with low-chromium steel rebar.
- The Mackey Bridge, also known as the Marsh Rainbow Arch Bridge, on 120th Street over Squaw Creek in Boone County, Iowa, outside Des Moines (IA-2004-01). HPC was used for all of the precast concrete on the job, including the prestressed I-beams, full-depth deck panels, pile caps, and integral abutment footings supported on steel piles.

2. Self-Consolidating Concrete (SCC)*Definition*

SCC, sometimes referred to as self-compacting concrete, is typically produced by adjusting traditional mix designs with the use of superplasticizers and viscosity modifiers. These admixtures create a flowing concrete that can fill in complex structural shapes and around congested steel reinforcing while resisting separation and maintaining uniform suspension of solids, eliminating the need for mechanical vibration. Amounts of these admixtures can be balanced to meet shrinkage and other standard performance requirements and to control undesirable effects like bleeding and segregation based on project needs.

Intended Benefits

SCCs benefits derive from its flowability and consolidation. Structural concrete elements that have restricted worker access need highly workable concrete to ensure consolidation around congested rebar and posttensioning. The long-term performance of these elements using traditional low-slump concrete mixes is affected in part by the quality of the mechanical vibration process during placement. SCC is

formulated to self-consolidate during placement, thus eliminating the human factor to ensure complete consolidation.

Compared to conventional concrete mixtures, SCC will have a small increase in material-related costs due to some of the ingredients and the need for more and higher dosages of chemical admixtures. However, the material's flowability and consolidation can result in reduced placement labor and increased speed of construction. The reduction in labor requirements can also have the added benefit of enhancing worksite safety. These savings during construction can offset the increased material cost of SCC. Further, the improved consolidation of SCC mixes is expected to improve surface appearance, strength, and durability.

Example Projects

Applications of SCC in IBRC projects can be found in drilled shafts, foundations, girders, decks, and overlays. Examples are:

- Route I-280/Garden State Parkway Interchange 145 project in New Jersey. SCC was used in four 6-ft-diameter drilled shafts.
- The M-50 Bridge over the Grand River, Jackson, Michigan (MI-2004-01). The project used SCC to construct bridge beams.

3. Ultra-High Performance Concrete (UHPC)

Definition

UHPC has mechanical and durability properties that exceed that of conventional concrete (Graybeal 2011, Haber et al. 2018). By using an optimized particle size distribution, a low water to cementitious material ratio, and a high percentage of discontinuous internal fiber reinforcement, UHPC exhibits significantly higher compressive and tensile strengths as compared to conventional concrete. Conventional concrete is weak in tension, with the tensile strength on the order of one-tenth of the compressive strength. Because

of its discontinuous pore structure, UHPC reduces water ingress, which enhances durability as compared to conventional concrete or HPC.

Intended Benefits

In the FHWA state-of-the-art report on UHPC, Russell and Graybeal (2013) identified four primary characteristics that distinguish UHPC from conventional concrete: higher compressive strength, higher tensile strength with ductility, increased durability, and higher initial unit cost. Based on these characteristics, they indicated that UHPC is well-suited for applications in which compressive strength is the predominant design factor or for use in outdoor or severe exposure environments due to its durability. In addition, the high tensile strength of UHPC can be advantageous for both service and strength design for flexure, shear, and torsion.

The addition of the fibers in UHPC enables the concrete to exhibit ductile behavior even after initial cracking without the addition of traditional rebar. Elimination of the reinforcing steel can greatly simplify construction. In addition, UHPC exhibits superior durability due its dense matrix created by a combination of fine powders (that is, grain size maximum of 600 micrometer as reported by PCA) and chemical reactivity. This results in the small disconnected pores that prevent deleterious solutions from penetrating into the matrix, which can cause conventional concrete to deteriorate (Russell and Graybeal 2013). Enhanced durability stems from increased resistance to freezing and thawing, alkali-silica reaction (ASR), scaling, and abrasion; and decreased permeability and carbonation depth.

The higher initial unit cost of UHPC requires consideration of the life-cycle costs of the applications to be considered viable. The reduced labor and material costs associated with the elimination of mild reinforcement in UHPC systems is also a potential benefit.

Example Projects

In the IBRC program, UHPC projects are mixed among some of the other categories and in some cases classified as HPC. Example projects are:

- The single-span Mars Hill bridge in Wapello County, Iowa (over Little Soap Creek on 100th Avenue, Keokuk Township), which contains UHPC bridge girders. The UHPC girders were smaller and eliminated the need for transverse shear reinforcement.
- Virginia Route 58 Business over Route 58 Bypass (Route 624 over Cat Point Creek). In this new construction, the superstructure consisted of prestressed bulb tee girders that used UHPC.

FIBER-REINFORCED POLYMER (FRP) COMPOSITE TECHNOLOGY

4. **Externally bonded FRP reinforcement**
5. **FRP deck elements**
6. **FRP superstructure elements**
7. **FRP rebar**
8. **FRP prestressing tendons (strand or bar)**

Definition

FRP composites consist of polymeric material systems (for example, epoxy, vinylester, polyester, and phenolic) reinforced with fibers such as carbon, glass, and aramid. State transportation agencies have integrated FRP composites into a wide range of bridge applications. Externally bonded FRP technology is used to repair and strengthen concrete, steel, and timber bridges. FRP materials are also used for modular bridge decks, prefabricated superstructure elements, concrete reinforcement, and prestressing tendons.

Intended Benefits

In general, FRP materials are intended to provide durable solutions for the construction of new bridges and for the rehabilitation and strengthening of existing bridges. Because of its light weight, FRP composites can lead to reduced material transportation costs and faster erection times. In the case of externally bonded FRP composite materials, their light weight, high tensile strength, and ease of installation have the potential to reduce the cost and expedite the repair and strengthening of bridges that have suffered deterioration or that do not meet current load requirements. Modular FRP bridge decks have

the potential to be rapidly installed in the field with less labor and lighter weight construction equipment than conventional deck replacements. These attributes facilitate accelerated bridge construction with reduced impact on the traveling public. The reduced weight of the deck may allow the bridge to carry additional vehicle loads, thereby allowing for an upgraded classification of the bridge.

Prefabricated FRP decks and superstructures offer the potential for accelerated bridge construction and lower maintenance. FRP rebar and prestressing tendons have the advantage of not being susceptible to corrosion, which is a primary source for the deterioration of reinforced concrete bridge members. For precast prestressed concrete members such as precast girders, and posttensioned members such as bridge box-girders that use internal or external tendons, corrosion of the prestressing is a source of premature deterioration. Again, the light weight of the FRP materials promises to accelerate bridge construction and reduce the weight of the structure.

Example Projects

The following are examples of the use of FRP in IBRC projects:

- West Virginia Market Street Bridge in Wheeling, West Virginia (WV-1999-02), was originally constructed in 1930 as a two-span riveted steel structure. A bridge condition assessment by the West Virginia Department of Transportation (WVDOT) during the late 1990s revealed that the existing bridge deck was in poor condition. In addition, one of the bridge sidewalks had been closed (Whipp 2001). Due to its economic importance to local businesses, the WVDOT decided to replace the bridge with one in which the deck was made of FRP composites manufactured by the pultrusion process. As a result of reducing the weight of the bridge superstructure, it was possible to eliminate the construction of the middle pier from the original bridge and, thus, to replace the two 78.66-ft-span bridges with a single 177-ft-span bridge. As of 2015, the WVDOT inspection record showed that the bridge was in good condition.
- New York Route 418 Bridge over Schroon River (NY-1999-07) is located in the town of Warrensburg of Warren County, New York. The bridge was built in 1933, and its original deck was

constructed from steel gratings filled with concrete. In 2000, the New York State Department of Transportation restored the roadway to unrestricted traffic by replacing the original concrete-infill steel grate deck with a lightweight FRP deck that had a high initial installed cost of \$75/ft². According to state personnel, the periodic inspection report of August 2018 indicated that the FRP deck was still in service and had a Fair rating.

- The Bridge Street Bridge spanning the Rouge River in Southfield, Michigan (MI-1999-02), was the first U.S. vehicular concrete bridge constructed with objectives of (1) demonstrating the use of noncorrosive FRP prestressed tendons, (2) extending the service life of highway bridges, and (3) reducing construction-related safety concerns and maintenance costs (Grace et al. 2002). In the state's most recent inspection report, several full-length reflective cracks in the deck were observed. However, the bridge was reported to be in "Fair" condition. The information available to the committee does not indicate whether the cracks reported are related to the use of FRP prestressed tendons or are from other sources.
- Texas FM 1362 over Sue Creek in Burleson County (TX-2001-01) is a two-span bridge that carries the highway over water. The bridge had a low load rating and was in need of strengthening, which was accomplished by using externally bonded FRP reinforcement. The Texas Department of Transportation was able to reduce design and construction time while avoiding road closure (Yang and Jahedkar 2003).

CORROSION CONTROL TECHNOLOGIES: CONCRETE REINFORCEMENT

9. Low-chromium steel rebar

10. Galvanized rebar

11. Stainless steel rebar (solid or clad)

General Definition

Low-chromium steel (also known as ASTM A1035/1035M steel) is a low-carbon, chromium, microcomposite steel. Galvanized steel is a type of steel that has been coated with a layer of zinc coating.

Stainless steel (solid or clad) is an alloy that contains chromium and other elements. All three materials can be used as rebar in concrete bridges.

Intended Benefits

The main benefits of all three materials when used as rebar is to reduce susceptibility to corrosion that leads to higher bridge maintenance and repair costs from spalling and surface damage to concrete elements.

Example Projects

The following are examples of IBRC projects that used corrosion-resistant rebar materials:

- Iowa used low-chromium steel rebar on a bridge constructed in 2001. The structure, eastbound IA 520 over South Beaver Creek, contains a 274-ft-long, 39 ft-wide deck on prestressed concrete I-beams. Low-chromium steel was used for deck reinforcement. The westbound structure was built with conventional epoxy-coated rebar. Electrodes were installed at various locations to monitor for corrosion activity in each direction.
- In Missouri, two bridges were constructed to evaluate the performance of stainless steel rebar (MO-2000-01, Route 6 in Galt, and MO-2001-02, Route 86 over Hickory Creek). The control bridge was constructed with epoxy-coated rebar. Performance was documented using nondestructive fiber optic chloride sensors, permeability testing, half-cell potential readings, and visual inspection.
- A project in Illinois (IL-1999-07, City of Quincy, 18th Street over Cedar Creek) incorporated galvanized rebar in the substructure and deck. Galvanized steel was also used for other applications on the bridge, including as structural steel in girders.

CORROSION-CONTROL TECHNOLOGIES: COATING AND ANODES

12. Metallizing

13. Cathodic protection anodes and electrochemical chloride extraction

14. Galvanic protection and other corrosion-control technologies

Definition

Metallizing is the application of a sprayed-on galvanic cathodic system as a means of extending the life of embedded reinforcement in structural concrete. The system is typically composed of a zinc-rich thermally applied spray. It also acts to some degree as a coating as it can assist in mitigating the ingress of aggressive elements. Another means of providing galvanic protection to mitigate the spread of corrosion is by connecting sacrificial anodes to the exposed reinforcement steel. Deteriorated areas of concrete are removed and discrete sacrificial anodes, usually zinc, are connected to the exposed reinforcement. The anodes cathodically protect the surrounding concrete area that may be chloride contaminated.

Chloride extraction removes chloride ions from contaminated concrete and reestablishes the passivity of steel reinforcement. The extraction is carried out by temporarily applying an electric field between the concrete reinforcing and an externally mounted anode mesh. During the process, chloride ions are transported back through the concrete toward the surface.

Intended Benefits

The long-term intended benefit of coatings and anode technologies is a reduction in the deteriorating effects of corrosion of steel reinforcement in concrete to enable longer service life. Coatings are also primarily used for existing construction to provide a physical barrier on the surface of repaired concrete to mitigate the further intrusion of moisture, oxygen, and chloride ions into concrete. Coatings can also be used in new construction, but there has not been widespread use for this category. The anode technologies primarily benefit existing concrete construction and are used where corrosion of reinforcing steel has reached the initiation phase.

Example Projects

Examples of IBRC projects that used coating and anode technologies are the following:

- In a project in Illinois (IL-2000-02, I-474 FR 174 to Illinois River), three types of zinc-based metals were tested in a cathodic protection application to protect against corrosion. Evaluation results indicated that the systems did not perform as intended.
- Electrochemical chloride extraction was used by Minnesota (MN-1999-02, I-94 and Glenwood Avenue) to protect against corrosion in concrete bridge piers. Evaluation found that the process reduced average chloride levels in the treated structures by approximately 50 percent, but that chloride concentrations remained above the acceptable level at some locations.

OTHER TECHNOLOGIES

15. High-Performance Steel

Definition

High-performance steel (HPS) is higher in strength than conventional steel and can improve the cost-effectiveness of steel bridges that take advantage of the superior properties of the material. The three most common types of HPS are: HPS100W, HPS70W, and HPS50W. The number following HPS designates the strength of the material in ksi units. HPS is produced by two different processes: thermo-mechanical control process and quenched and tempered plates. The selected method of manufacture may limit the overall length and thickness of the HPS plates.

Intended Benefits

The high strength of HPS may allow longer spans without increasing the depth of the beams, eliminating or reducing the number of piers and increasing horizontal clearance while maintaining vertical clearance. Alternatively, the strength of HPS may allow reducing the depth of beams, increasing vertical clearance while maintaining the existing approach roadway profile.

Applications for HPS found in the IBRC projects include folded plates, beams and girders, corrugated webs, and an investigation regarding bracing requirements for HPS girders. Advantages of

HPS in IBRC projects, as reported by the states that conducted the projects in the HDR report (HDR 2013), were the following:

- Higher yield strength.
- Less material needed to provide required strength.
- Expected service life as high as 75 years.
- Ability to accommodate tight vertical clearances.
- Improved toughness (ability to resist cracking).

Example Projects

California's (CA-2001-05) White's Hill Sidehill Viaduct project used HPS in plate girders of the new bridge for high strength; longer spans allowed for eliminating piers in an active landslide area.

Nebraska's (NE-2002-01) Highway N-79 over Wagon Tongue Creek project demonstrated the use of folded plate technology in which the bridge girders are fabricated by bending flat plates into an inverted steel box shape. The new shape reduces the cost of girder fabrication and provides an alternative for short span bridges.

16. Accelerated Bridge Construction

Definition

Accelerated bridge construction (ABC) uses innovative planning, design, materials, and construction methods to reduce the on-site construction time when building new bridges or replacing and rehabilitating existing bridges. ABC technologies can be divided into the categories of project planning, geotechnical solutions, and structural solutions. Examples of technologies in the project planning category include early environmental clearance and permitting, alternative technical concepts, and A plus B bidding, where "A" is the traditional bid for the contract items and "B" is the time estimated by the bidder to complete the work. Examples in the geotechnical solutions category include micropiles and lightweight fill.

Examples in the structural solutions category include prefabricated bridge elements such as modular decked beams and precast substructures and prefabricated bridge systems such as superstructure spans moved into place using self-propelled modular transporters or lateral slides.

Intended Benefits

Bridge owners use ABC in their projects for a number of reasons. These include reduced traffic impacts, reduced on-site construction time, improved work zone safety, improved site constructability, improved material quality and product durability, and minimized environmental impacts. Other reasons include contractor-initiated change, maintenance of existing alignment, limitation of right-of-way take, emergency replacement, ability to use local contractor or county workforce to construct, need to minimize business and other commercial impacts, and maintenance of essential services such as emergency response, police, mail delivery, transit, and garbage collection.

Direct construction costs of ABC using prefabricated bridge elements and systems are expected to be more economical than conventional cast-in-place construction after the use of ABC becomes standard practice. A historical example of such cost savings for prefabrication versus cast-in-place construction is the use of pretensioned concrete I-shaped beams, which became standard practice more than half a century ago because of their economy and quality control relative to cast-in-place beams. During the current transition stage of moving standard practice from conventional to ABC, the construction cost of ABC projects is frequently higher.

Construction contractors' bid prices for ABC projects are frequently higher due to the increased risk perceived by the contractor when using unfamiliar means and methods. Also, additional mobilization costs are incurred with system moves such as when using self-propelled modular transporters to quickly install superstructure spans. Even so, construction contractors are field-changing ABC technologies into conventionally bid projects because of the various advantages offered by ABC, including cost savings for fabricating repetitive precast concrete elements, reduced environmental impacts that can speed a project

and thereby save costs, and increased safety because of the reduced time in the work zone, which can also cut costs.

Although a number of reasons may drive the use of ABC, the original and primary reason for the use of ABC is reduced traffic disruption. This is because bridge construction in the United States has changed from the capacity-building focus needed in the mid-1900s when the Interstate was being built to the preservation and maintenance focus required today as the average bridge is reaching its design life and requiring upgrade while still maintaining traffic flow. When user costs are included for high-traffic-volume locations, ABC is usually the least costly solution due to the reduced onsite construction time that reduces traffic delay.

Example Projects

Two examples of ABC projects in the IBRC program are as follows:

- Mill Street Bridge over the Lamprey River Epping, New Hampshire. ABC elements for this project are the adjacent pretensioned concrete box beams and the precast concrete abutment walls, wingwalls, and spread footings..
- The Live Oak Creek Bridge on Texas State Highway 290 over Live Oak Creek in Crockett County. ABC elements on this project are the full-depth precast concrete deck panels. The superstructure consists of I-shaped pretensioned concrete beams with an 8-in.-thick full-depth precast concrete deck.

17. Monitoring and Instrumentation Technology

Definition

Monitoring and instrumentation technology includes advanced sensors and data acquisition systems to monitor the performance of new and existing bridges. Data from these systems are used to evaluate the safety and integrity of bridges and to evaluate the progression of deterioration and damage. Data from the in-place sensors are typically stored on site and downloaded at regular intervals over an Internet connection or by wireless transmission for engineering analysis of performance.

Typically, sensors are used to monitor integrity by observing changes in strain, deformation, acceleration, and vibration as affected by vehicular traffic, temperature, and other load effects. Sensors can also be used to assess the fatigue damage that occurs at critical details in structural steel bridge elements. Sensors are also available to monitor changes in corrosion activity of reinforcing steel in concrete and embedded steel piles in soil.

Intended Benefits

The intended benefit of monitoring and instrumentation of bridges is to establish ongoing performance and safety. Changes in structural behavior can be associated with deterioration or other risk factors that can be evaluated to assess remaining service life and to ensure ongoing safety of a bridge. In recent years, instrumentation and monitoring has evolved to discussion of “smart bridges” in which measured field data is fed into analytical models of anticipated behavior to determine real-time assessment of ongoing safety and integrity.

Example Projects

Examples of monitoring and instrumentation technology in IBRC projects include the following:

- New single-span precast prestressed concrete bulb tee bridge on State Route 36 in California (CA-2001-03) in which passive sensors were cast into the concrete to monitor the ingress of chloride ions into the concrete. The devices consisted of a chloride sensor and a radio-frequency identification tag that could be interrogated remotely.
- In the replacement of a bridge over Kealakaha Stream on Route 19 in Hawaii (HI-2000-01), a three-span posttensioned concrete segmental bridge, fiber optic sensor technology was installed for dynamic monitoring of deformations and strains during earthquake shaking and traffic vibrations.

STUDY COMMITTEE BIOGRAPHICAL INFORMATION

Mary Lou Ralls (*Chair*) is Principal of Ralls Newman, LLC, a structural engineering consulting firm in Austin, Texas, and Director of Technology Transfer for the Accelerated Bridge Construction University Transportation Center at Florida International University. Ms. Ralls joined the Texas Department of Transportation (TxDOT) in 1984. From 1999 to 2004, she was TxDOT's State Bridge Engineer and Director of the Bridge Division. She was chair of the TRB F-SHRP Renewal Panel. In TRB's SHRP2 program, Ms. Ralls was a member of the Renewal Technical Coordinating Committee, a member or chair of several of the Expert Task Groups, and a member of the Committee for the Strategic Highway Research Program 2: Implementation. She holds an MS in structures engineering and a BS in civil engineering from the University of Texas at Austin. She is a registered Professional Engineer in Texas.

Ross B. Corotis, NAE, is Denver Business Challenge Professor in the Department of Civil, Environmental and Architectural Engineering at the University of Colorado. From 1994 to 2001, he served as Dean of the College of Engineering and Applied Science at the University of Colorado at Boulder. He was formerly a member of the faculties of Johns Hopkins University and Northwestern University. Dr. Corotis's primary research interests are in the application of probabilistic concepts to civil engineering problems, including stochastic modeling of loads on structures and structural system reliability. He is a past Editor-in-Chief of the *ASCE Journal of Engineering Mechanics* and of *Structural Safety*. He was awarded the American Society of Civil Engineers (ASCE) Walter L. Huber Civil Engineering Research Prize in 1984 for his work on stochastic modeling of structural loads. Dr. Corotis is a registered professional engineer in Colorado, Maryland, and Illinois and a registered structural engineer in Illinois. He received the PhD, MS, and BS degrees in civil engineering from Massachusetts Institute of Technology.

Rebecca L. Curtis is Bridge Management Engineer for the Michigan Department of Transportation. In this position she oversees operation of the department's annual bridge inspection program, development of bridge management systems, and development of bridge strategy and performance measures. Before joining the Department of Transportation in 2006, she was an engineer with Orchard, Hiltz, and McCliment, Inc., an architectural, engineering, and planning firm. She is a member of the Technical Review Team for the American Association of State Highway and Transportation Officials' BRIDGEWare bridge management software and a former member of the TRB Long-Term Bridge Performance Committee Expert Task Group for Bridge Evaluation and Monitoring. She is a registered professional engineer in Michigan. She received an MS in civil engineering from The University of Michigan and a BS in civil engineering from Michigan State University.

Catherine French is College of Science and Engineering Distinguished Professor in the Department of Civil, Environmental, and Geo- Engineering at the University of Minnesota. She has been a member of the faculty since 1984. Her research involves the experimental investigation of reinforced and prestressed concrete structural systems, field monitoring of structures, numerical and experimental investigations of structural systems including time-dependent and environmental effects, evaluation and repair of damaged structures, and development and application of new material. She was elected a Distinguished member of ASCE and Honorary member of ACI in 2018. She is a recipient of the ACI Joe Kelly Award, ACI Henry L. Kennedy Award, ACI Reinforced Concrete Research Council Arthur J. Boase Award, and ASCE Raymond C. Reese Research Prize. She is a past member of the ACI Board of Directors and numerous other ACI committees. She currently serves on ACI 318, Structural Concrete Building Code, of which she has been a member since 1995. She received the PhD and MS degrees from the University of Illinois at Urbana-Champaign and a BSCE from the University of Minnesota.

Raymond Paul Giroux is a Senior Engineer with Kiewit Bridge and Marine, Kiewit Infrastructure West Co., Vancouver, Washington. He has been with Kiewit since 1980 and has contributed to major

infrastructure construction projects throughout the United States. He was elected as a Distinguished Member of ASCE in 2016. He is a recipient of ASCE's Roebling, G. Brooks Earnest, and History and Heritage Awards and the Augustine Award of the American Association of Engineering Societies. Mr. Giroux lectures widely on civil engineering history at universities and professional conferences. He received a BS in construction engineering from Iowa State University.

Yidong (Eddie) He is a Technical Director with Parsons Corporation in Chicago, Illinois. He has extensive experience in the design, analysis, and construction of bridges and buildings. He has been involved in the design and construction of more than 30 complex bridges, including posttensioned concrete, steel box girder, segmental concrete, arch, truss, cable-stayed, and suspension bridges and transit structures. He is an expert in accelerated bridge construction, mass-produced prefabricated bridge elements, erection equipment, and concrete formwork. Before joining Parsons in 1987, Dr. He held engineering positions at HNTB, Inc., and at J. Muller International. He is a registered professional engineer in Illinois, Indiana, and Wisconsin. He received a PhD in structural engineering and Master of Engineering in structural engineering from West Virginia University and a BS in civil engineering from South China University of Technology.

Malcolm T. Kerley is President of NXL Construction Services, Inc., a transportation engineering firm in Richmond, Virginia. From 2002 until 2012, he was Chief Engineer of the Virginia Department of Transportation, where he was responsible for all engineering aspects of the department. From 1992 to 2002, he served as State Structure and Bridge Engineer. He is a former chair of the American Association of State Highway and Transportation Officials Subcommittee on Bridges and Structures. Mr. Kerley is a registered professional engineer in Virginia. He received a Master of Engineering in civil engineering from the University of Virginia and BS in civil engineering from Virginia Military Institute.

Bijan Khaleghi is State Bridge Design Engineer in the Washington State Department of Transportation. He has been with the department since 1991. He is experienced in the design of prestressed and posttensioned concrete bridges, tunnel construction and rehabilitation projects, and bridge preservation projects. He is an adjunct professor at Saint Martin University, Olympia, Washington, teaching courses in advanced concrete, earthquake engineering, and bridge design, and has served as a member or chair of numerous National Cooperative Highway Research Program (NCHRP) project panels. Dr. Khaleghi received the Precast/Prestressed Concrete Institute's Martin P. Korn Award in 2005 and the American Society of Civil Engineers' T.Y. Lin Award in 2006 for outstanding research papers. He is a Registered Professional Civil and Structural Engineer in Washington State. He received the degrees of Doctor of Engineering—Concrete Structures and Master of Sciences—Structural Engineering from the National Institute of Applied Sciences in Lyon, France, and a MS in civil engineering from Tabriz Technical University, Tabriz, Iran.

Norman McDonald retired in 2017 as State Bridge Engineer with the Iowa Department of Transportation. The State Bridge Engineer is responsible for developing structure plans for all Interstate and primary highways in Iowa and is also responsible for inspection and coordination of bridge improvement plans for over 4,100 bridges. The Iowa Department of Transportation Bridge Office is recognized as a leading transportation agency in bridge research. Mr. McDonald was with the Bridge Office for 32 years, including 17 as State Bridge Engineer. While with the Iowa Department of Transportation, he served on various technical committees of the American Association of State Highway and Transportation Officials, including recently as Chair of the Structural Steel Design Technical Committee. He has also served as a member or chair of numerous NCHRP project panels on research topics related to steel structures.

R. Shankar Nair, NAE, is Senior Vice President exp US Services, Inc. He has more than 45 years of experience in structural engineering. His work has focused on structural engineering for large

architectural and civil engineering projects, including the longest tied-arch bridge span in the world and many high-rise buildings. Dr. Nair has worked for Teng and Associates and its successor firm exp since 1995 in Chicago, and before that was a principal at RTKL Associates in Baltimore and Alfred Benesch and Company in Chicago. His work has received numerous awards, including four American Institute of Steel Construction (AISC) Prize Bridge awards and six annual Most Innovative Structure awards from the Structural Engineers Association of Illinois. Dr. Nair chairs the AISC Committee on Specifications and is a past chairman of the Council on Tall Buildings and Urban Habitat. He was elected to membership in the National Academy of Engineering in 2005. Dr. Nair has a PhD in civil engineering from the University of Illinois at Urbana-Champaign and is licensed to practice engineering in 44 states.

Randall W. Poston, NAE, is Senior Principal with Pivot Engineers in Austin, Texas. The focus of his work has been forensic structural engineering and the rehabilitation and strengthening of civil infrastructure. This work has included the investigation of numerous structural collapses and in-service performance and durability problems with concrete structures. He is a past Chair of the ACI Structural Building Code Committee and received the ACI Henry L. Kennedy Award for his leadership in the reorganization of the ACI Building Code Requirements for Structural Concrete. Several of his projects have received the International Concrete Repair Institute Award of Excellence. Dr. Poston received a PhD in structural engineering, a MS in structural engineering, and a BS in civil engineering from the University of Texas at Austin.

Abdul-Hamid Zureick is Professor of Structural Engineering, Mechanics, and Materials at the School of Civil and Environmental Engineering at Georgia Tech. He is an authority on the use of innovative materials in civil engineering applications. His research has been to develop criteria and specifications for the design, testing, and construction of polymer composite structural systems. Professor Zureick serves on the editorial boards of the *Journal of Composites for Construction* and of *Structural Engineering and Mechanics* and was the founder and first chair of the ASTM International Technical Subcommittee on Composites for Civil Engineering and Marine Applications. He received the 1989 ASCE Norman Medal, awarded for a technical paper that makes a definitive contribution to engineering science. He received the PhD and MS degrees in civil engineering from the University of Illinois at Urbana-Champaign and a BS in civil engineering from Tichreen University, Lattakia, Syria.

Senator WHITEHOUSE. It points out that one of the problems is we lack comprehensive design standards and specifications, as well as programs for detailed long-term monitoring. A better composite solution might actually be harder to get to because the engineers never bothered to write down the specs for composite.

What is in the book is rebar, steel, concrete or whatever, so the engineers automatically go to the old and perhaps less effective and efficient technology. Trials of composite materials were a major interest of participants in the study but "Few of the States that responded to the survey use or have specifications for FRP deck elements, super structure elements, and pre-stressing tendons. Most States had little or no prior experience with these materials." I think we need to continue to press forward to make sure these new and potentially better, lighter, smarter, more durable materials have a fair chance to compete against the traditional materials.

In my State, we see more and more of a priority on bicycling and walking as an alternative. Obviously, as our roads get more and more use, if people were willing to ride a bike, many actually prefer to, we shouldn't be foreclosing that option. Pedestrian and bike infrastructure, to me, is very important in this conversation.

I will echo our Ranking Member's remarks about the charging infrastructure for electric vehicles. I am not a serious car person but I like cars and I like driving. When you look at the electric vehicles coming into the marketplace, these aren't golf carts. This is Jaguar. This is Audi. This is Mercedes.

I have a Chevy Volt, so I have a GM electric vehicle already but they are moving it to their top line, to their Cadillac division because they see this as a really huge opportunity. The performance specs of these things are, to use Elon Musk's words, ludicrous. That is actually what he describes as one of the performance options in the Tesla. You can blow the doors off a Lamborghini with your electric Tesla for about one-fifth the price of the vehicle.

I think we have to be prepared for a larger and more rapid adoption of electric vehicles as the market sees how incredibly cool they are and what fun they are to drive. It is like basic human characteristics here.

Senator BARRASSO. The question is, do they need a \$7,500 tax credit for people who do buy it?

Senator WHITEHOUSE. They are easily worth \$7,500 compared to the \$7,500-plus worth of damage that emissions from automobiles do. I am eager to support that.

I have two last comments. As far as environmental streamlining goes, I am all for it. I actually led the environmental streamlining for offshore wind that actually got offshore wind built.

Once we showed that it could be done, there have been literally multiple hundreds of millions of dollars of investment in offshore wind that have come immediately into the market because we showed the permitting did not have to be fatal to the project. I am all for that as long as it is not a pretext for crummy environmental protection and rolling local communities.

I do think we, in Congress, need to find ways to reassert our priorities through these bills, whether it is highway bills or Army Corps water bills. The idea that we just shovel enormous amounts of money into these executive agencies and then beg and plead for

their consideration as to what might get funded and get lost in their priorities and their bureaucracy, I think we need to revisit that and create a stronger system of regard for congressional priorities.

With all of that, I would be happy if anyone wants to comment on that, please do so as a question for the record. However, my time has expired so I have to go on. Take that as a question for the record and put your answers in writing if you would like to respond to any of those thoughts.

Senator BARRASSO. Thank you, Senator Whitehouse.

Senator CAPITO.

Senator CAPITO. Thank you, Mr. Chairman.

Thank you all for being here today.

Mr. McKenna and Mr. Demetriou, you both cited several statistics on the return of investment for infrastructure as being as high as maybe one to four. There is another side of the ledger, I think, that you all are aware of.

A study was released in 2017 for our State of West Virginia that said drivers in West Virginia spent \$1.4 billion, including an average of \$647 per vehicle, increased operating expenses due to potholes and poor conditions of the roads. We also have rural bridges and you mentioned Missouri with the same kind of issues with your bridges that are in poor condition. We have quite a few bridges in our State. I want to bring that up and my colleague from Indiana brought up what they are doing.

Driving the message in our State probably two-and-a-half to 3 years ago was more the negative effects of not doing anything, not improving your infrastructure and the negative effects it was having on the lifestyle and ability to do business in our State, the opposite side of the ledger.

We actually passed a \$1.6 billion road bond in the State of West Virginia which has difficulty on our economics much like my colleague said. It raised the gas tax with people willing to pay to have better and improved infrastructure in their lives. You can follow the progress we are making in West Virginia on the website. It is very transparent at the DOT website.

I guess my question is, do you think the better driving of the message from here is on the negative? We are obviously good at driving negative messages from time to time. Is it a message that needs to be obviously both a positive benefit through the business? Mr. Demetriou, you outlined that quite well.

From a State perspective, I am sure in Missouri you can drive a negative message and drive more voter satisfaction on that. Do you have any comments on that?

Mr. McKenna. I do, Senator. That is a wonderful point. I think we do, as an industry, and all States need to drive a lot of the messaging forward, the costs and benefits and also really what the cost of doing nothing is.

We put together a citizen's guide for transportation funding in Missouri and put it on a website. We have determined the price people pay is about \$30 a month for access and use of the transportation network but the cost of doing nothing exceeds \$180 a month.

Those higher maintenance costs, the cost for insurance for increased damage to vehicles and for, unfortunately, incidents that

rise up as much as to fatalities all over the Nation, those costs are very important. You can see very clearly, I think, the path for solutions in policy when you understand that you are exceeding your costs by \$150 a month.

Senator CAPITO. Mr. Demetriou, do you have a response to that?

Mr. DEMETRIOU. I think at the end of the day, you stated it very nicely, if people understand what the purpose is and buy into that purpose, they are going to support it.

Senator CAPITO. Right.

Mr. DEMETRIOU. Whether it is to overcome the negative or it is to enhance lifestyle and make things more efficient.

I will also talk from a business standpoint that as infrastructure is improved, it is going to accelerate business investment because businesses are going to be more confident in expanding their business facility, whatever it is, knowing there is going to be more efficient infrastructure and transportation adjacent to their facility.

Senator CAPITO. Right. Thank you.

One of the things we talked about in the President's proposed infrastructure package last year and over the last 2 years was to try to look at what infrastructure really means. For me in a rural State, enhanced broadband deployment is an exceedingly important part of an infrastructure package that we would put together, realizing that the highway bill is different.

I am thinking if we are looking for efficiencies, we have a lot of dig once provisions to be able to enhance not just what is going in surface transportation. There might be some economic benefits to doing that too. In other words, working with internet service providers, we will dig once for you, but it is going to cost you maybe not that much, but it is a better efficient way to move about.

Do you have any thoughts on that?

Mr. DEMETRIOU. You just touched on what is a tremendous opportunity for the United States, smart infrastructure, and connected infrastructure. I think the more we can look at it holistically, connecting buildings, highways, airports, the whole infrastructure community and create smarter cities, smarter buildings, smarter infrastructure, it will accelerate the improvement we are all talking about.

Senator CAPITO. And make our dollars go further, I think.

Mr. DEMETRIOU. Exactly.

Senator CAPITO. Thank you so much.

Senator BARRASSO. Thank you, Senator Capito.

Senator Van Hollen.

Senator Van Hollen. Thank you, Mr. Chairman.

Thanks to all of you for your testimony today.

We all know we have a huge infrastructure gap in our Country, the gap between the need to modernize our infrastructure and the resources we are dedicating to it. I hope, as a Congress, we can figure out a way to significantly increase our investment in that area.

We talked about some of the proposals today. That is true whether we are talking about broadband, highways or transit. This is one little sample of what is happening every day around our Country.

This is from yesterday's Baltimore Sun. The potholes are so bad on a stretch of the Baltimore-Washington Parkway that the speed limit was lowered to 40 miles an hour because the potholes were

so bad. Senator Cardin, my colleague from Maryland, may even come that way. It is just one more example of what we are seeing every day. We cannot just keep fiddling here while our infrastructure crumbles away. I want to thank all of you for being here.

Let me ask you, Mr. Replogle, and thank you for your prior service in the State of Maryland, I think in Montgomery County with the Park and Planning Commission, is that right?

Mr. REPLOGLE. Yes.

Senator Van Hollen. Our loss is New York's gain.

You have a statement from your testimony saying you "urge Congress to increase public transportation capital investment grants and take steps to ensure that competitive grants like BUILD are not largely directed away from urban areas. Rather than allocating funding solely to existing formula programs, we urge new support and flexible funding for State and local traffic safety initiatives for the redesign of our streets to accommodate multiple travel options and for efforts to safeguard transportation assets against extreme weather."

Can you just elaborate a little bit on that? I am wondering if that sentiment is shared by our other witnesses here as well.

Mr. REPLOGLE. We are at a place where we can direct our transportation dollars in a way that does more to advance our national and community goals or we can direct it as we have directed it in the past where it does not always deliver the most performance.

We have 37,000 people a year killed on our highways. Those numbers are moving in the wrong direction nationally. If you look across the Country, there are a few communities like New York City that have been able to significantly push those numbers down with some concerted action.

We call our initiative Vision Zero. It involves lowering the speed limit on city streets, enforcing traffic laws that provide for better traffic safety, doing reengineering on our streets and our intersections to make it safer to walk, bike and move about, and making sure we have multimodal street designs that accommodate bus traffic more efficiently so that buses are not stuck in traffic but can move more quickly.

These helps the whole transportation system be more productive at getting people to jobs and opportunities with less taxpayer spending.

Senator Van Hollen. That would require directing some formula funds outside the current formula or additional funds?

Mr. REPLOGLE. The challenge we have now is a lot of the formula funding goes to the States and yet a lot of these kinds of initiatives that I described are done at the local government level. The money is not getting to the local level.

Senator Van Hollen. It has been a major frustration, I know, with a lot of counties in the State of Maryland.

Mr. REPLOGLE. We are calling for direct funding to larger jurisdictions following the model of the Federal Transit Administration which directly allocates funding and allows for design processes and effective delegation of authority for project reviews and permitting so that we do not have to go through an extra layer at the State level which makes for inefficiency and often, in fact, filters out the funding so it does not get to the local level at all.

Senator Van Hollen. I look forward to following up with you on that.

I know the time is limited. You talked about the transit programs. Within the FTA programs, there is the capital investment grant program. I am interested in adapting that idea to help create a fund of money for bridges.

When I talk to folks across our State and hear about the crumbling bridges, it is a huge safety issue. They do not seem to rank very high on the list of priorities when it comes to the funds.

I am also interested in whether all of you would support the establishment of the equivalent to the Capital Investment Grant Fund at FTA within the Transportation Fund for bridge purposes?

Mr. REPLOGLE. As a city with 789 bridges, I think we would support that kind of initiative, especially if the funding enabled some direct allocation to larger jurisdictions below the State level.

Mr. MCKENNA. If I might, I do not disagree with any of the comments about the need. I do think if we look at this as a single pie that is not growing and we carve it up differently, the asset management needs of State DOTs, with the backlogs and numbers we have talked about, the difficulty and the reason why some of those funds are not moving through into those other priorities is simply there are not enough dollars going into the pie.

That is a critical issue for all of us. As a State with 24,000 bridges, bridge funding is an absolute priority but if you reduce flexibility for the States to address the most important priorities in their asset management plans without a concurrent rise in the resources available to do so, you will not have the desired effect.

Senator Van Hollen. Back to the bridge program, I am talking about additional funding source.

Thank you all very much.

Senator CAPITO.

[Presiding.] Thank you.

Senator ERNST. Thank you, gentlemen, for being here today.

I think through the discussion we have heard, there are a lot of ideas out there. We all need to make sure there is smart investment in our infrastructure. I think we could all agree, we do need to control waste and do need to encourage greater efficiencies in what we do as well.

Mr. McKenna, one of the streamlining ideas you touched on in your testimony relates to the categorical exemptions or the CEs. You recommend allowing any Federal agency to use the CE if it is already in place at another agency.

This does seem to make sense to me. It would provide that greater efficiency. If one agency has a CE for a certain action, then another agency should also have a CE for that same action.

Do you have any examples of how the lack of a CE or CE interchangeability between agencies has actually slowed projects?

Mr. MCKENNA. We can certainly draw in several examples from all over the Country. I will submit those for the record.

What we do know is that in our own dealings, in many cases when we are working on our bridge work, when we are crossing major rivers, even if there are slight replacements, we can have circumstances where we have what we need from one agency and an-

other does not have that authority, so they have to go through a more substantial environmental assessment.

That is where we find the slow-down. When that does happen, in fact, it is a very similar process within each agency. USDOT has some ability to do that across modes, but not across to other agencies of the government.

Senator ERNST. It would be helpful in your estimation?

Mr. McKENNA. Yes, it would.

Senator ERNST. Between agencies.

Is this recommendation something that most folks you have worked with would agree on?

Mr. McKENNA. Yes. We do believe that the work done by one agency versus another is quite similar, so it is a matter of speeding up the process, not short shifting the environmental regulations.

Senator ERNST. Certainly, but if one agency has done it?

Mr. McKENNA. That is right.

Senator ERNST. Right. Where would you receive pushback on this idea?

Mr. McKENNA. As we have made progress with the FAST Act and MAP-21, I think we have made progress there. I believe we are gaining momentum to continue with that forward. It is when we come across statutory limitations between the programs and between different agencies with different congressional mandates, that is where we see some of the issues.

It is not so much that people do not wish to do it. It is that they may not have the statutory authority to do so.

Senator ERNST. Very good. I appreciate that.

Mr. McKenna, can you go into some detail on what you think are the benefits of States participating in the NEPA assignment program? I think there are only a few States right now that do participate in that. If you could, what do you think is keeping other States from getting onboard with that?

Mr. McKENNA. I think we have seven States now that are participating in that assignment. We do have some resource issues at the State level, being able to receive that responsibility and coordinate that.

Some work to further streamline the application and approval process I think would be beneficial to help encourage others. In other cases, it is really a matter of working on a programmatic basis to set agreements that benefit both the State and the Federal Government. Being able to coordinate those efforts more could encourage that.

Certainly in the States that have much more significant and complicated projects, it is a higher priority. In States like Missouri, our average project delivery timeframe is under a year. We have wonderful partners with Federal Highway, our division office is a terrific partner with us, and we work with our locals, our cities and our communities to try to quickly make commonsense investments.

Senator ERNST. I appreciate that. I have very little time left. I will stop there but I do think as long as we are taking a look at this, we need to understand our dollars need to go a little bit further. The less we spend on the bureaucracy, the more we can actually spend on our infrastructure.

Thank you. I appreciate that.

I will yield back.

Senator BARRASSO.

[Presiding.] Thank you, Senator Ernst.

Senator CARDIN.

Senator CARDIN. Thank you, Mr. Chairman. Thank you for this hearing.

The economic impact of modernizing our infrastructure I think is obvious. It is good to be able to establish the record here.

I want to cover a couple of points, if I might, as we deal with the economic returns of the infrastructure. Senator Van Hollen mentioned the fact that the B-W Parkway, I do take that road, the highway speed has been reduced to 40 miles an hour because of potholes. I admit that is under the Park Service, not under these programs, but it does point out the fact that we are not maintaining our transportation infrastructure.

One of the things that concerns me is we all look at the opportunities to modernize our infrastructure and we always look for the glamorous new opportunities, as we should because it does provide economic growth.

However, we do not invest in maintaining our infrastructure at a level that we need to. That is why we have bridges that are falling down, roads that are not really safe and we do not really invest in resiliency recognizing the realities of the changing climate conditions.

We invest for the purposes of getting a good return. In reality, we are not investing in maintaining or dealing with resiliency. As we look at the reauthorization of surface transportation, I am wondering if any of you have thoughts as to how we can have a better decisionmaking process at both the Federal and local levels so that we do not just throw money at new projects and see existing essential transportation programs sort of crumble.

I could also mention not only in this committee's jurisdiction but our transit systems are in horrible condition. We have seen loss of life in the transit system here. How do we make sure that we deal with maintenance and resiliency?

Mr. DEMETRIOU. Let me start and tell you what I am seeing it takes with regard to our clients across the United States. More and more everyone is seeing what you are talking about.

Every project we are working now has not only the corrective action for the infrastructure or the expansion, but it is putting sustainable solutions in place, putting in new technology and innovation to make it more efficient, both to operate and maintain as well as the construction side of it. I think as we go forward, we need to put policy in place that ensures everything is addressed not just the short-term solution.

Mr. REPLOGLE. In New York City, we are increasingly taking a triple bottom line approach to asset management. We have stepped up the amount we are investing in repaving our asphalt roadways. We are taking strong action on behalf of our \$15 billion, 10-year capital program from my agency goes to keeping our bridges in a State of good repair and trying to improve that.

We are looking increasingly at where we need to replace or modify old bridges. The average age of our bridges in New York City is over 75 years. As the city has evolved and grown around those,

it commands us to take a fresh look at how we manage and redevelop those assets over time.

I think the Federal Government could take those kinds of models and embed them in new legislation to encourage a triple bottom line asset management program for the United States as part of a performance-based transportation initiative.

Mr. McKENNA. I would agree with what Michael said. Asset management is really the key. I think you are seeing that across the Country. Some of the requirements on performance management and metrics were put first in MAP-21 and then in the FAST Act.

Some of the State DOTs are really waking up to that and doing a very good job of asset management. Simply put, asset management alone cannot do it. We need steady funding, need to know that it is coming, and need to know what amount it will be in so long-term reauthorization and steady funding is vital.

You are planning, in a budgetary sense, on a one Fiscal Year basis in a budget sense. State DOTs and asset management plans are 10 years long. We are projecting out 20 and 30 years. Without knowing the amount we can invest, all of those plans are for naught.

Senator CARDIN. Let me respond to the point from Senator Van Hollen on local input without having to go through the States. We do have a model under the Transportation Alternative Program so we might be able to build on that type of model on some of the issues you refer to because that has been a successful model for local governments being able to have more control over projects in their own communities without having to go through the State funds.

Senator BARRASSO. Thank you, Senator Cardin.

Senator Braun, you had a question or two you wanted to follow-up with?

Senator BRAUN. Thank you.

This is for Mr. McKenna. I am asking you this because it was stated early on that it has been a long time since we have adjusted the fuel tax. We are in the worse shape possible doing things out of our general fund in the current context. I want to put you on the hot seat but I think I know what the answer would be in Indiana.

Do you think in Missouri, if the formula was changed from the 20-80 to where it would ask States to do more, or whether there was a separate grant process or funding say on a 50-50 basis like we did in Indiana with cities and counties, do you think that is something Missouri would be interested in, in terms of not relying on something that is not currently working because I think roads across the Country are getting in worse and worse shape. Where do you think Missouri would be?

Mr. McKENNA. Frankly, we have challenges with funding across the board. States across the Country and in Missouri, we do count on Federal partnership and we do not rely solely on that Federal partnership.

As I said, we have a cost share program where we are encouraging local participation, but we do need, as I mentioned in the example and what you can see in my testimony, a single bridge, the

Rocheport Bridge needs to be replaced. Within 72 hours, the commercial vehicles that travel on that touch every single State in the continental U.S.

Even local projects require that. There is a purpose for the national program to be able to invest in those.

I am hesitant to think we would go off or move away, from in its entirety, the Federal-State partnership that exists today. However, we just dropped two discretionary grant applications for INFRA into the hopper where the State is assuming a 70 percent share.

On a case-by-case basis, one of them is to solve that Rocheport Bridge problem, but on a case-by-case, project-by-project basis, yes. On a programmatic basis, I think we are a little hesitant.

Senator BRAUN. You would still be interested in keeping it on the 20–80 formula?

Mr. MCKENNA. Yes.

Senator BRAUN. I think that would be the reaction from most States. I just think it is going to be shortsighted because I think if we want to get those things done within our States, we are going to have to start being willing to do more because if you look at what is happening here, we are in the least capable shape of doing what needs to be done across the Country.

I am glad you are at least taking advantage of the INFRA grants. I think I would think about maybe doing more as a State. I know in Indiana, we would definitely think about it.

Thank you.

Senator BARRASSO. Thank you, Senator Braun.

Senator CARPER.

Senator CARPER. I just want to follow-up.

As a former Governor, one who has thought a lot about State-Federal partnership on this front, I just jotted down five or six ideas on trying to pay for this hole, how to fill this hole for infrastructure and surface transportation.

One would be to restore the purchasing power of the traditional user fees that we have had for many, many years. Two is a toll. I talked about tolling, a four-lane highway we just opened in Delaware a month or so ago.

Public-private partnerships, a lot of people say that is the key, that is the magic. It is probably not. I think there were about 40 public-private partnerships in the Country in the last decade or so. It is not a lot but it is part of the answer.

We talked about streamlining. We have done a fair amount of that already. There may be other ways to do some more. I am not interested in degrading the environment but exploring technology to be able to build more durable structures as we go forward in time.

This is your point, somehow figure out how to leverage more State and local funding and craft our Federal funding in a way that does that. I think eventually, for the folks driving vehicles that do not use any gas or diesel they have to start paying something as well.

Eventually, what I would like to do is ramp us up to some kind of vehicle miles traveled. I think a dozen or so States have been

involved a bit in these pilot programs. I think there are seven active right now. I think that is part of the future.

Thank you very much for mentioning that.

Mr. Replogle, in your testimony, you urged Congress to increase Federal funding for transportation infrastructure. You also State not all transportation investments yield similar benefits. Could you elaborate for us how Congress should ensure that increased spending is directed to supporting productive long-term investments?

Mr. REPLOGLE. I think there are a number of studies that have been done over the years showing if you invest \$1 in a new highway, it creates little over a dollar's worth of economic activity.

If you invest that dollar in public transportation, you play this through economic multiplier models, 80 percent of that dollar in public transportation goes into transportation into wages for the people who are providing the public transportation services. That multiplies to about \$2.80 in the local economic activity.

You can look at this from an economic multiplier. The economic multipliers are heavier for transit investment than they are for highway investment. Those vary somewhat from region to region.

You can also look at this from the standpoint of capital investment dollars. If you put those dollars into expanding a highway, an interstate highway, it is going to certainly create jobs in the construction industry and provide for long term mobility.

If you put that same money into building sidewalks and bike paths in communities, it is actually more labor intensive and creates more local jobs that are somewhat less skilled, so it helps support the local base of the economy while also helping traffic safety and saving lives in ways that we have not been paying sufficient attention to in America.

That is one of the reasons why pedestrian deaths keep going up at a much sharper rate than overall highway deaths which are still going up. We need to address both of those. We need to think about those things together, again, triple bottom line, economic, social and environmental.

Senator CARPER. I have a follow-up question for you.

Later today, I am going to be introducing legislation entitled The Clean Corridors Act of 2019 which expands opportunities for electric vehicle charging. I would ask, how critical is EV charging infrastructure build out as a tool to address the global emergency of climate change?

Mr. REPLOGLE. It is quite urgent that we rapidly invest in electric vehicle charging opportunities so that you can take a trip, most trips across America, without having to have range anxiety that you are going to have trouble finding a place to recharge your vehicle in a convenient way.

We have that ability with the gasoline and diesel-powered fleet, but we do not have that quite yet for electric. We will need to electrify our surface transportation if we are to decarbonize it and to address the climate change challenge that is an existential crisis for our society and our civilization.

Senator CARPER. Thank you.

You mentioned a trip across America. My wife and I went to see a movie last weekend that won the Academy Award for Best Motion Picture, *Green Book*, which is a trip across wide parts of

America by a talented African American pianist, Don Shirley, I think was his name, he was actually quite a concert musician as well, and a guy from the Bronx who was Italian-American. The two of them could not have been more different.

The story is set in 1962 and going through the South. If you were African-American, you had to use this Green Book to find a place where you could stay and eat. It was a wonderful, wonderful film. It reminded me a bit of Hidden Figures, the NASA stuff with John Glenn which was also inspiring.

It is nice to know they still make movies like that. It is nice to know we still have hearings like this.

Thank you all.

Senator BARRASSO. Thank you very much, Senator Carper.

Mr. McKenna, earlier Senator Carper cited the Government Accountability Office statistic that about 96 percent of environmental reviews are completed through categorical exclusions.

Does this figure mean there are no more or other meaningful ways we could further accelerate project delivery?

Mr. McKenna. No, I think actually that citation shows that even within the process for categorical exclusion that might be one of the areas that moves the needle even further. If we make a 50 percent gain in efficiency on 95 percent of the projects in this Country, that is a significant gain on process, not on projects that would impact the environment.

I think even when we shave a week, a month, 2 months or 3 months off that, in a lot of States in this Country that is the whole construction season. It is really impactful.

Senator BARRASSO. Mr. Demetriou, do you have any examples or thoughts on that specific question as well?

Mr. DEMETRIOU. I want to use three projects I want to highlight and how it can be done in today's environment.

The 11th Street Bridge is a project I mentioned earlier and the Anacostia River. Average infrastructure projects of an equivalent type nature were six-plus years. That project was 27 months to get a record of decision.

I already mentioned the Colorado project, 2 years. Then the Elgin-O'Hare West Bypass is another great example, 6 months ahead of schedule to get the record of decision.

All three of these projects basically had the four key elements needed in addition to policy. It had up-front funding that was committed. A lot of times that is the major driver. Two, it had upfront commitment by the political environment, the regulatory and the business purpose was clear whether it was a need to respond to a disaster or need for improvement.

I think the biggest piece was the collaboration and communication people committed to. The regulatory agencies, the owners and the contractors altogether made sure that upfront everyone knew what had to get done.

It is already happening. I think the more we can codify and put this into law, we will further accelerate all of that.

Senator BARRASSO. I appreciate that.

I do have AASHTO's FAST Act reauthorization proposals from November 2018 which include a number of the recommendations

for streamlining these environmental reviews for transportation projects.

If there is no objection, I ask unanimous consent to enter this into the record. It is so ordered.

[The referenced information follows:]

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OF STATE HIGHWAY AND
TRANSPORTATION OFFICIALS

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AASHTO FAST ACT REAUTHORIZATION

Compilation of 11 White Papers from Committees

Final Version: November 5, 2018

INTRODUCTION

The Fixing America's Surface Transportation (FAST) Act enacted in December 2015 represented the first comprehensive, long-term surface transportation legislation since 2005's SAFETEA-LU. The FAST Act continues to fulfill the Constitutional directive that investment in transportation is a core federal responsibility. Its authorization of \$305 billion for federal highway, highway safety, transit, and passenger rail programs from 2016 to 2020 could not have been timelier in supporting our economic growth and maintaining our multimodal transportation infrastructure.

Yet at the same time, the FAST Act provides only a one-time and near-term—though absolutely necessary—reprieve when it comes to federal surface transportation funding. By not enacting a long-term funding source, the Highway Trust Fund (HTF) continues to remain at a crossroads. The HTF has provided stable, reliable, and substantial highway and transit funding for decades since its inception in 1956, but this is no longer the case. Since 2008, the HTF has been sustained through a series of General Fund transfers now amounting to \$140 billion. Without a solution to this crisis, AASHTO estimates that states will see about a 40 percent drop in highway funding from FY 2020 to the following year—\$46.2 billion to \$27.7 billion in FY 2021. In the past, such similar shortfall situations have led to the possibility of a reduction in federal reimbursements to states on existing obligations, leading to serious cash flow problems for states and resulting in project delays. More alarmingly, due to a steeper projected shortfall in the Mass Transit Account, new federal transit obligations are expected to be zeroed out between FY 2021 and FY 2023, excluding any “flex” of highway dollars to transit. Simply put, this is a devastating scenario that we must do all we can to avoid. Beyond maintaining program levels, there has been broad consensus among states that additional Federal funding and investment is warranted.

Beyond funding stability, after decades of adding layers of regulatory requirements on state transportation agencies, some aspects of the Moving Ahead for Progress in the 21st Century Act (MAP-21) and the FAST Act provided helpful policy reforms. Through the proposed infrastructure package and the next surface transportation reauthorization, AASHTO recognizes that we need to continue the momentum of MAP-21 and the FAST Act by making further efficiency gains on transportation policies and project delivery and provide increased flexibility for states. State DOTs strive to maintain responsible stewardship of taxpayer resources and both human and natural environments, all the while improving both mobility and accessibility for all residents and businesses.

POLICY WHITE PAPERS FROM ELEVEN AASHTO WORKING GROUPS

Resulting from the first phase of the 18-month reauthorization policy development process, this document comprises in-depth policy white papers from the eleven Working Groups listed below.

1. Connected and Automated Vehicles
2. Data Management and Analytics
3. Funding and Finance
4. Operations
5. Performance-based Management
6. Planning
7. Project Delivery: Engineering
8. Project Delivery: Environmental Protection
9. Research and Innovation
10. Safety
11. Transportation System Security and Resilience

After the meeting of the AASHTO Transportation Policy Forum in Atlanta on September 22, 2018, recommendations from TPF will be provided to each of the Working Groups for their consideration before finalizing each of these white papers. Upon completion, this package of papers will be updated for review by each of AASHTO's Modal Councils and the Special Committee on Freight for their respective white papers to be completed in early 2019.

TIMELINE

COMPLETED

- **May 2018:** Formally kick off the FAST Act reauthorization effort at the TPF meeting; *2018 AASHTO Spring Meeting, Franklin, TN*
- **May 2018 to September 2018:** Committees to develop and approve their five-page white paper.

CURRENT

- **September to November 2018:** TPF, Modal Councils, and Special Committee on Freight to receive briefings on each white paper; *2018 AASHTO Annual Meeting, Atlanta, GA*

FUTURE

- **November 2018 to February 2019:** Modal Councils and Special Committee on Freight to develop and approve their five-page white paper.
- **February 2019:** TPF to receive briefings on each Modal and Special Committee white paper; *2019 AASHTO Washington Briefing, Washington, DC*
- **February 2019 to May 2019:** TPF to develop draft policy resolutions based on each white paper.
- **May 2019:** TPF to deliberate on draft policy resolutions developed to date; *2019 AASHTO Spring Meeting, Park City, UT*
- **Summer 2019:** TPF to hold an in-person reauthorization meeting to finalize and adopt draft policy resolutions for Board consideration, amend white papers as necessary, and develop legislative outreach strategy; *2019 AASHTO Joint Policy Conference, Location TBD*
- **October 2019:** AASHTO Board of Directors to consider and formally adopt TPF policy resolutions, and amend white papers as necessary; *2019 AASHTO Annual Meeting, St. Louis, MO*

- **October to November 2019:** AASHTO staff to develop a comprehensive suite of reauthorization policy information composed of policy resolutions, white papers, and visual complements intended to serve different audiences in the transportation stakeholder community.
- **November 2019 to September 2020:** AASHTO members and staff to communicate and explain AASHTO's formal policy position.

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1: Connected and Automated Vehicles

INTRODUCTION AND BACKGROUND

The potential of Connected and Automated Vehicle (CAV) technologies to save lives, enhance mobility, and serve as the platform of a new generation of transportation management systems is vast. While there is tremendous potential in significantly improving transportation mobility and accessibility for people with CAVs, the top priority for AASHTO and the state DOTs is the safety associated with the implementation of the technologies. Safety has been, and will remain, at the forefront of AASHTO's policy goals as state DOTs have the primary responsibility for the safe and efficient movement of people and goods on our nation's highways and streets.

Ultimately, it is in the best interest of society that vehicles equipped with CAV technologies be introduced as quickly under appropriate regulatory oversight to realize the saving of lives and to improve the quality of life, and a collaborative approach on the challenges will help avoid pitfalls on a much-needed deployment pathway. The traditional division of responsibilities for vehicle safety, under purview of the federal government, and safe operation of vehicles through licensing and registration under purview of the state government has worked well and needs to be maintained in the future. However, the advent of automated vehicles is blurring the role of the vehicle and the operator subject to traditional jurisdictional lines and requires a new collaborative approach to what lies ahead.

The transformative nature of CAVs is just now coming into focus. There are still many questions to be answered from both a policy and technological perspective. While current media attention appears to focus on automated vehicles, AASHTO believes the future includes both connected and automated vehicles. AASHTO's member DOTs believe that establishing a strong foundation for CAVs requires robust connectivity using vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication.

SPECIFIC POLICY ISSUES AND RECOMMENDATIONS

ISSUE 1-1: Deploying CAV Technologies in the Safest Manner Possible is Paramount

- *Current Federal Policy:* None
- *Issue:* The safety of all users of the transportation system is the most important consideration for AASHTO and state DOTs with respect to transportation infrastructure and the emerging deployment of CAVs. It is estimated that over 90 percent of fatal vehicle crashes are a result of human error, some of which could be significantly mitigated through CAV technologies occurring on the transportation system. CAVs have the potential to positively influence the safety of not only vehicle occupants, but also highway maintenance and construction workers, bicyclists, and pedestrians. While the prospect for safety improvement is exciting, we are also acutely aware that this is truly innovative technology and there are still uncertainties surrounding it. However, any slowdown in the deployment of CAV technologies will result in a substantial setback in our nation's efforts to reduce the number of crashes that result in death or injury.
- *Recommendations:*
 - AASHTO continues its commitment to safety as a top priority for the transportation industry and strongly believes that connected and automated vehicles have the potential to further reduce motor vehicle crashes and traffic related fatalities.

- The development and demonstration of connected and automated vehicles must continue and provide the data and examples necessary to establish the safety benefits of this technology. Initial, non-proprietary data generated by automobile manufacturers, technology developers, research organizations, and public agencies that may improve overall safety outcomes should be shared and the results made transparent to the public and decision makers.
- Government regulators and lawmakers should revise or remove outdated safety related laws, regulations and guidance as data demonstrates a technology's ability to provide an equivalent or higher level of safety than current regulations support or incorporate.

ISSUE 1-2: The Future of Transportation Includes Connected and Automated Vehicles

- *Current Federal Policy:* None
- *Issue:* While there has been significant focus on automated vehicles (AV) and the benefits they may bring, there has been less attention on a future that includes connected vehicles (CV). As infrastructure owners and operators, state DOTs agree that establishing a strong foundation for AVs requires ensuring robust connectivity for V2V and V2I communication. The overwhelming support for the development and deployment of CAV systems is evident in the significant commitment that state and local agencies have already made in leading, supporting, and fostering the testing and deployment of these new technologies. To date, 33 locations in the US are deploying CV technologies under sponsorship of USDOT and seventeen locations are deploying the technologies without sponsorship from USDOT. Combined, this represents 72,000 vehicles on the road and 65,000 devices installed on the infrastructure.
Many of these CV deployments involve state transportation agencies and AASHTO is working and supporting the states in many different ways. For example, AASHTO is supporting a national traffic signal phasing and timing (SPaT) challenge, which is challenging state and local public sector transportation infrastructure owners and operators to achieve deployment of dedicated short-range communications (DSRC) 5.9 GHz infrastructure with SPaT broadcasts in at least one corridor or network (approximately 20 signalized intersections) in each of the 50 states by January 2020. As of August 30, 2018, at least 26 states have committed to the challenge. More than 200 signals are broadcasting SPaT and more than 2,000 additional signals are planned. States and local transportation agencies have invested millions of dollars in DSRC, and they do not want that investment to be wasted. However, the lack of further federal direction regarding communications between V2V and V2I communication standards is creating uncertainty among state and local agencies. Absent clear direction, states and local agencies will likely make no significant implementation of CV technology since many states are unsure if they should invest in DSRC, 5G, or both for V2I communications. This uncertainty slows the advancement of this technology and future integration into our fleet and facilities.
- *Recommendations:*
 - AASHTO supports integrating Connected Vehicle technologies with the development and deployment of Autonomous Vehicles to maximize public safety.
 - AASHTO urges USDOT to ensure that its effort to establish a nationwide standard for V2V safety communications continues unimpeded such that other connected vehicle applications can be developed and deployed.
 - AASHTO believes the transportation industry must use every tool available, including DSRC, to make our vehicles, highways and roads safer. The DSRC spectrum is the only viable technology available now and USDOT should support its use for connected vehicle applications. Also, DSRC should be protected solely for vehicle-to-everything (V2X) uses and the spectrum should not be shared for other uses.

- AASHTO also recognizes the future is uncertain with regard to technological innovation. The industry must remain flexible with regard to technical approaches and standards development. While DSRC is the only viable technology available now to support V2X applications, any standards developed that occurs now should not impede technological innovation and implementation in the future.
- A universal, seamless approach to security management and CV communication is essential for the widespread deployment of connected vehicles. The Federal government should quickly lead this development through standardization and appropriate research and technology demonstration programs. This will enable states to better understand when and how to make appropriate investment decisions.

ISSUE 1-3: Any New Laws or Regulations Must Maintain the Current Federal-State Regulatory Paradigm and Any Changes Should be Done Collaboratively with the States

- *Current Federal Policy:* 49 CFR Part 571: *Federal Motor Vehicle Safety Standards*
- *Issue:* Historically, the regulation concerning the design, construction, and performance of a motor vehicle is a Federal obligation that has been under the oversight of the National Highway Traffic Safety Administration through the Federal Motor Vehicle Safety Standards (FMVSS). The licensing of motor vehicle operators, registration of vehicles, and enforcement of traffic laws have been the domain of states. In other words, the federal role is focused on *what can be sold* through the establishment of safety standards, emissions standards and consumer protection. The state and local role is focused on *who* can operate and *where, when and how* vehicles are used. The development of automated vehicles (AVs) has the potential to disrupt this separation of design versus operation whereby motor vehicles are no longer driven by a person but by the AV systems (i.e., artificial intelligence) and important questions about design, regulation, and certification of complex computer systems must be addressed. Already, there are bills in both the House and Senate that would potentially preempt state law by focusing, in part, on the performance of AV systems and affecting the *how* aspect of vehicles which is currently under the domain of states.
- *Recommendation:*
 - AASHTO recommends that the current federal-state regulatory paradigm remain intact when it comes to developing any new federal law, regulation or guidance. In addressing this and many other questions, states should be able to maintain their traditional oversight of vehicle operations and enforcement of traffic laws.
 - As technical and policy developments occur and lessons are gained, any regulations and laws needed to rebalance this separation of roles should be done collaboratively with the states (through the American Association of Motor Vehicle Administrators [AAMVA] and AASHTO) to assure the safe, efficient and effective deployment of CAVs.

ISSUE 1-4: State Laws Concerning the Operation of Connected and Automated Vehicles Need to be Uniform and Consistent

- *Current Federal Policy:* None
- *Issue:* Each state enacts laws and creates regulations for the licensing, registration and insuring of vehicles, and states have honored registrations and licenses from other states through harmonization of minimum requirements. As states begin to grapple with how to approach AVs, some are instituting restrictions on their operation, requiring special license plates or limiting their operation to specific areas, while others are treating AVs as a standard motor vehicle, allowing operation anywhere under any safe condition. As the technology advances faster than the ability of state regulatory agencies or legislatures to respond, those laws and regulations may end up

hindering technological advancements or encouraging companies to operate in states that offer friendlier regulatory environments. Thus, a patchwork system for the operation of AVs could slow nationwide deployment, leading to the uneven accrual of benefits across the states.

For example, New York garnered attention with a debate over a state law that requires drivers to keep one hand on the steering wheel, which could limit the use of AVs based on the definition of “driver.” Also, many states have regulations prohibiting video screens from being visible to drivers as well as prohibitions against the consumption of alcohol by drivers and, in most states, passengers. These regulations are being questioned by the anticipated deployment of Level 5 (fully automated) AVs. Another example of a regulation that could hamstring future technology is the common requirement that drivers remain a reasonable distance behind other vehicles to allow for safe braking, also known as “following too closely” laws. Pennsylvania statutes include language requiring vehicles being driven in a caravan or motorcade to “allow sufficient space between each vehicle or combination of vehicles so as to enable any other vehicle to enter and occupy space without danger.” Even before Level 5 AVs are common on the roads, connected vehicle technology will allow for the safe platooning of vehicles; strictly applied, “following too closely” laws could prohibit the use of platooning on public roads, eliminating anticipated benefits to fuel efficiency and congestion.

AASHTO recognizes the need to foster innovation and the development of CAV technologies and to not penalize states or stifle innovation. In the current CAV development environment, state laws allowing the on-road testing of CAVs are an important aspect to the research and development of the CAV technology and their eventual wide-scale deployment. In addition, AASHTO recognizes the need of states working together to harmonize state-level traffic and vehicle rules to ensure CAVs can legally operate and ensure interstate commerce is not adversely affected.

- *Recommendation:*
 - State DOTs should commit to working with their sister agencies at the state level to ensure a unified national framework to facilitate the development, testing, and deployment of CAV technologies, including further harmonization of state-level traffic and vehicle rules affecting the safe operation of such technologies.
 - State DOTs should continue to work through the Autonomous Vehicle Best Practices Working Group, hosted by the AAMVA that is providing states and other stakeholders with a venue in which to gather, organize and share information about the testing, operation and regulation of AVs.

ISSUE 1-S: State DOTs Need Additional Funding and Flexibility in Order to Deploy CAV Technologies and Accommodate CAV Vehicles

- *Current Federal Policy:* None
 - *Issue:* States are struggling to find the fiscal resources to maintain their current infrastructure, so having to invest in new technology to retrofit existing roads, bridges and other infrastructure to accommodate CAVs will be difficult with current funding. Consequently, benefits will not accrue unless states can afford to make the necessary investments. There are a number of test bed and pilot connected vehicle programs taking place where there is much learning about CV hardware deployment. As with all technology, costs can change rapidly as the new developments occur.
- State DOTs know considerably less about the cost of ensuring automated vehicles are able to operate on the roadways. Currently, state DOTs (and other infrastructure owners) are uncertain, at least at a detailed level, which roadway characteristics are critically important to the safe and efficient operation of AVs: pavement condition, signage, detailed GPS base maps, or striping. We know some of the developers’ needs in a general way as industry has filed comments at USDOT identifying the importance of signage, lane marking, and striping. In fact, one state has responded to

this concern by going from 4-inch to 6-inch stripes to help the technology developers with their sensors and lane departure warning systems. Other states, however, are not as willing to modify their lane striping widths because this is seen as a major investment. Further, there is uncertainty whether or under what circumstances replacing pavement marking for purpose of AV deployment is a capital investment (eligible under FHWA programs) or a maintenance activity and not eligible for reimbursement.

- *Recommendation:*
 - Congress is urged to grow federal surface transportation funding significantly above the current FAST Act funding levels and to make the deployment of connected and automated vehicle infrastructure needs eligible for funding beyond the historical aspect of funding only capital expenses to include maintenance activities necessary to the proper and safe operation of CAVs.
 - Flexibility is needed in the federal-aid procurement rules as they relate to both the purchase, installation, and maintenance of CAV technologies by a state DOT. The procurement and maintenance of CAV equipment is not the same as procurement for a more traditional civil infrastructure project and that other considerations need to be made. States need flexibility in procuring the services and equipment needed to install and maintain the computer technology assets.
 - State DOTs are committed to maintaining their assets in good a condition based on resource availability. At this point, state DOTs do not know what, or if, minimum conditions are needed for ADS to operate effectively or what the minimum condition levels should be. The state DOTs look forward to working with other public and private sector partners in updating the practical meaning of state of good repair in a world of deployed CAVs.
 - AASHTO recommends additional federal funding for building new testbeds and maintaining existing ones to allow industry and technology developers to test their hardware and applications on such testbeds. This will enable infrastructure owners and technology developers to better understand each other's requirements, resulting in better standards and better infrastructure.

ISSUE 1-6: CAVs Will Produce Significant Amounts of Data and There is a Data Governance Gap

- *Current Federal Policy:* None
- *Issue:* The data concerns of CAVs are complex and the needed laws, regulations, and guidance are simply not well known at this time. It is very likely that CAVs will collect and transmit massive amounts of data from an array of sensors and cameras. These data elements will become extremely valuable to many different stakeholders. For example, AV data could include origin-destination and ridership data (for better planning) or the condition of pavements, signs, and road markings (for better asset management). Should such information become available to state and local transportation officials through AVs, the improved data quality would likely facilitate improved planning and decision making. The availability of such information from AVs also could reduce some state data collection costs, freeing up personnel and funds for other important uses. However, this data would likely be valuable and useful to others as well. The private sector would likely monetize it in some way and may also collect it. Law enforcement could use the information as evidence of a crime that was committed near a vehicle.

Further, AASHTO has a number of concerns about the data being generated by CAVs specifically in a testing environment, which we are currently in:

- Who is this information intended to be shared with?
- Will state and local law enforcement agencies, state DOTs, and insurance companies have access to it?

- Will data sharing be the prerogative of the individual manufacturers, or will there be regulation governing access?
- Who owns and controls this data: the vehicle owner, the manufacturer, or a government agency?

Without controls in place to regulate or monitor use of the data that CAVs collect, there needs to be clarification over who “owns” the data that AVs generate; otherwise fears over invasions of privacy will likely increase. To complicate matters, most state agencies are subject to open government records requests, which can become very burdensome. Data sharing should be evaluated carefully to determine which data is able to be shared with all entities.

- **Recommendation:**
 - Continue to collaborate with industry to better understand data issues and develop consensus on future paths forward related to the collection, sharing, and use of data related to CAVs. This would include a discussion on:
 - What data and information are important to collect;
 - What is the purpose of using the collected data and information purpose; and
 - Who and why should the data and information be shared with.
 - Due to the industry’s preliminary testing phase of AV operation on public roadways, AASHTO strongly recommends:
 - The broad sharing of information associated with crashes and near-miss occurrences so that collective learning can take place while still protecting proprietary information of the technology developers.
 - The data for which events are shared includes non-crash data such as “near miss” and disengagement events which can be as important as crash scenarios when assessing road conditions. Currently, the data recording is suggested to be limited to fatal crashes, personal injury crashes, and crashes involving towed vehicles.
 - Ensure that no personally identifiable information can be included in any of the data that are shared to protect the privacy of the individuals.

ISSUE 1-7: The Deployment of CAVs Will Continue to Require a Collaborative Approach

- **Current Federal Policy:** USDOT Automated Vehicles 3.0: Preparing for the Future of Transportation (published October 2018)
- **Issue:** In NHTSA’s *Automated Driving Systems 2.0: A Vision for Safety* they specifically state that “Collaboration is essential as our Nation embraces the many technological developments affecting our public roadways.” AASHTO agrees with this statement and looks forward to working collaboratively with NHTSA, local governments, and the private sector on the testing and deployment of connected and automated vehicles. For example, infrastructure owners and operators want more information from the automakers about what infrastructure elements they need in order to successfully deploy the technology. The advent of ADS and connected technology represents a new paradigm in the relationship between these two segments of the transportation community. We recognize that automakers work in a very competitive environment and may be challenged to reach consensus on their needs. Similarly, road agencies range in size, capability and perspective. However, if we are to provide infrastructure that supports these new technologies, both physical (roadways, bridges, traffic signals, signs, etc.) and digital (software applications, algorithms, business intelligence, mobile communications, etc.) clearer guidance from the automaker industry would be helpful.

- *Recommendation:*
 - Greatly expanded overall industry collaboration to include broader and active participation from both public and private sectors. Leverage existing structures in place such as the Cooperative Automated Transportation (CAT) Coalition, the Connected Vehicle Pooled Fund Study, and the Collision Avoidance Metrics Partnership that bring together state and local DOT representatives, research partners, USDOT, auto industry, original equipment manufacturers, and technology vendors. There should be more engagement from non-traditional original equipment manufacturers.
 - Establish a structured advisory and deployment coordination program between automakers, original equipment manufacturers and government to support the development and deployment of vehicle and infrastructure innovation for enhanced mobility, goods movement and safety.

CROSS-REFERENCE OF RELATED ISSUES IN OTHER WHITE PAPERS

- ISSUE 2-1: Unfunded Mandates
- ISSUE 2-2: Privacy, Security, Cyber Security
- ISSUE 3-1: Increase Federal Funding
- ISSUE 3-2: Fix the Federal Highway Trust Fund (HTF) and Strengthen Federal Transportation Funding
- ISSUE 3-3: Prioritize Formula-based Federal Funding
- ISSUE 3-4: Eliminate Rescissions of Contract Authority
- ISSUE 3-6: Increase flexibility and transferability of funding
- ISSUE 4-2: Communications Technology for Highway Operations
- ISSUE 4-7: Public Safety Radio Communication Spectrum
- ISSUE 6-2: Enhance Flexibility and Avoid Imposing New Administrative Burdens, whether through statute, Rulemakings, or Guidance
- ISSUE 6-6: Make More Flexible the Projects that can be funded through the Congestion Mitigation and Air Quality (CMAQ) Improvement Program
- ISSUE 9-1: Increase Research, Technology & Education Program Funding Levels
- ISSUE 9-2: Allow Highway Safety Improvement Funds to be used for Safety Related Research Activities
- ISSUE 9-3: Allow States to Use Non-SP&R Federal Funding when Contributing to Multi-State Pooled Fund Research Studies
- ISSUE 9-5: Recommend Third Strategic Highway Research Program
- ISSUE 10-1: Non-infrastructure Eligibilities under the Highway Safety Improvement Plan
- ISSUE 11-7: Promote Cyber Security Strategies

2: Data Management and Analytics

INTRODUCTION AND BACKGROUND

The Committee on Data Management and Analytics addresses data issues that are inherently cross disciplinary and multi modal. Policy and legislation on data tends to be limited to specific purposes, such as safety or performance measures; there are no explicit policy resolutions or legislative language that addresses Data as a whole, or as a practice. Therefore, the Committee on Data recommends AASHTO's policy and legislative agenda to disseminate and promote the AASHTO Core Data Principles and focus strategically on a few important policy issues including unfunded mandates, specifically dictated data sources and data security. The Core Data Principles are developed to help AASHTO members and data practitioners maintain good data practices for all data uses.

AASHTO Core Data Principles are as follows:

- Principle 1 – VALUABLE: Data is an asset—Data is a core business asset having value and should be managed accordingly.
- Principle 2 – AVAILABLE: Data is open, accessible, transparent and shared —Access to data is critical to performing duties and functions, data must be open and usable for diverse applications and open to all.
- Principle 3 – RELIABLE: Data quality and extent is fit for a variety of applications—Data quality is acceptable and meets the needs for which it is intended.
- Principle 4 – AUTHORIZED: Data is secure and compliant with regulations—Data is trustworthy and is safeguarded from unauthorized access, whether malicious, fraudulent or erroneous
- Principle 5 CLEAR: There is a common vocabulary and data definition —Data dictionaries are developed and metadata established to maximize consistency and transparency of data across systems.
- Principle 6 – EFFICIENT: Data is not duplicated —Data is collected once and used many times for many purposes.
- Principle 7 – ACCOUNTABLE: Decisions maximize the benefit of data Timely, relevant, high quality data are essential to maximize the utility of data for decision making.

SPECIFIC POLICY ISSUES AND RECOMMENDATIONS

ISSUE 2-1: Unfunded Mandates

- *Current Federal Policy:* None.
- *Issue:* It is of great concern to the Committee on Data Management and Analytics that policies and legislation may be proposed or enacted that create unfunded/underfunded mandates regarding data collection and management. Instead, a focus on the core data principles at a broad level allows for the unique needs of each state to be met within a data driven approach to address management and operation of the transportation system.
- *Recommendations:* The data committee recommends that, if a data requirement is proposed or enacted, that sufficient resources be made available beyond simply providing for federal eligibility or flexibility to use funds for the purposes as that may require a diversion of resources from transportation services, to manage the required data in accordance with the seven AASHTO Core Data Principles detailed above.

ISSUE 2-2: Privacy, Security, Cyber Security

- *Current Federal Policy:* None.
- *Issue:* Transportation initiatives are subject to privacy and security rulings made both within and outside of transportation's purview. The focus and resources associated with data security need to be integrated with any elements in the rapidly evolving world of transportation data. From vehicles themselves and the associated intelligent infrastructure, to probes, crowdsourcing and any other sources and uses of data and operations that are dependent on the flow of data, data security becomes a greater operational concern.
- *Recommendation:* Data privacy and data security must be considered in any recommendations regarding data as it relates to transportation and transportation issues. In the era of big data, probe data, commercially collected, bought and sold data, any legislation regarding data privacy and security must be gravely and thoughtfully considered.

CROSS-REFERENCE OF RELATED ISSUES IN OTHER WHITE PAPERS

- ISSUE 1-1: Deploying CAV Technologies in the Safest Manner Possible is Paramount
- ISSUE 1-6: CAVs Will Produce Significant Amounts of Data and There is a Data Governance Gap
- ISSUE 3-1: Increase Federal Funding
- ISSUE 3-6: Increase flexibility and transferability of funding
- ISSUE 3-10: Reduce and Simplify Regulations, Requirements, Data Collections, and Process to Expedite the Process
- ISSUE 5-3: Performance Management Regulations Should Be Improved to Reduce the Burden on State DOTs
- ISSUE 6-7: Mitigate the Burden of Data Collection Related to the Performance-Based Planning and Performance Management Regulations
- ISSUE 10-2: Data Protection
- ISSUE 11-7: Promote Cyber Security Strategies

3: Funding and Finance

INTRODUCTION AND BACKGROUND

The Fixing America's Surface Transportation (FAST) Act was signed into law on December 4, 2015. The FAST Act authorizes Federal highway, highway safety, transit, and rail programs for five years from Federal fiscal years (FY) 2016 through 2020. The FAST Act authorized \$305 billion from both the Highway Trust Fund (HTF) and the General Fund (GF) of the United States Treasury. The bill preserved HTF solvency with general fund transfers totaling \$70 billion through 2020.

The nation needs a significant increase in federal transportation formula funding, beyond FAST Act funding levels, along with timely, sustainable, long-term funding to meet national needs for economic competitiveness, connectivity, safety and security. New transportation revenue options should be considered to supplement or replace the deteriorating federal revenue stream. As investment needs grow, HTF revenues derived from fuel taxes will continue to decline due mainly to increased vehicle fuel efficiency.

Additionally, the FAST Act includes a \$7.6 billion rescission of unobligated contract authority scheduled for July 2020. Congress should avoid using rescissions of highway contract authority because they impede state DOT flexibility in programming Federal dollars and can result in cuts to highway funding and services, reducing transportation system performance.

The Committee on Funding and Finance is charged with identifying specific policy issues and recommendations related to funding and finance. This white paper presents recommended policies for consideration by AASHTO and the Transportation Policy Forum.

SPECIFIC POLICY ISSUES AND RECOMMENDATIONS

ISSUE 3-1: Increase Federal Funding

- *Current Federal Policy:* The FAST Act authorized \$305 billion from both the HTF and the GF of the United States Treasury. It provided \$225 billion in HTF contract authority over five years for the Federal-Aid Highway Program and \$61 billion over five years for Federal transit programs. It also includes funding for highway safety, authorized general funding for rail, and increased emphasis on freight investments through new highway program elements supported by the HTF.
- *Issue:* Our nation is currently faced with aging infrastructure, a growing national population, and a major transportation funding shortfall. The American Society of Civil Engineers has identified a \$1.1 trillion funding gap for surface transportation between 2016 and 2025. It is essential to increase federal funding for surface transportation to sustain national and regional connectivity and mobility for people and business. The federal government must connect the nation. Reducing that role or proposing turn back of the system is not appropriate. The states cannot fund a dynamic and efficient national transportation system alone.
- *Recommendation:* Congress is urged to increase federal surface transportation funding significantly above the current FAST Act funding levels. Enhanced federal funding is required for both rural and urban areas of the country to improve the quality of life and to increase the nation's economic vitality, well-being, and competitiveness.

ISSUE 3-2: Fix the Federal Highway Trust Fund and Strengthen Federal Transportation Funding

- *Current Federal Policy:* The HTF serves as the backbone of Federal highway and transit programs and was once supported solely by user fees. Since 2008, the HTF has been sustained by supplementing user fees through a series of General Fund transfers now amounting to \$140 billion. According to the Congressional Budget Office, annual HTF spending at current levels plus inflation is estimated to exceed receipts by \$16 billion in FY 2020, growing to \$23 billion by FY 2027.
- *Issue:* HTF revenues, mainly derived from fuel taxes, will continue to decline due to increased vehicle fuel efficiency and growing use of alternative fuel vehicles. Absent legislation, in FY 2021, the HTF is expected to experience a significant cash shortfall leading to an estimated 40 percent drop in highway obligations from the year before, or from \$46.2 billion to \$27.7 billion, and a near zeroing out of the Mass Transit Account.
- *Recommendation:* Congress must provide sustainable, certain, long-term funding to the HTF to support multi-year legislation. There is no shortage of technically feasible tax and user fee options that Congress and the Administration can consider. See the *Matrix of Illustrative Surface Transportation Revenue Options* appendix for a menu of options to fix the HTF and strengthen Federal surface transportation funding, including funding from sources currently dedicated to the General Fund. Congress should continue to fund the development and implementation of revenue alternatives to the motor fuel tax, such as the Surface Transportation System Funding Alternatives Program, which was established under the FAST Act and provides \$95 million in federal share (for up to 50 percent of project cost) over five years to states to demonstrate alternative revenue methods that incorporate a user fee structure to maintain the long-term solvency of the HTF. If Congress does not provide money needed to increase federal surface transportation funding through options included in AASHTO's *Matrix of Illustrative Surface Transportation Revenue Options*, Congress should provide the funds through other means.

ISSUE 3-3: Prioritize Formula-based Federal Funding

- *Current Federal Policy:* The Federal-aid Highway Program is a Federally-assisted state program that is rooted in Article 1, Section 8 of the United States Constitution and confirmed by 23 U.S.C 145. Currently, approximately 90 percent of the Federal highway program funds are distributed to the states by formula. This approach of emphasizing formula funds has a decades long track record of success in supporting long-term capital improvements across the United States. This enables funds to be distributed to states in a stable and predictable manner and allows the Federal program to efficiently deliver projects that have been identified and prioritized through the statewide and metropolitan planning processes.
- *Issue:* Recently proposals have been advanced that would greatly increase the discretionary funding programs, with projects chosen by the Federal Government. These proposals combine the discretionary programs with requirements that states and others greatly increase their contributions or greatly leverage Federal dollars. For a variety of reasons, many states cannot leverage funding beyond the current matching requirements. This makes it critical that Congress continue to recognize the importance of continuing the current prioritization of formula funding over discretionary funding. Using discretionary programs, the Federal government must solicit applications and review them before awarding funds which delays the deployment of funds. In addition, not only are grant applications costly both in time and dollars, such grant dollars are uncertain by nature preventing states from properly planning. This results in lost efficiency and added complexity to processes and project delivery. More funding for discretionary programs will likely result in an even lengthier processing timeframe making them an inefficient way to increase investments in transportation infrastructure.

- *Recommendation:* Congress should continue to prioritize formula funding over discretionary funding. State and local governments have existing plans and processes in place and can put new Federal formula funds to work promptly.

ISSUE 3-4: Eliminate Rescissions of Contract Authority

- *Current Federal Policy:* Congress has used rescissions of highway contract authority as budgetary offsets. An \$856 million rescission in unobligated contract authority was enacted in June 2017 and a \$7.6 billion rescission is scheduled for July 2020 under the FAST Act. The \$7.6 billion rescission would be derived from Federal-aid Highway Program categories other than those that are exempt including: Highway Safety Improvement Program, Railway-Highway Crossing Program, and sub-allocated portions of the Surface Transportation Block Grant Program (STBGP). Non-exempt program dollars are required to be rescinded from unobligated balances remaining on that date on a proportional basis.
- *Issue:* Rescinding previously-authorized highway contract authority greatly impedes the flexibility of state departments of transportation to program Federal dollars and could result in hard cuts to highway funding and seriously delay project construction.
- *Recommendation:* Congress is urged to repeal the scheduled FY 2020 rescission and avoid using rescissions of highway contract authority. However, if a rescission is imposed, no funding categories should be exempt. States should have the flexibility to choose among all the funding categories to rescind so they can reduce the negative impact of the rescission on transportation service and performance.

ISSUE 3-5: Preserve the Current Federal/State Matching Ratio Requirements

- *Current Federal Policy:* While there are exceptions, 23 U.S.C. 120 generally requires most federal-aid transportation projects to have an 80 percent federal share and a 20 percent state matching share. This 80/20 Federal/Non-Federal funding share means Federal support is focused on larger capital projects and leverages state and local dollars to be used for a much broader array of projects.
- *Issue:* This 80/20 Federal/Non-Federal funding match has a proven track record of success. Many states have recently raised highway revenues. However, some states remain challenged to meet the 20 percent non-Federal match requirements. States and local governments already provide approximately 75 percent of transportation funding for highways and transit. Achieving national goals require our federal partners to contribute an equitable share. There are significant needs for state and other non-federal transportation funding to operate and maintain the federal system as well as provide capital, operating, and maintenance funding for non-federal, state and local transportation systems. The current matching requirements allow state and local dollars to be used to match federal funds and also to be used for non-federal transportation.
- *Recommendation:* Maintain the current federal/state matching ratio requirements for projects and explore innovative match strategies (e.g., the sale of toll credits).

ISSUE 3-6: Increase Flexibility and Transferability of Funding

- *Current Federal Policy:* The total amount of Federal highway funding apportioned to a state is divided among the individual apportioned programs. Each program has rules that are not always flexible regarding how the funds may be used. Each program is governed by transferability provisions that are established in statute.

- *Issue:* AASHTO supports increased flexibility in programs and in transferring funding among the programs. Such reform would enable states to direct funding to better meet their needs, whether for preservation, capacity, safety or other needs. This flexibility in directing funds is especially important when overall funding is insufficient.
- *Recommendation:* AASHTO recommends increased flexibility and transferability between highway program funds.

ISSUE 3-7: Maintain the Current Balance of Funding Among Highways, Transit, and Highway Safety

- *Current Federal Policy:* The Highway Trust Fund supports highway, transit, and highway safety programs. The FAST Act also added a new National Highway Freight Program (NHFP) and a new discretionary program entitled the Nationally Significant Freight and Highway Programs (now known as Infrastructure for Rebuilding America or INFRA) within the highway program. Additionally, the general fund supports rail programs.
- *Issue:* The current funding balance along with transferability and flexibility allows states to direct available funding to meet highway, safety, and transit needs. The most recent FHWA Conditions and Performance report estimated the highway backlog at \$836 billion and a transit backlog of \$90 billion. States need all the tools to address such a high level of need.
- *Recommendation:*
 - Maintain the current balance of funding among highways, transit and highway safety from the HTF and continue General Fund support for rail programs.
 - Further increase flexibility within the STBG Program by expanding the state departments of transportation's share of funding (which will be reduced to 45 percent by FY 2020 under the FAST Act) which can be used in any area within a state. This flexibility includes each state's ability to direct more of its own STBG program funding to their local partners, over and above suballocated STBG Program funds, if they so wish.

ISSUE 3-8: Provide Flexibility to Toll Federal-aid Highways

- *Current Federal Policy:* In most cases, federal law (23 USC 301) restricts states from tolling Federal-aid Highways, which eliminates a potential source of revenue. The Interstate System Reconstruction and Rehabilitation Pilot Program (ISRRPP) was authorized under Section 1216(b) of TEA-21 to permit up to three existing interstate facilities to be tolled to fund needed reconstruction on interstate corridors that could not otherwise be adequately maintained or functionally improved without the collection of tolls.
- *Issue:* In some states, a portion of the transportation facilities cannot be adequately maintained or functionally improved without toll collection; however, federal law imposes restrictions on states from tolling interstate routes.
- *Recommendation:* Provide increased tolling flexibility to states to maximize revenue-raising opportunities in light of federal funding challenges.

ISSUE 3-9: Support for Financing Tools

- *Current Federal Policy:* Title 23 authorizes a number of beneficial transportation financing tools, including the Transportation Infrastructure Finance and Innovation Act (TIFIA), Grant Anticipation Revenue Vehicles (GARVEEs), State Infrastructure Banks (SIBs), and Private Activity Bonds (PABs).
- *Issue:* While not a substitute for adequate funding, states need access to financing tools to help maximize the value of existing resources, particularly when federal funding is insufficient.

- *Recommendation:* While most projects require Federal support in the form of direct funding rather than financing incentives, Congress should continue to support the financing tools currently provided and support new innovative financing tools.

ISSUE 3-10: Reduce and Simplify Regulations, Requirements, Data Collections, and Process to Expedite the Process

- *Current Federal Policy:* Preserve useful program and policy reforms and support additional opportunities to streamline and simplify the federal surface transportation programs.
- *Issue:* Notwithstanding efforts by AASHTO, current Federal surface transportation programs are subject to significant requirements and processes. Appropriate reduction of such requirements will save money, increase efficiency, and allow more funding to be used to improve transportation services. Some requirements are particularly tied to finance and funding. Under the current uncertain federal funding conditions, performance management, asset management, and financial planning requirements have far less value for decision making and risk is multiplied. If federal transportation appropriations are not known at the beginning of the federal fiscal year, financial planning, financial forecasting, programming, performance, and asset management are adversely affected. This is further accentuated if these decision systems use financial optimization methods over long-time frames. Many of the financial planning and forecasting requirements are associated with the statutory language “reasonably expected to be available.” For such purposes it is critical to know both ‘how much funding and when the funding will reasonably be available.’
- *Recommendation:* There are financial process difficulties caused by federal funding uncertainty in the fiscal constraint and financial planning provisions related to the State Long Range Plan, the Statewide Transportation Improvement Program, the Asset Management Plan, and Performance Management. Defining “reasonably expected to be available” is important. Fiscal constraint and other financial requirements in planning and programming are excessive and should be reduced. At most, they should be imposed for no more than the STIP timeframe. States should have the option to do financial estimates for longer periods if desired.

Other AASHTO committees’ white papers will identify additional Title 23 statutory and regulatory recommendations to improve project delivery to supplement these financial and funding recommendations. Because any inefficient process requirements reduce funding available to improve transportation services, other inefficiencies need to be addressed. They directly affect the ultimate result we all seek—a better transportation system.

Exhibit 1: Estimated Highway Trust Fund Receipts and Outlays

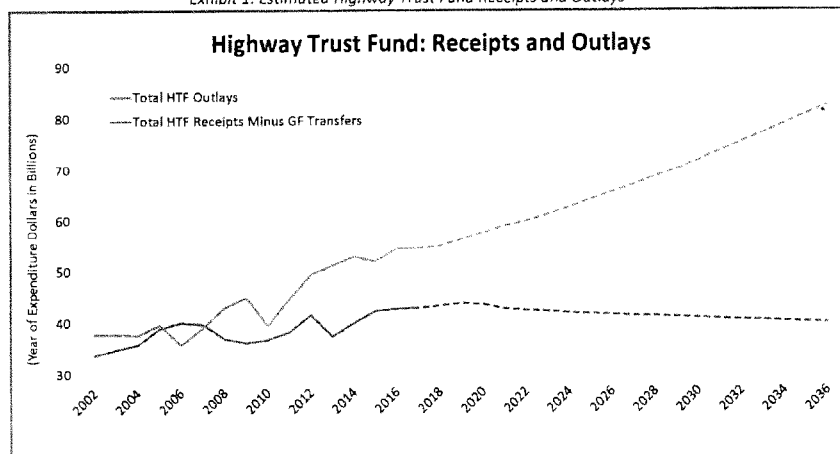


Exhibit 2: Estimated Highway Trust Fund and General Fund Obligations

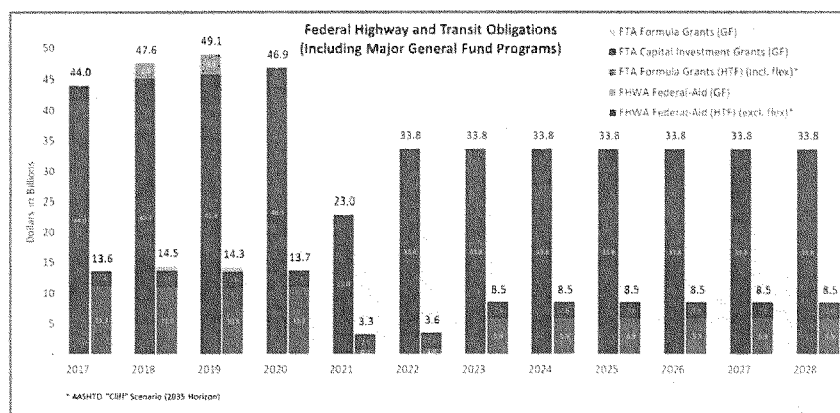


Exhibit 3: Estimated Highway Trust Fund Obligations

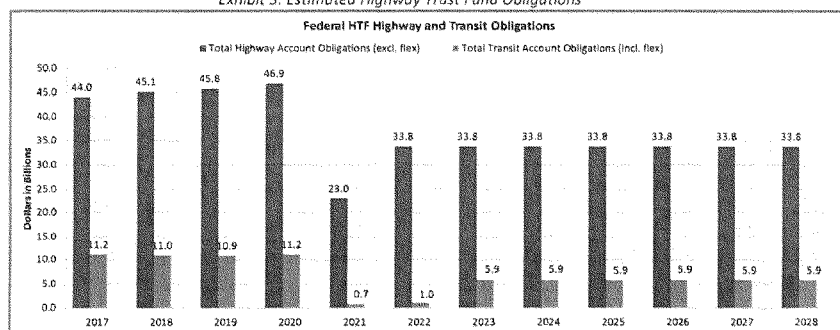


Exhibit 4: Matrix of Illustrative Surface Transportation Revenue Options

			(\$ in Billions)	
	Illustrative Rate or Percentage Increase	Description of Mechanism/ Increase	Current Yield Estimate	Estimated 5-Year Revenues
Existing HTF Funding Mechanisms				
Diesel Excise Tax	20.0¢	\$/gal increase in current rate	\$8.8	\$42.2
Gasoline Excise Tax	15.0¢	\$/gal increase in current rate	\$21.8	\$102.1
MFT Indexing of Current Rate to CPI (Diesel)	--	\$/gal excise tax		\$3.7
MFT Indexing of Current Rate to CPI (Gas)	--	\$/gal excise tax		\$8.8
Truck and Trailer Sales Tax	20.0%	increase in current revenues, structure not defined	\$0.6	\$4.2
Truck Tire Tax	20.0%	increase in current revenues, structure not defined	\$0.1	\$0.5
Heavy Vehicle Use Tax	20.0%	increase in current revenues, structure not defined	\$0.2	\$1.2
Other Existing Taxes				
Minerals Related Receipts	25.0%	increase in/reallocation of current revenues, structure not defined	\$2.2	\$11.6
Harbor Maintenance Tax	25.0%	increase in/reallocation of current revenues, structure not defined	\$0.4	\$2.3
Customs Revenues	5.0%	increase in/reallocation of current revenues, structure not defined	\$1.8	\$9.7
Income Tax - Personal	0.5%	increase in/reallocation of current revenues, structure not defined	\$6.7	\$36.0
Income Tax - Business	1.0%	increase in/reallocation of current revenues, structure not defined	\$2.8	\$15.0
License and Registration Fees				
Drivers License Surcharge	\$5.00	dollar assessed annually	\$1.1	\$5.8
Registration Fee (Electric LDVs)	\$100.00	dollar assessed annually	\$0.0	\$0.1
Registration Fee (Hybrid LDVs)	\$50.00	dollar assessed annually	\$0.2	\$0.9
Registration Fee (Light Duty Vehicles)	\$5.00	dollar assessed annually	\$1.2	\$6.4
Registration Fee (Trucks)	\$100.00	dollar assessed annually	\$1.1	\$5.8
Registration Fee (All vehicles)	\$5.00	dollar assessed annually	\$2.3	\$12.2
Weight and Distance Based Fees				
Freight Charge - Ton (Truck Only)	10.0¢	¢/ton of domestic shipments	\$1.2	\$6.3
Freight Charge - Ton (All Modes)	10.0¢	¢/ton of domestic shipments	\$1.4	\$7.7
Freight Charge - Ton-Mile (Truck Only)	0.5¢	¢/ton-mile of domestic shipments	\$10.1	\$53.9
Freight Charge - Ton-Mile (All Modes)	0.5¢	¢/ton-mile of domestic shipments	\$21.4	\$114.5
Transit Passenger Miles Traveled Fee	1.0¢	¢/passenger mile traveled on all transit modes	\$0.6	\$3.0
Vehicle Miles Traveled Fee (Light Duty Vehicles)	1.0¢	¢/LDV vehicle mile traveled on all roads	\$27.2	\$146.6
Vehicle Miles Traveled Fee (Trucks)	1.0¢	¢/truck vehicle mile traveled on all roads	\$2.7	\$14.7
Vehicle Miles Traveled Fee (All Vehicles)	--	¢/vehicle mile traveled on all roads	\$29.9	\$160.3
Sales Taxes on Transportation Related Economic Activity				
Freight Bill - Truck Only	0.5%	percent of gross freight revenues (primary shipments only)	\$3.1	\$16.8
Freight Bill - All Modes	0.5%	percent of gross freight revenues (primary shipments only)	\$3.9	\$20.8
Sales Tax on New Light Duty Vehicles	1.0%	percent of sales	\$2.4	\$12.9
Sales Tax on New and Used Light Duty Vehicles	1.0%	percent of sales	\$3.5	\$18.6
Sales Tax on Auto-related Parts & Services	1.0%	percent of sales	\$2.3	\$12.5
Sales Tax on Diesel	2.0%	percent of sales (excl. excise taxes)	\$2.5	\$13.6
Sales Tax on Gas	2.0%	percent of sales (excl. excise taxes)	\$8.6	\$46.1
Tire Tax (LDVs)	1.0%	of sales of LDV tires	\$0.3	\$1.8
Sales Tax on Bicycles	1.0%	percent of sales	\$0.1	\$0.3
Other Excise Taxes				
Container Tax	\$15.00	dollar per TEU	\$0.7	\$3.5
Imported Oil Tax	\$2.50	dollar/ barrel	\$5.8	\$30.9

Description of Mechanism/ Increase		
Existing HTF Funding Mechanisms		Current Revenues
Diesel Excise Tax		\$10.7 \$ in billions
Gasoline Excise Tax	Federal motor fuel tax rates are currently 18.4 cents per gallon for gasoline, gasohol and special fuels (rates on special fuels vary, but average about 18.4 cents), and 24.4 cents per gallon for diesel.	\$25.4 \$ in billions
MFT Indexing of Current Rate to CPI (Diesel)	o Pros – Large revenue yield with small rate change; a tried-and-true user fee; ease of administration	
MFT Indexing of Current Rate to CPI (Gas)	o Cons – Long-term sustainability issues; strong public opposition; somewhat regressive	
Truck and Trailer Sales Tax	A federal sales tax of 12 percent is imposed on the retail sales price for the first sale of all tractors and trucks over 33,000 pounds in gross vehicle weight (GVW) and trailers over 26,000 pounds in GVW, including parts and accessories associated with the sale. o Pros – Strong sustainability that tracks with inflation; strong history that is easy to administer; reasonably acceptable from a public/political perspective; tax at national level creates even playing field; recover heavy vehicles' cost to the system o Cons – Revenue potential is limited; unstable and highly cyclical; no relationship with system use; disincentive to purchase newer vehicles	\$3.1 \$ in billions
Truck Tire Tax	A federal tax is imposed on the purchase of all tires with a maximum rated load over 3,500 pounds. The tax is justified in part because it helps to recover some of the additional system damage costs caused by heavier vehicles. The current tax rate is 9.45¢ for every 10 pounds of maximum capacity that exceeds 3,500 pounds. o Pros – Strong correlation between tax and user benefit/impact; easy and cost-effective to administer o Cons – Does not raise a lot of revenue	\$0.5 \$ in billions
Heavy Vehicle Use Tax	An annual fee is currently imposed on all trucks 55,000 pounds Gross Vehicle Weight (GVW) or greater. The tax rate is \$100 plus \$22 for each 1,000 pounds of GVW in excess of 55,000 pounds, up to a maximum annual fee of \$550 (thus, all trucks with GVW greater than 75,000 pounds pay the maximum). o Pros – Strong correlation between tax and user benefit/impact; easy and cost-effective to administer o Cons – Does not raise a lot of revenue	\$1.2 \$ in billions

Other Existing Taxes		Current Revenues	
Minerals Related Receipts	<p>Oil, Gas, Minerals Lease - Royalty, Rent, Bonus, and Other Income (Partial Dedication) – The federal government receives various income from the extraction of oil, natural gas, and minerals from federal lands and offshore mining activities. Aside from a portion designated for the states, the remaining amount of these revenues currently goes to the federal General Fund which could be redirected for transportation purposes.</p> <p>o Pros – Sustainable; can help to promote US energy independence</p> <p>o Cons – Diverts funds from US General Fund; link to transportation is not as strong as user fees; revenues could be volatile</p>	\$2.5	\$ in billions
Harbor Maintenance Tax	<p>This is an existing revenue mechanism, similar to customs duties and fees, that supports the federal Harbor Maintenance Trust Fund through an ad valorem tax on the value of passenger tickets and declaring commercial cargo loaded onto or unloaded from vessels using federally maintained harbors. The current tax is largely used to pay for harbor dredging and thus primarily benefits deep-draft oceangoing vessels carrying cargo on trans-oceanic routes.</p> <p>o Pros – Largely sustainable; would not require major administrative effort or expansion of legal authority</p> <p>o Cons – Portion levied on imports could increase international trade laws conflicts; tax is not levied on US exporters that use much of the local highway system around ports</p>	\$1.4	\$ in billions
Customs Revenues	<p>(Partial Dedication) – Customs duties are imposed at varying rates on various imported goods passing through US international gateways and currently go to the General Fund of the US Treasury. A number of interest groups, as well as the National Surface Transportation Policy and Revenue Study Commission, have suggested that given the role transportation infrastructure plays in facilitating the import of goods, a portion of current customs duties should be allocated to support transportation investment.</p> <p>o Pros – Small percentage of current revenues provides significant revenues; highly sustainable</p> <p>o Cons – Diverts or expands a mechanism that is currently used and viewed as an important US General Fund revenue source</p>	\$37.5	\$ in billions
Income Tax - Personal	<p>(Partial Dedication) – A national income tax for transportation could be created fairly easily and inexpensively by dedicating a portion of the existing tax or by adding an across-the-board increase to current personal and/or corporate income tax rates.</p> <p>o Pros – Small percentage tax yields significant revenue; strong sustainability; inflation-neutral; easy to administer and enforce; relatively progressive</p> <p>o Cons – Support for dedicating revenues to transportation needed though good transportation aids income growth; strong political opposition; weak link to economic efficiency and equity; negative impacts on the federal budget</p>	\$1,038.0	\$ in billions
Income Tax - Business		\$162.0	\$ in billions

License and Registration Fees		Current Count	
Driver's License SurchARGE	States charge a fee for issuing drivers' licenses. In some cases, the fee simply recovers the cost of administering the licensing programs. In many states, however, license fees also are used as a source of funding for transportation or other purposes. o Pros – Significant revenue yield; well-established in each state with minimal additional administrative cost o Cons – Strong public and political opposition; different licensing practices in each state; infringes on states' reliance on this fee; poor social equity	221,711,918	Licenses
Registration Fee (Electric LDVs)	All states impose annual vehicle registration and related fees, and at least half the states raise more than a quarter of their dedicated transportation revenues through this mechanism. The structure of registration fees varies widely, from a flat per vehicle fee to a schedule of rates based on factors such as vehicle type, weight, age, horsepower, and value.	294,596	Vehicles
Registration Fee (Hybrid LDVs)		4,828,487	Vehicles
Registration Fee (Light Duty Vehicles)	o Pros – Small federal fee; sustainable; well-established; little additional administrative cost; could charge for indirect impacts such as carbon emissions	247,544,961	Registrations
Registration Fee (Trucks)	o Cons – No relation to system use; could be viewed as double taxation at the federal level due to the existing heavy vehicle use tax; infringes on states' reliance on this fee	11,498,561	Registrations
Registration Fee (All vehicles)		259,143,542	Registrations
Weight and Distance Based Fees		Current Activity	
Freight Charge - Ton (Truck Only)	Ton or Ton-Mile – Freight-related taxes could be imposed on a pure tonnage or ton-mile basis. A ton-based tax would charge shippers a flat fee for every ton of freight moved. Variations of these taxes have been imposed by a few states in the past, but there has not been an equivalent tax imposed at the federal level.	11	billions of tons
Freight Charge - Ton (All Modes)	o Pros – Decent revenue yield potential; justifiable as a transportation user fee; potential positive impact on efficient system use o Cons – Strong trucker/trail opposition; impact of tax heaviest on low-value bulk items; significant implementation, administration, and compliance issues; not a viable short-term option	13	billions of tons
Freight Charge - Ton-Mile (Truck Only)		1,984	billions of ton-miles
Freight Charge - Ton-Mile (All Modes)		4,243	billions of ton-miles
Transit Passenger Miles Traveled Fee	Distance based fee on transit passenger trips. o Pros – Could provide direct user funding for transit infrastructure o Cons – Does not raise significant revenues; potentially significant administrative and compliance issues; social equity issues	58.3	billions of passenger-miles

Vehicle Miles Traveled Fee (Light Duty Vehicles)	Drivers can be charged for the total number of miles traveled (VMT), regardless of the road used or the time of day. The fee can be charged in a number of ways. Oregon launched its OReGO Program in 2015, which is the nation's first operable road usage charge (RUC) system. Under this system, over 1,300 vehicles pay a per mile fee in lieu of the state gas tax, with either a global positioning system (GPS) enabled mileage reporting device (MRD), or an MRD without GPS. Several other states have launched RUC pilots.	2,849.7	billions of vehicle-miles
Vehicle Miles Traveled Fee (Trucks)	o Pros – Large revenue yield potential; highly sustainable; appropriate user fee; leads to more efficient use of system o Cons – Public and political opposition is high, especially on privacy grounds; considerable costs and challenges (institutional, administrative, and cultural); not enough real-world experience with implementation; not a viable short-term option	287.9	billions of vehicle-miles
Vehicle Miles Traveled Fee (All Vehicles)		3,137.6	billions of vehicle-miles
Sales Taxes on Transportation Related Economic Activity		Current Economic Activity	
Freight Bill - Truck Only	A freight waybill tax would serve as a sales tax on the shipping costs for freight. Such a tax could be modeled on the aviation system tax, in which passenger and freight users who rely on the same infrastructure and carriers all contribute to fund the system. The air-freight waybill tax currently provides 5 percent of contributions to the federal Airport and Airway Trust Fund	\$726.4	\$ in billions
Freight Bill - All Modes	o Pros – Large revenue yield potential; reasonably equitable o Cons – Expensive to administer and enforce; more of an indirect user fee, as not directly related to system use	\$891.3	\$ in billions
Sales Tax on New Light Duty Vehicles	Most likely levied as a percentage of the total sales price for either all new or new/used vehicle purchases (similar to the existing sales tax on trucks and trailers). o Pros – Small fee could raise significant revenue; highly sustainable, captures revenues from alternative fuel vehicle users; could likely be implemented through either existing state tax mechanisms or imposed through vehicle manufacturers	\$273.4	\$ in billions
Sales Tax on New and Used Light Duty Vehicles	o Cons – Could cannibalize a traditionally important state/local transportation and general fund revenue source; limited user-benefit correlation	\$409.8	\$ in billions
Sales Tax on Auto-related Parts & Services	Similar to the vehicle sales tax, a national sales tax could be established on all products and services related to vehicle use, including part and accessories, lubricants, and repairs. o Pros – Small tax rate could yield relatively large revenues; strong sustainability; justifiable as a flexible, dedicated source for transportation o Cons – Significant administrative and compliance issues; social equity issues; little relationship with system use; limited public acceptance; potential to disincentive repairs and create safety issues	\$264.2	\$ in billions

Sales Tax on Diesel	A national sales tax on motor fuels could be imposed as a percentage of motor fuel costs. A handful of states currently impose a motor fuels sales tax, most in the 4 percent to 6 percent range, as a supplement to a traditional cent per gallon tax (note: not all states that impose a motor fuels sales tax dedicate all of the resulting revenues to transportation). The revenue generation capabilities of a national motor fuels sales tax would be driven by several variables, including the price of fuel, the tax collection point (e.g., at the pump vs. points along the distribution network), the basis for the tax (e.g., inclusion vs. exclusion of state and local taxes), and the imposition of tax ceilings or floors.	\$72.6	\$ in billions
Sales Tax on Gas	o Pros – Small percentage tax raises significant revenues; sustainable in the short term; provides flexible, dedicated transportation funding o Cons – Fuel price volatility could lead to unpredictable revenue levels; unsustainable in the long-term; political/public resistance can build during price spikes	\$256.0	\$ in billions
Tire Tax (LDVs)	A national tax on light-duty vehicle tires for both tires on new vehicles and replacement tires. Would likely be implemented in conjunction with the current federal truck tire tax. o Pros – Provides a counter light-duty vehicle balance to the current truck tire tax; highly sustainable; strong user-benefit correlation o Cons – Does not raise significant revenues; may discourage timely replacement of worn tires	\$26.1	\$ in billions
Sales Tax on Bicycles	A national sales tax on bicycles. o Pros – Could provide direct user funding for bike related infrastructure o Cons – Does not raise significant revenues; potentially significant administrative and compliance issues; social equity issues	\$6.2	\$ in billions
Other Excise Taxes		Current Activity	
Container Tax	A national fee imposed on some or all containers moving through the US. If the charge is only assessed on imports, it can be expected to raise approximately one-third less revenues. Revenues from such a fee would be strictly dedicated to fund freight investment activities. o Pros – Raises a decent level of funding relative to freight needs; moderate implementation, administration, and compliance costs; strong sustainability o Cons – Does little to promote efficient system use; potential international trade laws conflicts; could have regional equity issues	48,381,723	TEUs
Imported Oil Tax	A tax on imported oil charged as either a fixed amount per barrel of oil or as a percentage on the value of imported oil. o Pros – Small fee could raise significant revenue; can help to promote US energy independence o Cons – Broad nature of tax creates limited user pay/benefit relationship (e.g., home heating oil would be taxed for transportation); raises geographical equity issues; could raise broader free trade issues	1.8	billions of barrels

CROSS-REFERENCE OF RELATED ISSUES IN OTHER WHITE PAPERS

- ISSUE 1-5: State DOTs Need Additional Funding and Flexibility in Order to Deploy CAV Technologies and Accommodate CAV Vehicles
- ISSUE 2-1: Unfunded Mandates
- ISSUE 4-1: Strengthen Eligibility for Investments in Transportation System Management and Operations (TSMO) and Related Technology

- ISSUE 4-3: Establish a Permanent Transportation Operations Program Budget Line Item within USDOT Funding to help Ensure Better Sharing of Quality Practices and Accelerate Development of Solutions for Consideration by the States
- ISSUE 4-4: Expand Eligible Activities Through National Highway Freight Program
- ISSUE 4-6: Update National ITS Architecture Rule 940
- ISSUE 5-1: Federal Funding Apportionment Should Not be Tied to Target Achievement
- ISSUE 5-3: Performance Regulations Should Be Improved to Reduce the Burden on State DOTs
- ISSUE 5-6: Help Advance Towards a More Flexible Transportation Program
- ISSUE 6-2: Enhance Flexibility and Avoid Imposing New Administrative Burdens, whether through statute, Rulemakings, or Guidance
- ISSUE 6-4: Fiscal Constraint
- ISSUE 6-5: Make State DOTs and MPOs Eligible Recipients under the Set Aside from the Surface Transportation Block Grant Program (aka transportation alternatives program)
- ISSUE 6-6: Make More Flexible the projects that can be Funded through the Congestion Mitigation and Air Quality (CMAQ) Improvement Program
- ISSUE 6-7: Mitigate the Burden of Data Collection Related to the Performance-Based Planning and Performance Management Regulations
- ISSUE 7-19: Delegation of Preventive Maintenance Projects
- ISSUE 7-21: Delegation of Federal Funds Obligation Management
- ISSUE 9-1: Increase Research, Technology & Education Program Funding Levels
- ISSUE 9-2: Allow Highway Safety Improvement Program Funds to be used for Safety Related Research Activities
- ISSUE 9-3: Allow States to Use Non-SP&R Federal Funding when Contributing to Multi-State Pooled Fund Research Studies
- ISSUE 9-4: Support for Associated National Research Programs
- ISSUE 10-1: Non-infrastructure Eligibilities under the Highway Safety Improvement Program
- ISSUE 10-2: DATA PROTECTION
- ISSUE 11-3: Modify Emergency Relief (ER) Program to be More Flexible and More Responsive to System Resilience Needs
- ISSUE 11-4: Provide More Flexibility in Use of Federal Funds for Preventive and Response Actions to System Disruptions
- ISSUE 11-7: Promote All-Hazards Risk and Resilience Analysis for Critical Facilities

4: Operations

INTRODUCTION AND BACKGROUND

In recent years, state DOTs have increasingly focused on ways of improving highway and transportation system operations. The demand for effective transportation operations solutions is increasing rapidly due to volume increases and technology development. Building and maintaining capacity is not always enough to ensure optimum or even satisfactory throughput. This is the case not only in congested metropolitan areas but also in other areas that face seasonal traffic peaks or in cases of vehicle crashes, disasters or other incidents that result in traffic jams and require a response.

Recognizing the importance of operations, for years the Federal program has embraced eligibility for capital investments that have a particular focus on improving highway operations. These include investments in improved traffic signalization and message signs and, more recently, such items as capital technology investments to facilitate vehicle-to-infrastructure (V2I) communications, such as dedicated short-range communications (DSRC) equipment. AASHTO also strongly supports flexibility for state DOTs in using Federal funds for eligible purposes, including capital expenditures to assist highway operations. AASHTO is also strongly committed to research and demonstration programs to help advance the practice of improving highway and transportation system operations.

Below are some specific proposals to improve the Federal transportation programs and assist states in providing an excellent operating environment on the highways and transportation systems that they build and maintain.

SPECIFIC POLICY ISSUES AND RECOMMENDATIONS

ISSUE 4-1: Strengthen Eligibility for Investments in Transportation System Management and Operations (TSMO) and Related Technology

- *Current Federal Policy:* Eligibility for funding TSMO and related technology from National Highway Performance Program (NHPP), Surface Transportation Program (STP), Surface Transportation Block Grant (STBG) Program, Congestion Mitigation and Air Quality Improvement (CMAQ) Program, and Highway Safety Improvement Program (HSIP)
- *Issue:* The use of TSMO strategies and technologies is expanding. The states have dramatically increased the use of TSMO and it is difficult to continue to increase investment in TSMO due to overall budgetary constraints. Additionally, funding is sometimes split by planning partner region (e.g., controlled by a Metropolitan Planning Organization, or MPO) when the states would like to use it statewide.
- *Recommendation:* States should have broader control to use existing funding sources on TSM&O activities, and overall transportation funding should be increased.

ISSUE 4-2: Communications Technology for Highway Operations

- *Current Federal Policy:* None
- *Issue:*
 - There is little federal guidance regarding interaction between vehicle-to-vehicle (V2V) and V2I communication. Some states are unsure if they should invest in DSRC, 5G, or both for V2I communications, which slows the advancement of this technology. Nationwide interoperability, including further deployment of DSRC, is essential.

- The Security Credential Management System (SCMS) is currently a proof-of-concept message security solution for V2V and V2I communication. SCMS involves significant cost, which can discourage state investment into CAV technologies.
- **Recommendation:** A universal, seamless approach to security management and CAV communication is essential for the widespread deployment of connected vehicles. The Federal government should quickly lead this development through standardization and appropriate research and technology demonstration programs. This will enable states to make informed decisions for investing resources toward these technologies.

ISSUE 4-3: Establish a Permanent Transportation Operations Program Budget Line Item within USDOT Funding to help Ensure Better Sharing of Quality Practices and Accelerate Development of Solutions for Consideration by the States

- **Current Federal Policy:** None
- **Issue:** States need help determining when to apply their scarce apportioned funds to investments that facilitate effective, efficient, and safe operations on the highways and transportation system.
- **Recommendation:**
 - Congress should appropriate additional money to fund such a permanent transportation operations discipline and program at USDOT to assist states in determining when to apply their scarce apportioned funds to investments that facilitate effective, efficient, and safe operations on the highways and transportation system. Such a program could focus on supporting private and public sector integration of operations technologies, interstate operations management solutions, and a leadership forum and clearinghouse for operations best practices. It could also continue funding for the National Operations Center of Excellence and provide research funding for operations technology development and data utilization, including the Cooperative Automated Transportation (CAT) Coalition
 - Establish a structured advisory and deployment coordination program between automakers, original equipment manufacturers and government that would support the development and deployment of vehicle and infrastructure innovation to support mobility, goods movement and safety.

ISSUE 4-4: Expand Eligible Activities Though National Highway Freight Program

- **Current Federal Policy:**
 - FAST Act Section 1116; 23 U.S.C. 167 establishes a National Highway Freight Program (NHFP) that funds activities that “must contribute to the efficient movement of freight on the [NHFP] and be identified in a freight investment plan included in [the state’s freight plan.]”
 - FAST Act Section 1105; 23 U.S.C. 117 establishes the Nationally Significant Freight and Highway Projects (NSFHFP) program to provide financial assistance—competitive grants, known as INFRA grants, or credit assistance— “for nationally or regionally significant freight and highway projects.”
- **Issue:** The use of the nation’s highway system for freight is increasing, and the need for integrated solutions to better move freight throughout the country is increasing. Integrated freight management solutions and freight safety programs do not currently qualify as eligible activities for NHFP or INFRA funds.

- *Recommendation:* Reform the National Highway Freight Program, both formula program to states and the discretionary program (INFRA), to more clearly include eligibility for investment in integrated freight management solutions (e.g., intermodal systems, freight lanes on interstates, and parking and staging areas) and freight safety programs (platooning, remote sensing technology, etc.), including for emergency responders. Eligibility should include multi-state proposals, such as for regions and corridors.

ISSUE 4-5: Improve Buy America Requirements

- *Current Federal Policy:* 23 U.S.C. Section 313: Buy America states “The Secretary of Transportation shall not obligate any funds...unless steel, iron, and manufactured products used in such project are produced in the United States.” The provision is subject to certain waivers.
- *Issue:* AASHTO supports investment in America and use of American-made products. However, at times U.S. made products are difficult to find, whether due to scarcity or notable cost differential. Buy America was originally intended for products made primarily of steel (like steel poles). It is extremely difficult to try to apply this law to signal controllers, utility equipment, vehicles, etc.
- *Recommendation:* USDOT should improve the Buy America waiver application, policies, and processes to ensure timely consideration and determinations that reduce schedule and cost burdens to state transportation agencies.

ISSUE 4-6: Update National ITS Architecture Rule 940

- *Current Federal Policy:* Under the 17-year old National ITS Architecture Rule, 23 CFR 940: “ITS projects shall conform to the National ITS Architecture and standards in accordance with the requirements contained in this part. Conformance with the National ITS Architecture is interpreted to mean the use of the National ITS Architecture to develop a regional ITS architecture, and the subsequent adherence of all ITS projects to that regional ITS architecture. Development of the regional ITS architecture should be consistent with the transportation planning process for Statewide and Metropolitan Transportation Planning.”
- *Issue:* States have mainstreamed systems engineering into their ITS project process, and they will continue to use good systems engineering processes in ITS projects. However, keeping up with the National ITS Architecture requirements unnecessarily increases the costs of projects and in some cases can delay or add time to our projects.
- *Recommendation:* This policy should be reformed to modernize it, and provide more deference to the states.

ISSUE 4-7: Public Safety Radio Communication Spectrum

- *Current Federal Policy:* 47 CFR 90, Private Land Mobile Radio Services “states the conditions under which radio communications systems may be licensed and used in the Public Safety, Industrial/Business Radio Pool, and Radiolocation Radio Services.”
- *Issue:* Specific radio frequency bandwidths are reserved for public safety use through §90.16 Public Safety National Plan, §90.19 Nationwide Public Safety Broadband Network, and §90.20 Public Safety Pool. However, there are interested parties who want to reassign portions of these bandwidths for commercial wireless purposes. DOTs use the Low band to UHF radio spectrum (42 MHz through 800 MHz Bands) and microwave systems (1GHz through 23 GHz) for their normal daily activities and for incident and emergency response.

- *Recommendation:* These frequencies should remain dedicated to public safety. More than half of the state DOTs utilize FCC §90 regulated wireless services for last-mile ITS device communications – including variable message signs (VMS), closed circuit television (CCTV) cameras, road weather information systems (RWIS), and highway advisory radios (HAR) – all of which are critical parts of traveler information and traffic incident management systems. Furthermore, as connected and automated vehicles (CAVs) become more prevalent, the need for vehicle-to-infrastructure (V2I) communications increases. AASHTO, as well as several member states, have previously filed comments supporting this position in FCC dockets.

CROSS-REFERENCE OF RELATED ISSUES IN OTHER WHITE PAPERS

- ISSUE 1-1: Deploying CAV Technologies in the Safest Manner Possible is Paramount
- ISSUE 3-1: Increase Federal Funding
- ISSUE 3-6: Increase flexibility and transferability of funding
- ISSUE 6-5: Make State DOTs and MPOs Eligible Recipients under the Set Aside from the Surface Transportation Block Grant Program (aka transportation alternatives program)
- ISSUE 6-6: Make More Flexible the Projects that can be Funded through the Congestion Mitigation and Air Quality (CMAQ) Improvement Program
- ISSUE 7-8: Buy America
- ISSUE 7-18: Delegation of ITS Architecture
- ISSUE 8-8: Allow Utility Relocations to Start Earlier
- ISSUE 9-6: Redefine “Manufactured Products” Requirement within Buy America Law

5: Performance-based Management

INTRODUCTION AND BACKGROUND

MAP-21 and the FAST Act required USDOT to develop federal performance management rules governing State DOTs and others. In May 2018, USDOT completed the development of the new regulations¹ pertaining to the federal performance management requirements as part of 23 CFR Section 490, *National Performance Management Measures* and 23 CFR Section 515, *Asset Management Plans*. These regulations require state DOTs to establish and report on making progress towards achieving targets for a set of federal performance measures related to safety, asset condition, and system operations. In addition, USDOT updated existing regulations related to the transportation planning process (23 U.S.C. Section 135, *Statewide and Nonmetropolitan Planning* and 23 U.S.C. Section 134, *Metropolitan Transportation Planning*) to make them consistent with federal law. These updates modified existing transportation planning to a performance-based approach to support the national goals specified in 23 USC 150(b) which relate to safety, infrastructure condition, congestion reduction, system reliability, freight movement and economic vitality, environmental sustainability, and reduced project delivery delays.

State DOTs are at the early stages of implementing the new and updated Federal performance management regulations. The first four-year reporting cycle started on January 1, 2018 and will go through December 31, 2021. State DOTs will first report their targets for the federal performance measures on October 1, 2018 and the first indication of making progress to achieving those targets will not come until the beginning of CY2020. During the time that first regulation was published (May 2015) and the last one was finalized (July 2018), state DOTs have gained significant experience and understanding related to the complexities of collecting, analyzing, managing and reporting on the data; the significant cost (time and money) in addressing the regulations; and the unexpected consequences of trying to address a set of national performance measures alongside state-based performance measures.

SPECIFIC POLICY ISSUES AND RECOMMENDATIONS

ISSUE 5-1: Federal Funding Apportionment Should Not Be Tied to Target Achievement

- Current Federal Policy:** The Federal-aid Highway Program is a Federally-assisted state program that is rooted in Article 1, Section 8 of the United States Constitution and confirmed by 23 U.S.C 145. Currently, approximately 90 percent of the Federal highway program funds are distributed to the states by formula. This approach of emphasizing formula funds has a decades-long track record of success in supporting long-term capital improvements across the United States. This approach enables funds to be distributed to states in a stable and predictable manner and allows the Federal program to efficiently deliver projects that have been identified and prioritized through the statewide and metropolitan planning processes.
- Issue:** 23 CFR 490 implemented the new performance management statute so that state DOTs are required to establish performance targets for federal performance measures and report on how they have made progress on achieving those targets. Current performance management regulations—correctly—do not require making substantial progress towards meeting the federal performance management targets to federal funding apportionment.

- *Recommendations:*
 - While AASHTO member states support the use of performance management to improve the transportation system, we remain opposed to using performance measures and the achievement of federal performance management targets as the basis for apportioning or allocating federal funds among the state DOTs.
 - AASHTO recommends the federal performance management regulations be clarified to make clear that a principal purpose of the requirements is to provide an authoritative source to communicate with decision-makers and the public on the condition of the national highway system as a whole and be part of a larger story to communicate the unmet transportation needs.

ISSUE 5-2: Continue to Focus on Implementation of the Performance Management Regulations

- *Current Federal Policy:*
 - 23 USC Section 134, *Metropolitan Transportation Planning*
 - 23 USC Section 135, *Statewide and Nonmetropolitan Planning*
 - 23 CFR Section 490, *National Performance Management Measures*
 - 23 CFR Section 515, *Asset Management Plans*
- *Issue:* The new and updated performance management regulations were developed and published over a six-year time period beginning in 2013 and ending in 2018 with the publication of the final rule regarding 23 CFR Section 490, *National Performance Management Measures, Subpart H* and FTA Safety final rule in July 2018. State DOTs are currently working to implement the first required aspect of these provisions, which is to establish targets for the federal performance measures, incorporate those targets into the planning process, and report on progress towards achieving targets. The first comprehensive report document for the first reporting cycle will not be developed and published until CY2022 at the earliest. AASHTO has recommended that no consideration be given to changes to existing regulations that would increase requirements until after at least two full reporting cycles in order to give the state DOTs time and experience in addressing the regulations.
- *Recommendations:*
 - AASHTO opposes additional federal performance measures; associated performance management requirements; and any other new complexities regarding federal performance measures.
 - To the extent a state or an MPO wants to pursue any additional steps in performance management, it is free to do so without additional federal rules or statutes.
 - AASHTO recommends that no consideration be given to making changes to existing performance management regulations that would increase burdens until multiple reporting cycles by states have occurred.
 - AASHTO supports selected reforms to existing performance management requirements to reduce the burden of performance measurement and management on state DOTs and looks forward to working with USDOT on these reforms.

ISSUE 5-3: Performance Management Regulations Should Be Improved to Reduce the Burden on State DOTs

- *Current Federal Policy:* 23 CFR Section 490, *National Performance Management Measures*
- *Issue:* State DOTs have only recently begun to understand and appreciate the resources required of them to implement the Federal performance management regulations. First there is the direct and indirect cost of setting performance targets for the federal performance measures. In some cases, like the safety measures, State DOTs were already collecting and analyzing the required data and it

was not a heavy lift to address the new federal safety performance management regulations. However, for other performance measures, specifically system performance, the state DOTs are now required to collect, manage, and analyze a significantly larger data set; calculate performance measures that are new to the industry; and establish targets having little or no historical trend data. While the NPMRDS data from FHWA may be free, the resources required to analyze it requires real effort and specialized expertise.

Second, there is the burden placed upon state DOTs to be held accountable for assets they do not own or manage but must set targets for. For example, state DOTs are responsible for meeting targets for all NHS bridges and pavement condition regardless of who owns and maintains the asset. In some cases, the state DOT has no control over establishing the targets for these assets and must incorporate them into the state-based targets. However, the state DOT is held accountable for target achievement and not the asset owner. Also, rural states are now required to report on congestion on rural highways, including very low volume routes that could become congested only due extreme weather, unusual accidents or other non-routine events. In this case, the resources required to conduct the analysis are a misdirection of planning effort.

Finally, the performance management provisions place a lot more burden on the state DOTs to coordinate with many other transportation agencies regarding the development of planning documents, establishing targets and assessing performance. While the incremental changes required by the various performance management provisions may seem small, taken all together the amount of additional work is significant and costly.

- *Recommendations:*
 - Identify and implement ways to reduce the burden associated with the development of performance measures (including collecting and setting targets) for current performance measures:
 - Additional financial resources could be given to state DOTs to analyze data.
 - Decisions could be made to collect less data or not to have to report targets on certain less critical roadways such as low volume roads.
 - Assessment of data collection requirements could be conducted and recommendations on the elimination of non-useful data could be made.
 - Ensure state DOTs are held accountable for only those assets within their control.

ISSUE 5-4: Make Consistent the Financial Planning Requirements among the Required Performance-Based Planning Documents

- *Current Federal Policy:*
 - 49 USC Section 70202, *State Freight Plans*
 - 23 USC Section 119, *National Highway Performance Program*
 - 23 U.S.C. Section 135, *Statewide and Nonmetropolitan Planning*
 - 23 CFR Section 515, *Asset Management Plans*
- *Issue:* Certain Federal surface transportation programs are subject to significant planning requirements and processes. In particular, certain planning documents require a financial plan tied to a certain number of years in the future. For example, the Statewide Transportation Improvement Program (STIP) under 23 USC Section 135 requires a fiscally constrained four-year program of projects. The State Freight Plan under 49 USC Section 70202 requires a five-year financial plan for the projects listed in it. The asset management plan regulations impose a non-statutory ten-year financial plan requirement for the projects listed in it. Currently, the significant uncertainty associated with federal funding conditions result in the financial planning requirements associated with the STIP, State Freight Plan, and asset management plan have far less value for decision making with risk and uncertainty being multiplied.

- *Recommendation:*
 - AASHTO recommends all financial plan requirements associated with any federally-required plan be consistent with the four-year duration that has been historically required of the STIP. Any longer duration would be at the election of a state DOT.

ISSUE 5-5: Minimum Condition Levels for National Highway System (NHS) Bridges and Pavements Could Encourage a Worst-First Asset Management Approach

- *Current Federal Policy:*
 - 23 USC Section 119, National Highway Performance Program
 - 23 CFR Section 515, Asset Management Plans
- *Issue:* Current federal law requires states utilize and document an asset management plan for the NHS. State DOTs must also manage the transportation system well beyond the designated NHS. One of the principles of asset management is to focus on reducing life-cycle costs, not on addressing the “worst first” for the transportation network. FHWA’s current guidance states that a successful asset management program “must have moved away from a ‘worst first’ investment strategy, and instead have adopted investment principles that are based on life cycle costing and incorporate life-cycle planning principles.” Current federal law set minimum condition levels for NHS bridges in poor condition and also requires USDOT to establish a minimum condition level for Interstate System pavement. If the minimum conditions are not met, the State would be required to redirect certain funds to improve those conditions until the minimum conditions are met.

A core principle of transportation asset management is to provide the right treatment at the right time in the life cycle of the asset. This may mean the option not to treat the worst item or segment first may be the most cost effective for the system. State DOTs are concerned that the minimum condition requirements for NHS bridges and Interstate System pavement may force state DOTs into adopting a worst-first approach to asset management.
- *Recommendation:*
 - Eliminate the minimum condition requirements written into law for both NHS bridges and Interstate System pavement.
 - If the minimum condition requirements are not eliminated, do not use the achievement of meeting the minimum condition requirements for NHS bridges or Interstate System pavement as the basis for apportioning or allocating federal funds among state DOTs.
 - Ensure that the minimum condition requirements for NHS bridges and Interstate System pavement do not force a state DOT to adopt a worst first approach to asset management.

ISSUE 5-6: Help Advance Progress Towards a More Flexible Transportation Program

- *Current Federal Policy:* None.
- *Issue:* Congress has, correctly, provided states with increased flexibility to transfer funds among categories to better align funding with state priority needs. Many states have a long history with incorporating performance goals into their planning processes to guide state programming decisions. Concurrently, Congress has established national performance goals and the states are implementing the performance management regulations established by FHWA. However, even with increased transferability among fund categories, states still face constraints to align available funding with priority needs.
- *Recommendation:* Authorize a pilot program that allows a limited number of states the option to treat all federal funds they receive during the pilot program years as having been apportioned to that state under the most flexible of the existing federal funding categories. The purpose of the pilot program is to demonstrate how states produce results toward state goals and needs

using a flexible needs-based and outcome-oriented project prioritization and programming process. States that use performance indicators in their programming or project selection processes would be eligible to apply for the pilot program. The program would not eliminate statutory set-asides for geographic areas within such states or eliminate the applicability of federal performance requirements. Such a pilot would enable USDOT to consider the impact of the increased flexibility – positive, negative, or neutral – on results, including under the federal transportation performance management process. The proposed pilot program will provide practical, real-world experience that will help inform future policy making.

CROSS-REFERENCE OF RELATED ISSUES IN OTHER WHITE PAPERS

- ISSUE 2-1: Unfunded Mandates
- ISSUE 2-2: Privacy, Security, Cyber Security
- ISSUE 3-1: Increase Federal Funding
- ISSUE 3-3: Prioritize Formula-based Federal Funding
- ISSUE 3-6: Increase flexibility and transferability of funding
- ISSUE 6-3: Maintain the Existing Balance of Authority among State DOTs, MPOs, and Rural Planning Organizations

6: Planning

INTRODUCTION AND BACKGROUND

The Moving Ahead for Progress in the 21st Century Act (MAP-21) and the FAST Act modified planning statutes governing state DOTs and Metropolitan Planning Organizations (MPOs) to, among other things, ensure that planning is performance-based. Implementation of the statute has resulted in updated planning regulations (23 CFR Part 450; 49 CFR 613) as well as new regulations pertaining to the federal performance management requirements as part of 23 CFR Section 490, *National Performance Management Measures* and 23 CFR Section 515, *Asset Management Plans*. The updated *Statewide and Nonmetropolitan Transportation Planning*; *Metropolitan Transportation Planning* rule updates modified the then-existing transportation planning requirements to a performance-based approach to support the national goals specified in 23 USC 150(b): goals related to safety, infrastructure condition, congestion reduction, system reliability, freight movement and economic vitality, environmental sustainability, and reduced project delivery delays. The performance and asset management regulations require state DOTs to establish and report on making progress towards achieving targets for a set of federal performance measures related to safety, asset condition, and system operations.

State DOTs are at the early stages of implementing the new and updated federal performance management and performance-based planning regulations. Now, all updated long range transportation plans must be performance-based and incorporate the performance targets set by each state DOT. Statewide Transportation Improvement Programs (STIPs) must now include references to how a set of projects will enable a state DOT to reach its targets. The first four-year reporting cycle started on January 1, 2018 and will go through December 31, 2021. During the time since the first regulation was published (May 2015) and the last one was effective (May 2018), state DOTs have gained significant experience and understanding related to the complexities associated with implementing the performance-based planning regulations. State DOTs have found that the analysis cost associated with the regulations was underestimated by federal estimates and that it would be beneficial for USDOT and Congress, working with the state DOTs, to find ways of reducing the overall financial and personnel time burden associated with the new regulations and requirements. This would still leave a thorough planning process but enable states to deliver programs and projects more efficiently and at less cost.

SPECIFIC POLICY ISSUES AND RECOMMENDATIONS

ISSUE 6-1: Do Not Increase Any Regulatory Burdens Related to Planning but Rather Look for Opportunities to Reduce Burdens and Unnecessary Requirements While Maintaining a Thorough Planning Process

- *Current Federal Policy:*
 - 23 USC Section 134, *Metropolitan Transportation Planning*
 - 23 USC Section 135, *Statewide and Nonmetropolitan Planning*
 - 23 CFR Section 490, *National Performance Management Measures*
 - 23 CFR Section 515, *Asset Management Plans*
- *Issue:* The new and updated performance management and performance-based planning regulations were developed and published over a six year time period beginning in 2013 and ending in 2018 with the publication of the final rule regarding 23 CFR Section 490, *National Performance Management Measures, Subpart H*. As of May 2018, state DOTs are now required to implement the performance-based planning process articulated in the updated 23 CFR Section 450, Subpart B,

Statewide and Nonmetropolitan Transportation Planning and Programming. Further, state DOTs are currently in the middle of completing the first aspect of performance management provisions requiring them to establish targets for the federal performance measures, incorporate those targets into the planning process (Statewide Transportation Improvement Program [STIP] and long range transportation plan [LRTP]), and report on making progress towards achieving targets. The first comprehensive report documenting the first reporting cycle will not be developed and published until CY2022 at the earliest. AASHTO has long cautioned against complicating changes to these regulations until after at least two reporting cycles to give the state DOTs time and experience in addressing the regulations. As set forth more fully in this paper, AASHTO opposes any complicating changes or additions to the updated performance-based planning regulations and would welcome opportunities to simplify or eliminate processes and requirements, reduce administrative and regulatory burdens, expedite project and program delivery, and increase state flexibility. This can be done while leaving in place a thorough planning process.

- *Recommendations:*
 - AASHTO opposes any complicating changes or additions to the updated performance-based planning regulations included in 23 CFR Section 450, Subpart B. There should be time to implement and evaluate recent changes.
 - Within that framework, AASHTO would welcome opportunities to simplify processes and requirements, reduce administrative and regulatory burdens, expedite project delivery, and increase state flexibility.
 - To the extent a state wants to pursue any additional steps related to improving its performance-based planning process, it is free to do so without additional federal rules or statutes.

ISSUE 6-2: Enhance Flexibility and Avoid Imposing New Administrative Burdens, whether through statute, Rulemakings, or Guidance

- *Current Federal Policy:* None
- *Issue:* AASHTO urges federal decision makers to continue to look for ways to reduce regulatory burdens and improve agency effectiveness consistent with the national goal of “reduced project delivery delays”. In addition, states and metropolitan planning organizations need flexibility to accelerate implementation of projects to meet national and state goals.
- *Recommendations:*
 - AASHTO opposes new program mandates in general, ranging from new program process requirements, to required investment levels in certain activities (e.g., sub allocation of Congestion Mitigation and Air Quality Improvements, or CMAQ, funds), to design related mandates (e.g., practical design).
 - AASHTO supports the following:
 - Additional flexibility in state’s ability to expeditiously complete planning and project delivery processes
 - States’ ability to make the best investment decisions for the state without siloed programs
 - Any program growth should be in the most flexible categories.

ISSUE 6-3: Maintain the Existing Balance of Authority among State DOTs, MPOs, and Rural Planning Organizations

- *Current Federal Policy:*
 - 23 USC Section 134, *Metropolitan Transportation Planning*
 - 23 USC Section 135, *Statewide and Nonmetropolitan Planning*

- *Issue:* The FAST Act generally maintained the balance of authority as updated in MAP-21 with the option of State DOTs to establish Rural Planning Organizations and to maintain the existing relationships between State DOTs and MPOs. The performance management regulations implemented in 23 CFR Section 490 added some additional requirements for state DOTs and MPOs to work more closely together in terms of establishing performance targets and incorporating those targets into the various short and long range plans. However, the performance management regulations did not make any significant changes to the balance of authority between the state DOTs and MPOs.
- *Recommendation:*
 - AASHTO recommends the balance of authority that currently exists among state DOTs, MPOs, and rural planning organizations remain and not changed through new legislation, rulemakings, or guidance.

ISSUE 6-4: Fiscal Constraint

- *Current Federal Policy:*
 - 23 USC Section 134, *Metropolitan Transportation Planning*
 - 23 USC Section 135, *Statewide and Nonmetropolitan Planning*
 - Various FHWA Guidance
- *Issue #4a:* Update Laws, regulations and/or guidance so that “fiscal constraint” requirements do not impede the ability of state DOTs to develop and deliver transportation projects. Programming of federal transportation dollars is based on the four-year window through the STIP. FHWA has decided, by interpretation, to impose a duplicative fiscal constraint requirement, not included in statute or rule, on completing the National Environmental Policy Act (NEPA) process for a project. Specifically, FHWA has interpreted that, to receive NEPA approval a project must come from a fiscally constrained STIP or Transportation Improvement Program (TIP). See FHWA website, “Transportation Planning Requirements and Their Relationship to NEPA Process Completion.” Yet it is impractical to estimate cost and include a project, or even a phase of a project (such as preliminary engineering), in a fiscally constrained STIP or TIP until the NEPA process is complete, as that process helps define the final project (and in some cases the NEPA process results in a no build decision). So, the fiscal constraint requirement for projects undergoing NEPA review creates instability in the STIP or TIP, as an overestimate of costs keeps other projects out of the STIP or TIP and an underestimate results in excess projects being included in the fiscally constrained STIP or TIP: at least until the NEPA process is completed and any adjustment made. USDOT should revise its current practice and allow the completion of the NEPA process for a project regardless of whether the project or a phase of it is included in a fiscally constrained STIP or TIP. This will expedite environmental review. It will not violate the principle of fiscal constraint because, even with this recommended change, the project cannot advance to construction unless it is in a fiscally constrained STIP or TIP.
- *Recommendation:* AASHTO recommends decoupling fiscal constraint from NEPA so fiscal constraint does not have to be met prior to a NEPA decision.
- *Issue #4b:* Reconsider more broadly the extent of “fiscal constraint” requirements. In addition to the recommendation made above (#4a), the entire concept of “fiscal constraint” regulation in planning warrants reconsideration. Simply, a state cannot spend or obligate more funds than it has. Programming of federally funded transportation projects is subject to “fiscal constraint” rules which are a complex set of rules measuring projects against budget resources at multiple points in the planning process. Fiscal constraint of TIPs and STIPs by year is not required in statute but is required by USDOT rules. States, MPOs and transit agencies should be allowed to

develop and implement STIP plans based on realistic financial assumptions. The complex technical “fiscal constraint” rules are not what prevent excessive spending, rather it is the limited resources that keep spending in check. The rules, however, limit flexibility and impose excessive requirements, especially when they must be applied in the context of unpredictable rescissions and delayed appropriations. Federal decision makers need to reduce the inflated workload for USDOT as well as for regulatory-burdened states.

- *Recommendation:*
 - Reexamine fiscal constraint requirements and reducing them, such as by applying them to fewer decision points and shortening the applicable time frames.
 - Remove fiscal constraint regulatory requirements that are not compelled by statute and by reconsidering statutory requirements, such as by shortening the applicable time period to one where resources can reasonably be anticipated, such as the four year STIP cycle.

ISSUE 6-5: Make State DOTs and MPOs Eligible Recipients under the Set Aside from the Surface Transportation Block Grant Program (aka transportation alternatives program)

- *Current Federal Policy:* 23 U.S.C. 133(h)(4)(B)
- *Issue:* State DOTs and MPOs are not eligible recipients of project funding under a set aside of the Surface Transportation Block Grant Program (STBG) (either as a project sponsor or to administer the program). However, it does take resources (time and money) to administer the program for those funds, set aside by 23 U.S.C. 133(h) and sometimes referred to as “transportation alternatives” or “transportation enhancements”. In addition, a number of state DOTs have been project sponsors and implemented a number of programs that are now combined under this element of the STBG Set Aside program. Thus, it is important states and MPOs be allowed to use a portion of the STBG program funds for administrative expenses associated with the subsection (h) set aside and that they be allowed to receive grants to carry out projects.
- *Recommendation:*
 - New legislation should ensure state agencies (including state DOTs) and MPOs are included in the list of eligible entities to receive STBG Set Aside funds (subsection (h)), such that state DOTs and MPOs have the ability to implement projects and designate a limited amount of discretionary funding to allow for flexibility in sound program and project management and oversight.
 - Should an MPO fail to spend their obligation authority in a fiscal year, a state DOT should be able to flex MPO STP set aside funding.

ISSUE 6-6: Make More Flexible the Projects that can be Funded through the Congestion Mitigation and Air Quality (CMAQ) Improvement Program

- *Current Federal Policy:* 23 U.S.C. 149
- *Issue:* The projects eligible for CMAQ funding are limited by a variety of conditions. For example, prior to MAP-21, FHWA guidance set a three-year cap on the use of CMAQ funds for operating assistance. Updated guidance allows new transportation services (e.g., transit and passenger rail services, traffic operation centers, etc.) to “taper down” the last year of operating assistance over two additional years (i.e., to spend 3 years of operating assistance over a 5-year period). Beyond five years, operating costs are not eligible for CMAQ funding.

- *Recommendations:* AASHTO recommends increasing the flexibility in the use of CMAQ funds, including but not limited to by:
 - Increase flexibility and decrease restrictions on the use of CMAQ funds for ITS and Transit operations. States should be able to continue to use CMAQ for these projects as long as they continue to demonstrate net air quality benefits.
 - Requiring obligation of the CMAQ funds in PM 2.5 non-attainment and maintenance areas only when it is determined that the non-attainment issue results from transportation activities.
 - Making explicit that technology deployments such as Connected and Automated Vehicles are eligible for funding under CMAQ.

ISSUE 6-7: Mitigate the Burden of Data Collection Related to the Performance-Based Planning and Performance Management Regulations

- *Current Federal Policy:*
 - 23 USC Section 134, *Metropolitan Transportation Planning*
 - 23 USC Section 135, *Statewide and Nonmetropolitan Planning*
 - 23 CFR Section 490, *National Performance Management Measures*
 - 23 CFR Section 515, *Asset Management Plans*
- *Issue:* The new performance-based planning regulations and performance management regulations create a data intensive environment where state DOTs are having to collect, store, analyze, and report significantly more data and information. Implementation of the national-level performance measures has been dependent on the availability of quality data and many state DOTs and MPOs have determined that the cost associated with the data collection is significantly more than estimated by FHWA.
- *Recommendations:*
 - Consistent with recommendation Issue 6-1, look for opportunities to reduce the scope and/or amount of data required to be collected and handled by state DOTs, including but not limited to:
 - Use a collaborative approach to develop more consistent and/or streamlined or simplified data collection, analysis, and management practices. FHWA should work collaboratively with state DOTs to establish less burdensome methodologies for collecting data related to implementation of the planning and performance management requirements in MAP-21.
 - Allocate additional funding (from accounts other than apportionments for programs) to state DOTs specifically to mitigate the cost of data collection, analysis and management.
 - Create legal safe havens as appropriate to facilitate sharing of data across safety organizations without concerns for the legal and litigation concerns associated with 23 USC 409 and 23 USC 148(h)(4).

ISSUE 6-8: Expand the Extent of both the Primary Highway Freight System and National Multimodal Freight Network

- *Current Federal Policy:*
 - 23 U.S.C. 167, *National Freight Policy*
 - 49 U.S.C. 70103, *Interim National Multimodal Freight Network*
- *Issue:* The definition and limitations of the Primary Highway Freight System (PHFS) and National Multimodal Freight Network (NMFN) will not allow the states to attain the comprehensive goals in MAP-21 and FAST and do not take into account the challenges of rural, large, land based states and other concerns of states. The PHFS network currently consists of 41,518 centerlines miles, including 37,436 centerline miles of Interstate and 4,082 centerline miles of non-Interstate roads. The designation of PHFS roads in various states has resulted in a limited and disconnected network. The

ability of a state to designate some additional mileage to the PHFS as critical urban and rural corridors still leaves an unduly limited and disconnected network. For the NMFN, the current draft network is limited and does not include all of the NHS road nor critical rural and urban transportation links.

- **Recommendations:**
 - Expand the PHFS to include all Interstate System roadways regardless of how much freight funding a state receives. Freight program eligibility should include all Interstates by default.
 - Remove restrictions on state authority to add mileage to the PHFS and NMFN, including but not limited to mileage caps on critical urban and critical rural corridors.
 - Add eligibility to use funds on any portion of a state's multimodal freight network as defined in a state's freight plan.

ISSUE 6-9: Streamline and Simplify the Development and Updating of the Multitude of Transportation Plan Documents Currently Required of States

- **Current Federal Policy:** Various
- **Issue:** The new performance management provisions and updated performance-based planning provisions have required state DOTs to develop, update, and modify a host of transportation planning documents. What began with the Intermodal Surface Transportation Efficiency Act (ISTEA) in 1991 simply as a short range plan (STIP) and long range plan (LRTP) has mushroomed into a family of plans that focus on different topics, durations, update cycles, and level of detail. It appears many of these planning documents have now conflated long-term visionary planning documents with short-term implementation plans. For example, several federal plans mandating states must complete are required to be updated every 4 or 5 years. These include Freight, Rail, and Safety. In the case of Freight and Rail, the requirements also call for a list of planned investments over the next 4 or 5-year period. Freight, for example, required the inclusion of a project list—the same list as a programming document of the STIP. It makes little sense that states are required to list programmed projects in two different places and requires valuable resources (time and money) to develop to different plans with similar information.
- **Recommendations:**
 - Make consistent the duration, updating cycle, and content of numerous planning documents required of state DOTs and eliminate redundancy among these documents.
 - All financial plan requirements associated with any federally-required plan should be no longer than the four year duration as has been historically required of the STIP and, if possible, shorter.
 - Allow states to consolidate these and other plans as needed and appropriate to reduce the burden.

CROSS-REFERENCE OF RELATED ISSUES IN OTHER WHITE PAPERS

- ISSUE 1-1: Deploying CAV Technologies in the Safest Manner Possible is Paramount
- ISSUE 2-1: Unfunded Mandates
- ISSUE 3-1: Increase Federal Funding
- ISSUE 3-4: Eliminate Rescissions of Contract Authority
- ISSUE 3-6: Increase flexibility and transferability of funding
- ISSUE 3-10: Reduce and Simplify Regulations, Requirements, Data Collections, and Process to Expedite the Process
- Issue 4-1: Strengthen Eligibility for Investments in Transportation System Management and Operations (TSMO) and Related Technology

- ISSUE 5-3: Performance Management Regulations Should Be Improved to Reduce the Burden on State DOTs
- ISSUE 7-13: Preventative Maintenance
- ISSUE 7-14: Small/Local Projects and Transportation Alternatives Projects
- ISSUE 8-15: Streamline Agency Involvement in Section 4(f) Decisions
- ISSUE 8-16: Allow Alternatives to Providing “Replacement Parkland” under Section 6(f)
- ISSUE 8-17: Streamline Section 404 Compliance for Routine Road Maintenance Activities
- ISSUE 7-17: Delegation of Modifications to State Policies and Procedures
- ISSUE 7-18: Delegation of ITS Infrastructure
- ISSUE 7-19: Delegation of Preventive Maintenance Projects
- ISSUE 7-20: Delegation of Authorization for Right-of-Way Acquisition
- ISSUE 7-21: Delegation of Federal Funds Obligation Management
- ISSUE 7-22: Delegation of Project Agreements
- ISSUE 8-1: Enhance Role of Lead Agency in Managing the NEPA Process
- ISSUE 8-2: Provide a Consistent Legal Framework for Linking Planning and NEPA
- ISSUE 8-3: Make All Categorical Exclusions Available for Use by Any Federal Agency
- ISSUE 8-5: Clarify and Expand NEPA Assignment Authorities
- ISSUE 8-6: Allow Increased Use of Programmatic Agreements to Balance FHWA and State DOT Roles
- ISSUE 8-9: Allow Conformity and Fiscal Constraint to be Determined Post-NEPA, Prior to Construction
- ISSUE 8-14: Streamline Section 106 Requirements for Post-WWII Properties
- ISSUE 8-15: Streamline Agency Involvement in Section 4(f) Decisions
- ISSUE 8-16: Allow Alternatives to Providing “Replacement Parkland” under Section 6(f)
- ISSUE 8-17: Streamline Section 404 Compliance for Routine Road Maintenance Activities
- ISSUE 8-19: Allow Delegation of Section 404 Permitting Authority for Transportation Projects
- ISSUE 8-20: Require Interim Guidance to Be Issued at Time of Species Listing

7: Project Delivery—Engineering

INTRODUCTION AND BACKGROUND

AASHTO believes that the state DOTs and the Federal government can continue the momentum of MAP-21 and the FAST Act by making further efficiency and effectiveness gains on transportation program and project delivery while continuing the state DOTs' responsible stewardship of taxpayer resources and both the human and natural environments. Streamlining processes and delegating authorities to the state DOTs will reduce costs, reduce delays, and provide more bang-for-the-buck to citizens for their transportation dollars.

As part of this effort, a survey was distributed to various AASHTO committees asking what causes delay, what drives costs up, and what changes would they propose at the federal level to improve these situations. Over 600 comments were received, and an ad-hoc task force reviewed the issues and proposed solutions in a wide range of areas including design, construction, right-of-way, utilities, maintenance, materials, and traffic engineering. The following are the issues considered to be the highest priority.

SPECIFIC POLICY ISSUES AND RECOMMENDATIONS

ISSUE 7-1: Adoption of PROWAG

- *Current Federal Policy:* 28 CFR 36, Nondiscrimination on the Basis of Disability by Public Accommodations and in Commercial Facilities
- *Issue:* The Americans with Disabilities Act (ADA) strives to ensure access to the built environment for people with disabilities. To facilitate this access, the US Access Board is responsible for developing and updating design guidelines known as the ADA Accessibility Guidelines (ADAAG), which focus primarily on *facilities on sites*. These guidelines are currently used by the US Department of Justice and the US Department of Transportation in setting enforceable standards that the public must follow. However, sidewalks, street crossings, and other elements in the *public right-of-way* can pose different challenges to accessibility. While the current ADAAG addresses certain features common to public sidewalks, such as curb ramps, the Access Board determined more than a decade ago that additional guidance was necessary to address conditions and constraints unique to public rights-of-way.

Thus, the Access Board has been collaboratively developing guidelines for facilities within the public rights-of-way – the Public Rights-of-Way Accessibility Guidelines (PROWAG) – which address transportation-specific issues, including access for blind pedestrians at street crossings, wheelchair access to on-street parking, and various constraints posed by space limitations, roadway design practices, slope, and terrain. Once these guidelines are adopted by the US Department of Justice, they will become enforceable standards under Title II of the ADA. Unfortunately, since the current “officially adopted” guidance is still the ADAAG, which is intended more for vertical than horizontal construction, there has been uncertainty in transportation agencies regarding what is or is not acceptable. In addition, several agencies are being required, as the result of litigation, to implement suboptimal accessibility solutions that were truly intended for buildings, not transportation facilities. Adoption of the PROWAG would provide transportation agencies with solid, researched solutions for accessibility within their transportation corridors.

- *Recommendation:* Official adoption of the Public Rights of Way Accessibility Guidelines (PROWAG) is needed to ensure consistency across the country in the application of accessibility features within the streetscape. Adoption would also ensure that the horizontal construction guidelines are used by transportation agencies instead of the vertical construction guidelines.

ISSUE 7-2: Right of Way Acquisition from Federal Agencies

- *Current Federal Policy:* No specific law or regulation identified
- *Issue:* The acquisition of rights of way from federal agencies continues to delay and increase the cost of transportation projects. For example, much-needed projects in rural Alaska have been held up due to lengthy processes through the Bureau of Indian Affairs, which have delayed projects for more than a decade including Kwigillingok Airport, Angoon Airport, and Haines Highway. Other agencies mentioned by states include the Bureau of Land Management, US Postal Service, USDA-Natural Resources Conservation Service, and others. USDOT and FHWA should be advocates for the states with its sister departments and agencies to help speed right-of-way acquisition with their sister departments and agencies.
- *Recommendation:* Establish a set process and timeline, to include templates or model agreements, for acquiring right-of-way from federal agencies to promote fairness and speed up project delivery.

ISSUE 7-3: Right of Way Acquisition Processes

- *Current Federal Policy:* Various right of way laws and regulations
- *Issue:* Right of way procurement is consistently one of the top reasons for delay in transportation project delivery. While many changes to laws and regulations as part of MAP-21 and the FAST Act have improved and streamlined the acquisition process, additional flexibilities could still provide benefit, including cost savings and delay reductions.
- *Recommendations:* Streamline the right of way acquisition process in numerous areas to simplify the process and speed acquisition without compromising the rights of the property-holder. Potential suggestions for further review include the following: allowing state procurement procedures to be used on federal-aid projects; allowing protective purchases with preliminary engineering funding (to be returned if not utilized in final design); increasing the waiver valuation threshold, or removing the threshold with the only qualifier being whether the assignment is complex or not; removing the 4(f) restriction on the Early Acquisition process (23 CFR 710.501) as it will better align itself with the Advance Acquisition process and a 4(f) review will still be conducted through the required acquisition-specific NEPA review; allowing states the option to use the "short form" for appraisals, which is quicker and less expensive.

ISSUE 7-4: Federal Bridge Inspection Program Audit

- *Current Federal Policy:* FHWA Bridge Inspection Program Audit Cycle
- *Issue:* Currently, FHWA performs a formal audit of each state's Bridge Inspection Program on an annual basis. The state DOTs receive FHWA's assessment, including compliance ratings for each of the 23 Federal metrics, at the end of the calendar year in which the audit was performed. The state DOT response, including Plans of Corrective Action and Improvement Plans, are due back to FHWA in February or March of the following year, meaning the inspection cycle for that year could be as much as a quarter of the way completed by the time corrections are put into place. Such a schedule does not allow sufficient time to implement corrective action before the following year's audit period commences. If FHWA moved to a two-year audit cycle, state DOTs would have sufficient time to implement Plans of Corrective Action and Improvement Plans before the next audit cycle begins.

- *Recommendation:* Modify FHWA's audit cycle of states' bridge inspection programs to two years (or more) to allow time for the meaningful implementation of improvements and corrections recommended in the previous cycle.

ISSUE 7-5: Emergency Relief (ER) Program

- *Current Federal Policy:* 23 USC 125, Emergency Relief; 23 CFR 658, Emergency Relief Program
- *Issue:* Certain federal requirements slow the delivery of projects using Emergency Relief funds in declared emergencies. More flexibility is needed with regard to contract requirements as well as with environmental and right of way reviews, as damage is often limited to repair of existing facilities to pre-damage condition, which in essence is replacing a previously-approved project. In addition, requiring a new letting for emergency projects often delays emergency repairs while expecting states to include federal requirements in state funded projects. Thus, for ER projects, state DOTs should be allowed to change-order all federal requirements into a previously-let, state-funded project that did not contain the federal provisions. Finally, reimbursement of ER funds can be onerous and lengthy.
- *Recommendation:* Streamline federal requirements for transportation projects related to declared emergencies. Establish a panel to review current procedures and recommend changes to streamline projects consistent with the goals of the Emergency Relief Program.

ISSUE 7-6: Emergency and Tow Vehicles

- *Current Federal Policy:* FAST Act, Sec. 1410, Interstate Weight Limits; 23 USC 127, Vehicle Weight Limitations—Interstate System, subsections (m) and (r)
- *Issue:* The FAST Act increased the maximum gross vehicle weight allowance of an emergency vehicle on the Interstate System (and routes that provide reasonable access to the Interstate System) to 86,000 pounds and exempted heavy-duty tow and recovery vehicles (regardless of weight) from Federal Interstate weight limits. These vehicles can create greater load effects in certain bridges than the previous legal loads. If not appropriately rated and posted (i.e., restricted), bridge safety, serviceability, and durability may be compromised by these vehicles. States recognize the safety and mobility benefits of facilitating prompt movement of emergency and tow vehicles. However, these two new weight-limit exemptions are not subject to state permit authority and are considered "unrestricted" exceptions; thus, every state is now required to re-evaluate the load rating for all Interstate bridges (and those that provide access to the Interstate) and post restrictions on those bridges that cannot safely carry these new maximum unrestricted vehicle loads.

An unintended consequence of the FAST Act is that hundreds—or potentially thousands—of bridges in each state now must be load-rated for the higher limits and "posted" with any applicable load restrictions. Furthermore, while the provision for emergency vehicles includes a stated maximum gross vehicle weight of 86,000 pounds and requirements as to axle limits, the heavy-duty tow and recovery vehicle provision does not state a weight limit and allows for the unspecified weight of a towing and towed vehicle combined, making it impossible for states to determine how to load rate the bridges and determine which ones must be posted. The unexpected additional costs associated with load-rating and posting thousands of bridges will cause financial burdens on state and local transportation agencies. Additionally, posting load restrictions on thousands of bridges on the nation's Interstate System (and reasonable access roads) will likely create confusion among drivers that could affect the safety of the traveling public and operators of said emergency and heavy-duty tow and recovery vehicles. If these vehicles were to be subject to state permit authority, states would be able to designate appropriate routes, reducing the number of posted bridges, reducing costs for state and local governments, protecting bridges, and continuing to

facilitate prompt movement of emergency vehicles to the scenes of emergencies and prompt clearance of disabled vehicles from roads.

- *Recommendation:* Rescind the FAST Act provisions concerning emergency vehicles and heavy-duty tow vehicles (23 USC 127(m) and (r)) and allow states to accommodate these vehicles as they have done successfully prior to the FAST Act, through real-time permitting or other methods. Another option is to modify 23 U.S.C. 127 (m) and (r) to allow states to apply for FHWA authority to use a permit system for subsection (m) and subsection (r) vehicles over 80,000 lbs gross vehicle weight.

ISSUE 7-7: Reduce Federal Regulation of State Policies and Procedures Through Reduction of Requirements, Less Frequent Reviews, and Delegation

- *Current Federal Policy:* Stewardship and Oversight Agreements
- *Issue:* Attachment B to the standard Stewardship and Oversight Agreement requires FHWA review and approval for many state policies and procedures, such as a state's standard specifications; pavement design policy; value engineering policy and procedures; liquidated damage rates; quality assurance program; and other matters. Attachment B also requires, in some cases, pre-approval of changes in such state policies and procedures even though statute does not call for pre-approval. Many of these FHWA reviews of state policies are annual and many of these requirements, including pre-approval of changes, are not specified by statute. These requirements should be reduced and made less frequent than annually.
- *Recommendation:* States should be authorized to approve modifications to these procedures without preapproval by FHWA, subject to FHWA's ongoing oversight of the state's compliance with federal requirements. Attachment B's requirements should be reduced by authorizing states to modify their policies and procedures without preapproval, with review of those changes conducted no more frequently than every two years.

ISSUE 7-8: Buy America

- *Current Federal Policy:* 23 USC 313, Buy America; 23 CFR 635.410, Buy America Requirements
- *Issue:* The Buy America provisions of the Surface Transportation Assistance Act of 1982, 23 USC 313, state that the Secretary of Transportation "shall not obligate any funds authorized to be appropriated to carry out the Surface Transportation Assistance Act...unless steel, iron, and manufactured products used in such project are produced in the United States." While state DOTs support the tenets of the Buy America Act, they need a more common-sense application of the provisions in law and regulation to ensure project delivery is not delayed. Currently, there is no consistent guidance from FHWA at a national level, which leaves states and FHWA Division Offices to interpret the rules, often varying widely from state to state. In addition, without specific guidance, states can be left with a strict interpretation, meaning that every single nut, bolt, washer, tie wire, etc., has to meet Buy America: and in many cases, the documentation does not exist to track the origins of those items, so states end up spending vast amounts of time on very small items.

In addition, components of specialty equipment used on movable bridges, cranes, ferries, bridge inspection equipment, bridge preservation work, research, etc., often contain parts not produced in the United States, and transportation agencies are not a large enough market to compel the companies producing this equipment to comply with Buy America. In one state, the inability to find American producers combined with the extreme delay in receiving waiver responses has resulted in a shift in focus away from extremely beneficial projects, such as purchasing sweeping and flushing equipment (CMAQ), to other types of work. The effectiveness of the nation's surface transportation program is dependent on the availability of construction materials and equipment, some of which is sourced through global supply chains; thus, the Administration's approach to reauthorization needs

to address the competing needs of supporting American producers and the impact of increased delays in project delivery and the associated costs in terms of the safety and efficiency of the transportation system.

- Another problematic issue is related to the application of Buy America to utility relocations. Buy America should not apply to compensable utility relocations, as relocations are an entitlement provided by CFR. Forcing utility companies to comply with Buy America delays relocations for highway projects because transportation work is a small portion of their business, and many utility companies have existing contracts with national and international suppliers that do not allow them to purchase materials elsewhere.
- **Recommendations:**
 - Implement the exceptions to Buy America proposed previously by FHWA in Federal rule making, and reinstate the waiver process to ensure transportation projects are progressing without significant delays.
 - Develop clear guidelines on exceptions at the Federal level to create a consistent nationwide application of rules and reduce the burden, delays, and resources expended over small percentages of material.
 - Implement an exemption from Buy America for utility companies that are required to relocate their facilities as part of a transportation project.

ISSUE 7-9: Roadside Hardware

- **Current Federal Policy:** FHWA procedures for reviewing crash tests and issuing federal-aid eligibility letters.
- **Issue:** FHWA has proposed to cease issuing federal-aid eligibility letters for roadside hardware as of December 31, 2019. The potential termination of these letters greatly impacts how the state DOTs will approach the certification process going forward. State DOTs are committed to upgrading roadside hardware systems to the latest, safest standards in the Manual for Assessing Safety Hardware (MASH), and to providing a safe environment for errant vehicles on our roadsides. However, as the states and AASHTO have worked to implement a joint agreement made with FHWA in 2015 and meet the deadlines for transitioning to MASH-compliant devices, FHWA has announced that it is stepping back from its traditional role of reviewing crash tests and providing “eligibility letters” for roadside safety hardware. This is a concern for most states, as they have relied on these letters to certify compliance with the crash-test standards. In addition, if individual states took on this role of reviewing and certifying crashworthy devices for use on the nation’s roadways, the result could be as many as 50+ individual interpretations, leading to inconsistencies from state to state and increased costs from manufacturers who must now seek approvals from multiple entities.
- **Recommendation:** Ensure that FHWA continues to oversee the review and approval process for crash testing roadside safety hardware for use on the nation’s road and highway system.

ISSUE 7-10: Outdoor Advertising: Elimination of Tracking the Federal-Aid Primary Route System

- **Current Federal Policy:** 23 USC 131, Control of Outdoor Advertising
- **Issue:** Currently, states are tasked with the control of outdoor advertising (i.e., billboards) along the National Highway System (NHS) and the Federal-Aid Primary System (FAP) as it was designated on June 1, 1991. The FAP system has not been used in other areas of regulation for decades (with the exception of the National Truck Network for policies governing truck size and weight) and it generally overlaps the NHS (as the NHS was, basically, a successor to the FAP system). In addition, some of the old FAP routes are now under city or county jurisdiction, so oversight of those billboards should be given to the local governments that control those routes. State and federal

roadway and maintenance funds are not involved in these roads, so why should state and federal funding still be used to control and inventory signs on these roads? Thus, it makes sense to remove the requirement for the control of outdoor advertising on the FAP system from the federal requirements.

- *Recommendation:* Discontinue the regulatory oversight of billboards on the June 1, 1991, Federal-Aid Primary System (FAP) routes by eliminating this requirement from 23 USC 131(t).

ISSUE 7-11: Outdoor Advertising: Nonconforming Signs

- *Current Federal Policy:* 23 CFR 750.707, Nonconforming Signs, subsections (d)(3) and (d)(5)
- *Issue:* Typically, when a highway project necessitates the relocation of an outdoor advertising sign (i.e., billboard), the sign is allowed to be moved perpendicularly off the right of way using relocation assistance funds. This move does not require a new outdoor advertising permit, and the sign owner is "made whole." However, under current federal regulations, "nonconforming signs" (e.g., billboards greater than 825 sq. ft.) are treated differently and cannot be similarly moved. Rather, for nonconforming signs, a new *conforming* location has to be found or just compensation (i.e., paying for the "total loss" of the sign) must be paid to the permit holder. This is a time consuming, costly, and contentious process: and the cost of nonconforming sign removal can be in the hundreds of thousands of dollars. In addition, for signs on a Scenic Byway or All American road, the law doesn't allow for reconstruction or relocation, only maintenance and upkeep. The unintended consequence is that federal law is protecting these nonconforming signs, which are personal property of private companies, essentially in perpetuity. However, case law indicates that outdoor advertising sign permits are a privilege, not a right, and there is no fundamental right for them to be seen from the interstate. Thus, the solution is to change the above-mentioned federal regulations to allow for the movement of a nonconforming sign perpendicularly off the right of way by indicating that such movement is not considered a "new location" (since the mile marker does not change) and that the sign can only be moved in-kind, hence preserving their nonconforming structure status. This would allow highway projects to move forward at less cost.
- *Recommendation:* Revise federal law/regulation to allow the relocation of nonconforming billboards to essentially the same "location" perpendicular to the right of way, with permission from the landowner, when impacted by a highway project.

ISSUE 7-12: Outdoor Advertising: Bonus Act Program

- *Current Federal Policy:* 23 USC 131, Control of Outdoor Advertising, subsection (j); 23 CFR 750.713, Bonus Provisions
- *Issue:* There are 23 state DOTs that must still comply with the antiquated outdoor advertising control regulations of the Bonus Act of 1958. The Bonus Act is incongruent with the Highway Beautification Act (HBA) in many aspects and disrupts national uniformity in the erection and maintenance of outdoor advertising of signs/displays in areas adjacent to the Interstate: a basic program objective of the HBA. Applying the tenets of the Bonus Act often requires a state DOT to regulate outdoor advertising on sections of roadway that are no longer state highways. Additionally, the relocation of outdoor advertising signs as a result of highway projects within those sections of roadway that have been transferred to the local jurisdictions cost Federal dollars to relocate and compensate for loss. States that voluntarily participated in the Bonus Act (for an additional ¼ of 1 percent of funding) are currently afforded only one avenue of exit from the program: the repayment of federal funds received during the early years of the program, as is stated in Bonus Act agreements signed between state DOTs and FHWA. It is understood that an FHWA Division Office administrative waiver could nullify the Bonus Act stipulations on a case-by-case basis

(unless a nationwide blanket waiver was issued). However, it is recommended that federal law and regulations be amended so that the remedy would apply to all states seeking an exit from the Bonus Act agreement, which is outdated and causes problems for state DOTs in their regulation and control of outdoor signs along the Interstate.

- *Recommendation:* Allow States to exit the Bonus Act Program without penalty. The following sections should be amended:
 - Section 131(j) of Title 23, United State Codes, should be amended by striking “shall be entitled to receive the bonus payments” and all that follows through “provided in this section” and by inserting “shall no longer be bound by such agreement.”
 - 23 CFR 750.713 should be amended by striking Section (j) and by inserting, “Specifically provides that any state which had entered into a bonus agreement before June 30, 1965, will no longer be bound by such agreement.”

ISSUE 7-13: Preventive Maintenance

- *Current Federal Policy:* 23 USC 135, Statewide and Nonmetropolitan Transportation Planning, subsection (f)(8)
- *Issue:* Including preventive maintenance projects in the STIP and State Transportation Plan slows down the application of maintenance techniques to the road system. Delays caused by the STIP process can lead to pavements deteriorating past the point at which a given maintenance process is a viable improvement.
- *Recommendation:* Allow preventive maintenance projects to be conducted outside the STIP process. Alternately, allow for a general statement of preventive maintenance work in the STIP to promote needed flexibility in applying the most appropriate treatments at the best time and in the best locations.

ISSUE 7-14: Small/Local Projects and Transportation Alternatives Projects

- *Current Federal Policy:* 23 USC 133, Surface Transportation Block Grant Program, subsection (h); FAST Act, Sec. 1109, Transportation Alternatives Set-Aside of the Surface Transportation Block Grant Program
- *Issue:* Applying the full range of federal requirements to small projects inhibits the efficient delivery of those projects, which is further exacerbated by the sub-allocation of federal funds into small funding categories. For example, the sub-allocation of the Transportation Alternatives Set-Aside as mandated by federal requirements creates funding levels that are inefficient in delivering some projects. As much as 50 percent or more of TA funding can be spent on preliminary engineering activities when following the federal process, leaving less than half for project construction. In addition, local public agencies (LPAs) are typically unfamiliar with federal processes, which also slows down the delivery of such projects. Small projects are difficult for DOTs and local governments to manage because of the red tape surrounding them, despite their small nature. Simplifying federally-funded projects for local agencies would expedite project delivery and better match the amount of work and regulation to the simple nature of the projects. Alternatively, flexibility for local governments to use their own approved procurement processes could be beneficial: while there may be a need for a certification process for the LPAs, the certification could be in place for multiple years and save time in the long run.

In addition, there are many reasons to restore the authority for state DOTs to sponsor TAP projects. The current prohibition of state DOT sponsorship hinders fund obligation since local government sponsors are often reluctant to use federal funding for small projects. Instead, to maximize available dollars, one state has developed a process to convert TA funds to STP funds,

which are then converted with state highways dollars. The state highway dollars are then used for local TAP projects, more than doubling the amount of funding to TA projects because local entities are willing to partner with the state funding, but not with federal dollars. Another example is an important project that is located within a small town that is not experienced enough to administer the contract for a larger project. If a town elects to have the state DOT administer contract for a larger project, then it should be allowable.

- *Recommendations:*
 - Streamline federal processes for smaller transportation projects.
 - Restore the authority for states to sponsor Transportation Alternatives projects.

ISSUE 7-15: Coordination with Railroads

- *Current Federal Policy:* 23 CFR Part 646, Subpart B, Railroad-Highway Projects
- *Issue:* Restrictions and delays imposed on transportation agencies by railroad owners, either intentionally or unintentionally, significantly affect the timely delivery of public works projects, including pedestrian, bicycle, road and highway projects. Obtaining fair and equitable railroad agreements as well as ensuring the commitments are made in a timely manner are often a struggle and adds time and cost to these projects.
- *Recommendation:* Establish, or authorize USDOT to establish, consistent requirements, commitments, and time frames across all public and private railroad owners to facilitate transportation work within and across railroad rights of way, and provide USDOT the authority to enforce those provisions with the railroads. Require USDOT to establish template/model agreements for standard activities conducted by the state DOTs in railroad right-of-way (and vice versa), and provide guidance on the establishment of agreements for special or more complex activities.

ISSUE 7-16: Drones/Unmanned Aircraft Systems (UAS)

- *Current Federal Policy:* 14 CFR 107, Small Unmanned Aircraft Systems
- *Issue:* Current restrictions on the use of drones are impeding the development of significant potential beneficial uses in such areas as preliminary design, right of way, bridge inspection, safety, and operations. The full potential of this continually evolving technology is not being realized, in part because regulation is unable to keep pace with the developing technology. Current restrictions include where and when drones can be flown, the amount of pre-planning needed, and the inability to fly over traffic. An example of a currently restricted use is the documentation of a crash site, which would allow for quicker clearing of the incident and potentially reduce secondary crashes.
- *Recommendation:* Expand flexibilities for transportation agencies to use drones in broader applications and with fewer restrictions when reasonable safety measures can be accommodated to help realize the full potential of this continually evolving technology.

ISSUE 7-17: Relocation of Utilities

- *Current Federal Policy:* 23 USC 123, Relocation of Utility Facilities
- *Issue:* 23 USC 123 provides that states may be reimbursed with federal funds when the state pays for utility relocations for project construction.
- *Recommendation:* Amend 23 USC 123 to allow utility relocation to take place after a preferred alternative is identified but prior to NEPA completion with appropriate limitations to ensure the integrity of the NEPA process, and allow federal funds to be used for the relocation.

ISSUE 7-18: Delegation of ITS Architecture

- *Current Federal Policy:* 23 CFR 940, Intelligent Transportation System Architecture and Standards
- *Issue:* Implemented as part of TEA-21 in 2001 (Sec. 5206(e)), requirements were established for ITS architecture at a time when the technology was in its initial development. Almost two decades later, with the maturation of ITS systems and architecture, reporting to the federal level on every project is time consuming and excessive. States can take on this responsibility.
- *Recommendation:* Eliminate the requirements for production of project-level, regional, and statewide ITS Architectures. States can be delegated this responsibility.

ISSUE 7-19: Delegation of Preventive Maintenance Projects

- *Current Federal Policy:* 23 USC 116, Maintenance, subsection (e)
- *Issue:* Under 23 USC 116(e), a state may use Federal-aid highway funds for a preventive maintenance project "if the state demonstrates to the satisfaction of the Secretary that the activity is a cost-effective means of extending the useful life of a Federal-aid highway." Because this is a statutory requirement, FHWA cannot currently assign to states the authority to determine that a preventive maintenance project qualifies for federal reimbursement.
- *Recommendation:* This provision should be amended to allow states to determine that a preventive maintenance project meets the applicable criteria for federal reimbursement. This change would require an amendment to 23 USC 116(e).

ISSUE 7-20: Delegation of Authorization for Right-of-Way Acquisition

- *Current Federal Policy:* 23 USC 106, Project Approval and Oversight
- *Issue:* Currently, there is no specific authorization in 23 USC 106 (or elsewhere in Title 23) for states to assume FHWA's responsibilities for authorizing federally funded right-of-way acquisitions. In addition, FHWA's right-of-way regulations state that "as a condition of Federal funding under Title 23, the grantee shall obtain FHWA authorization in writing or electronically before proceeding with any real property acquisition using Title 23 funds, including early acquisitions under §710.501(e) and hardship acquisition and protective buying under §710.503."
- *Recommendation:* New legislative authority should be established for states to voluntarily assume some or all of FHWA's responsibilities for approval of right-of-way acquisitions, subject to the same legal protections that currently apply to the right-of-way acquisition process. This would require an amendment to 23 USC 106.

ISSUE 7-21: Delegation of Federal Funds Obligation Management

- *Current Federal Policy:* 23 USC 106, Project Approval and Oversight
- *Issue:* Currently, a state must obtain FHWA's approval to obligate funds for a specific project. This is required to allow states to actually draw down specific Federal funds so that the state can seek reimbursement from FHWA for actual costs incurred. This approval is provided for a project after FHWA determines that all applicable Federal requirements have been met.
- *Recommendation:* A new legislative authority should be provided to allow states to assume FHWA's responsibilities for determining that all federal requirements have been met, without the need for an individual project-level obligation approval by FHWA.

ISSUE 7-22: Delegation of Project Agreements

- *Current Federal Policy:* 23 CFR 630.106, Authorization to Proceed
- *Issue:* Currently, a state must obtain FHWA's authorization to proceed before beginning work on any Federal-aid project, including an advance construction project. This authorization can be

provided by FHWA for a project or a group of projects through or after the execution of a formal project agreement with the state, only after FHWA determines that all applicable Federal requirements have been met.

- *Recommendation:* States should be provided new legislative authority to assume FHWA's responsibilities for determining that all federal requirements have been met prior to commencement of construction.

CROSS-REFERENCE OF RELATED ISSUES IN OTHER WHITE PAPERS

- ISSUE 3-3: Prioritize Formula-based Federal Funding
- ISSUE 3-6: Increase flexibility and transferability of funding
- ISSUE 4-5: Improve Buy America Requirements
- ISSUE 4-6: Update National ITS Architecture Rule 940
- ISSUE 6-1: Do Not Increase Any Regulatory Burdens Related to Planning but Rather Look for Opportunities to Reduce Burdens and Unnecessary Requirements While Maintaining a Thorough Planning Process
- ISSUE 6-5: Make State DOTs and MPOs Eligible Recipients under the Set Aside from the Surface Transportation Block Grant Program (aka transportation alternatives program)
- ISSUE 6-9: Streamline and Simplify the Development and Updating of the Multitude of Transportation Plan Documents Currently Required of States
- ISSUE 8-8: Allow Utility Relocations to Start Earlier
- ISSUE 8-10: Provide Greater Flexibility for Early Acquisition of Right-of-Way
- ISSUE 9-6: Redefine "Manufactured Products" Requirement within Buy America Law
- ISSUE 11-1: National Transportation System Security and Resilience Plan
- ISSUE 11-3: Modify Emergency Relief (ER) Program to be More Flexible and More Responsive to System Resilience Needs

8: Project Delivery—Environmental Protection

INTRODUCTION AND BACKGROUND

Over the past decade, significant progress has been made toward the goal of streamlining environmental reviews for transportation projects. Average review times are faster, programmatic approaches are used more widely, and environmental documents are becoming more reader-friendly. This progress has been spurred by streamlining measures enacted in SAFETEA-LU, MAP-21, and the FAST Act, including the environmental review process in 23 USC 139. But even with this great progress, the environmental process still takes too long and is unduly costly and delay-prone. Some of the most persistent difficulties arise from the interaction among NEPA and other federal environmental laws, each with its own distinct procedures and requirements. Our recommendations focus on making continued improvement in the NEPA process itself, and in making the NEPA process work more smoothly with other federal requirements.

SPECIFIC POLICY ISSUES AND RECOMMENDATIONS

NEPA / Environmental Review Process

ISSUE 8-1: Enhance Role of Lead Agency in Managing the NEPA Process

- *Issue:* Section 139 requires lead agencies to prepare a “coordination plan” when an Environmental Impact Statement (EIS) or Environmental Assessment (EA) is prepared and requires the plan to include a “schedule for completion of the environmental review process for the project.” Section 139 requires both the initial schedule and any changes that “shorten” the schedule to be adopted by the lead agency with “concurrence” of all participating agencies and the project sponsor. As amended by the FAST Act, Section 139 now also requires the “status and progress” of all projects requiring an EA or EIS to be posted on the Permitting Dashboard; this requirement ensures that a current schedule showing key project milestones is posted on the Dashboard.
- *Recommendation:* Eliminate the requirement to obtain “concurrence” from other agencies in project schedules, and clarify that posting on the Dashboard satisfies the requirement to maintain and update the project schedule under Section 139. Retain the existing requirement for lead agencies to consult with participating agencies and project sponsor in setting the schedule, for project schedules to be consistent with applicable legal requirements, and for schedules to be posted on the Dashboard. If disagreements arise about schedules, they can be resolved through elevation to the Council on Environmental Quality (CEQ) and/or the Permitting Council. These changes will help to ensure efficiency, flexibility, and transparency in setting project schedules, while minimizing the risk of bogging down the process over scheduling issues.

ISSUE 8-2: Provide a Consistent Legal Framework for Linking Planning and NEPA

- *Issue:* In its planning regulations, FHWA has recognized two distinct processes for linking transportation planning with the NEPA process, known as planning-environmental linkage (PEL): (1) a flexible process that was established in the regulations before MAP-21; and (2) a more restrictive process that was enacted in MAP-21 and is codified at 23 USC 168. The main difference between the two is that Section 168 requires the lead agency to obtain concurrence of cooperating agencies with approval roles. It is confusing to states to have two different PEL authorities with two different processes and requirements. Moreover, the inflexibility of the Section 168 process means that it is rarely if ever used.

- *Recommendation:* Amend 23 USC 168 to conform the statutory process to the more flexible preexisting process that existed in FHWA's regulations (23 CFR Part 450) before Section 168 was enacted in MAP-21. The amendments to Section 168 should, at a minimum, eliminate the "concurrency" requirement.

ISSUE 8-3: Make All Categorical Exclusions Available for Use by Any Federal Agency

- *Issue:* Under current NEPA regulations, each federal agency adopts its own list of categorical exclusions (CEs) applicable to actions that the agency carries out. If multiple federal agency approvals are needed for the same project, and only one agency has an applicable CE, then that agency can issue as CE, but the other federal agencies must prepare an EA - slowing down the process unnecessarily. An existing law—49 USC 304—allows any USDOT agency to use any other USDOT's agency's CE, but this authority has two important limitations: (1) applies only to "multimodal projects," which are defined as projects that require approval from two or more USDOT agencies; and (2) it does not apply to agencies outside the USDOT. These restrictions are unduly limiting.
- *Recommendation:* Amend 49 USC 304 or enact new legislation authorizing any federal agency to apply a CE that had been adopted by any other federal agency; this authority would make CEs interchangeable among all federal agencies. For example, the Corps could apply a CE from FHWA's CE list. If this change is not made, Congress should at least amend 49 USC 304 to allow any USDOT agency to use any other USDOT agency's CE, regardless of whether the project is "multimodal."

ISSUE 8-4: Maximize Use of CEs, Including Clarification that Programmatic Agreements Can be Used to Authorize Additional CEs

- *Issue:* Most states have entered into Programmatic Agreements under which FHWA authorizes the State to make CE determinations on FHWA's behalf. In Section 1318 of MAP-21, Congress specifically authorized these types of Programmatic Agreements to include CEs for additional activities beyond those specifically listed as CEs in FHWA's NEPA regulations, as long as the additional CEs are "consistent with section 1508.4" of the CEQ's NEPA regulations. However, in rulemaking, FHWA has interpreted that statutory language in a way that effectively prevents that flexibility from being used: under FHWA's interpretation, additional activities can be included as CEs in a Programmatic Agreement only if the CEs are adopted through the same federal rulemaking process that FHWA would need to use in order to establish new CEs in its regulations. (See 78 Fed. Reg. 57587, 57581 (Sept. 19, 2013) ("The FHWA interprets section 1318(d)(3) as limiting this expanded authority to actions listed in regulation (i.e., all (c)-list CEs and the examples provided in the (d)-list) and any other CE that is added through a process consistent with the requirements of 40 CFR 1508.4.")) FHWA's interpretation is inconsistent with the statutory language, which only requires the additional CEs to be "consistent with section 1508.4" of the CEQ's regulations - a provision that defines a CE, but does not include any process requirements. FHWA's interpretation negates the flexibility that Congress intended to provide in Section 1318 of MAP-21.
- *Recommendation:*
 - Clarify that additional CEs may be included in Programmatic Agreements between a state DOT and FHWA, without needing to undertake a federal rulemaking process. This clarification can be provided by amending Section 1318 of MAP-21 to provide that such CEs must be "consistent with the criteria for a Categorical Exclusion in section 1508.4 of title 40 ..."
 - Direct USDOT to solicit public comment suggesting additional CEs and, promptly after the close of the comment process to publish an NRPM with any additional proposed CEs, with final action to follow promptly.

ISSUE 8-5: Clarify and Expand NEPA Assignment Authorities

- *Issue:* Under 23 USC 327, states may assume, by written agreement, responsibilities of the USDOT under NEPA and related federal environmental laws for highway, transit, rail, and multimodal projects. To assume federal NEPA responsibilities for transit, rail and multimodal projects, a state must first assume federal responsibilities for highways. To date, six states have successfully completed the application process, and several more are in the application process to assume federal responsibilities for highways. Experience in assignment states has shown that assignment greatly reduces average completion times. But the application process currently takes 1 to 2 years to complete, and once states obtain assignment, they remain subject to a burdensome and complicated audit and renewal process. In addition, the assignment statute prohibits assignment of project-level air quality conformity determinations, which are an essential part of the NEPA process for many projects, and FHWA has interpreted the statute to further limit the range of responsibilities that can be assigned. Further clarification, simplification, and expansion of this program are all needed. In addition, this program should be added to Title 49 to allow states to assume the federal NEPA responsibilities of any USDOT modal administration.
- *Recommendation:* Clarify, simplify and expand streamlining authorities under 23 USC 327 as follows:
 - Standardize the information that states need to meet to apply for the NEPA assignment program; a checklist approach where states certify to meet certain requirements.
 - Require that the term of NEPA Assignment MOUs be a minimum of ten years, while maintaining the current four-year audit period.
 - Clarify and simplify the assignment audit process to focus on compliance with the substantive areas of the assignment MOU.
 - Clarify that, at their option, states may be assigned project-level air quality conformity determinations, as well as floodplain determinations, which FHWA has interpreted to be excluded from assignment.
 - Clarify that state attorneys' fees may be paid with federal funding, including court ordered payments of opposing counsel.
 - Remove the pre-condition for a state to have taken on NEPA assignment for highways prior to being able to take on NEPA assignment for rail and transit projects.
 - Add NEPA assignment authority to Title 49 to allow states to assume the federal NEPA responsibilities of any USDOT modal administration.

ISSUE 8-6: Allow Increased Use of Programmatic Agreements to Balance FHWA and State DOT Roles

- *Issue:* In states without NEPA assignment, the FHWA and state DOT carry out the environmental review process in partnership with one another. Much of the subject-matter expertise on environmental issues resides within the state DOT on issues ranging from endangered species to historic preservation to traffic forecasting. But because FHWA is the lead agency, many routine functions must be carried out by FHWA staff, even when the substantive work has been done by the state DOT. It is wasteful and inefficient for a state DOT to prepare a report, draft a transmittal letter, and then wait for FHWA to sign the letter. It would be far more efficient to allow the state DOT to carry out routine inter-agency coordination tasks, while maintaining regular communication with FHWA. This increased efficiency would also free up FHWA's limited staff resources to focus on issues such as program oversight and major project decisions.
- *Recommendation:* Authorize FHWA to enter into programmatic agreements under which state DOTs (without NEPA assignment) could take on increased responsibility for carrying out routine FHWA responsibilities during the NEPA process, including but not limited to: requesting concurrence in findings of de minimis impact under Section 4(f) of the USDOT Act; submitting Biological Assessments under Section 7 of the Endangered Species Act; preparing and circulating air quality

conformity determinations under the Clean Air Act; initiating and carrying out Section 106 consultation activities under the National Historic Preservation Act, including submittal of historic preservation reports to consulting parties (but not including government-to-government consultation with tribes). FHWA would retain responsibility for all final decisions, while maximizing the opportunity for state DOTs acting under FHWA oversight to carry out the procedures leading up to those final decisions. In addition, direct FHWA to amend its regulations to remove the requirement for FHWA approval of state DOT procedures and policies for routine activities such as public involvement and noise mitigation.

ISSUE 8-7: Establish Project Delivery Innovation Pilot Program

- *Issue:* The NEPA process requires compliance with a host of other federal environmental laws, each of which is implemented by separate regulations, under the jurisdiction of different agencies. Streamlining the NEPA process alone will not be successful without also streamlining compliance with the other federal laws that also must be addressed as part of the same process. Yet efforts to amend or improve those other laws have not been successful, at least to date. Because other federal environmental laws are subject to complex and prescriptive regulations, agencies are highly restricted in their ability even to consider innovative practices that could yield “win-win” solutions for infrastructure development and the environment. One possible solution is to borrow from the “SEP-15” model used by FHWA – an experimental program that allows the agency to waive certain requirements on a project-specific basis as a way to test innovative approaches, which can inform future changes to the agencies regulations. This same flexibility should be provided to other agencies.
- *Recommendation:* Establish a pilot program, modeled on SEP-15, that would allow USDOT modal administrations and federal environmental agencies to waive or otherwise modify their own requirements to develop innovative practices to streamline project delivery and achieve positive environmental outcomes. The flexibility provided under this framework would include appropriate safeguards—including interagency consultation and public notice and involvement—to ensure adherence to federal environmental laws, regulations, and policies. For example, all federal agencies required to consult on a project would need to agree to the inclusion of the project in the pilot program, consulting resource agencies would need to determine that equal or improved environmental outcomes would be achieved, and no agency would be allowed to override or modify requirements that fall within another agency’s authority.

ISSUE 8-8: Allow Utility Relocations to Start Earlier

- *Issue:* Utility relocations are a common source of delay in project schedules. Utility relocations tend to be time-consuming because they often require other regulatory approvals and involve property acquisition outside the transportation right-of-way. Utility relocations required for FHWA-approved projects also become subject to Buy America requirements, which may create further delays if compliant products are not readily available. In addition, utility relocations require extensive coordination and agreement with the utility companies, which generally are responsible for carrying out the relocations. To avoid project delays, it would be highly beneficial to allow utilities to begin relocating utilities before the NEPA process for the transportation project is complete. However, under FHWA’s NEPA regulations, construction work on the project—including the utility relocations, generally is not allowed to begin until after the NEPA process is completed. 23 CFR 771.113(a).)
- *Recommendation:* Direct FHWA to amend its NEPA regulations to allow utility relocations to begin prior to NEPA completion, with appropriate limitations to ensure the integrity of the NEPA process, and allow federal funds to be used for such relocation. Appropriate limitations would include (1) treating the utility relocation as a separate federal action, so that it’s subject to its own NEPA review

before the utility relocation occurs; (2) allowing the utility relocation to occur only after a preferred alternative has been identified in the NEPA process for the transportation project, and prohibiting the utility relocation itself to be considered as a factor in approving an alternative; and (3) if federal funds are used for the utility relocation, requiring the state to reimburse those funds to FHWA if the transportation project is not approved and implemented within a defined time period (e.g., 20 years). This flexibility would apply to a utility relocation using an Environmental Impact Statement, Environmental Assessment, or Categorical Exclusion.

ISSUE 8-9: Allow Conformity and Fiscal Constraint to be Determined Post-NEPA, Prior to Construction

- *Issue:* For projects located in air quality nonattainment and maintenance areas, FHWA must make an air quality conformity determination (i.e., a finding that the project conforms to the state's plan for achieving federal air quality standards per 42 USC 7506(c)). The conformity determination, in turn, requires a finding that the project is included in a "fiscally constrained" metropolitan transportation plan and transportation improvement program (TIP). 40 CFR 93.108. These findings are required prior to completion of the NEPA process under current EPA and FHWA regulations and guidance. This requirement creates a Catch-22 for many large projects: without NEPA approval, it is difficult to confirm funding sources, but the NEPA process cannot be completed until funding sources are identified. The timing of the fiscal constraint determination can be especially challenging for large P3 projects and other innovative-finance projects, where funding and financing plans are not (and cannot be) resolved until after the NEPA process is complete.
- *Recommendation:* Allow flexibility to complete the NEPA process with approval conditioned on making an air quality conformity and fiscal constraint determination before proceeding to construction. This approach would not change any substantive requirements related to fiscal constraint and project level conformity, it merely changes the timing of making these determinations. This change would be implemented with legislation directing FHWA and FTA to update their joint environmental and planning regulations (23 CFR Part 771 and Part 450), and directing EPA to make a corresponding change to its conformity regulations.

ISSUE 8-10: Provide Greater Flexibility for Early Acquisition of Right-of-Way

- *Issue:* Section 108 of Title 23 allows right-of-way to be acquired for a transportation project, under certain conditions, prior to completion of the NEPA process for the project itself. FHWA's right-of-way regulations (23 CFR Part 710) impose restrictions that are not required by the statute, in particular an absolute prohibition on early acquisition of property protected by Section 4(f)—i.e., any historic property, and publicly owned land within a park, recreation area, or wildlife or waterfowl refuge. This prohibition applies regardless of whether the Section 4(f) status of the property (e.g., its eligibility for the National Register of Historic Places) was known at the time the property was acquired, and the regulations allow no flexibility for FHWA to make exceptions. As a result, inadvertent acquisition of Section 4(f)-protected properties can permanently deprive a project of eligibility for federal funding.
- *Recommendations:* Direct FHWA to amend its regulations governing early right-of-way acquisition carried out with non-federal funds (23 CFR 710.501(b)) to remove the prohibition on acquiring Section 4(f) properties. All conditions specified in the statute would still need to be met. This change would ensure that the regulations provide the full degree of flexibility allowed under 23 USC 108.

Air Quality Conformity

ISSUE 8-11: Require Air Quality Conformity Only for the Current Air Quality Standards

- **Issue:** As required by the Clean Air Act, the EPA periodically reviews and updates the National Ambient Air Quality Standards (NAAQS), typically by replacing an old standard with a new, more stringent standard. When a new NAAQS is adopted, EPA issues rules for transitioning to the new standard. In a recent court decision, *South Coast v. EPA*, the U.S. Court of Appeals struck down an EPA rule that provided for the transition from the 1997 ozone standard to the stricter 2008 standard. The court held that even though the 1997 standard had been revoked and replaced by a stricter standard, states and MPOs still were required to continue making conformity determinations for the revoked 1997 standard. This decision will result in wasteful effort of demonstrating conformity to plans for achieving an air quality standard that has already been met.
- **Recommendation:** Require that when a new standard is established for a pollutant, transportation agencies only need to conform to the most recent standard for that pollutant. This would require an amendment to 42 USC 7506.

ISSUE 8-12: Allow Programmatic Air Quality Conformity Determinations

- **Issue:** Currently, air quality conformity determinations must be made when an MPO updates or amends its plan or TIP—regardless of whether the changes being made are likely to have any material effect on air quality. In addition, conformity determinations are required for every project (with the exemption of certain ‘exempt’ projects), even when there is no realistic chance that the project will cause the region to violate applicable air quality standards.
- **Recommendations:** Direct EPA to amend the transportation conformity regulations (40 CFR Part 93) to allow the USDOT, in consultation with EPA, to make programmatic conformity determinations that can be relied upon as the basis for demonstrating conformity for individual plans, programs, and projects. The programmatic conformity determinations could be made at a national, state or local level. Conditions could be specified in the regulations so that the programmatic determinations can be used only for plans, programs, and projects that meet specified criteria. If emissions budgets are exceeded, the state and MPO would need to resume making individualized conformity determinations.

ISSUE 8-13: Adjust Timing of Transportation Conformity Requirements to Align with SIP Approval

- **Issue:** After a NAAQS is established by EPA, nonattainment areas for that standard are designated. One year after this designation, transportation conformity applies. In concept, a conformity determination is a finding that a transportation plan, program, or project “conforms to” the motor vehicle emissions budgets in the State Implementation Plan (SIP) adopted by the state for achieving the NAAQS. But under the Clean Air Act, the SIP is not submitted until three years after nonattainment areas are designated. As a result, there is a two-year period in which conformity determinations are required but the SIP is not yet established, and this time period may become much longer if there are delays in EPA’s approval of the SIP. During this time, conformity determinations can only be made by proving that “build” emissions are no worse than “no build” emissions. It is paradoxical to require “conformity” to a SIP before the SIP has even been adopted.
- **Recommendation:** Amend the Clean Air Act (42 USC 7506(c)) to provide that transportation conformity requirements for a newly adopted NAAQS do not come into effect until six months after EPA approves the SIP motor vehicle emissions budgets for that NAAQS.

Section 106, 4(f), and 6(f)**ISSUE 8-14: Streamline Section 106 Requirements for Post-WWII Properties**

- *Issue:* Section 106 of the National Historic Preservation Act (NHPA) requires federal agencies to identify all historic properties listed in or “eligible for” the National Register of Historic Places (NRHP), assess effects on those properties, and consult on ways to mitigate adverse effects. In addition, Section 4(f) of the USDOT Act imposed on USDOT agencies additional, stringent requirements to protect all historic properties listed in or eligible for the NRHP. Under National Park Service standards, properties under 50 years of age generally are not eligible unless they have “extraordinary” significance. But in practice, this “50-year rule” has commonly been interpreted to mean that all structures older than 50 years of age must be evaluated for eligibility, and in many states, the 50-year threshold is measured from the anticipated date of construction – so the surveys include properties in the 40- to 50-year age range at the time the surveys are conducted. This means entire suburban subdivisions built in the 1970s must now be evaluated for National Register eligibility, and soon 1980s-era developments will need to be evaluated as well.
- *Recommendation:* Direct the Advisory Council on Historic Preservation to issue program comments or other exemption to streamline Section 106 reviews for common, post-World War II buildings, districts, neighborhoods and commercial development from Section 106 review, and establish a statutory Section 4(f) exemption for the same properties covered by that Section 106 exemption. Direct the National Park Service to reassess the 50-year age threshold used in determining eligibility for the National Register of Historic Places, particularly in related to post-WWII residential properties, and submit a report to Congress on whether the 50-year threshold should be modified.

ISSUE 8-15: Streamline Agency Involvement in Section 4(f) Decisions

- *Issue:* Section 4(f) of the Department of Transportation Act establishes requirements and considerations for USDOT to use land from a historic site, publicly owned park, recreation area, or wildlife and water fowl refuge. Implementing regulations require USDOT to coordinate and seek comments from “officials of jurisdiction” prior to making a 4(f) determination. Depending upon the resource, this could include the State Historic Preservation Office (SHPO), the Tribal Historic Preservation Office (THPO), the Advisory Council on Historic Preservation (ACHP), the National Parks Service, and/or the Fish and Wildlife Services (FWS). After coordination with these entities and public review, the evaluation is then required to be reviewed by the Department of the Interior (DOI), and sometimes the Department of Agriculture (DOA) and/or Department of Housing and Urban Development (HUD). This last level of review slows down project delivery and adds little value to the 4(f) determinations.
- *Recommendation:* Remove the requirement for DOI, DOA and/or HUD review for individual 4(f) evaluations. These agencies would still have the opportunity to comment as part of the NEPA process and/or as officials with jurisdiction, and could use that comment opportunity to raise any issues or concerns regarding potential impacts to Section 4(f) resources. This change would require amending 49 USC 303 and 23 CFR 774.5(a).

ISSUE 8-16: Allow Alternatives to Providing “Replacement Parkland” under Section 6(f)

- *Issue:* Section 6(f) and Land and Water Conservation Fund Act (LWCF) prohibits the conversion of property acquired or developed with LWCF grants to a non-recreational purpose without the approval of the National Park Service. Section 6(f) further directs NPS to approve such conversion only if the converted area is replaced with parkland of equal fair market value, location, and usefulness. These Section 6(f) requirements apply to the entire park for which an LWCF grant was received, even if the grant was used only for a small portion of the park. Consequently, where

conversions of Section 6(f) lands are proposed for highway projects, no matter how small the conversion, replacement lands are necessary. Often, local officials would prefer for the state to make improvements to the existing property rather than finding replacement property, which could be at a different site; however, Section 6(f) specifically requires replacement parkland.

- *Recommendation:* Amend Section 6(f) of the LWCFA to allow flexibility for a public agency acquiring Section 6(f)-protected parkland to compensate for those impacts through enhancements to the existing park or other enhancements acceptable to the parkland owner. This mitigation method would still require approval of the National Park Service; but would simply allow broader flexibility as to the method used to compensate for impacts to parkland.

Section 404 of the Clean Water Act

ISSUE 8-17: Streamline Section 404 Compliance for Routine Road Maintenance Activities

- *Issue:* Many transportation projects require permits under Section 404 of the Clean Water Act for the discharge of dredged or fill material into “waters of the United States.” Section 404 permitting requirements can be a significant burden on transportation project development, especially for minor maintenance and construction activities that only impact man-made wetlands located adjacent to roads.
- *Recommendation:* Expand exemptions from Section 404 permitting for routine maintenance projects with minor impacts and streamline the use of Nationwide Permits for projects that remain subject to Section 404 as follows:
 - Clarify and expand exemptions in the Corps’ regulations (33 CFR Part 325) for activities involving maintenance and/or construction of roadside ditches, emergency activities, and impacts on wetlands within the highway median or operational right of way.
 - Expand opportunities for using non-reporting national and regional permits to greatly reduce timeframes for obtaining Section 404 permits.
 - Modify permitting requirements so that projects that require a relocation of a roadside ditch that also carries a Water of the US, will not require mitigation above and beyond the replacement of the roadside ditch, assuming no loss of channel occurs.

ISSUE 8-18: Allow Programmatic Approach to Compliance with Section 404(b)(1) Guidelines

- *Issue:* Section 404 of the Clean Water Act requires the U.S. Army Corps of Engineers to comply with EPA regulations—the “Section 404(b)(1) Guidelines”—when issuing Section 404 permits authorizing projects that impact wetlands and other waters under the Corps’ jurisdiction. The Guidelines require, among other things, that the Corps only issue a permit for the practicable alternative that causes the least impact to aquatic resources; this is the so-called ‘LEDPA’ requirement. In practice, inter-agency disagreements over interpretations of the LEDPA requirement are a frequent source of project delays. When applied rigidly, this requirement can effectively force the choice among alternatives to be based solely on small differences in wetland impacts, rather than a comprehensive and balanced comparison of impacts on all types of natural resources and communities.
- *Recommendation:* Create alternative process allowing approval of Section 404 permit for a surface transportation project to be approved pursuant to programmatic agreement with a state that ensures no-net-loss at watershed level, in lieu of making a LEDPA determination at the project level.

ISSUE 8-19: Allow Delegation of Section 404 Permitting Authority for Transportation Projects

- *Issue:* Under existing law, the Corps is responsible for issuing Section 404 permits, subject to EPA's oversight and veto authority. The Corps has authority to delegate its permitting responsibilities to a state, but this is an all-or-nothing proposition; the state's only option is to take on the entire program, a major burden. As a result, most states are reluctant to take on this responsibility (to date, only New Jersey and Michigan have done so). By contrast, the NEPA assignment program established under 23 USC 327 allows FHWA to assign all or a portion of its environmental responsibilities within a state; the scope of assignment under that program is determined by negotiation between FHWA and the state. To date, six states are participating in the NEPA assignment program and several more are considering it. The flexibility allowed under the NEPA assignment program should be extended to the Section 404 program.
- *Recommendation:* Allow delegation of Corps permitting responsibility to a state department of transportation for a subset of projects or activities as agreed by the Corps and the state, e.g., just for transportation projects. Providing this flexibility would encourage states to take over Section 404 permitting for at least a portion of the projects currently handled by the Corps, reducing the burden on the Corps' staff, while also promoting greater efficiency in the processing of permits for major public projects.

Endangered Species Act**ISSUE 8-20: Require Interim Guidance to Be Issued at Time of Species Listing, and then a Full Recovery Plan**

- *Issue:* The ESA requires recovery plans for all species listed as threatened or endangered. However, for most listed species recovery plans are out of date or have not been developed. This creates numerous challenges for project sponsors in addressing threatened or endangered species as there is no guidance regarding species recovery goals or acceptable mitigation tools.
- *Recommendation:* Amend 16 USC 1533 to require Fish and Wildlife Services (FWS) and National Marine Fisheries Service (NMFS) to, issue interim guidance at the time of listing of a threatened or endangered species, and then to issue a full recovery plan within 12 months of listing. The interim guidance would include general species recovery goals and acceptable species survey protocols and mitigation. The Services, federal action agencies, and project sponsors would be required to use the interim guidance in making effect determinations and in determining appropriate measures to avoid, minimize, and mitigate for impacts to the species. The interim guidance would remain in effect until the full recovery plan is developed and approved.

ISSUE 8-21: Provide a Framework for Exempting Projects with Minor Effects

- *Issue:* Section 7 of the ESA requires consultation for all federal actions with the potential to affect threatened and endangered species, and Section 10 of the ESA prohibits the taking (including incidental taking) of endangered species without a permit or incidental take authorization provided through Section 7 consultation. The existing statute and regulations do allow for exemptions or categorical determinations to be made for routine projects with minor impacts. By contrast, such flexibility is provided under other environmental laws - for example, Categorical Exclusions under NEPA and findings of *de minimis* impact under Section 4(f). Similar flexibility can be achieved through Programmatic Agreements under the ESA, but the negotiation of PAs is a lengthy process and where PAs exist, they often do not cover all of the species affected by a particular project.

- *Recommendation:* Amend 16 USC 1536 to require the Services to establish activities-based exemptions from the ESA, which would avoid the need for Section 7 consultation and incidental-take permits for specific types of routine activities, such as road maintenance projects. The availability of such exemptions could be limited to projects carried out by public agencies, such as state DOTs, where the state has committed to participate in ecosystem-scale efforts to protect and promote recovery of listed and other sensitive species.

ISSUE 8-22: Allow Project Sponsors to Serve as “Non-Federal Representatives” in Formal Consultation

- *Issue:* Section 7 of the ESA allows a “designated non-federal representative,” typically the project applicant, to “conduct informal consultation and/or to prepare any biological assessment” on behalf of the federal action agency. See 50 CFR 203.02 and 402.08. This designation allows a project applicant, such as a state DOT, to initiate the Section 7 consultation process and perform much of the work that would otherwise need to be conducted by the federal action agency, such as FHWA. Under current regulations, the designated non-federal representative’s role is limited to informal consultation. This constraint creates inefficiencies with no offsetting benefits. Federal agencies should have the flexibility to designate a non-federal representative to serve during both informal and formal consultation.
- *Recommendation:* Direct the Services to amend the Section 7 regulations to allow a “designated non-federal representative” to act on behalf of the federal action agency during both informal and formal consultation. This change would promote streamlining by ensuring continuity in agency relationships throughout the consultation process rather than forcing a mid-course change when the process transitions from informal to formal consultation. It would also avoid bottlenecks that can occur when the federal agency’s staff resources are limited, or where officials with necessary expertise are not located in the project area. This change would not alter the Services’ role; it would simply allow a project applicant to consult directly with the Service in all stages of consultation rather than force the federal action agency to serve as an intermediary.

CROSS-REFERENCE OF RELATED ISSUES IN OTHER WHITE PAPERS

- ISSUE 3-1: Increase Federal Funding
- ISSUE 4-5: Improve Buy America Requirements
- ISSUE 6-1: Do Not Increase Any Regulatory Burdens Related to Planning but Rather Look for Opportunities to Reduce Burdens and Unnecessary Requirements While Maintaining a Thorough Planning Process
- ISSUE 6-2: Enhance Flexibility and Avoid Imposing New Administrative Burdens, whether through statute, Rulemakings, or Guidance
- ISSUE 6-4: Fiscal Constraint
- ISSUE 7-2: Right of Way Acquisition from Federal Agencies
- ISSUE 7-3: Right of Way Acquisition Processes
- ISSUE 7-8: Buy America
- ISSUE 7-17: Relocation of Utilities
- ISSUE 7-20: Delegation of Authorization for Right-of-Way Acquisition
- ISSUE 9-6: Redefine “Manufactured Products” Requirement within Buy America Law

9: Research and Innovation

INTRODUCTION AND BACKGROUND

Continuous improvement, fueled by research and innovation, is critical for state Departments of Transportation (DOTs) to provide safe, world-class transportation services to their customers. In October 2013, AASHTO published policy recommendations and passed resolutions specific to the reauthorization effort at that time. Many of those efforts related to research and innovation still apply and are restated in this paper. In addition, the Special Committee on Research and Innovation, with input from the Research Advisory Committee, has approved additional policy recommendations to capture new opportunities for Congress to consider related to research and innovation.

State Planning and Research (SP&R) funding, which is set at two percent of the core Federal Transportation programs allocated to each state by formula, helps states conduct research, disseminate results and encourage implementation of research findings. State DOT Research programs rely on a required 25 percent minimum of SP&R funds to administer their Research, Development, and Technology Transfer (RD&T) activities. SP&R funds support a variety of transportation research needs that improve all modes and enable the transportation community to build safer, longer lasting infrastructure, in less time and for less money. RD&T projects directly contribute to innovative or improved 1) safety, 2) standards, 3) methods, 4) materials, 5) products, 6) programs and 7) services.

The state DOTs need well-managed research programs to make informed decisions and ensure a strong future for the transportation network. This FAST Act reauthorization should provide the funding and institutional framework to support the success of these programs.

SPECIFIC POLICY ISSUES AND RECOMMENDATIONS

ISSUE 9-1: Increase Research, Technology & Education Program Funding Levels

- *Current Federal Policy:* FY 2018 funding request for the Federal Research, Technology & Education Program (RT&E) was \$418 million which is the same amount requested for FY 2017 and is a slight increase from FFY16's \$415 million. The program is anticipated to remain constant for FY 2019 as well, essentially representing a reduction in overall program funding due inflation and other cost increases. *23 U.S.C 505(b)(1) Minimum Expenditures on Research, Development, and Technology Transfer Activities* establishes funding for state research programs, separately from the above mentioned federally managed RT&E funded programs, by mandating a minimum of 25 percent of each state's SP&R funding be dedicated to their respective research programs.
- *Issue:* The FAST Act reduced the flexibility of MAP-21 funding by designating three new efforts to be funded from several federal research funding sources, including Highway Research and Development (R&D) funds, the Technology and Innovation Deployment Program (TIDP), and/or the Intelligent Transportation Systems Research program. These efforts include:
 - A competitive grant program to deploy advanced transportation and congestion management technologies (\$60 million per year) which is a competitive grant program open to local agencies and research institutions;
 - Competitive grants to states to demonstrate user-fee-based alternative revenue mechanisms to ensure the long-term solvency of the Highway Trust Fund (STISFA \$15 million in FY 2016, \$20 million per year thereafter); and

- A study by the Transportation Research Board on needed upgrades and repairs to the Interstate Highway System to meet the demands of the next 50 years (up to \$5 million for FY2016).

In addition, USDOT is authorized to use up to \$10 million per year to develop, use, and maintain data sets and data analysis tools to assist state and Metropolitan Planning Organization performance management activities. (This was requested in the GROW AMERICA legislative proposal from the Obama Administration, but was not intended to be funded from R&D.)

Because these new activities are mandated in the research title of the FAST Act without a commensurate increase in the overall funding, funding for existing federal research programs have effectively been reduced. After accounting for the three research funding emphasis areas newly specified by Congress, the FAST Act reduces the level of discretionary funding in the R&D, TIDP, and ITS programs by approximately 25 percent, or from about \$292.5 million per year to about \$232.5 million per year.

Assuming the project on advanced transportation and congestion management technologies, \$678 million per year (including inflation projected) is necessary for state DOTs to participate in research and advancing technology solutions to support and improve the transportation system at state and local levels. This assumes only ATCMTD listed above is continued. If the other two sub-allocated programs are reauthorized, then additional funding would be needed to administer these programs.

If the national formula funding were to change in the future, the impacted SP&R funds would need to be accounted for in another way in order to maintain the overall minimum amount of \$678 million necessary for the RT&E program.

- *Recommendations:*
 - Maintain the State Planning and Research program in its current, formula-based configuration and continue the 25 percent set-aside for research, development, and technology transfer activities in order for state DOTs to continue their commitments to research and implementation of innovative transportation technologies and processes in across the country.
 - To maintain the current level of effort for federal RT&E programs, a budget level consistent with the current proportioning of funding is requested. Specifically, to account for inflation, reduced program flexibility, and increased project delivery costs since FY2016, a minimum budget of \$678 million per year for RT&E is requested.

ISSUE 9-2: Allow Highway Safety Improvement Program Funds to be used for Safety Related Research Activities

- *Current Federal Policy:* 23 U.S.C Section 148 Highway Safety Improvement Program (a)(4)(B)-Inclusions
- *Issue:* During the FAST Act authorization process, the previous terminology in the above mentioned section was changed from "The term "highway safety improvement project" includes but is not limited to the following..." to "The term "highway safety improvement project" only includes a project for 1 or more of the following:" This has limited state DOTs from carrying out non-infrastructure projects that are within their state's Strategic Highway Safety Plan such as education, enforcement, and evaluation.
- *Recommendations:* Reinstate the MAP-21 language for the sub section above to again allow Highway Safety Improvement Program funded safety projects to include education, enforcement, and research activities. This will better allow DOTs to carry out state Strategic Highway Safety Plans with their respective safety offices and local and state enforcement agencies.

ISSUE 9-3: Allow States to Use Non-SP&R Federal Funding when Contributing to Multi-State Pooled Fund Research Studies

- *Current Federal Policy:* The FAST Act authorizes a single amount for each year for all apportioned highway programs combined. That amount is apportioned among the states, and each state's apportionment is then divided among the individual apportioned programs. Each program has transferability provisions that are statutorily set and the majority of them require state funding matches.
- *Issue:* AASHTO supports flexibility for states to transfer federal program funding among the different highway programs as it allows states to best meet their needs, which is especially important when overall funding is insufficient. Currently state DOTs can use SP&R funds (100 percent federal with no state match) for pooled fund studies which are a quarter of each state's 2 percent SP&R funding allocation. For smaller states, increased flexibility to use other federal fund sources at 100 percent for pooled funds would strengthen the program and allow more states to participate in pooled fund studies.

Several examples include: 1) Transfer construction funding for an innovative pavement construction pooled fund study and 2) Use Congestion Mitigation and Air Quality funding to contribute to a pooled fund study on connected and autonomous vehicles.

- *Recommendation:* AASHTO recommends legislation that allows states to use non-SPR apportioned federal highway funds for multi-state pooled fund studies (research) without requiring state match. This modest incentive could strengthen research on topics that are important to the nation's infrastructure needs, as evidenced by multi-state support.

ISSUE 9-4: Support for Associated National Research Programs

- *Current Federal Policy:* To maximize the effectiveness of state DOTs' R&T activities, the FHWA carries out or funds a host of activities necessary to support a vibrant nationwide R&T program including research administration, communication, coordination, conferences, and partnerships with other national and international organizations.
- *Issue:* Throughout its history, a core element of the FHWA RD&T's mission has been to promote innovation and improvement in the American highway system. Over the last decades, this critical mission element has developed into a broad array of research and technology activities covering the spectrum of advanced research, applied research, technology transfer, and implementation.
- *Recommendations:* AASHTO recommends USDOT has sufficient, flexible funding to carry out its core support programs beyond the amount prescribed for the federally managed RT&E programs and state SP&R funding. Currently these programs include: 1) Exploratory Advanced Research Program, 2) Every Day Counts, 3) University Transportation Centers, 4) U.S. Secretary of Transportation's Office of Research and Technology, and 5) National Highway Traffic Safety Administration. In addition, AASHTO supports reinstating the National Cooperative Freight Research Program, and continuation of the Transit Cooperative Research Program and the Behavioral Traffic Safety Cooperative Research program with funding beyond the amount prescribed for the federally managed RT&E programs and state SP&R funded programs. Lastly, AASHTO supports federal training, data, and knowledge management programs including Local/Rural Transportation Assistance Programs, National Highway Institute, and the National Transportation Library that should all be funded at levels adequate to meet the needs of state DOTs.

ISSUE 9-5: Recommend Third Strategic Transportation Research Program

- *Current Federal Policy:* The Strategic Highway Research Program (SHRP) and SHRP2 were widely supported national research efforts with no future Strategic Transportation Research program mandated going forward.
- *Issue:* Since the early 1980s, Congress has mandated two national studies of strategic highway transportation research needs. The original SHRP was initiated in response to a 1986 TRB Special Report titled *America's Highways: Accelerating the Search for Innovation*. This five-year \$150 million program focused on highway infrastructure needs for better materials and asphalt mixes, longer life pavements, cost-effective maintenance procedures, and chemical control of snow and ice on highways. This program has a major positive impact on our ability to construct and preserve the nation's roadway infrastructure.

In 2001, TRB once again responded to a Congressional mandate and published *Strategic Highway Research – Saving Lives, Reducing Congestion, and Improving Quality of Life*. The resulting SHRP2 looked at cost-effective ways to preserve infrastructure but ventured more into operational changes that would provide safer roads with adequate capacity and reliable travel times. Resulting products from SHRP2 included: cost-effective bridge designs for faster, longer lasting replacement; pavement preservation techniques for high-traffic roadways; methods to improve operations and extend highway capacity; innovative strategies for managing large, complex projects; behavioral studies for safer transportation facilities; and training for fast, multi-agency incident response. A large-scale implementation effort ensured that the state DOTs would benefit from these research results.

In 2018, as technology is rapidly changing and impacting transportation more than ever, it is time to take the next step forward and address the major issues that are affecting the transportation system today in order to adapt and fully integrate technology and innovation into the transportation network. Potential focus areas include: advancing connected and autonomous technologies; incorporating safety related technologies; addressing infrastructure resiliency; and meeting the needs of multi-modal connectivity.

- *Recommendations:* AASHTO recommends Congress allocate \$1 million for scoping a third Strategic Transportation Research Program.

ISSUE 9-6: Redefine “Manufactured Products” Requirement within Buy America Law

- *Current Federal Policy:* 23 USC Section 313 Buy America (1/1/2014); 23 CFR Section 635.410 (4/1/2013)
- *Issue:* The intent of the Buy America Act is to support and encourage the nation's materials and manufacturing industries, to promote quality materials being used in construction of public infrastructure, and to allow for consistent review of associated materials and costs nationwide. However, the requirement has had the unforeseen consequence of limiting DOTs' abilities to carry out innovative research and testing of preassembled products or equipment not readily available within the United States. The waiver process outlined in the above law and regulation is an impractical burden for the DOTs to carry out and has resulted in less innovative product testing and research.

On April 17, 2018 FHWA granted a Buy America Waiver for 955 vehicles and equipment for 151 state DOT projects requested in 2016. In that waiver, the Agency acknowledged that “...FHWA is aware that in today's global industry, vehicles are assembled with iron and steel components manufactured all over the world. The Agency also understands the difficulty of identifying vehicles that have 100 percent components made in the U.S.” This same finding could be said for assembled specialty items in the research and laboratory equipment industry.

- *Recommendations:*
 - USDOT should improve the Buy America definition, waiver application, exceptions, policies, and processes to ensure timely consideration and consistent application of the law across the country to reduce costs to state transportation projects.
 - Implement the exceptions to Buy America previously proposed by FHWA in Federal rule making, and streamline the waiver process to ensure transportation projects are progressing without significant delays.
 - Implement an exemption from Buy America requirement for research related equipment and materials for transportation research projects.

CROSS-REFERENCE OF RELATED ISSUES IN OTHER WHITE PAPERS

- ISSUE 1-1: Deploying CAV Technologies in the Safest Manner Possible is Paramount
- ISSUE 1-2: The Future of Transportation Includes Connected and Automated Vehicles
- ISSUE 3-1: Increase Federal Funding
- ISSUE 3-2: Fix the Federal Highway Trust Fund (HTF) and Strengthen Federal Transportation Funding
- ISSUE 3-6: Increase flexibility and transferability of funding
- ISSUE 4-5: Improve Buy America Requirements
- ISSUE 7-8: Buy America
- ISSUE 8-8: Allow Utility Relocations to Start Earlier
- ISSUE 10-1: Non-infrastructure Eligibilities under the Highway Safety Improvement Program

10: Safety

INTRODUCTION AND BACKGROUND

To make the most significant reductions in traffic fatalities and serious injuries, states combine efforts from multiple safety disciplines to implement the most effective countermeasure in the most efficient manner. This involves combining resources (such as funding and data) from various agencies with a role in traffic safety, including infrastructure, law enforcement, public education, emergency medical services, and public health. Reauthorization of the FAST Act should allow for sharing and combining resources to allow states the flexibility to address their safety.

SPECIFIC POLICY ISSUES AND RECOMMENDATIONS

ISSUE 10-1: Non-infrastructure Eligibilities under the Highway Safety Improvement Program

- *Current Federal Policy:* Highway Safety Improvement Program funds are restricted to use on specific activities and cannot be used for education, enforcement, safety research, or emergency medical service safety programs.
- *Issue:* The FAST Act (section 1113) amended 23 USC 148 to revise the definitions of what is a Highway Safety Improvement Project. The change effectively restricts HSIP eligibility to only 28 strategies, activities or projects listed in the legislation, eliminating the ability to use HSIP funds for public awareness and education efforts, infrastructure and infrastructure-related equipment to support emergency services, and enforcement of traffic safety laws that are identified in the states' Strategic Highway Safety Plans. SAFETEA-LU and MAP-21 had provided the flexibility to deploy additional enforcement to problem areas and help reverse a trend of increasing crashes on specific highway segments. The changes are inconsistent with the intent of a state's Strategic Highway Safety Plan (SHSP) which is a multidisciplinary approach to reducing highway fatalities and serious injuries on all public roads. The lack of flexibility in safety project selection in the HSIP program, particularly non-infrastructure related activities, stifles innovative safety improvements that lead to crash reductions and reduced highway fatalities.
- *Recommendations:* Restore flexibility for states to use a portion of HSIP funds for non-infrastructure safety programs and for safety research.

ISSUE 10-2: DATA PROTECTION

- *Current Federal Policy:* 23 USC 409 does not explicitly protect safety partner agencies from discovery when coordinating with the state DOT to analyze and report safety data.
- *Issue:* Under changes outlined by MAP-21 and FAST Act for US 23 148, state highway agencies are required to work with other state and regional safety agencies and organizations in the development of the Strategic Highway Safety Plans, Highway Safety Improvement Programs, and safety performance targets. This differs from the past. The entities include, but are not limited to Highway Safety Offices, transit agencies, partner safety organizations (e.g., health data and safety data linkages) and Metropolitan Planning Organizations. To adequately perform analyses and identify and prioritize safety improvements, data from multiple disciplines, including public health, must be incorporated. 23 USC 409 does not currently provide protection from discovery for the agencies that state DOTs will collaborate with. It is assumed the privilege does already exist, but without specific language in the code or guidance from FHWA, state DOTs' ability to collaborate on

analyzing and reporting safety data as openly as possible among the numerous safety partners will be limited. Similarly, this issue exists with data used for public transportation agency safety plans.

- **Recommendations:** Explicitly protect partner agencies' data from discovery when used for safety analysis, reporting, and implementation of safety programs. The intent of this proposed clarification is not to limit availability of data to the general public. Suggested wording:

Notwithstanding any other provision of law, reports, surveys, schedules, lists, or data compiled or collected for the purpose of identifying, evaluating, ~~or~~ planning or reporting the safety enhancement of potential accident sites, hazardous roadway conditions, or railway-highway crossings, pursuant to sections 130, 134, 135, 144, and 148 of this title or for the purpose of developing any Strategic Highway Safety Plan, Highway Safety Improvement Program or highway safety construction improvement project which may be implemented utilizing Federal-aid highway funds shall not be subject to discovery or admitted into evidence in a Federal or State court proceeding or considered for other purposes in any action for damages arising from any occurrence at a location mentioned or addressed in such reports, surveys, schedules, lists, or data. This bar to discovery and admissibility shall apply even if such information was originally created or held by an entity for some other purpose.

ISSUE 10-3: Opportunity to Take Corrective Action

- **Current Federal Policy:** Financial penalties for noncompliance with federal requirements are imposed without an opportunity for states to enact legislation that corrects the issue.
- **Issue:** Injuries and fatalities associated with driving under the influence continues to be a serious concern, which is why states continue to strengthen state laws and policies to effectively address impaired driving. Failure to adhere to those specific federal requirements can result in a significant financial penalty against the state highway program. Due to the complexity of federal laws and regulations, coupled with the nuances associated with state laws, states can inadvertently fall out of compliance with federal requirements. Administration of current federal regulations neither provides states with informed advanced notification, nor an opportunity to take corrective action prior to imposition of financial penalties. As a result, states may not be aware of compliance issues and are unable to take corrective action before penalties are applied.
- **Recommendations:** Provide states with a reasonable opportunity to take corrective action to bring themselves back in compliance with federal impaired driving requirements prior to the imposition of financial penalties to the state highway program.

CROSS-REFERENCE OF RELATED ISSUES IN OTHER WHITE PAPERS

- ISSUE 1-1: Deploying CAV Technologies in the Safest Manner Possible is Paramount
- ISSUE 2-2: Privacy, Security, Cyber Security
- ISSUE 3-1: Increase Federal Funding
- ISSUE 3-6: Increase flexibility and transferability of funding
- ISSUE 9-2: Allow Highway Safety Improvement Program Funds to be used for Safety Related Research Activities

11: Transportation System Security and Resilience

INTRODUCTION AND BACKGROUND

Many state Departments of Transportation (DOTs) have faced significant disruptions to transportation system performance over the past five years for a variety of reasons. Flooding, extreme heat, wildfires, cyberattacks, critical infrastructure failure, coastal erosion, and storm surge are just some of the hazards state DOTs have had to respond to along with many of their partners. A focus on system disruptions, the ability of the transportation system to anticipate and respond to such disruptions, and the subsequent consequences to transportation system performance and to a state and its communities are primarily perceived as system resilience and security concerns. Many different components of a resilience and security strategy can influence overall effectiveness and success, including 1) anticipating potential threats through a data-based analysis process as part of a planning process, 2) analyzing different mitigation and response strategies, 3) establishing collaborative partnerships with many different stakeholders, 4) implementing infrastructure design, construction and other actions selected for mitigation/response, and 5) implementing communications strategies to support resilience planning and design and to convey information to system users before and during a disruption. Viewing system security and resilience from a broad perspective, that is, from how system disruptions can be considered and prepared for in all state DOT functions, is a critical foundation for making the transportation system more resilient.

The Committee on Transportation System Security and Resilience (TSSR) is charged with identifying specific policy issues and recommendations related to security and resilience. This white paper recommends policies for consideration by AASHTO and the Transportation Policy Forum.

The Fixing America's Surface Transportation (FAST) Act, signed into law on December 4, 2015, included several requirements that reflected this concern for resilience and security:

- New requirements were created for the statewide and metropolitan transportation planning processes to consider projects/strategies to improve the resilience and reliability of the transportation system (security had been added in previous legislation).
- The Nationally Significant Freight and Highway Projects (NSFHP) program was established to support nationally and regionally significant freight and highway projects that achieve a range of program goals including improving the reliability of the movement of freight and people; and enhancing the resiliency of critical highway infrastructure.
- Section 1432 placed limitations on the reconstruction of damaged facilities in the same location, and with the same capacity (as measured in anticipated traffic volumes), dimensions, and design, as it had before a declared emergency (Section 1432 applies to the reconstruction of roads, highways, railways, bridges and transit facilities that are either operational or under construction and are damaged by an incident resulting in one of the following: 1) an emergency declaration by the Governor of the State, with the concurrence of the Secretary of Homeland Security, or 2) an emergency or major disaster declaration by the President). Reconstruction activities covered by Section 1432 may not change the function or character, or extend beyond the footprint of the damaged facility. However, the reconstruction may include resiliency or hazard mitigation measures, as well as upgrades to codes and standards, as long as the reconstruction occurs within the existing right-of-way and in a manner that substantially conforms to the preexisting design, function and location.

- With respect to asset management,
 - MAP-21 codified in 23 U.S.C. 119 a requirement for state DOTs to develop and implement a risk-based Transportation Asset Management Plan (TAMP). Risks were considered anything that affects the condition of National Highway System (NHS) pavements and bridges and the performance of the NHS, including risks associated with current and future environmental conditions (such as extreme weather events, climate change, and seismic activity), financial risks (such as budget uncertainty), operational risks (such as asset failure), and strategic risks (such as environmental compliance) (23 CFR Part 515).
 - TAMP investment strategies were to collectively make or support progress toward, among other issues, achieving and sustaining a desired State of Good Repair over the life cycle of the assets.
 - "Critical infrastructure" was added to the considerations that a state may include in its asset management plan.
 - State DOTs were required to conduct periodic evaluations to determine if reasonable alternatives existed to roads, highways, or bridges that repeatedly require repair and reconstruction activities
- All prior National Highway Performance Program (NHPP) eligibilities were continued, and four new eligible categories were added, including one for projects that reduce the risk of failure of critical NHS infrastructure (defined as a facility where an incapacity or failure would have a debilitating impact in certain specified areas).

SPECIFIC POLICY ISSUES AND RECOMMENDATIONS

ISSUE 11-1: National Transportation System Security and Resilience Plan

- *Current Federal Policy:* None
- *Issue:* Federal legislation has required the development of a National Freight Plan, a National Aviation Plan and a Critical Infrastructure Protection Plan, but no national plan exists for transportation system security or resilience. The intent of such a plan would be to identify the risks to the nation's transportation system from a range of sources, the types of physical, operational, institutional and technology strategies that might be considered by national and state transportation agencies, the effect of those strategies on improving the efficiency and effectiveness of the transportation system, and recommendations on how such strategies can be funded. Note that the Cyber Security Strategy described in Issue #7 below could be subsumed in this effort. Of interest, such an effort was conducted prior to 9/11 where a National Academies panel was empowered to examine potential terrorist attacks against the nation's surface transportation system. This effort needs to be updated with a publicly available plan (it is assumed that such plans exist but are not available for public consumption).
- *Recommendations:* USDOT, DHS and other relevant agencies should be directed, in collaboration with states, transportation system operators, local jurisdictions and users of the transportation system, to develop a National Transportation System Security and Resilience Plan. This plan should identify the major natural and human-caused threats to transportation system performance; the limitations current laws and rules impose on addressing security and resilience; the institutional structure for planning and designing for, responding to and recovering from disruptions; proposed analysis methods that could be used by transportation agencies to assess vulnerabilities and risks; and the types of strategies to enhance system resilience. The Plan would not impose requirements upon states or authorize any federal official to impose requirements upon states, but would be available to state DOTs for their consideration as they implement federal transportation planning statutes and rules.

ISSUE 11-2: Promote All-Hazards Risk and Resilience Analysis for Critical Facilities

- *Current Federal Policy:* There is no current law, regulation or policy relating to the use of an all-hazards risk and resilience analysis approach for critical assets.
- *Issue:* FAST required states to examine whether feasible alternatives exist for those locations where repeat reconstruction and repairs often occur, but no action was required to improve those locations where problems exist. FHWA and FTA pilot studies over the past five years has illustrated different approaches that can be used for examining the vulnerability of transportation assets to extreme weather hazards. The frequency of major system disruptions due to a variety of reasons has increased in recent years, and it seems likely that states will face increasing pressures in anticipating and responding effectively to such disruptions in the future.
- *Recommendations:* States should be encouraged to conduct all-hazards risk and resilience analysis on critical transportation systems and networks (to be defined with criteria), which should include discrete assets and facilities such as communications networks and ITS systems. This analysis should incorporate considerations of risk and consequences within the federal approach of supporting transportation infrastructure, service continuity, and efficiency. Pilot studies should be funded that illustrate this approach as part of a state DOT's asset management program.

ISSUE 11-3: Modify Emergency Relief (ER) Program to be More Flexible and More Responsive to System Resilience Needs

- *Current Federal Policy:* Current law and regulations provide ER funds for declared emergencies; states take action and federal monies are used to reimburse the costs.
- *Issue:* Responding to and recovering from a major disruption is a critical component of an effective system resilience strategy. Current procedures require unnecessarily lengthy and inefficient administrative burdens on states, with reimbursement of ER funds typically taking two to three years. System disruptions are increasing and it is important for the ER program to be structured and administered as efficiently as possible.
- *Recommendations:*
 - Conduct a comprehensive assessment of the ER program to identify where improvements can be made to: 1) allow advance planning for ER project implementation to include a range of project strategies, 2) efficiently administer program funds, and 3) return the system to functional operation as quickly as possible and provide opportunities to incorporate resilience strategies into project design.
 - Allow ER projects to include actions that increase the resilience of the replacement project to future hazards. Allow ER funds to be used for actions outside of the right-of-way and/or for other strategies that improve the resilience of the damaged asset and/or facility.
 - Allow more flexibility with contract requirements and NEPA review as part of the ER program. For example, emergency projects should receive expedited clearances or waivers for environmental, right-of-way, and railroad certifications in order to recover from a disruption.
 - Allow DOTs to change order all required federal requirements into a previously-let, state-funded project that did not contain the federal provisions. Requiring a new letting for emergency projects often delays emergency repairs, while expecting states to include federal requirements in state-funded projects is unrealistic.

ISSUE 11-4: Provide More Flexibility in Use of Federal Funds for Preventive and Response Actions to System Disruptions

- *Current Federal Policy:* Current law and USDOT regulations have very specific eligibility requirements for different federal funding programs. In some cases, these requirements inhibit states from taking preventive actions with these funds that provide benefits to the states of reducing the risks of future disruptions. For example, Highway Safety Improvement Program (HSIP) funds are constrained in terms of what they can be used for.
- *Issue:* This issue can be considered a general concern for many federal transportation programs. In particular, there is a need to streamline the use of HSIP funds to allow for enhanced resilience actions.
- *Recommendations:* Expand eligibility of HSIP projects to include actions to improve system resilience while also enhancing safety.

ISSUE 11-5: Foster Collaboration in Preparing for System Disruptions

- *Current Federal Policy:* There is no current law or regulation that requires collaboration and coordination in preparing for, responding to and recovering from system disruptions.
- *Issue:* Experience with system disruptions has shown that the most effective preparation for, response to and recovery from includes very high levels of collaboration and coordination among many different agencies and groups. This coordination can be very challenging, especially when multiple states are involved in responding to a widespread disruption. Although emergency response agencies have an established collaboration and coordination framework for responding to major disruptions, nothing similar exists for collaborative planning efforts on the part of transportation system providers.
- *Recommendations:* The federal government should conduct a study and support pilot studies of collaborative system security and resilience planning efforts. The intent is to recommend alternative institutional structures for anticipating system disruptions that can then be linked to emergency response efforts.

ISSUE 11-6: Reaffirm Security and Resilience as Factors in Statewide and Metropolitan Transportation Planning Processes

- *Current Federal Policy:* Current law and USDOT regulations require the consideration of both security and resilience as part of the transportation planning process.
- *Issue:* System resilience and security will continue to be an important influence on transportation system performance, most likely increasing in importance. Although most concern in transportation has been in efficient response to disruptions, there is an important opportunity for considering resilience and security issues in the planning process (e.g., conducting systematic risk assessments)
- *Recommendations:*
 - The security and resilience planning factors should be retained as part of federal law. While states are fulfilling their obligations under the planning statutes, USDOT is encouraged to hold webinars or other activities to facilitate sharing of information by states of how they consider these two factors in the planning process.
 - USDOT should be instructed to fund pilot studies on how security and resilience-related performance measures can be used to support performance-based transportation decision making.

ISSUE 11-7: Promote Cyber Security Strategies

- *Current Federal Policy:* There is no current law or regulation targeting the protection of vital transportation command and control information technology systems.
- *Issue:* Transportation systems are increasingly relying on sophisticated information technology systems to control operations and provide information to system users. Over the past 10 years, transportation systems have been the #1 target of terrorists worldwide, with increasingly more attacks occurring on system operations capabilities. Cyberattacks will likely be one of the major means of disrupting transportation systems in the nation in future years, but there is no consistent approach, institutional infrastructure or standards directing effective protection of system operations control assets.
- *Recommendations*
 - USDOT should be directed in collaboration with DHS and other relevant agencies to develop a National Transportation Cyber Security Strategy, building on the September 2018 National Cyber Strategy, which establishes suggested practices for protecting the nation's transportation cyber assets. Oversight might take the form of a National Commission or a National Academy of Sciences Committee.
 - Targeted federal funding should be provided from the General Fund of the Treasury of the Department of Homeland Security or, failing that, from the Department of Transportation, to protect vital national transportation command and control information technology resources. These important security needs should be supported by security agencies, not from transportation accounts that do not have funding sufficient to meet needs.

CROSS-REFERENCE OF RELATED ISSUES IN OTHER WHITE PAPERS

- ISSUE 1-1: Deploying CAV Technologies in the Safest Manner Possible is Paramount
- ISSUE 2-2: Privacy, Security, Cyber Security
- ISSUE 3-1: Increase Federal Funding
- ISSUE 3-3: Increase flexibility and transferability of funding
- ISSUE 3-10: Reduce and Simplify Regulations, Requirements, Data Collections, and Process to Expedite the Process
- ISSUE 7-5: Emergency Relief (ER) Program
- ISSUE 7-15: Coordination with Railroads

Senator BARRASSO. Director McKenna, in the last Congress we heard from a number of State Departments of Transportation that the Department of Transportation's non-environmental requirements could be reduced in ways that would give States more flexibility, empower States to focus on priority tasks, and accelerate projects.

One idea is to make stewardship and oversight agreements more standardized and less proscriptive, and more efficient. These agreements are often too complex and can add burdensome requirements in Federal approvals that are not required by statute.

Do you see opportunities for these agreements to be simplified and for the Federal Government to be more flexible?

Mr. MCKENNA. Mr. Chairman, thank you for the question.

Yes, we do, particularly in those areas where some of the requirements when we talk about the State standard specifications, when we talk about pavement design policy, value engineering policy and a number of those other areas, there are, in many of the stewardship and oversight agreements, requirements that those be preapproved, those State policies be preapproved although that is not a statutory requirement.

We do think there are some good commonsense areas to further that discussion, to narrow it and make more programmatic the agreements.

Senator BARRASSO. As you also know, Congress often has difficulty reauthorizing Federal transportation legislation on time, often requiring repeated short-term extensions to the program. Could you talk a bit about what happens to your projects if we do not enact a long-term reauthorization bill before it expires next year and instead just do short extensions?

Mr. MCKENNA. Very specifically, when I joined the Missouri Department of Transportation, it was just at passage of the FAST Act. Prior to that, there had literally been a halt on new projects. Because of that short-term funding scenario, the State stopped taking financial risk, risk on reimbursement of the Federal program.

It very much narrowed the types of projects we were working on. That was a great harm, I think, to the State. As it stands for what we are projecting right now, we very specifically already seeing in 2021 \$330 million of project risk in our current capital plan we have already committed to. Our communities are getting really concerned about that.

Further, we try to do a 5-year capital program. When we do not have the Federal certainty, we cannot commit to those projects. We are running with our metropolitan planning organizations and our regional planning commissions throughout the State. We are actually running two capital programs in the event that the Federal Government, that Congress does not act to bolster that Highway Trust Fund and provide funding certainty. That will literally take 35 to 40 percent of our capital program right off the books.

Senator BARRASSO. Mr. Demetriou, a final question. Could you give us your thoughts on how the lack of certainty caused by the absence of long-term Federal highway funding impacts the private sector?

Mr. DEMETRIOU. I think it is a major issue if we do not get the long term, six-plus year type funding. At the end of the day, busi-

nesses all have a long-term strategy. We all have our funding that is laid out for the next several years. Unless we have long term certainty around infrastructure improvement, enhancements and innovation, then we are not going to make decisions to invest in expansion or growth in our own businesses.

I think it is critical and I think it is a global competitive situation for the United States because most of us are global companies. We are trying to figure out where to put our assets. Everything is set up here to do it in the United States except for the infrastructure equation that needs to get solved.

Senator BARRASSO. I appreciate the three of you being here and for your excellent testimony. There are some members who might want to submit some written questions so I ask that you respond. We will keep the record open for 2 weeks.

I think all the members want to thank you and I want to thank all members who attended today. I think our esteemed guests really did an excellent job bringing home the points, Senator Carper, that we have been looking at, the time and crucial discussions regarding our Nation's surface transportation needs.

Thank you so very much.

Senator CARPER. Before we adjourn, I have one question I wanted to ask Mr. McKenna about a freight enhancement program you all have in Missouri that my staff tells me has been quite successful in making meaningful and targeted investments in transfer points within the supply chain.

Can you take a minute and tell us about that?

Mr. MCKENNA. Thank you, Senator.

Yes, we have small general revenue that comes through our legislature. We put it in freight enhancement. It enables us to target very specific work. In many cases, we have been able to do rail spurs at our ports. Those are very important considerations when we consider the multimodal, the trans-loading needs for the agricultural economy in the State of Missouri.

We work with our regional partners and our freight advisory committees to determine what those project priorities are and how to apply those funds. It has been very successful. We are really pleased with it and hope to be able to continue it.

Senator CARPER. Thanks for sharing that.

Thank you all. It has been delightful and informative. I would like to bring you back next week but we probably could not do that.

Mr. Chairman, I would ask unanimous consent to submit a letter to the record from nine environmental organizations strongly opposing any tax and integrity of environmental laws and any attempts to limit the ability of ordinary citizens access to the courts or limit consideration of environmental, economic and social justice impacts on public projects in any infrastructure bill considered by this Congress.

Thank you.

Senator BARRASSO. Without objection.

[The referenced information follows:]

March 6, 2019

Chairman Barrasso and Ranking Member Carper
Senate Environment and Public Works Committee
410 Dirksen Senate Office Building
Washington, DC 20510

RE: Letter for the Record for the Hearing on “The Economic Benefits of Highway Infrastructure Development and Accelerated Project Delivery”

Dear Senator:

On behalf of our millions of supporters, we ask that you strongly oppose any attacks on the integrity of our environmental laws, any attempts to limit the ability of ordinary citizens’ access to the courts, or limit consideration of environmental, economic and social justice impacts of public projects in any infrastructure bill considered by this Congress.

The American Society of Civil Engineer’s most recent report card currently rates the U.S. infrastructure overall at a D+ level.¹ Our drinking water systems, mass transit, and public parks all receive inadequate funding and are in need of urgent repair. More broadly, our infrastructure needs to be greened and modernized to insure it is sustainable and resilient to address the threat of climate change. Undermining public safeguards will not help the United States make the right choices about what infrastructure projects to invest in, but weakening our environmental laws will make it harder to ensure that taxpayers and citizens benefit fully and are not harmed from the infrastructure that is built.

Efforts to rollback the National Environmental Policy Act (NEPA), the Endangered Species Act (ESA), environmental justice, and citizen access to the courts are cynical, counterproductive and harmful. These critical safeguards provide crucial government oversight and help to produce better project outcomes, ensure that taxpayers’ money are used wisely, avoid conflict and corruption, and prevent significant harms and injustices that occur when federal agencies cut corners in approving large projects. The situation of massive lead contamination of public drinking water in Flint, Michigan is emblematic of the infrastructure challenges our nation faces. And as with most infrastructure concerns the issue is lack of funding. The city needs funding to address its lead-contaminated water system. Attacking regulatory safeguards is a harmful distraction that does not help the people of Flint. If anything, such rollbacks are likely to lead to more situations like the one in Flint in the future. Undermining our safeguards is akin to putting our “head in the sand.” And it puts at risk the well-being of ordinary people across the country. In short, we need to oppose these attacks because our safeguards matter.

The National Environmental Policy Act Saves Lives and Taxpayer Funds

Large scale infrastructure projects approved without adequate review and oversight often lead to the waste of millions of dollars, undermine entire communities, and harm the public health and environment. The National Environmental Policy Act, or NEPA, acknowledges that while industry may profit from a federal project, it is the public that must live with its consequences.

¹ American Society of Civil Engineers, 2017. Infrastructure Report Card, available at: <https://www.infrastructurereportcard.org/wp-content/uploads/2016/10/2017-Infrastructure-Report-Card.pdf>

NEPA is the backstop that provides the public with the information, the analysis, and the forum to address projects that may not represent wise investments.

Without NEPA, for example, no one would have discovered that a vehicle battery manufacturing facility construction project in Michigan was going to contaminate the air at a nearby day-care. The project would have disturbed soil that had already been contaminated with dioxin, a highly toxic carcinogen that also causes developmental problems in children. Fortunately, the NEPA review process uncovered the problem and provided the opportunity for simple adjustments to the project that protected the children's health while allowing the factory to go forward.²

In 2011, the City of Los Angeles was going to force construction of a railway through a community, upending homes and businesses at an enormous cost to the public. The NEPA review, however, identified an alternative route for the project over derelict pre-existing tracks. The NEPA alternative alleviated significant community opposition to the project and saved taxpayers millions.

Short-cutting the NEPA review process increases the risk of disasters. For example, in 2010 the government approved BP's drilling plan for the Deepwater Horizon project without any environmental review by categorically excluding it from a NEPA analysis.³ This categorical exclusion was premised on an inadequate environmental review that simply ignored the possibility of a catastrophic blowout. The Deepwater Horizon disaster killed eleven people, spilled 4.9 million barrels of oil, bankrupted businesses and sickened clean-up worker exposed to the spill, resulting in billions of dollars in damage that will take decades to restore.

Proposals that weaken NEPA review or curtail public input – and certainly those that waive NEPA outright – would render infrastructure projects more susceptible to waste, fraud and abuse and open the door to shoddy, ill-considered projects that put people at risk and harm the environment.

The Endangered Species Act Saves Wildlife and Facilitates Smarter Infrastructure

Poorly designed infrastructure can cause significant harm to endangered wildlife and plants that Americans overwhelmingly want to protect. The Endangered Species Act (ESA) is our nation's most effective means of protecting wildlife and other species in danger of extinction. The consultation provisions and flexibilities already built into the ESA provide the information, forum, and opportunity to advance smart development projects that include plans for protecting endangered species and the habitats on which they depend.

For example, between 2008 and 2015, the Fish and Wildlife Service conducted over 88,000 consultations under Section 7 of the ESA. In every single case, the Service worked with project proponents and used the ESA's flexibility to provide a pathway for the projects to move forward. In addition, the overwhelming majority of these reviews are completed well within the 135 day deadline required under the law.⁴ And, by ensuring that an infrastructure project is properly designed at the outset, we can prevent projects from causing unintended harm to wildlife and

² See, Department of Energy, Examples of Benefits from the NEPA Process for ARRA Funded Activities (May 2011) at Section D: https://energy.gov/sites/prod/files/2013/09/t2/ARRA_NEPA_Benefits_List_May122100.pdf

³ See, National Commission on BP Deepwater Horizon Oil Spill & Offshore Drilling, Report to the President. Deep Water: The Gulf Oil Disaster and the Future of Offshore Drilling 82 (2011).

⁴ Malcom J. Li Y-W (2015) *Data contradict common perceptions about a controversial provision of the US Endangered Species Act*. Proceedings of the National Academy of Sciences USA 112(52):15844–15849

protect taxpayer's conservation investment at the same time.

Infrastructure legislation that undermines the ESA — by exempting projects from compliance, undermining consultations, or otherwise — would increase the threats to already imperiled species. It also would undermine conservation investments already made and make future efforts more expensive.

Public Access to the Courts is Critical to Ensuring Safe Infrastructure

All of our environmental safeguards are put at risk if they cannot be enforced by the public. Federal agencies are not immune from mistakes and sometimes make rushed decisions that they, and the public, will later regret. Allowing citizens and organizations from across the political spectrum to challenge poorly conceived projects and violations of the law is squarely in the public interest and can prevent waste of taxpayers' funds. Facts show that lawsuits challenging projects are rare, but those that have been filed have exposed boondoggles and blatant violations of the law. They also ensure that the government complies with the law and is accountable to the people.

The prospect of judicial scrutiny also serves as a disincentive to project proponents who might otherwise attempt to defraud agencies or steamroll communities with unsavory projects. Instead, a project's proponents are encouraged to engage communities to resolve conflict before anyone thinks of going to court.

Punitive bonding requirements, forced arbitration, and other efforts to undermine public access to the courts tip the scales and are squarely intended to favor wealthy special interests. Such proposed changes would block or severely undermine the ability of citizens seeking to protect their communities. Barring the courtroom door undermines our system of checks and balances. And, making the courts the exclusive province of wealthy special interests is antithetical to our country's tradition of justice.

Undermining our Safeguards Leads to Greater Social Injustice

The issue of public safeguard rollbacks is a problem for all Americans but acutely so for people of color and other disenfranchised communities. These communities continue to disproportionately suffer from the adverse human health and environmental impacts of infrastructure.⁵ They are consistently exposed to higher levels of air pollution, are more likely to drink from unsafe water systems, and are more likely to be exposed to toxic chemicals. Removing lead from water lines, from cities like Flint and many others, funding lead-paint remediation and cleaning up toxic waste sites are just a few of the infrastructure-related issues that must be addressed to deal with current environmental justice issues.⁶

An infrastructure package needs to enhance, not undermine, environmental justice. It must preserve the responsibility of agencies to disclose project impacts and the public's ability to

⁵ See, e.g., U.S. Department of Justice, 2016 Implementation Progress Report on Environmental Justice at 6, <https://www.justice.gov/file/929616/download>

⁶ See, e.g., Pennsylvania Dept. of Health, 2014, Childhood Lead Surveillance Annual Report, available at: <http://www.health.pa.gov/My%20Health/Infant%20and%20Childrens%20Health/Lead%20Poisoning%20Prevention%20and%20Control/Documents/2014%20Lead%20Surveillance%20Annual%20Report%20r2.pdf> (finding 17 cities in Pennsylvania had a higher percentage of children with blood lead levels (≥ 5 $\mu\text{g}/\text{dL}$) above those in Flint, MI.)

influence those projects; and ensure the right of citizens to full access to the courts to remedy injustices. It must fund projects that meet critical needs. And it must empower people of color and other disenfranchised communities to fight past injustices and prevent future ones caused by taxpayer-funded infrastructure.

Undermining Our Safeguards Can Cause Delay and is Unnecessary

More attacks on safeguards could exacerbate delays while contributing to the safety problems chronic underfunding has already caused. In fact, the misguided obsession with undermining time-tested safeguards has already led to a bottleneck that has contributed to delay. The Department of Transportation's Inspector General has found that numerous delays under the Moving Ahead for Progress in the 21st Century Act (MAP-21) are the result of the additional — and conflicting — safeguard rollbacks mandated in the Fixing America's Surface Transportation Act (FAST Act).⁷ Indeed, the Department of Treasury identified 40 economically significant infrastructure projects and found that “a lack of public funding is by far the most common factor hindering the completion of transportation and water infrastructure projects.”⁸

Furthermore, the success of the American Recovery and Reinvestment Act of 2009 illustrates that with adequate funding and environmental review, projects are completed that stimulate the economy without compromising our core laws and environmental principles. All projects went through environmental review under the National Environmental Policy Act (NEPA), allowed for judicial review of each project, and nearly all projects were completed on time, helping the U.S. economy recover from the Great Recession.

We urge you to pass legislation that funds the infrastructure we need while preserving critical public safeguards and access to the courts access so that we protect taxpayers, communities, social justice and our environment.

Sincerely,

Center for Biological Diversity
Defenders of Wildlife
Earthjustice
Environmental Protection Network
GreenLatinos
Natural Resources Defense Council
Sierra Club
The Wilderness Society
Western Environmental Law Center

⁷ Department of Transportation, Office of Inspector General Audit Report, *Vulnerabilities Exist In Implementing Initiatives Under Map-21 Subtitle C To Accelerate Project Delivery*, March 6, 2017

<https://www.oig.dot.gov/sites/default/files/DOIT%20Implementation%20of%20MAP-21%20a5E3-6-17.pdf>

⁸ *40 Proposed U.S. Transportation and Water Infrastructure Projects of Major Economic Significance*, prepared for the Department of the Treasury, at 6 <https://www.treasury.gov/connect/blog/Documents/final-infrastructure-report.pdf>

Senator BARRASSO. Thank you all very much.
The hearing is adjourned.
[Whereupon, at 11:39 a.m., the committee was adjourned.]

