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BETTER, FASTER, CHEAPER, SMARTER, AND STRONGER: INFRASTRUCTURE DEVELOPMENT OPPORTUNITIES TO DRIVE ECONOMIC RECOVERY AND RESILIENCY

HEARING

BEFORE THE

COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS

UNITED STATES SENATE

ONE HUNDRED SIXTEENTH CONGRESS

SECOND SESSION

JULY 1, 2020

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COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS

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C O N T E N T S

BETTER, FASTER, CHEAPER, SMARTER, AND STRONGER: INFRASTRUCTURE DEVELOPMENT OPPORTUNITIES TO DRIVE ECONOMIC RECOVERY AND RESILIENCY

WEDNESDAY, JULY 1, 2020

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

The Committee met, pursuant to notice, at 10:06 a.m. in room 106, Dirksen Senate Office Building, Hon. John Barrasso (Chairman of the Committee) presiding.

Present: Senators Barrasso, Carper, Capito, Rounds, Boozman, Cardin, Whitehouse, and Booker.

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

Senator BARRASSO. I would ask now that the witnesses for today's hearing please come forward.

Good morning. I call this hearing to order.

Investing in America's infrastructure is critical; it is critical as our economy recovers from the coronavirus pandemic. Last month, we held a hearing on how rebuilding our highways and bridges will create jobs, will reduce the cost of goods and services, and will drive our Nation's economic recovery. Today, we are going to examine how America's Transportation Infrastructure Act will help build roads and bridges faster, better, cheaper, smarter, and stronger.

Three months from today, the surface transportation authorization will expire. This cannot be allowed to happen, especially during this pandemic-caused economic downturn. To make matters worse, the Highway Trust Fund is rapidly approaching insolvency.

Prior to the pandemic, the Congressional Budget Office projected that the Highway Trust Fund would run out of money in mid-2021. Now, with Americans driving less, the Highway Trust Fund will reach insolvency far sooner than first predicted. The time for Congress to pass meaningful, bipartisan infrastructure legislation is now.

Last year, this Committee approved historic and bipartisan highway infrastructure legislation. We worked together across the aisle to pass a bipartisan bill that greenlights broad, widely supported ideas.

Democrats in the House, on the other hand, put up a partisan stop sign. The House Democrats' transportation bill stands in sharp contrast to our own. House Democrats cut their Republican

counterparts out of the process, and they wrote a completely partisan bill. That is why, after a 36 hour markup, it received no Republican votes in committee.

By comparison, this Committee unanimously passed our highway bill in less than an hour.

The House Democrats' partisan bill is a road to nowhere. Instead, Congress should pass the Senate's bipartisan legislation and send it to President Trump's desk for signature.

America's Transportation Infrastructure Act will provide record levels of investment: $287 billion will be available over 5 years to fix our roads and bridges, to create jobs, and to boost our economy. The legislation increases funding for all States and tribes, it cuts red tape, and it protects the environment. It will also increase needed certainty for States and communities to plan, to permit, and to build infrastructure projects.

Given the unprecedented economic damage inflicted by the coronavirus pandemic, we must assure infrastructure projects are not needlessly delayed. The environmental review process is important and necessary. It can also cause unnecessary delays. Delays increase costs, they limit private investment, and they hurt the American worker.

America's Transportation Infrastructure Act will speed up project delivery by cutting red tape and simplifying agency reviews. Reducing the time it takes to get environmental permits is essential for building new highways and repairing existing ones. To improve the permitting process, the bill increases predictability, accountability, transparency, and flexibility.

From 2010 to 2017, the Federal Highway Administration completed environmental impact statements for 114 highway projects. On average, it took almost 7 years to complete each one of these environmental reviews.

America's Transportation Infrastructure Act sets a goal to complete the process in just 2 years. The bill also requires Federal agencies to establish a unified schedule and empowers the project's lead agency to coordinate the entire permitting process. These are key elements of the One Federal Decision policy.

The legislation will also ensure America's infrastructure is more resilient. Our roads and bridges must be strong enough to handle extreme weather events like hurricanes and floods. At the same time, our highways must withstand natural disasters such as wildfires, earthquakes, and rockslides.

America's Transportation Infrastructure Act provides nearly $5 billion to help protect our roads and bridges from natural disasters and extreme weather events. More durable, longer lasting roads are safer; they last longer, of course; and are more efficient for everyone.

Passing America's Transportation Infrastructure Act into law is critical for our Nation's economic recovery. It will ensure better, faster, cheaper, smarter, and stronger projects.

I look forward to hearing from today's witnesses on this important topic.

Now, I would like to turn to Ranking Member Carper for his opening statement.

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

Senator CARPER. Thanks, Mr. Chairman.

I do want to welcome our witnesses. Thank you all for joining us live and in person this morning. We do a lot virtually around here; I am sure you do where you live and work as well. It is nice to see you here, and thank you for your work and for your presence and your testimony.

Mr. Chairman, I want to thank you for holding this important hearing today.

I want to say a special thanks to all of our members of this Committee, Democrat and Republican, and one Independent, to thank them and their staffs for helping us produce a bipartisan surface transportation reauthorization bill a year ago that we reported unanimously out of this Committee.

Let me begin by noting that as we meet here today, the House is also debating a broad infrastructure bill of their own that includes not just surface transportation, but also drinking water, energy infrastructure, and broadband. Those are very important subjects.

The cornerstone of their bill, however, is the House Transportation and Infrastructure Committee's surface transportation legislation. With the anticipated adoption of that bill, perhaps even later today, the House is poised to move closer to joining us in reauthorizing our Nation's surface transportation programs, which are set to expire this fall. I am sure we all welcome their progress. Although we may disagree on some of the particulars there, we do welcome their progress.

Now, with the surface transportation reauthorization bill moving in the House, it is time for the Senate Banking Committee and the Senate Commerce Committee to develop their own bipartisan titles so that a truly robust surface transportation reauthorization bill can come to the Senate floor in the months ahead. The American people are counting on us to get this done. Let's not let them down.

Every member of our Committee knows that America's transportation infrastructure is essential to our economy, to our society, and if truth be known, to our way of life. The more than 4 million miles of roadway and 600,000 bridges in this country are essential not just in connecting us to commerce and to services, but more importantly, connecting us to one another. Unfortunately, across our country, many of those same roads, highways, and bridges are in desperate need of repair.

Whether you happen to be driving an 18-wheeler truck hundreds of miles a day on interstates across the heartland, or hitting pot holes on your way to work or the grocery store, or to drop off the kids, just about every driver in America will agree that our surface transportation infrastructure needs work, a lot of it.

While some roads simply need repairs or repaving, others need to be rebuilt or completely redesigned. According to the U.S. Department of Transportation, approximately 20 percent of our Federal aid highways are in poor condition—20 percent—as are some 46,000 bridges.

For decades, we have invested in surface transportation infrastructure as a country oftentimes without making meaningful

progress toward improving safety, reducing harmful emissions, and enhancing resilience. Now, we face a growing climate crisis that will only make those challenges even more daunting.

Last week, some of the coldest places on Earth experienced a historical heat wave. I don't know if my colleagues got to see the news, but temperatures exceeded 100 degrees Fahrenheit in the Arctic Circle for the first time in recorded history. Think about that, 100 degrees.

Earlier this year, on the other side of the planet in Antarctica, my wife and some of her girlfriends from their days at DuPont were down in Antarctica. Shortly after they left, the temperatures there reached 70 degrees Fahrenheit, 70 degrees Fahrenheit, another record.

With historic heat waves reaching the coldest corners of our planet, 2020 is on course to be the hottest year in recorded history. Moreover, we are being told that the forecast for this year's hurricane season may well set new records, too, raising serious concerns all along the Atlantic Coast and throughout the Gulf Coast.

Speaking of the Gulf of Mexico, one of our Republican colleagues from Louisiana volunteered to me last week that sea level rise continues to worsen in his State, too, where they are losing roughly a football field of land a day—a football field of land a day—to the sea. You will recall that a year ago, the target of Mother Nature's fury was the Midwest, where torrential rains and catastrophic flooding brought havoc to many farming communities, delaying planting for a month or more in some places.

Farther west, in places like California, Nevada, Oregon, and Utah, communities are still reeling from last year's wildfires, some of which were bigger than my State. And now, they are preparing out there for another dangerously hot and dry summer season.

These extreme weather events are happening more frequently, pushing the National Flood Insurance Program ever further into the red and damaging our infrastructure to the tune of hundreds of billions—not millions, billions—of dollars each year.

As global temperatures continue to warm, ice caps melt and sea levels rise, scientists tell us that the record breaking heatwaves, devastating hurricanes, catastrophic floods, and drought fueled wildfires we are already witnessing throughout the world aren't likely to get better. If we don't get on the stick, as my grandfather used to say, they are likely to get worse.

Now, having said that, I understand that some of our colleagues are interested in talking about the importance of streamlining today, and it is important that we do that. As we pivot to streamlining, however, let me ask that we keep in mind that only about 1 percent of Federal highway projects require the most complicated type of Federal environmental review. That means 99 percent don't.

When Chairman Barrasso and I, with the help of our staffs, first began our work on this legislation before us, America's Transportation Infrastructure Act, nearly 2 years ago, we learned that Congress has passed more than 60 streamlining provisions all told in the last four transportation bills, even though, I am told, the most detailed environmental reviews are needed for about only 1 percent of Federal projects. I believed then, and I still believe now, that we

need to do more than just stack more streamlining provisions on top of existing ones. We ought to be able to move streamlining provisions. We also need to ensure that the ones we have adopted are being implemented.

In ATIA, we address streamlining needs in part by focusing on how to make existing processes work better. In doing so, we demonstrate that it is possible to facilitate important projects without forgoing environmental protection. That is a win for all of us who use America's roads, highways, and bridges, and it is a win for our planet. Where I come from, we call that a win-win situation. We could all use a few more of those.

Some of our colleagues know that I am fond of quoting Albert Einstein, who once said famously, "In adversity lies opportunity." God knows we face plenty of adversity these days in our country and on our planet; pandemics, tens of millions of Americans out of work, and the list goes on and on.

Having said that, there is opportunity here if we look for it and seize the day. That is what our Committee did last summer under the leadership of our Chairman, John Barrasso. We led by our example. We didn't wait until the last minute. We got out of the starting gate early.

A year ago, we unanimously approved ATIA, our bipartisan surface transportation reauthorization bill that would make an historic $287 billion investment in our Nation's roads, highways, and bridges. We then said to our sister committees, the Banking Committee, our friends on the Commerce Committee, and those on the Finance Committee, including me, we are doing our job on EPW; it is time for you on these other three committees to do your jobs.

Is ATIA perfect? No. No bill that I have ever helped write has been perfect, but this is legislation that we can be proud of, even as we work to make it better in the days ahead.

Coming from the lowest lying State in the Union, I am especially proud and grateful that our bill includes the first ever climate title in a transportation bill in the history of the Congress, investing some $10 billion over the next 5 years directly in programs and policies that will combat climate change by reducing emissions and improving the resiliency of our transportation networks and infrastructure.

ATIA invests nearly $5 billion over 5 years in a new resilience formula program available to all States, as well as a competitive resilience grant program. These new PROTECT grants would support projects across America that reinforce, upgrade, or realign existing transportation infrastructure to better withstand extreme weather events and other effects of climate change.

ATIA also harnesses the power of Mother Nature by establishing new eligibilities for natural infrastructure, like the marshes and wetlands that protect our roads and bridges from storm surges, in the National Highway Performance and the Emergency Relief Program.

Mr. Chairman and colleagues, let me close with this. A lot has changed in the world since we first reported our surface transportation reauthorization legislation nearly a year ago. It seems like a decade ago. The coronavirus pandemic has radically changed our lives, and tragically, taken nearly 130,000 American lives.

Just as all of us have been compelled to adjust and adapt to a new normal in our everyday lives over the last several years, we as a nation need to face the facts of the climate crisis. With our bill, we are beginning to do so. We need to keep it up, and while doing so, we need to build and rebuild a surface transportation infrastructure of roads, highways, bridges, and transit systems that are, once again, the envy of the world.

With that, Mr. Chairman, I look forward to our conversation this morning and to hearing from our witnesses, and to the work ahead of us to make America's infrastructure better, smarter, and truly, stronger.

Thank you very, very much.

Senator BARRASSO. Thank you very much, Senator Carper. We appreciate it.

We are joined by three witnesses today that we are delighted to welcome to the Committee. We have Mr. Jason Grumet, who is the President of the Bipartisan Policy Center. We have Mr. Bob Lanham, who is the President of the Associated General Contractors of America. And we have Ms. Christy Goldfuss, who is the Senior Vice President, Energy and Environment Policy, of the Center for American Progress.

Welcome to all three of you. I want to remind you that your full written testimony will be made a part of the official record today. So we ask you to please try to keep your statement to 5 minutes, so that we may have some time for questions. I look forward to hearing testimony from all three of you.

If we may start with Mr. Grumet.

STATEMENT OF JASON GRUMET, PRESIDENT, BIPARTISAN POLICY CENTER

Mr. GRUMET. Thank you, Chairman Barrasso, Ranking Member Carper, and the Committee, for the hard work, and particularly for the very collaborative process you have undertaken in developing the America's Transportation Infrastructure Act.

I am pleased to be here this morning to share the Bipartisan Policy Center's strong support for this actionable, bipartisan effort that will spur economic recovery, strengthen surface transportation, and create a new model of bipartisan cooperation that I believe offers a real solution to the climate crisis.

I should apologize to your staff for the undue length of our written testimony, but want you to understand this as an expression our exuberance for being involved in a process that is actually trying to put legislation on the desk of the President of the United States.

All too often, we find the legislative process being used to score political points and come up with messaging bills. I think the time is now actually to act, and I commend the Committee for the spirit of this legislative approach.

I will try to summarize my testimony by focusing on a few of the highlights of the bill, and then also really explain why we believe the combined focus on an official regulatory approval process, emissions mitigation, and resilience, represent the essential ingredients of a serious bipartisan response to climate change.

There are three aspects of the legislation I would like to call out. The first is the effort to unleash $300 billion of critical economic activity at a moment when we have millions of Americans looking for work, and State and local budgets in disarray.

I also want to acknowledge the efforts to promote the significant investment in clean technologies, and emissions reductions, and in resilience against climate driven risk. And finally, embrace the common sense permitting reforms that focus on coordination and efficiency while sustaining the core values and protections of the environmental review process.

As a democracy that respects private ownership and local governance, I am proud that American citizens play a role in decisions that affect their families and communities. I think we have to resist the infrastructure envy and anecdotes about how quickly totalitarian regimes can build airports.

We also have to avoid an exaggerated focus on horror stories, as I think Senator Carper indicated. The vast majority of projects do move forward quickly.

But the truth is that our record on infrastructure is mixed. While most projects do move forward, we could do much better to create predictability, transparency, and accountability.

I also think we have to contend with the likelihood that the long timeframes in our permitting process result in political risks to investments that are causally related to the private sector's vast under-investments in critical infrastructure. So I commend the Committee for efforts to create a more efficient, transparent, timely, and predictable process.

I think the improvements that you are suggesting in permitting fall into three basic categories. You are creating a presumption of timeliness to encourage agencies to complete their environmental reviews within an average of 2 years, a presumption of coordination by codifying the bipartisan components of the One Federal Decision, and requiring Federal agencies to work together in applying categorical exclusions, and a presumption of accountability by requiring a new performance system for tracking major projects.

I would like to now turn to the broader implications for the energy and climate debate. The hearing is titled Better, Faster, Cheaper, Smarter, and Stronger. Mr. Chairman, I think you have buried the lede by leaving out cleaner.

The future of our environment and our economy demands a new coalition committed to building fast and building clean. While conservation and energy efficiency are essential components of an effective strategy, the solution to climate change and to global competition depend on vast and urgent efforts to develop, finance, permit, site, and construct new technologies on a scale beyond what we have ever contemplated.

The Bipartisan Policy Center is increasingly concerned that the United States will in fact succeed in inventing new, low cost, competitive technologies for decarbonization but fail to deploy these systems in time to avoid and manage the worst effects of climate change.

I think members of this Committee appreciate far better than most what it will take to achieve net zero emissions across our economy. We need vast increases in solar and wind power, sup-

ported by new transmission and massive battery storage facilities, thousands of miles of new pipelines to move CO_2 from power generation to manufacturing, to permanent underground sequestration reservoirs. We need electric vehicle and hydrogen refueling infrastructure, new fleets of advanced nuclear reactors, deep bore geothermal, advanced hydropower, new facilities to capture carbon from the air.

With continued leadership from many of you on this Committee on efforts like the USE IT Act, and the Nuclear Energy Leadership Act, and the efforts of your colleagues in the Energy Committee on the Energy Innovation Act, I am actually optimistic that the United States will invent low carbon cost effective solutions. It would be beyond tragic to excel at technology but fail at bureaucracy.

The focus on transportation, the provisions in this Act spur forward looking infrastructure investments that can improve the siting process much more broadly than just the transportation sector. I would like to just note three enhancements that I think are consistent with the spirit of this legislation that I encourage you to consider.

The first is to reauthorize FAST-41. This is legislation that has had bipartisan support, and it codifies the same basic ideas in this package but applies them to a broader suite of technologies.

Second, I would urge you to focus on life cycle cost analysis. This must become the norm. Our history of building cheap and passing along the buck was never a good idea. Based on the extreme weather, it is revealing a tragic consequence. We are never going to get ahead of resilience if we don't start to think about full cost accounting.

Finally, I think our biggest challenge is our Federal Republic. I believe the national imperative to de-carbonize our economy while increasing global competitiveness will require much greater Federal authority to advance critical projects despite local opposition. And I believe that we have to revisit ideas like the Critical Corridors Section of the Energy Policy Act of 2005, which a number of you were a party to.

However, I also believe that certain place based assessments must be strengthened in order to advance an enduring and equitable climate solution. There is clear evidence that communities of color have borne a disproportionate burden of environmental harm from past energy and infrastructure siting. This history must not be brushed aside, nor repeated.

Many of these new, clean facilities will create jobs, grow the tax base, and improve the quality of life in surrounding communities. But in some cases, national and global benefits may come at a cost to local communities. These costs must be shared equitably.

In closing, Mr. Chairman, for too long we have allowed our economic future to be held captive to magical thinking across the political spectrum. In this caricature of extreme perspectives, some have ignored or otherwise sought to delegitimize the imperative of climate action. Others have embraced the un-serious view that a solution can be achieved quickly by transitioning to a sole reliance on renewed resources without considering the economic, land use,

and reliability concerns, or resolving the citing challenges that have plagued conventional energy projects.

Yet, these extremes have produced only paralysis and acrimony, as both sides focus on the irresponsible positions of the other, rather than facing their own limitations or seeking common ground. Against this backdrop, passing this legislation would be the highest common denominator affirmation that we have the political will and the capacity to rebuild our economy while meeting the climate challenge.

I thank you and your staff for your hard work and am eager to participate in the conversation.

Thank you.

[The prepared statement of Mr. Grumet follows:]

BIPARTISAN POLICY CENTER

Testimony on "Better, Faster, Cheaper, Smarter, and Stronger: Infrastructure Development Opportunities to Drive Economic Recovery and Resiliency"

United States Senate
Committee on Environment and Public Works

Jason Grumet, Founder and President
Bipartisan Policy Center

July 1, 2020

Chairman Barrasso, Ranking Member Carper, and members of the committee, thank you for the hard work and the collaborative process you have led to develop S. 2302, the America's Transportation Infrastructure Act (ATIA). On behalf of the Bipartisan Policy Center, I appreciate the opportunity to express our strong support for this legislation, highlight aspects of the bill that we believe are particularly significant, and suggest a few areas where we would urge the committee to explore additional enhancements. At a time when the need for economic recovery and public investment is more urgent than ever, an approach that focuses on improving the resilience of critical surface transportation systems, accelerating the planning and construction of needed projects through thoughtful permitting reforms, and facilitating the transition to low-carbon transportation and energy technologies to meet the enormous challenge of climate change offers a rare opening to move the country forward on a bipartisan basis—now and for the future.

I wish to make three key points:

- The United States is a world leader in developing the new, low-carbon technologies and innovative infrastructure solutions that will be needed to effectively mitigate and manage the worst effects of climate change. But without smart infrastructure investments now, we may not be able to deploy these technologies in time to reap the multiple benefits they offer—both for reducing our nation's own carbon footprint and for positioning American companies to supply the growing global market for climate-friendly energy and transportation alternatives. A bipartisan vision for "Better, Faster, Cheaper, Smarter, Stronger" ***and Cleaner*** infrastructure can unite traditional infrastructure advocates and climate advocates behind a shared mission to accelerate large investments in our nation's near- and long-term prosperity, competitiveness, energy security, and quality of life.

- ATIA—by coupling meaningful investments in infrastructure resilience and climate mitigation with commonsense permitting process improvements—presents Congress with the opportunity to score a major legislative achievement. I applaud this committee—especially Chairman Barrasso, Ranking Member Carper, and your staffs—for coming together to debate and negotiate a package of significant policy agreements that together address the profound, immediate need to restore economic growth, modernize our nation's outmoded and decaying surface transportation infrastructure, and lay the foundation for an effective response to climate change.

- Finally, without detracting from the hard-fought progress you have made in this legislation, I wish to identify some additional steps we hope Congress will consider as discussions around infrastructure, economic recovery, and climate change continue. A few targeted enhancements would further strengthen the ATIA as a durable model for pairing the decarbonization of a large and complex modern economy with continued job growth and competitive success.

1. Introduction

The Bipartisan Policy Center (BPC) is a Washington, D.C.-based think tank that actively fosters bipartisan solutions to critical public policy challenges by engaging with good ideas from across the political spectrum. BPC's Energy and Infrastructure Projects work to advance evidence-based, economically viable policies that will accelerate America's transition to a competitive, net-zero-carbon economy.

BPC has an established track record of building bipartisan support for smart policies to address climate change and support clean energy technology innovation. BPC has also led several initiatives to develop and advocate for consensus-driven, cost-effective, and bipartisan infrastructure policies. We have offered reforms to make federal surface transportation programs more performance-driven, more directly linked to clear national goals, and more accountable for results.[i] For example, BPC has proposed a new model for infrastructure investment that leverages private-sector capital and expertise, developed recommendations to address aging water and wastewater infrastructure, and offered a pragmatic roadmap for fixing the federal Highway Trust Fund.[ii] We appreciate the opportunity to share ideas at this hearing and welcome any opportunity to work with this committee as it explores and reconciles differing approaches to funding, financing, and delivering critical infrastructure projects.

The first part of my testimony focuses on three elements of S.2302 that we view as particularly significant and worthy of bipartisan support: (1) public investment on a scale that will meaningfully support economic recovery from the current coronavirus crisis; (2) provisions that directly address the need for emissions mitigation and greater climate resiliency in the nation's surface transportation systems; and (3) permitting reforms that will accelerate the pace of infrastructure investment and the realization of associated benefits. The second half of my testimony explores the link between permitting reforms and the broader challenge of economy-wide decarbonization. The last section discusses opportunities for enhancing ATIA that we would urge the committee and Congress as a whole to consider.

2. Key Elements of the America's Transportation Investment Act

Infrastructure Investment for Near-Term Economic Recovery and Long-Term Prosperity

The Senate Environment and Public Works Committee unanimously passed the America's Transportation Infrastructure Act (ATIA) in July 2019. By authorizing $287 billion from the Highway Trust Fund from FY 2021 to FY 2025, including $249 billion for highway formula programs, the bill makes a significant down payment on urgent infrastructure repair and improvement needs at a time when many states and localities are struggling and further federal support is widely viewed as essential to the nation's economic recovery from the coronavirus crisis. We are aware that the legislation still requires accompanying titles from the Senate's Commerce, Banking, and Finance Committees to address transit, rail and safety, and revenue issues, respectively, before it can advance. Therefore, we urge your colleagues on those committees to act quickly so as to enable consideration of a comprehensive package by the full Senate as soon as possible.

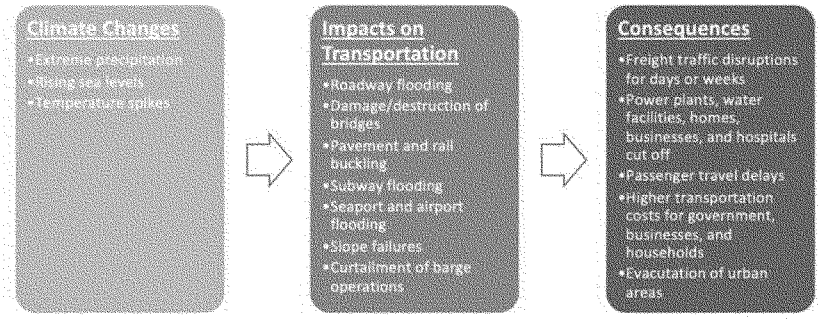
The poor condition of our nation's surface transportation infrastructure is a concern that pre-dates the current crisis and that has provided a rare basis for bipartisan alignment for some years now. In 2017, the nation as a whole received a D+ grade for the state of its infrastructure from the American Society of Civil Engineers. Proportional to GDP, the United States has lagged other developed countries in its rate

of infrastructure investment since at least the 1980s, and the accumulating toll of decades of neglect and disrepair—in public safety, economic efficiency, global competitiveness, and quality of life has continued to grow.

In our view, there could be no better time to meaningfully address these deficiencies than at a moment when the economy is struggling from the fallout of COVID-19, millions of Americans—including particularly many low-wage workers—are out of work, and delayed income tax payments, decreased sales tax receipts, and massive, unanticipated health and public safety expenses have wrecked state and local government finances. Private and public entities alike have faced and continue to face wrenching budget choices despite the emergency assistance provided by the CARES Act, including mass layoffs of employees and delayed or canceled capital expenditures and infrastructure projects.[iii] Rural, tribal, and other disadvantaged communities, which already faced challenges financing infrastructure improvements, will find it increasingly difficult to service existing debt obligations and finance new projects. Meanwhile, experience from previous crises has repeatedly demonstrated the potential benefits of smart public investment—both in near-term job creation and long-term economic returns. In this context, the well-targeted and certain transportation funding provided by ATIA would be exceedingly valuable as states and localities confront continued challenges in the months ahead.

Investments in Climate Resilience and Mitigation

A global pandemic and climate change represent very different kinds of threat. But in scale, complexity, and potential for far-reaching harm and economic damage, climate change rivals and even exceeds the current crisis for the simple reason that its consequences and cures will unfold on decade- and even century-long timescales. We therefore applaud the committee for its bipartisan acknowledgement that climate mitigation and resilience must be considered as central elements in planning for critical, long-lived infrastructure investments going forward. Among ATIA's most important provisions are those that support innovative low-carbon transportation technologies and make our surface transportation systems more resilient to climate-change-related risks. These risks and their possible impacts on transportation in particular, as summarized by the U.S. Global Change Research Program, are highlighted in the graphic below.



Source: U.S. Global Change Research Program

In recent years, as millions of Americans have seen their lives upended by increasingly catastrophic weather events and natural disasters, climate risks have moved from the realm of the theoretical or

abstract into the very real and tangible present. In fact, 2019 marked the fifth consecutive year in which ten or more billion-dollar weather and climate disasters impacted the United States, including devastating hurricanes, wildfires, and floods.

The overwhelming scientific consensus is that climate patterns will continue to shift and extreme weather events will continue to grow more frequent and severe as warming continues over the decades ahead. In light of these projections, America urgently needs to make investments to protect its $4.1 trillion in transportation infrastructure assets and to make those assets more resilient to climate conditions that could otherwise reduce their reliability and capacity. As just one example, 13 of the nation's 47 largest airports have at least one runway situated within reach of a moderate-to-high storm surge.[iv] Rising sea levels and extreme weather put these runways, and other critical infrastructure, at risk. The focus on resilience is essential as the climate is already changing in ways that severely threaten our built environment.

At the same time, the transportation sector itself must do its part to mitigate climate risks and slow the rate of warming by becoming more efficient and by transitioning to low-carbon technologies. Transportation, in fact, is the largest contributor to greenhouse gas emissions in the United States, accounting for 29% of national emissions. While many strategies and technologies must be pursued to effectively decarbonize this highly specialized and complex sector of the economy, multiple expert studies have found that vehicle electrification will need to play a central role as other technology platforms, such as hydrogen, mature. Because of the slow turnover of the personal vehicle fleet, investment in charging stations and other infrastructure to support vehicle electrification will be critical to accelerate consumer adoption of this technology. BPC appreciates the committee's support for vehicle electrification and other low-carbon alternative fuels in ATIA and we look forward to working with you to build on these provisions.

Overall, ATIA authorizes nearly $10 billion over five years for highway-related climate change mitigation and adaptation programs, with more funding available if state and local governments choose to use a portion of other federal highway grants for related activities. These provisions are summarized in the table below.

Major Climate Change-Related Provisions in the ATIA
Goal: Advance cleaner technologies and innovations Provides an average $200 million annually to develop charging stations for alternative fuel vehicles with an 80% federal share (Section 1401). Supports carbon utilization and air capture research and collaboration (Section 1406). Establishes a federal interagency working group to develop a strategy to transition federal vehicle fleets to alternative fuel vehicles (Section 1510).
Goal: Mitigate emissions on roads and at ports Provides $40 million on average annually for competitive grants to advance innovative, integrated, and multimodal solutions to congestion relief (Section 1404). Provides an average $74 million annually for a competitive grant program to reduce emissions at port facilities by reducing truck idling (Section 1402). Provides about $600 million annually in supplemental formula funds and $100 million annually for competitive grants to states to invest in transportation improvements designed to reduce on-road mobile sources of CO2 emissions (Section 1403).

Makes lock and dam modernization or marine highway projects eligible for the National Highway Freight Program if they reduce on-road source emissions (Section 1114).
Goal: Open existing funding streams to natural infrastructure and resilience improvements Provides a maximum federal share of up to 100% for a project to add protective features to improve resiliency on federal-aid highway or bridge projects (Section 1107). Allows Surface Transportation Block Grant Program funding to be used for some natural infrastructure and other resilience-enhancing projects (Section 1109). Allows a state to use up to 15% of its annual National Highway Performance Program funding to add "protective features" designed to mitigate climate-related risks, including risks from sea level rise, extreme weather events, flooding, and natural disasters (Section 1105).
Goal: Create new resilience planning and development incentives Establishes the PROTECT Grant program to provide $986 million on average annually—$786 million distributed to states by formula and $200 million distributed competitively—to support adaptation and resilience projects and encourage the development of resilience improvement plans (Section 1407).
Goal: Prioritize resilience in emergency relief Amends the Emergency Relief program definition of a natural disaster to include wildfires and sea level rise (Section 1106). Requires DOT to incorporate resilience into Emergency Relief projects (Section 1523).

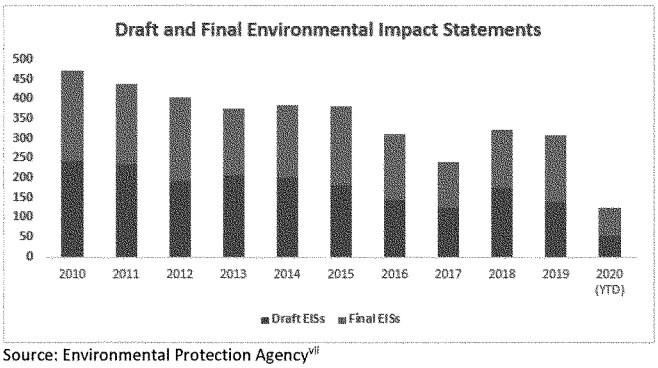
Permitting Reforms to Accelerate Project Delivery

Our nation's track record of delivering infrastructure projects is mixed. As a democracy that respects private ownership and local government, we should be proud that American citizens have a voice in decisions that affect their families and communities. I have always felt that "infrastructure envy" based on totalitarian regimes' ability to quickly build major facilities was misplaced if that ability was premised on a lack of concern about democracy. In this country, by contrast, regulatory processes work reasonably well to balance the desires for speed and effective public engagement. Examples certainly exist of major projects that failed due to local opposition despite the significant regional benefits they offered, but by and large most highway projects move forward once they have financing. That said, the complexity of current U.S. permitting processes leaves substantial opportunities for improvement that would increase predictability, shorten the time to project delivery, and reduce costs while still providing for robust consideration of public and environmental concerns.

The federal government's online permitting dashboard lists over 60 possible permits and other approvals that infrastructure projects may require from 12 different federal departments—separate and apart from environmental reviews under the National Environmental Policy Act (NEPA). State and local agencies typically require additional project approvals, covering everything from state environmental issues to local building codes to utilities and construction.

There is no single source of information on the time or costs involved in reviewing and permitting infrastructure projects. Most federal agencies track only the number of environmental impact statements (EISs), which represent the most comprehensive and rigorous level of review. An EIS is required for less than 1% of infrastructure projects and federal actions—specifically, those expected to have the most significant environmental impact.[v] According to a Council on Environmental Quality (CEQ) review of EIS timelines, the median time to completion—from "notice of intent" to "record of decision" —was 3.6 years. The average of time to completion was 4.5 years, skewed by a handful of projects that

exceeded 10 years.[vi] The CEQ found that median EIS completion times for the U.S. Department of Transportation's (DOT's) modal agencies were even longer: 6.6 years for the Federal Aviation Administration, 6.85 years for the Federal Highway Administration, and 4.18 years for the Federal Transit Administration. Between 2010 and 2019, federal agencies issued about 184 draft EISs and 180 final EISs annually.



Source: Environmental Protection Agency[vii]

Despite extensive anecdotal evidence, there is little substantive data to pinpoint where in current permitting processes projects tend to languish, nor to identify who is most responsible for delays. The reality is that the outcome and speed of the process largely depends on the type of project, how it is prioritized, public expectations, and the commitment of all public officials involved. Recent success in permitting major projects, such as the Tappan Zee Bridge in New York and the rebuilding of the collapsed I-35W bridge in Minneapolis, demonstrate what can be accomplished if public officials are aligned in sharing a common purpose and are held accountable by public interest. Lack of funding/priority, local controversy, and project complexity can also delay the EIS process, NEPA reviews, and permitting broadly.

Despite these data gaps, there is evidence that unnecessary delays in the permitting process occur and are costly to both the public and private sectors. Direct costs can go up if the costs of materials, supplies, and labor rise during a delay. There is also a public cost to delaying needed infrastructure improvements, as older facilities may produce more emissions or break down more often. Permitting delays may also increase political risk, because the longer a project stays in the review phase, the higher the likelihood of unforeseen changes in public policy, priority, or support. In BPC's work examining the potential to increase private sector infrastructure investment, we concluded that the most obvious challenge was the lack of good, investment-grade projects. However, we concluded that this weak project pipeline was connected to the uncertainty that results from long permitting processes—particularly when those processes extend beyond the tenure of the political leadership and circumstances in place when the project is conceived. "Political risk," which is a polite way of describing the fear of stranded investment due to changes in political leadership, was consistently cited as a barrier to investment. While one can fairly defend the current system for eventually getting most needed transportation projects built, we must contend with the likelihood that the long timeframes in our permitting processes are casually related to our nation's vast underinvestment in critical infrastructure.

Historically, there has been strong bipartisan support for incremental and common-sense improvements to the environmental review and permitting process. For example, such measures were included in transportation reauthorization bills passed in 1998, 2005, 2012, and 2015.[viii] Moreover, Republican and Democrat administrations have authored generally consistent guidance documents, issued executive orders, and launched other initiatives designed to improve the NEPA process.[ix]

I commend the committee for working in a bipartisan way to build on these past efforts and further improve the process for approving federal projects. To accelerate project delivery and project approvals, and to create a more efficient, transparent, timely, and predictable process that attracts greater private investment, ATIA would:

- Codify the bipartisan components of "One Federal Decision," consolidating permitting decisions for major infrastructure projects into a single environmental document with a review schedule set by the federal lead agency.
- Encourage federal agencies to complete their environmental review process within an average of two years.
- Require all authorization decisions for a major project to be completed within 90 days of a record of decision.
- Require a new performance accountability system for tracking major projects that includes setting schedules for the environmental review process, determining whether established schedules are being met, and documenting the amount of time taken to complete the environmental review process.
- Require DOT to work with other federal agencies involved in transportation projects to identify categorical exclusions, which, if applied by the other federal agencies, would accelerate project delivery.
- Allow metropolitan planning organizations and state DOTs to use social media and other web-based tools to encourage public participation and solicit public feedback as part of transportation planning processes.

Efforts to accelerate permit review processes are often challenged out of concern that increased speed will erode key environmental protections. However, BPC believes that the reforms in AITA are consistent with the criteria that define effective environmental review and public engagement:

- New procedures judiciously align with existing permitting initiatives, guidance, and regulations.
- Critical environmental protections and opportunities for meaningful and early public engagement are not undermined.
- Full transparency in tracking adherence to permitting timetables, and costs of environmental reviews and delays, are used to hold federal agencies and project sponsors accountable.
- Agency staff have the training, support, and resources needed to successfully develop appropriate internal policies and compliance procedures.

More broadly, concerns about accelerating new infrastructure development must be balanced against the cost to the environment of keeping degraded, outdated facilities in public use and delaying the introduction of new, cleaner, and more resilient infrastructure. When one peels back all the competing arguments, we are left with the fundamental question of whether new infrastructure investment is locking the nation in to an unsustainable high-carbon economy or directing our nation's economic might and technological prowess toward a low-carbon future. BPC believes that the key to realizing our

common economic and ecological aspirations requires aligning incentives for infrastructure modernization in ways that further other core policy goals. The magnitude of the climate challenge, in particular, demands such alignment. How the infrastructure investments and permitting reforms in ATIA can help advance a larger clean energy agenda is the subject of the next section of my testimony.

3. Infrastructure Investment and Permitting Reform as Part of a Larger Clean Energy and Climate Agenda

The United States is in the beginning stages of a dramatic energy transition. The scale and pace of the transformation required to avoid potentially dangerous levels of warming is difficult to overstate and fundamentally different from the rate of change observed in recent periods of technological progress, even compared to the rapid gains seen in wind and solar energy deployment. A permitting framework designed to support accelerated progress to low- and net-zero carbon systems must look very different from today's pattern of slow and cumbersome approvals for major projects. Larger commitments of public and private resources will also be needed. The engineering firm Wood Mackenzie has estimated that fully decarbonizing the U.S. power grid, for example, could cost $4.5 trillion.[x] Similarly, a major national utility recently concluded that achieving its own target of net-zero carbon emissions by 2050 would require an "unprecedented and sustained pace of capacity additions."[xi] Specifically, new generation capacity would have to be added over the next three decades at a pace more than double the rate this utility had added generation over the past three decades. [xii]

Members of this committee appreciate far better than most what it will take to achieve net zero emissions across the U.S. economy in the next thirty years. Success will depend on our ability to implement a national strategy with multiple complementary elements, which can be summarized as follows:

First, we must maximize the potential of all existing zero-carbon technologies. The current pandemic and economic crisis are threatening key aspects of the renewable energy supply chain. Congress must help confront these challenges as we can ill afford to lose ground in the deployment of renewable resources. Similar attention must be devoted to sustaining a role for nuclear power.[xiii] Nuclear energy currently accounts for more than half (55%) of the carbon-free electricity generated in the United States and is an essential piece of any pragmatic plan to decarbonize our energy system quickly.[xiv] While thankfully this is not a hearing about wholesale electricity market design, many existing nuclear plants are economically challenged partly due to the failure of the market to value their zero carbon attributes. This disadvantage has been further exacerbated by recent decisions of the Federal Energy Regulatory Commission (FERC). Simply put, the challenge ahead of us is immense. We must preserve and double down on all mature, commercially available forms of non-carbon power.

Second, we must increase the pace of energy innovation in America. The United States does not yet possess the technological capacity to decarbonize our energy systems consistent with the demands of a modern economy. And the challenge of decarbonization on a global scale is even more daunting when one factors in growing energy demand in developing economies. BPC's American Energy Innovation Council (AEIC), which includes CEOs from a variety of industries, has developed specific recommendations for scaling technology innovation to address climate change while also supporting economic growth. A key conclusion from this effort is that expanded federal investments in research, development, demonstration, and deployment are needed – and must be scaled appropriately. For over

a decade, the AEIC has consistently called for a tripling of federal energy innovation budgets. We have been encouraged by bipartisan legislation introduced in the Senate, including Chairman Barrasso and Senator Whitehouse's USE IT Act ("Utilizing Significant Emissions with Innovative Technologies Act"), Chairwoman Murkowski's and Senator Manchin's American Energy Innovation Act, and the bipartisan Nuclear Energy Leadership Act. All of these pieces of legislation would take significant steps toward laying the groundwork needed to make real progress on climate.

Third, we must rediscover the capacity to deploy "first of a kind," breakthrough technologies here in the United States. In the past, the AEIC has proposed a new federal approach to support the demonstration and commercialization of advanced energy technologies. For the United States to meet ambitious mid-century decarbonization commitments, some combination of innovative technologies such as advanced nuclear, zero-carbon fuels, long-duration electricity storage, and carbon capture and storage must achieve widespread commercial deployment. This requires first demonstrating new technologies at scale to prove their technical and economic viability, which can be a challenge for capital-intensive and complex energy technologies, especially if they operate in highly regulated commodity markets that do not appropriately value their beneficial attributes. Given the hurdles to private investment in large-scale energy technology demonstration projects, there is a role for the federal government to help promising innovations navigate the proverbial "valley of death" between invention and commercial deployment. Significant thinking has gone into how the government might provide this support most effectively, in many cases drawing from AEIC case studies that outline lessons learned from past efforts, including the successful demonstration of utility-scale solar in the United States and mixed results from the Department of Energy's carbon capture and storage (CCS) demonstration programs.[xv] The AEIC has recommended new ways to manage future projects more effectively via new authorities, as described in a recent review of the Clean Energy Deployment Administration proposal.

Finally, we must speed the deployment of new non-carbon energy production, transmission, and transportation technologies. This last imperative is the one most closely linked to the infrastructure legislation the committee is considering today. Most policy proposals aimed at accelerating the deployment of climate-friendly energy technologies have focused on economic factors—in other words, on making these new technologies more cost competitive. This remains an important focus because, although a variety of state and federal provisions are already in place to incentivize low-carbon energy production and use, additional efforts to value carbon emissions performance will be required to efficiently deploy promising technologies at scale.

However, there is an equally critical and challenging conversation that does not generate nearly the same attention as the debate over incentives, taxes, and mandates. An honest assessment of our nation's complex permitting and siting regulatory structure quickly reveals that we are not positioned to fully capitalize on American leadership in the invention and development of breakthrough clean energy technologies. Even with well designed-market based incentives, the United States will continue to fall short in actually deploying these technologies if our regulatory processes prevent us from siting and building new systems in time to make a difference. Though focused on the transportation sector, provisions in the ATIA to spur forward-looking infrastructure investments and improve the siting process can provide a model for similar modernization efforts across the broader economy.

The need for new models is well illustrated by the experience of the renewable energy industry, which has made great strides over the last decade and is quickly becoming an indispensable part of America's carbon-free energy portfolio. Since the advent of the modern wind industry in the 1990s and the launch of the utility-scale solar business two decades ago, the U.S. power sector has been revolutionized by

low-cost renewable energy. The DOE's Energy Information Administration notes that wind power capacity grew by 24% annually between 2000 and 2018.[xvi] Likewise, in the last decade alone solar energy development grew at an astounding average annual rate of 49%.[xvii] And yet, despite this rapid growth and unprecedented levels of new investment, the contribution of wind and solar still stands at less than 10% of total current U.S. electricity generation.[xviii] This suggests that even higher growth rates would have to be sustained year over year to achieve a target of net-zero greenhouse gas emissions by mid-century.

Clues to the role of siting and permitting frameworks in enabling this kind of growth can be found by looking, for example, at offshore wind. As other parts of the world, most notably Europe, have developed a successful offshore wind industry, progress toward developing this renewable resource in the United States has been slow—for reasons that have more to do with regulatory constraints than technology barriers. Our nation has a tremendous offshore wind energy resource—representing more than 2,000 gigawatts of power potential, nearly double the size of our nation's current electricity system. Moreover, offshore wind could deliver large amounts of clean electricity to the country's largest population centers along the eastern seaboard, where new capacity is needed most. In the Northeast and Mid-Atlantic states, ambitious state procurement activity together with technology improvements,[xix] have prompted efforts to develop some 25,000 megawatts of offshore wind capacity—in a region that currently has very little wind generation and that lacks the transmission infrastructure to connect offshore wind resources to the existing grid. [xx] Unfortunately it has become apparent from these efforts that the current regulatory system and permitting process is slow and struggling to reconcile the perspectives and needs of stakeholders as diverse as the commercial fisheries industry, coastal communities, and the U.S. military. In addition, the lack of an active U.S.-based offshore wind industry means that an entire supply chain and resource development business must be built from scratch. Manufacturing facilities, modernized and expanded ports, and transmission systems must all be sited, permitted, and financed with the corresponding regulatory frameworks necessary to enable to these significant investments.

Similar hurdles apply to other low-carbon technologies that will be needed for effective carbon mitigation. The International Energy Agency has estimated that meeting global climate goals will require an enormous expansion of renewable energy (up to 74% of electricity supply) along with increased nuclear production (up to 15%), and CCS (roughly 7%).[xxi] At the same time, significant deployment of new carbon capture utilization and storage (CCUS) technologies will be needed to address emissions from remaining conventional energy sources, which can be expected to continue to play a role for some decades to come, especially in industrial applications. A recent National Petroleum Council (NPC) study found that "the United States is uniquely positioned as the world leader in CCUS and has substantial capability to drive widespread deployment."[xxii] The United States currently deploys approximately 80% of the world's carbon dioxide (CO_2) capture capacity (largely from anthropogenic sources).[xxiii] However, this 25 million tonnes per annum (Mtpa) of CCUS capacity represents less than 1% of U.S. CO_2 emissions from stationary sources. The NPC study concludes that achieving CCUS deployment at scale means increasing CO_2 capture by an additional 350 to 400 Mtpa within the next 25 years.[xxiv] To enable this more-than-ten-fold increase in CCUS deployment, the United States will also need to dramatically expand its CO_2 pipeline network. By way of putting this challenge in perspective, it is worth noting that the nation's existing network of roughly 5,000 miles of operating pipeline was built over a period of 50 years.[xxv] The NPC estimates suggest that future investments in pipelines and supporting infrastructure for purposes of CCUS deployment would have to expand by an order of magnitude in far less time.

Put simply, I believe the national imperative to decarbonize our economy will require greater federal authority to advance critical projects despite local opposition. In making sometimes necessary tradeoffs, however, I also believe that certain place-based assessments must be strengthened in order to advance an effective, enduring, and equitable climate solution. There is clear evidence that communities of color have borne a disproportionate burden of environmental harm from past energy and infrastructure siting decisions, especially when compared against economically disenfranchised white communities. This history must not by brushed aside nor repeated as we seek to deploy the clean, green, resilient systems that will be necessary to protect our future. Many of the new energy facilities we'll need can be expected to create jobs, grow the tax base, and improve the quality of life in surrounding communities. In other cases, however, national and global benefits may come at a cost to local communities. These costs must be shared equitably.

4. Additional Considerations for S. 2302

The committee's vote to advance S. 2302 is welcome evidence of the bipartisan support that exists for meaningful and practical steps to address both climate change and regulatory reform. As the bill moves forward, we urge committee members and the full Congress to consider additional measures that would further strengthen S. 2302 along both these dimensions and that, in our view, likewise have the potential to attract broad bipartisan support. Our suggestions are summarized below.

Consider key provisions from the House bill (INVEST in America Act): Several provisions in the House bill would complement the objectives of S. 2302 and are worthy of consideration in conference. For example, the House bill codifies DOT's "Every Day Counts" initiative to provide technical assistance and education on speeding up project delivery. We also support provisions of the INVEST in America Act that would authorize significant climate-related investments and provide $83.1 billion to ensure that states, cities, tribes, territories, and transit agencies can continue to administer their programs, advance projects, and preserve jobs in the aftermath of the COVID-19 pandemic. Importantly, this "year one" funding would be made available at a 100% federal share. Finally, the House bill calls for the creation of a new Office of Transit-Supportive Communities within the Federal Transit Administration to coordinate transit and housing projects within DOT and across the federal government. Given the affordable housing crisis we face, spurring increased housing development around transit hubs, particularly developments than can capture the land value of transit-oriented development, is long overdue.

Reauthorize FAST-41: A key provision of the current highway authorization—FAST-41—will expire in 2022. FAST-41 is designed to improve the federal environmental review and permitting process for certain "covered" infrastructure projects through the creation of an interagency council empowered with tools and resources to improve the timeliness, predictability, and transparency of federal project approvals. The law also required the use of the online Permitting Dashboard, a website that tracks project permits and reviews, to help hold agencies publicly accountable.

FAST-41 applies to a variety of infrastructure projects, including renewable or conventional energy production, electricity transmission, pipelines, and broadband. Importantly, it is also the best mechanism in current law to help speed up infrastructure investments, including decarbonization projects. This success will help set the stage for new green infrastructure/clean energy projects and, if expanded, could apply to others. Therefore, it will be important to reauthorize FAST-41 and explore opportunities to enhance its effectiveness, expand its scope, and maximize its benefits.

Launch a pilot program to test innovative practices for environmental reviews: Former Rep. Bill Shuster (R-PA), who served as chairman of the House Transportation and Infrastructure Committee and authored BPC's report on extending the gas tax, released draft legislation in July 2018 authorizing a new pilot program that would permit waivers from certain federal rules and regulations for a select number of projects that adopt innovative practices. Examples of such practices include using innovative technologies that enable more effective public participation in decision-making and focusing on environmental and transportation outcomes rather than processes. Such a pilot could test and advance practices that both expedite project delivery and improve results.

Expand NEPA assignment programs: Congress and the administration should work together to encourage increased delegation that harmonizes state and federal permitting processes. The resource demands on federal permitting review are going to increase considerably as we modernize our nation's infrastructure with massive new energy production technologies and distribution networks and states will have a major role to play in effectively advancing more localized projects and infrastructure maintenance programs.

The "assignment" of certain NEPA authorities to states has proven successful in permitting highway projects. In fact, the Federal Highway Administration has agreements currently in place for Alaska, Arizona, California, Florida, Ohio, Texas, and Utah to assume NEPA responsibilities. According to the California Department of Transportation, NEPA assignment resulted in significant time savings, reducing the time for document processing (from notice of intent to final EIS approval) by a staggering 124 months. Similarly, the Texas Department of Transportation estimated an average time savings of 25%. With NEPA assignment and its attendant benefits increasingly well documented, DOT should consider how to encourage further uptake and offer lessons learned to other federal agencies. DOT also previously sought comments on a pilot program, authorized by the FAST Act's §1309, that would take a step further and allow states to substitute their environmental laws for NEPA when equally stringent. However, this rulemaking has not yet been finalized.

Improve asset management: Infrastructure providers often accumulate various assets such as land, rights of way, and buildings over the course of decades of building and operating infrastructure. Yet too often, governments do not have a full and in-depth accounting of all these assets. Before billions of public dollars are spent rebuilding infrastructure, a clearer understanding of baseline conditions and infrastructure needs, as well as climate-related vulnerabilities, is needed.

Preparing such an inventory is not without cost, but that expenditure would be dwarfed by the benefits that can be achieved in improved efficiency, transparency, new revenue generation, and disaster avoidance. Further, a comprehensive inventory can help mitigate the parochial political risks associated with project selection and prioritization, as it would provide an independent, technical basis for reviewing the state of public assets.

While state DOTs are still required to develop a risk-based transportation asset management plan and are encouraged to address resilience as part of that process, more could be done. Congress should incentivize state and local governments to complete comprehensive asset inventories as a condition for receiving federal assistance. Recipients of federal funding would then need to compile a centralized registry of all assets, including data on current condition, expected maintenance and operations costs through the asset's remaining useful life, the cost of replacement, and the potential impact of a failure. While ATIA—particularly in Section 1206—attempts to relieve the burden of federal rules and regulations on less dense and populated states, all recipients of federal funding should abide by asset

management best practices. Such assurances are needed to extract the most value from the expenditure of precious federal resources and to break the cycle of deferred maintenance that has created today's massive infrastructure liabilities. Congress should support these efforts through the provision of supplemental technical assistance, planning grants, and other resources to help with compliance.

Incentivize life-cycle cost analyses: In construction, forecasting upfront costs and long-term maintenance costs for an infrastructure project is called "life-cycle cost analysis." While it may seem intuitively obvious that project developers would want to know how much it will cost to build and keep a project in a state of good repair, existing incentives often encourage undue focus on low-cost construction over longer-term operating costs and project durability. Effective life-cycle cost analysis becomes all the more important as we face the need to adapt to extreme weather and recover from deadly, damaging natural disasters.

In distributing federal funding, state and local applicants should demonstrate that they have fully accounted for the long-term risks of planned projects and selected the project delivery model that provides the best value over the life of the project. Because rural and disadvantaged communities often lack the resources and capacity to perform such analyses, Congress should create a capacity-building program for infrastructure development, either as a standalone office or within existing federal agencies, and designate specific funding for rural technical assistance.

Revisit the "critical corridors" model: Section 368 of the Energy Policy Act of 2005 attempted to designate corridors for critical infrastructure on federal land, including oil, gas, and hydrogen pipelines, and electric transmission. The purpose of these provisions was to empower five federal agencies to work collectively on any necessary environmental reviews and incorporate the designated corridors into relevant agency land use and resource management plans. This statute has not been effective in supporting the development of energy infrastructure as originally intended. The corridor routing and spacing constraints, in particular, have remained problematic – especially in the east. As agreement builds over the imperative to decarbonize our economy, it will be necessary to revisit these challenging questions about how to balance the preference for local control with the need for coordinated regional and national investments in clean energy.

5. Conclusion

Our nation is at a defining crossroads. On the current course, infrastructure debates will continue to serve as a proxy battle over climate change. Absent a meaningful bipartisan commitment to prioritize low-carbon investments, opposing sides will continue to pursue national policy goals indirectly by battling over individual infrastructure projects. Neither the environment nor the economy is well served by this outcome. Instead, S. 2303 provides an opportunity to unleash massive investments that will rebuild and modernize our transportation infrastructure while helping to position the economy to achieve ambitious climate mitigation goals. At this moment of economic distress, the benefits of a new vision for forward-looking investment in America are hard to overstate.

Indeed, the most important and ultimately encouraging aspect of S. 2302 may be that it signals an inflection point, in which the combination of the current economic crisis and the growing climate crisis creates a new basis for bipartisan cooperation and action. Facing similarly daunting challenges at previous points in our nation's history, a willingness to think big and build big—from the construction of the interstate highway system to the space race—laid the foundation for generations of continued

prosperity and global economic leadership. We believe the current moment calls for a similar level of national ambition and resolve. The constructive vision embodied in the ATIA represents an enormous improvement over the decade of destructive partisanship that has prevented our nation from charting a realistic path forward on climate change. For too long we have allowed our economic future to be held captive to "magical thinking"—across the political spectrum. In this caricature of extreme perspectives some have ignored or otherwise delegitimized the imperative for climate action. Others have embraced the unserious view that a solution can be achieved quickly by transitioning to sole reliance on renewable resources, without considering land-use and reliability concerns, or resolving the siting challenges that have plagued conventional energy projects. These extremes have produced only paralysis and acrimony as both sides focus on the irresponsibility of the other rather than seeking common ground.

In this context, I believe the progress that S. 2302 represents in terms of a new bipartisan approach to transportation infrastructure has broader implications—for the economy as a whole and for all aspects of energy infrastructure. Passing it would be a highest-common-denominator reflection of what is before us—and a needed reaffirmation of what America can still accomplish if we come together in a can-do spirit to face the giant challenges that lie ahead.

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[xxiv] Ibid.
[xxv] Ibid.

Senate Committee on Environment and Public Works
Hearing entitled, *"Better, Faster, Cheaper, Smarter, and Stronger: Infrastructure Development Opportunities to Drive Economic Recovery and Resiliency."*
July 1, 2020
Questions for the Record for Jason Grumet

Senator Whitehouse:

As we consider our country's infrastructure development plans, we cannot ignore the urgent needs of our coastal communities, which continue to go unaddressed. Over the past decade, the Army Corps of Engineers spent between 19 and 120 times more on inland work than on coastal work in its Flood and Coastal Damage Reduction fund. The Land and Water Conservation Fund has similarly heavily favored inland projects over coastal projects, a disparity that Congress recently missed an opportunity to address. Coastal states are also seeing shores disappearing and properties threatened due to sea level rise. Should we not be focusing on infrastructure to support our coasts as they take the beating of climate change? What policies should we focus on pushing to address this coastal issue?

Jason Grumet Response:

Coastal storms and flooding pose significant risks to coastal communities and may cause substantial property damage. According to the U.S. Global Change Research Program's 2018 Fourth National Climate Assessment, damage to coastal areas from extreme weather events combined with rising sea levels threaten approximately $1 trillion in national wealth held in coastal real estate. As your question suggests, this reality demands a federal focus on the resilience of coastal communities and their infrastructure systems. Along with additional federal funding for resilience upgrades, which ATIA would provide, two recommendations in our written testimony are critical to improving coastal resilience:

Improving asset management: Infrastructure providers often accumulate various assets such as land, rights of way, and buildings over the course of decades of building and operating infrastructure. Yet too often, governments do not have a full and in-depth accounting of all these assets. Before billions of public dollars are spent rebuilding infrastructure, a clearer understanding of baseline conditions and infrastructure needs, as well as climate-related vulnerabilities, is needed. Preparing such an inventory is not without cost, but that expenditure would be dwarfed by the benefits that can be achieved in improved efficiency, transparency, new revenue generation, and disaster avoidance. Further, a comprehensive inventory can help mitigate the parochial political risks associated with project selection and prioritization, as it would provide an independent, technical basis for reviewing the state of public assets. While state DOTs are required to develop a risk-based transportation asset management plan and are encouraged to address resilience as part of that process, more could be done. Congress should incentivize state and local governments to complete comprehensive asset inventories as a condition for receiving federal assistance. Recipients of federal funding would then need to compile a centralized registry of all assets, including data on current condition, expected maintenance and operations costs through the asset's remaining useful life, the cost of replacement, and the potential impact of a failure. While ATIA—particularly in Section 1206—attempts to relieve the burden of federal rules and regulations on less dense and populated states, all recipients of federal funding should abide by asset management best practices. Such assurances are needed to extract the most value from the expenditure of precious federal resources and to break the cycle of deferred maintenance that has created today's massive infrastructure liabilities. Congress should support these efforts through the

provision of supplemental technical assistance, planning grants, and other resources to help with compliance.

Incentivizing life-cycle cost analyses: In construction, forecasting upfront costs and long-term maintenance costs for an infrastructure project is called "life-cycle cost analysis." While it may seem intuitively obvious that project developers would want to know how much it will cost to build and keep a project in a state of good repair, existing incentives often encourage undue focus on low-cost construction over longer-term operating costs and project durability. Effective life-cycle cost analysis becomes all the more important as we face the need to adapt to extreme weather, mitigate climate-related risks like sea level rise, and recover from deadly, damaging natural disasters. In distributing federal funding, state and local applicants should demonstrate that they have fully accounted for the long-term risks of planned projects and selected the project delivery model that provides the best value over the life of the project. Because rural and disadvantaged communities often lack the resources and capacity to perform such analyses, Congress should create a capacity-building program for infrastructure development, either as a standalone office or within existing federal agencies, and designate specific funding for rural technical assistance.

Additionally, Congress should ensure sufficient funding for infrastructure resiliency and disaster mitigation grants, outside of the resources included in ATIA. For example, Clean Water Act Section 319 grants provide states and tribes funds for source water management programs. The State Revolving Loan Funds provide loans to local governments to upgrade stormwater systems. EPA's Wetland Program Development Grants fund research, training and other activities related to reduction of water pollution. Wetlands play a key role in absorbing storm water runoff resulting from extreme weather events. Finally, among the Army Corp of Engineers programs warranting funding are the Planning Assistance to States program and the Flood Plain Management Service.

Senator BARRASSO. Thank you very much for your participation and your testimony. We are very, very grateful. And your suggestion to not bury the lede is a very good suggestion. Thank you.

Mr. Lanham.

STATEMENT OF ROBERT LANHAM, JR., PRESIDENT, ASSOCIATED GENERAL CONTRACTORS OF AMERICA BOARD 2020, AND PRESIDENT, WILLIAMS BROTHERS CONSTRUCTION

Mr. LANHAM. Chairman Barrasso, Ranking Member Carper, and members of the Committee on Environment and Public Works, thank you for the invitation to testify today.

My name is Bob Lanham. I am a highway and bridge contractor from Houston, Texas, and I have the pleasure of serving as the 2020 President of the Associated General Contractors of America.

AGC is a national organization representing 27,000 businesses involved in every aspect of construction activity in all 50 States, Puerto Rico, and Washington, DC. On behalf of AGC, the construction industry, and this Nation, I want to thank this Committee for its bipartisan work on the America's Transportation Infrastructure Act.

Our transportation infrastructure is not built by one contractor, nor should the laws governing it be developed by one political party. Bipartisan compromise enhances the likelihood of legislative success, and ensures that all these programs reflect the diverse needs of the States.

Before I talk about some of the important provisions in ATIA, I would like to first address two things. One, the immediate need of infusion of Federal funding for State DOTs; and two, the need for an enactment of a robust multi-year surface transportation bill.

With regard to the immediate needs of the DOTs, the COVID-19 pandemic has had an unprecedented impact on our economy, the American people, and the construction industry. States' transportation revenues are expected to decline by 30 percent over the next 18 months. This has caused many DOTs to delay letting new projects. Construction businesses, just like any other business, cannot survive many, many months without work.

In response, AGC is urging the Congress to provide an immediate infusion of $49.95 billion in Federal funding to support the State DOT funding shortfalls. I applaud Senator Rounds for leading, and many of you on this Committee, for signing the bipartisan letter to the Senate leadership in support of this funding request.

With regard to a long term bill, the pandemic has clearly reminded us that a safe, efficient, and reliable transportation system is vital to any national emergency response. Our system facilitates economic growth, and it improves the quality of life of all Americans. The enactment of a long term surface transportation bill, such as ATIA, will provide certainty needed by the States' DOTs to plan and carry out critical infrastructure investments. It will also provide a significant economic boost to our Nation at a time when it is sorely needed.

With regard to some of the other provisions in ATIA, it is not just enough to provide robust investment levels. The bill has other provisions in it that add extreme value. One, the improvement of the environmental review and permitting process, while all along

protecting the environment. Finally, the building of resilient infrastructure.

Over the years, the Congress has enacted laws that have tried to assure a balance between environmental, economic, and health concerns. However, in this complicated operation and complex network of these laws and the intersection of all these requirements, sometimes those were overseen, and the environmental review process was delayed.

AGC is pleased that ATIA has incorporated the provisions to improve the process. The most significant is simply the codification of Executive Order 13807, which institutes the One Federal Decision. This provision calls for a Federal authorization and reviews to rely on a single environmental document, establishes a 2 year goal for the completion of a review of a major project, and a 90 day timeline related to any authorization decisions to be issued after a record of decision.

It also improves transparency through performance accountability. It works like a business. Tracking system for the review and the permitting process itself, and in that allows for a monitoring and reporting of how the system is working.

Other important provisions include but are not limited to the establishing of deadlines for a Federal agency to review and respond to categorical exclusion projects, requiring certain reports that, especially one that details best practices and potential changes to internal procedures at USDOT to expedite the review process.

In recent years, our Nation has experienced significant natural disasters. I partially experienced Harvey in Houston, and the flooding associated. Our system is vital to our ability to respond to and recover from these disasters. However, we have all seen the pictures in the news of the roads that are submerged or bridges that are crumbling.

AGC appreciates that ATIA includes provisions to improve the resiliency of the transportation system. Arguably the most important of these is the PROTECT grant program, funded at nearly $1 billion per year. The diverse eligibilities of this program will help ensure that the different needs of the States can be addressed.

Chairman Barrasso, thank you for convening today's hearing. It is a golden opportunity for the Congress. At a time when it seems there is little that we can agree on, infrastructure might prove to be that missing link.

I thank the Committee for its steadfast bipartisan efforts to improve our Nation's transportation infrastructure, and I look forward to answering any of your questions.

Thank you, Mr. Chairman.

[The prepared statement of Mr. Lanham follows:]

Statement of

Robert Lanham
President
Williams Brothers Construction Co., Inc.

on behalf of

The Associated General Contractors of America

to the

U.S. Senate

Committee on Environment and Public Works

For a hearing on

"Better, Faster, Cheaper, Smarter, and Stronger: Infrastructure Development Opportunities to Drive Economic Recovery and Resiliency"

July 1, 2020

The Associated General Contractors of America (AGC) is the leading association in the construction industry representing more than 27,000 firms, including America's leading general contractors and specialty-contracting firms. Many of the nation's service providers and suppliers are associated with AGC through a nationwide network of chapters. AGC contractors are engaged in the construction of the nation's commercial buildings, shopping centers, factories, warehouses, highways, bridges, tunnels, airports, waterworks facilities, waste treatment facilities, levees, locks, dams, water conservation projects, defense facilities, multi-family housing projects, and more.

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Statement of Robert Lanham
Associated General Contractors of America
July 1, 2020

Chairman Barrasso, Ranking Member Carper, and members of the U.S. Senate Committee on the Environment and Public Works (Committee), thank you for inviting me to testify on this vitally important topic. My name is Bob Lanham. I am a highway and bridge builder from Houston, Texas and currently serve as the President of the Associated General Contractors of America (AGC). AGC is a national organization representing more than 27,000 businesses involved in every aspect of construction activity in all 50 states, Puerto Rico, and Washington, D.C.

The Committee has a strong history of developing and moving bipartisan legislation to improve our highways and bridges. This was most recently demonstrated with the unanimous vote of the Committee to advance the America's Transportation Infrastructure Act (ATIA) to the Senate floor last summer. AGC sincerely appreciates the bipartisan leadership of the Committee because just as America's transportation infrastructure is not built by one contractor, the laws governing federal transportation policies and programs should not be wholly developed by one political party. The give and take of bipartisan compromise not only enhances the likelihood for legislative victory, but also ensures that these policies and programs reflect the diverse needs and priorities of states and local communities across the country.

In my testimony today, I will address how ATIA sets forth a sound roadmap for reducing the timeframe for moving a transportation project from conception to completion through responsible reforms to the environmental review and permitting process. In addition, I will discuss how ATIA sets the course for building more resilient transportation infrastructure in order to address the impacts of climate change.

However, given the COVID-19 pandemic's impact on our economy, the American people, and the construction industry, as well as the impending expiration of the Fixing America's Surface Transportation Act (FAST Act) on September 30, 2020, I would like to first address the need for an immediate infusion of federal funding for state departments of transportation (DOTs) in addition to the swift enactment of a robust, multi-year surface transportation reauthorization bill. As such, I lay out my testimony as follows:

I. **The Pandemic-Induced Need for and Benefits of Immediate and Long-term Transportation Infrastructure Investment**
   A. The Benefits of Transportation Infrastructure Investment
   B. The Pandemic-Induced Need for and Benefits of an Immediate Infusion of $49.95 Billion for State Departments of Transportation
   C. Realizing the Long-Term Benefits of Investment through the Enactment of Multi-Year Surface Transportation Reauthorization Legislation, Like ATIA
II. **ATIA's Approach to Responsibly Reducing Transportation Construction Project Delivery Time and Costs through Sensible Environmental Review and Permitting Process Reforms**

I. The Pandemic-Induced Need for and Benefits of Immediate and Long-term Transportation Infrastructure Investment

A. The Benefits of Transportation Infrastructure Investment

The positive relationship between transportation infrastructure investment, economic output, and private sector productivity has been well documented for decades by business analysts, economists, and the research community. For example:

- Investing in transportation infrastructure increases productivity, as new efficiencies in transporting goods and services boost the productive capacity of businesses. In turn, increased productivity drives economic growth — every dollar spent on public transportation infrastructure investment is estimated to increase U.S. Gross Domestic Product (GDP) by roughly $3 via job creation, system improvements, and stimulated aggregate demand;[1] and
- A study by the Federal Reserve Bank of San Francisco found that every $1 spent from federal highway funds increases the recipient state's GDP by $2 over 10 years, although the multiplier can be as high as $8, depending upon the specific characteristics of the project.[2]

B. The Pandemic-Induced Need for and Benefits of an Immediate Infusion of $49.95 Billion for State Departments of Transportation

The ongoing COVID-19 pandemic continues to wreak havoc upon our lives, communities, and economy. As I speak before you today, the pandemic has killed more than 125,000 Americans, led to the unemployment of more than 40 million, and closed more than 100,000 small businesses. Some state governments are projecting budget shortfalls double those they experienced at the height of the Great Recession.[3] State transportation revenues are expected to decline by 30

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[1] National Association of Manufacturers, Catching Up: Greater Focus Needed to Achieve a More Competitive Infrastructure, 2014, available at: https://www.infrastructureusa.org/catching-up-greater-focus-needed-to-achieve-a-more-competitive-infrastructure/

[2] Sylvain Leduc and Daniel Wilson, Roads to Prosperity or Bridges to Nowhere? Theory and Evidence on the Impact of Public Infrastructure Investment, 2012, available at: https://www.journals.uchicago.edu/doi/abs/10.1086/669173?mobileUi=0&

[3] State revenue losses resulting from the COVID-19 recession are expected to well exceed the 11.6 percent drop states experienced during the Great Recession, with some states anticipating declines of more than 20

percent on average over the next 18 months, according to American Association of State Highway and Transportation Officials (AASHTO). The future for robust transportation infrastructure investment is dim when, for example:

- **ILLINOIS:** Average daily traffic counts declined nearly 50 percent throughout the state and the state DOT anticipates a reduction in all transportation revenues of at least 30 percent over the next 18 months. This calculates to a loss of $2.8 billion.[4]
- **IOWA:** In mid-April, traffic was down 44 percent compared with levels during the same week in 2019.[5] The state's road use tax fund is projected to decline by $100 million through October because the coronavirus has disrupted Iowans' travel and vehicle purchasing patterns.[6]
- **MARYLAND:** Motor fuel tax revenues are the largest single source of the Transportation Trust Fund and are currently being negatively impacted by a 50 percent decline in traffic and low gas prices. MDOT estimates that its budget will be out of balance in both state fiscal years 2020 and 2021, requiring significant spending reductions to bring them back into balance.[7]
- **NEW JERSEY:** Traffic research company Inrix estimated that traffic on New Jersey highways dropped by 62 percent after COVID-19 stay at home orders except for essential workers were issued in March. NJ Turnpike officials reported a $23 million loss in toll revenues caused by a 29 percent traffic drop in March due to COVID-19.[8]
- **NORTH DAKOTA:** In April, NDDOT reported a 40 percent drop in traffic levels having corresponding negative impacts on the collection of transportation tax revenues. If current abysmal traffic projections continue, the agency noted that it will have a major impact on its ability to maintain roadways and match federal aid.[9]

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percent. National Association of State Budget Officers, State Fiscal Outlook: Pre- & Post-COVID-19, 2020, available at: http://budgetblog.nasbo.org/budgetblogs/blogs/kathryn-white/2020/06/25/state-fiscal-outlook-pre-post-covid-19

[4] Illinois Department of Transportation, Letter to Congressional Delegation, April 20, 2020, available at: https://policy.transportation.org/wp-content/uploads/sites/59/2020/04/Congressional-Delegtion-COVID-19-Relief-Request-Letter.pdf

[5] Eleanore Lamb, Iowa Transportation Commission Approves Five-Year Plan, Transport Topics, June 16, 2020, available at: https://www.ttnews.com/articles/iowa-transportation-commission-approves-five-year-plan

[6] Rod Boshart, Commission approves $3.6 billion five-year transportation plan for Iowa But coronavirus outbreak presents some funding challenges for Department of Transportation, The Gazette, Cedar Rapids, Iowa, June 10, 2020, available at: https://www.masstransitmag.com/bus/news/21141587/ia-commission-approves-36-billion-fiveyear-transportation-plan-for-iowa-but-coronavirus-outbreak-presents-some-funding-challenges-for-department-of-transportation

[7] Maryland Department of Transportation, Letter to Congressional Delegation, April 20, 2020, available at: https://policy.transportation.org/wp-content/uploads/sites/59/2020/04/MD-April-20.pdf

[8] Larry Higgins, State highway agencies need a $50B federal cash infusion or construction could halt, group says, May 20, 2020, www.nj.com, available at: https://www.nj.com/coronavirus/2020/05/state-highway-agencies-need-a-50b-federal-cash-infusion-or-construction-could-halt-group-says.html

[9] North Dakota Department of Transportation, Letter to Congressional Delegation, April 20, 2020, available at: https://policy.transportation.org/wp-content/uploads/sites/59/2020/04/COVID19-impacts-to-ND.pdf.

- **WEST VIRGINIA:** The state's contribution to the Road Fund — mainly from fuel taxes, privilege taxes on vehicle sales, and vehicle registration fees — came up nearly $20 million, or 27 percent, short in April. A portion of those funds is used to pay off about $1.6 billion in road bonds sold under the state's Roads to Prosperity program. It is not clear at what point a prolonged shortfall in Road Fund collection would affect the schedule for repaying those bonds.[10]

In many states, the declines in transportation revenues have already translated into real delays in undertaking new transportation projects. For instance, the Kentucky Transportation Cabinet did not hold bid lettings for new transportation construction contracts in April or May.[11] Letting totals in the state during the last 12 years have averaged about $900 million per year; this year's total is projected to be around $350 million.[12]

Just as we have seen with many other types of businesses during this crisis, construction businesses cannot survive months at a time without work. My greatest fear is that by the time a robust, multi-year surface transportation reauthorization bill becomes law, there will be far fewer construction contractors—many of whom are both my greatest competitors and dearest friends—in business and even fewer construction workers employed to deliver transportation projects.

That is why I applaud Senator Rounds for leading—and many of you on this Committee for signing—the bipartisan letter to Senate Leadership in support of an immediate federal funding infusion of $49.95 billion for state departments of transportation. Without this funding, the ability of state DOTs to carry out their core functions is threatened. I am deeply concerned that more projects will be delayed, putting the viability of the transportation construction industry and good-paying jobs at risk. As the Senate considers this request, AGC asks that an appropriate balance be achieved between the various proposed eligible uses of this funding. That way, as opposed to other worthy pandemic-related funding requests, this funding will not only help protect many existing public and private sector jobs, it will also help put in place transportation assets that will provide benefits to our economy and communities long after this pandemic is over.

C. Realizing the Long-Term Benefits of Investment through the Enactment of Robust, Multi-Year Surface Transportation Reauthorization Legislation, Like ATIA

The pandemic has highlighted and reinforced that a safe, efficient, and reliable transportation system is a vital part of our ability to respond to a national emergency. It has ensured the safe travel of first responders, health care professionals, and essential workers as well as the expedient delivery of medical supplies to hospitals and basic necessities to homes.

However, the transportation system is not just a necessary component of our response to national emergencies, it plays an integral role in facilitating our nation's economic growth and improving

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[10] Phil Kabler, Federal windfall offsets plunge in W.Va. Road Fund collection in April, Coal Valley News, May 20, 2020, available at: https://www.coalvalleynews.com/news/federal-windfall-offsets-plunge-in-w-va-road-fund-collection-in-april/article_138fd842-f2ae-5a29-9b18-cfafde806ac2.html.

[11] This information was reported to AGC by its members who perform work for the Kentucky Transportation Cabinet.

[12] Id.

the quality of life for all Americans. As this Committee knows well, there have been numerous studies put forward documenting the overall condition of the transportation system and the improvements required to ensure that it can meet our needs now and well into the future.

Enactment of a robust, multi-year surface transportation reauthorization legislation, such as ATIA, will not only provide the long-term certainty state DOTs need to plan and carry out the critical improvements to transportation system, it will also provide a signification economic boost to our Nation at a time when it is desperately needed. Contractors across the country will have the confidence to invest in equipment and materials as well as retain and hire additional employees in anticipation of a strong pipeline of work. These activities will have a ripple effect, spurring economic growth and job creation in other industries, which will help put our Nation on the road to recovery.

While robust investment in our Nation's transportation infrastructure is necessary, its lone inclusion in the legislation is not enough. Such legislation should also include provisions improving the administration of the bureaucratic processes impacting project delivery and sensibly addressing the ways our transportation infrastructure can adapt to challenges. In the sections below, I will discuss how ATIA includes measures addressing these needs among other provisions.

II. ATIA's Approach to Responsibly Reducing Transportation Construction Project Delivery Time and Costs through Sensible Environmental Review and Permitting Process Reforms

Over the last 50 years, Congress enacted a host of laws that seek to ensure a balance among environmental, economic, and health concerns. However, the complicated operation of those laws and intersection of their requirements can lead to delays in environmental review and permitting decisions that can derail the efficient delivery of needed infrastructure projects for many years. These processes can be bureaucratic, lengthy, complex, and duplicative. For example:

- The National Environmental Policy Act (NEPA) may require a project interact with at least 22 federal statutes that incorporate the cooperation of at least 11 federal agencies;[13]
- In December 2018, the Council on Environmental Quality (CEQ) published a report on the amount of time federal agencies took to complete an environmental impact statement (EIS), finding that the average time to complete an EIS was four and a half years. CEQ reviewed 1,161 EISs for which a notice of availability of a final EIS was published between January 1, 2010 and December 31, 2017, and a record of decision (ROD) was issued by June 7, 2018;[14] and

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[13] Associated General Contractors of America, Reforms for Improving Environmental Review and Permitting, July 24, 2017, available at: https://www.agc.org/sites/default/files/Galleries/enviro_members_file/Reforms%20for%20Improving%20Federal%20Environmental%20Review%20and%20Permitting%207-24-17%20FINAL%20v2_0.pdf

[14] Council on Environmental Quality, Report on Environmental Impact Statement Timelines (2010-2017), December 14, 218, available at: https://www.whitehouse.gov/wp-content/uploads/2017/11/CEQ-EIS-Timelines-Report.pdf

- Per a National Association of Environmental Professionals (NAEP) review of the 194 EISs published in 2015, only 16 percent were prepared in two years or less.[15]

Project delays deny the public the substantial benefits that come from an infrastructure project: improving our economy and our quality of life.

ATIA sets the path to lessen the time and costs associated with federal environmental review and permitting by focusing on better integrating those processes—without jeopardizing necessary environmental protections or considerations—by avoiding sequential and duplicative reviews, minimizing the need to redo documentation and analyses for a permit, and fostering innovation and transparency.

A. Section 1301: Efficient Environmental Reviews for Project Decision-making and One Federal Decision

The most significant reform to the environmental review and permitting process in ATIA is the codification of Executive Order 13807, which institutes the One Federal Decision. This provision addresses significant bureaucratic issues without sacrificing substantive environmental protections that include, but are not limited to:

- **BUREAUCRATIC ISSUE: Time and money is wasted on redoing project analyses and reviews and on collecting duplicative information from permit applicants.** Challenges with environmental review and permitting process are root causes for delays on infrastructure projects. The environmental permit approval process generally entails sequential reviews by multiple agencies and various requests for project specific information. Even though each agency has slightly different forms and different information requirements, some of the information (like project descriptions) is duplicated across applications. This means that there can be multiple forms requesting the same information in different ways.
- **SENSIBLE ATIA SOLUTIONS:**
  - ✓ Calls for all federal authorizations and review for a project to rely on a single environmental document prepared under NEPA.
  - ✓ The final environmental impact statement for a major project must include an adequate level of detail to inform decisions necessary for the role of the participating agencies in the environmental review process.
- **BUREAUCRATIC ISSUE: The absence of completion goals and schedule modifications creates uncertainty.** Under current law, a lead agency is required to "establish a plan for coordinating public and agency participation in and comment on the environmental review process for a project...". As part of this coordination plan, a lead agency is also required to

[15] NAEP annually reports information on EIS time frames by analyzing information published by agencies in the Federal Register, with the Notice of Intent to complete an EIS as the "start" date, and the Notice of Availability for the final EIS as the "end" date. However, AGC members' experiences show that it's common for large and controversial projects to take even longer than these numbers reflect. See e.g., Federal Highway Administration, "Estimated Time Required to Complete the NEPA Process," available at - https://www.environment.fhwa.dot.gov/strmlng/nepatime.asp.

establish a schedule for completing the environmental review process after consulting with and receiving the concurrence of the participating agencies, the state in which the project is located, and the project sponsor (if applicable). Current law also allows the schedule to be modified under certain circumstances. The duration of such a schedule will vary from project to project. While a modification to a schedule may be necessary, the prospect of such a modification can create uncertainty. Establishing consistent goals to complete the environmental review and permitting process for a project, with appropriation option for extending such goals, will help ensure predictability.

- **SENSIBLE ATIA SOLUTION:**
  - ✓ Establishes a two-year goal for completion of environmental reviews under NEPA for major projects with an option to shorten or extend the goal under certain circumstances, and a 90-day timeline thereafter for related project authorizations (permits license, approval) after the issuance of a record of decision for major projects.
  - ✓ Requires the Secretary of the U.S. Department of Transportation (USDOT) to work with certain other federal agencies to identify which of its categorical exclusions (CEs), if applied by those agencies, would accelerate project delivery. The other federal agencies are further directed to issue a notice of a proposed rulemaking to adopt any of those CEs.[16]
- **BUREAUCRATIC ISSUE: Environmental reviews and permit processing can get lost in the paper churn among numerous government agencies.** A lack of transparency into a process that involves dozens of federal requirements and perhaps just as many government entities can lead to a project getting lost in the paper shuffle. This costs everyone involved and dependent upon the project time and money.
- **SENSIBLE ATIA SOLUTIONS:**
  - ✓ Requires the establishment of a performance accountability system for tracking major projects, which would include at a minimum the environmental reviews process schedule, whether the established schedule is being met, and time taken to complete the environmental review process.
  - ✓ If a cooperating agency fails to meet a certain deadline for a major project, the agency must submit a report to the USDOT Secretary that describes why the deadline was missed. The Secretary is then required to submit a report to Congress and make it publicly available on the internet.

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[16] In general, CEs have improved project schedules and efforts to provide additional avenues to identify CEs would further advance time savings efforts. As it stands, state DOTs and selected transit agencies report using such CE provisions already enacted in law to speed up the delivery of highway and transit projects. For example, according to a Government Accountability Office survey, 10 of 17 provisions that mainly created new CE were used by 30 or more state DOTs and generally sped up projects. Government Accountability Office, Highway and Transit Projects: Evaluation Guidance Needed for States with National Environmental Policy Act Authority, January 2018, available at: https://www.gao.gov/assets/690/689705.pdf

- ✓ Requires the USDOT Secretary to provide a report on environmental review best practices, programmatic agreements, and potential changes to internal departmental procedures to speed up the environmental review process for projects.

B. Other Notable Reforms that Accelerate Project Delivery without Sacrificing Substantive Environmental Protections

AGC also appreciates the additional provisions included in ATIA to advance efforts to tighten project schedules without jeopardizing environmental protections. These include, but are not limited to:

- **Section 1309:** Establishes deadlines for federal agency review and response (45 days with 30-day extension) of certain categorical exclusion (CE) projects within the operational right of way, including preventative maintenance, preservation, highway safety projects, and new turn lane projects.

- **Section 1310:** Requires the USDOT Secretary to develop an annual report describing the median time for the completion of environmental reviews. As part of the report, the Secretary must list any new CEs and all regulatory requirements that have been removed or reduced in the previous fiscal year.

III. ATIA's Sound Framework for Building More Resilient Transportation Infrastructure to Better Weather Climate Change Impacts

A. Section 1407: Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation (PROTECT) Grant Program

In recent years, our nation has experienced significant natural disasters and catastrophic events which have tested our resolve as a country and as individuals. My home state of Texas has faced devastating hurricanes, including Hurricane Harvey in 2017. Our infrastructure, and in particular our transportation system, is vital to ensuring that Americans can safely evacuate from their homes, bring first-responders and critical supplies to those in need, and begin the path to recovery when the event is over and it is safe to do so. However, we've all seen pictures on the news of roads submerged or crumbled and bridges that are impassable, threatening the ability of the system to perform these vital functions.

AGC is pleased that the Committee incorporated provisions in ATIA to improve the resiliency of the transportation system. Arguably, the most significant of these provisions is the establishment of Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation (PROTECT) Grant Program. This program would thoughtfully support projects that reinforce, upgrade, or realign existing transportation infrastructure to better withstand extreme weather. It also includes funding dedicated to specifically improving the resiliency of transportation infrastructure in coastal states and emergency evacuation routes.

The PROTECT Grant Program provides almost $1 billion each fiscal year in dedicated funding for resiliency-related projects. The funding is distributed through a mix of formula funding to state DOTs and competitive grants to eligible entities. The diverse eligibilities within the program will help ensure that differing needs of states and communities can be adequately addressed. Other provisions include, but are not limited to:

- Expanded eligibilities for resiliency-related projects under the National Highway Performance Program, the Surface Transportation Block Grant Program and the Emergency Relief (ER) Program;
- Consideration of strategies to promote resilience in the National Freight Strategic Plan and state freight plans; and
- Revisions to the manual for the ER program to include procedures that state DOTs can use to incorporate resilience into ER projects, among other items.

IV. Conclusion

Mr. Chairman, thank you again for convening today's hearing. AGC greatly appreciates the opportunity to appear before the Committee and share our perspective on this important topic. The role of our national transportation system in supporting U.S. competitiveness and our quality of life cannot be understated. Transportation impacts the daily lives of citizens and businesses in every state in the Union. The American public recognizes the need to improve our system and bring it back to world class status.

A golden opportunity is before Congress. At a time when it seems there is little we all agree on, infrastructure may prove to be the missing link. I thank the Committee for steadfast, bipartisan efforts to improve our nation's infrastructure.

Senate Committee on Environment and Public Works
Hearing entitled, *"Better, Faster, Cheaper, Smarter, and Stronger: Infrastructure Development Opportunities to Drive Economic Recovery and Resiliency."*
July 1, 2020
Questions for the Record for Robert C. Lanham, Jr.

Senator Whitehouse:

1. As we consider our country's infrastructure development plans, we cannot ignore the urgent needs of our coastal communities, which continue to go unaddressed. Over the past decade, the Army Corps of Engineers spent between 19 and 120 times more on inland work than on coastal work in its Flood and Coastal Damage Reduction fund. The Land and Water Conservation Fund has similarly heavily favored inland projects over coastal projects, a disparity that Congress recently missed an opportunity to address. Coastal states are also seeing shores disappearing and properties threatened due to sea level rise. Should we not be focusing on infrastructure to support our coasts as they take the beating of climate change? What policies should we focus on pushing to address this coastal issue?

   Response:
   AGC believes that Congress should increase federal funding to improve the nation's infrastructure, including water resources infrastructure. Water resources projects create jobs, improve the quality of life for all Americans, protect our communities, facilitate waterborne commerce, restore environmentally sensitive areas of the country, and help grow our economy. However, Congress should take certain actions to ensure that the water resources infrastructure along the coasts and inland is adequately meeting the needs of all local communities. Specifically, Congress should:

   - Enact biennial water resources development acts. The predictability of the biennial passage of water resources development acts cannot be understated and is critical for all stakeholders involved in the planning and execution of water resources projects. AGC applauds the bipartisan efforts of the Senate Environment and Public Works (EPW) Committee to develop the America's Water Infrastructure Act of 2020 (AWIA). In addition to setting federal water resources policies, AWIA ensures that the U.S. Army Corps of Engineers (Corps) Civil Works Program is appropriately responsive to the water resources needs of all local communities by authorizing pending Corps Chief's Reports and new feasibility studies.
   - Improve the environmental review and permitting process for water resources projects. Texas has faced devastating hurricanes, including Hurricane Ike in 2008 and Hurricane Harvey in 2017. In 2015, the Corps and the Texas General Land Office as the non-federal sponsor initiated a study to improve the resiliency of the Texas coast. The study is not expected to be completed until 2021. AGC applauds the EPW Committee's inclusion of provisions that improve the environmental review and permitting process in AWIA, which will allow for critical water resources projects to begin quickly and efficiently without sacrificing important

environmental protections. For example, AGC supports Section 1101, which requires the Corps to establish a goal of completing the feasibility study by no later than two years after the date of initiation. Section 1101 further directs the Corps to use all existing flexibilities and exceptions to any requirement administered by the Secretary to speed up feasibility studies. In addition, Congress should also consider policies that improve the efficiency and effectiveness of the Civil Works Program itself.

- Provide robust, predictable appropriations for the Corps Civil Works Program. Project and feasibility study authorizations must be subsequently paired with a robust appropriation of funding for the Civil Works Program, otherwise local communities will not realize the benefits of these projects. AGC believes that Congress should provide the Civil Works Program with a five-year appropriation of funding instead of the current yearly appropriations in order to ensure an efficient execution of these projects and avoid delays and cost increases. In addition, Congress should consider additional policies that incentivize non-federal sponsors to contribute additional funding or other resources to water resources projects and feasibility studies, which will complement robust federal funding. For example, if a non-federal sponsor is willing to pay more than the statutory required cost-share of a water resources project, the current benefit-cost analysis (BCA) will not factor in this change. As a result, both the Corps and local communities are disadvantaged by the inflexibility of the BCA and this creates a disincentive for non-federal sponsors who are willing to contribute more funds to expedite a project.
- Address bureaucratic delays facing water resources projects. AGC believes that one of the biggest obstacles facing future water resources projects is double vetting process by the Corps and the Office of Management and Budget (OMB). The Corps' Chief Reports submitted to Congress show that the benefits of a project are at least as great as the cost. However, OMB subjects these projects to a second, more rigorous, benefit-cost ratio. Specifically, OMB often requires that the benefits of a project be 2.5 times greater than the cost. OMB's separate BCA often requires additional reviews and adjustments, resulting in delays and additional scope adjustments. AGC urges to Congress reform the BCAs and eliminate the duplicative and confusing accounting process to ensure that appropriate water resources projects can move forward in the legislative process.

Senator BARRASSO. Thank you very much for that very helpful testimony. We appreciate your being here today.

At this time I would like to turn to Ms. Christy Goldfuss, who is the Senior Vice President of Energy and Environment Policy at the Center for American Progress.

Welcome.

STATEMENT OF CHRISTY GOLDFUSS, SENIOR VICE PRESIDENT, ENERGY AND ENVIRONMENT POLICY, CENTER FOR AMERICAN PROGRESS

Ms. GOLDFUSS. Thank you.

Good morning, everyone.

Good morning, Chairman Barrasso and Ranking Member Carper. Thank you for inviting me to participate in this important hearing. It is truly nice to be out of the house for the first time in 3 months and be here in person.

I am the Senior Vice President of Energy and Environment Policy at the Center for American Progress, and previously ran the White House Council on Environmental Quality during the Obama administration.

Here is what I would like to tell the Committee today. Infrastructure policy cannot be separated from its implications for climate change, land use, structural racism, and the health of our communities.

The transportation sector is now the leading source of carbon pollution. The best time to incorporate the imperatives of climate change and climate justice into transportation policy were decades ago. But the second best time is now.

I congratulate the Environment and Public Works Committee for S. 2302, America's Transportation Infrastructure Act, which takes some important steps to grapple with these thorny and critical issues.

The $10 billion climate change subtitle, the first ever in a transportation bill, sets aside about 3.5 percent of highway funding to retrofit or relocate existing infrastructure to reward States that reduce transportation related greenhouse gas emissions. This is a promising start, especially given the bipartisan support.

At the end of the day, the fact that there is a climate change subtitle in this bill will mean that there should never again be a transportation bill that fails to invest in climate mitigation and resilience. Following your lead, consider how the House's current infrastructure bill begins to incorporate climate policy into the core highway funding programs, in addition to creating new funding programs similar to ATIA, for adaptation and mitigation. This kind of bicameral interest in reform represents a critical recognition that infrastructure policy is climate policy.

However, the climate funding in this bill cannot be put to good use to build resilient, climate ready infrastructure without proper planning, community engagement, and public review of the anticipated results. As this Committee is aware, this environmental review is the purview of the National Environmental Policy Act, or NEPA, which you are all quite familiar with, and which is currently under significant and overreaching attack from the Trump administration in the rewrite of the NEPA regulations.

NEPA is central, not antithetical, to the rapid permitting and construction of resilient and equitable infrastructure projects. Such projects require hundreds of millions, often billions of taxpayer dollars. It does not make sense to leap before we look and build an expensive new bridge in a location, for example, that is going to be underwater in 5 years because of sea level rise and storm flooding. That common sense approach is why 80 percent of Americans support NEPA. They truly want both a clean environment and strong infrastructure, and don't want to sacrifice one for the other.

NEPA and the environmental review process also ensure that all communities, particularly Black communities and other communities of color, have a voice in decisions that affect their neighborhoods and livelihoods. Without NEPA and with the changes that the Trump administration is near to finalizing in the regulations, communities will be unable to push back on projects that may literally make it harder for them to breathe.

This is not an abstract concern. Just this week, the Rhodium Group released an analysis that found, on average, Black Americans are exposed to 46 percent more diesel particulate matter emissions and 22 percent more air toxic respiratory hazards than White Americans.

Given dozens of actions by Congress over the past 20 years, we already have the necessary tools to ensure that NEPA's process is efficient, transparent, and successful.

But the Federal Government must use the authorities granted and invest in staff, basic tracking technology, and project management systems, not slash support, as this Administration has done. Specific recommendations for improving NEPA based on my experience at CEQ are included in my written testimony.

As this Committee knows, infrastructure policy is climate policy. And climate justice is also racial justice. This bill is a first step toward both these goals.

With investment, community input, and careful planning, we can truly form a more perfect Union, one built around justice, opportunity, and hope.

I look forward to your questions. Thank you for having me.

[The prepared statement of Ms. Goldfuss follows:]

Senate Committee on Environment and Public Works
"Better, Faster, Cheaper, Smarter, and Stronger: Infrastructure Development Opportunities to Drive Economic Recovery and Resiliency"
Testimony of Christy Goldfuss
Senior Vice President for Energy and Environment Policy
Center for American Progress
July 1, 2020

Introduction

Thank you, Chairman Barrasso and Ranking Member Carper, for inviting me to participate in this important discussion about infrastructure development and investment in the face of economic recovery and climate change. The truth is that infrastructure policy cannot be divorced from its implications for climate change, land use, structural racism, and the health of our communities. America's Transportation Infrastructure Act (S. 2302) takes some important steps to grapple with these implications, for which I congratulate the Environment and Public Works Committee. When it comes to transportation infrastructure, we all must work to ensure that we as a country include community input; ameliorate, not exacerbate climate change and other major environmental hazards; and protect civil rights.

When this committee marked up its reauthorization bill almost a year ago (July 30, 2019), few anticipated that we would now be simultaneously facing an unprecedented global health crisis, a nationwide economic recession, and a nationwide uprising against racism and police violence. Meanwhile, the dire impacts of climate change have started to accelerate, with extreme weather events such as flooding, hurricanes, and wildfires causing billions of dollars in destruction annually. As communities of color and low income communities continue to suffer from COVID-19 and police violence, they are being disproportionately wracked by climate impacts as well.

Climate Change

The best time to incorporate the imperatives of climate change into transportation policy was 30 years ago. The second-best time is now. Achieving net-zero greenhouse gas emissions by 2050 will require immediate and wholescale changes to land use and infrastructure policy in the United States, along with enormous investments to prepare for the changes in climate that we have already set into motion.

The $10 billion Climate Change subtitle in America's Transportation Infrastructure Act (ATIA), the first ever in a transportation bill, is a notable step in that direction, amounting to about 3.5% of the proposed highway spending. This includes $4.9 billion over five years in Sec. 1407 to start retrofitting or relocating some of the nation's most vulnerable infrastructure, beginning to make our transportation system and communities more resilient to extreme weather. The title also creates a $3.5 billion incentives-based program in Sec. 1403 to reward states that substantially reduce transportation-related greenhouse gas emissions over the next five years, encouraging states to think creatively and honestly about their transportation systems as a whole. The new provisions of ATIA, if sufficiently funded, would give state departments of transportation the tools and the incentives to recognize that their decisions have a major influence on the severity of climate change and our ability to withstand it.

This bill also starts to address the disparate effects of climate change and pollution on Black and other communities of color through provisions that reduce emissions while also reducing these communities'

toxic burden of pollution. For example, Sec. 1402--Reduction of Truck Emissions at Port Facilities--serves to reduce emissions at ports by providing grants to reduce idling and support port electrification. This competitive grant program could achieve the dual goals of reducing greenhouse gas emissions and pollution, improving the health of port-adjacent communities which overwhelmingly tend to be communities of color. The same is true of Sec. 1408, reauthorizing the Diesel Emissions Reduction Act (DERA); which provides incentives to take the dirtiest vehicles off the road.

At a time when Congress is considering how infrastructure funding may help to revitalize our economy and set it up for long-term success, forward-thinking climate-oriented investments are essential. Building infrastructure that is prepared for future disasters, through making changes to projects before construction rather than trying to remediate after the fact, is good government and deeply cost-beneficial. Supporting the electrification of the vehicle fleet, including through the $1 billion in grant funding under Sec. 1401 for which electric charging infrastructure projects can compete, will make our economy more competitive internationally. Increasing the funding set-aside for the Transportation Alternatives Program from $850 million to $1.3 billion annually in Section 1109(b) will make our communities healthier, safer, and more equitable in ways that people can immediately understand. And investing in natural infrastructure in the form of coastal restoration and resilience, through the aforementioned $4.9 billion in Sec. 1407's PROTECT grants, is a win-win-win for our economy, our frontline communities, and our environment.

Perhaps the most significant aspect of the climate change subtitle in this bill is that there should never again be a transportation bill that fails to invest in climate mitigation and resilience. Momentum is already building in the right direction. Consider how the House's current infrastructure bill, likely being voted on this week, H.R. 2., begins to incorporate climate policy into the core highway funding programs, in addition to creating new funding programs similar to ATIA for adaptation and mitigation. This kind of bicameral interest in reform represents a critical recognition that infrastructure policy is climate policy.

Yet we still have much more work to do. In order to limit climate change to a global increase of 1.5 degree Celsius as the scientists say we must, and to adapt to the impacts that cannot be avoided, we must be more ambitious still. The Center for American Progress published a report last October on the many policy reforms we must pursue to build a 100% Clean Future, of which additional infrastructure funding is just one part. Similarly, the House Select Committee on the Climate Crisis yesterday released its own report, making clear the enormous range of policy responses required to address climate change, and the incredible opportunities that ambitious climate action can unlock for our economy, our health, and the wellbeing of our children and grandchildren.

Environmental Review

It is important to note that the climate funding in this bill cannot be put to good use in a way that will build resilient, climate-ready infrastructure without proper planning, community engagement, and public review of the anticipated results. In fact, this planning is critical--not antithetical--to the rapid permitting and construction of resilient transportation and infrastructure projects that will serve communities, reduce climate-causing pollution in overburdened neighborhoods, and withstand the future impacts of climate change that we can not avoid. As this Committee is aware, this environmental review is the purview of the National Environmental Policy Act, or NEPA, which you are all quite familiar with and which is currently under significant and overreaching attack from the Trump administration.

NEPA and its implementing regulations for Federal agencies ensure that all potential impacts on a community as a result of a project are considered, and also that the public has an opportunity to comment on projects that may impact them. NEPA is a procedural statute only. While environmental and public health impacts must be assessed and project alternatives considered, NEPA does not require an agency to choose the most environmentally sound option, just to do the work to gather information and inform the public of potential impacts.

More than that, however, NEPA is simply good policy, supported by 80% of Americans. Federal projects require hundreds of millions, often billions, of taxpayer dollars. It does not make sense to leap before we look, and build an expensive new highway in a location that is going to be underwater in five years as a result of climate change impacts like flooding and sea level-rise. Environmental review protects against that kind of waste.

NEPA and the environmental review process also underscore that Black lives matter, by ensuring that all communities, and particularly communities of color, have a voice in transportation and infrastructure decisions that affect their neighborhoods and livelihoods. Without NEPA, and with the changes that the Trump administration is near to finalizing for NEPA's implementing regulations for agencies, communities would be silenced, unable to push back on projects that may make it harder for them to breathe. For example, Mossville, Louisiana, was formed by freed former enslaved people in the 1790s, becoming one of the first vibrant Black communities in the south. Today, however, it sits in the center of an area known as Cancer Alley thanks to the number of polluting industry facilities now located in and around it. Testing has shown higher levels of cancer-causing dioxins in Mossville residents' blood that can be tied back to emissions from facilities in the area. Mossville is a perfect example of a community where environmental review is critical. It would not make sense to build yet another chemical manufacturing plant there and consider its additional impacts in isolation from the existing pollution in the community. Yet the Trump administration wants to do just that, by entirely removing the requirement that agencies consider the cumulative impacts of a project.

The ways in which proper NEPA analysis, including a review of cumulative impacts, intersect with environmental justice are particularly poignant in the current moment when members of Black, Latino and Indigenous communities are being hospitalized with COVID at rates four to six times higher than their white counterparts. This is particularly stark given the Harvard Journal of Medicine study which found that higher rates of air pollution exposure, specifically to small particulate matter, was correlated with an increase in mortality rates from COVID. The study also notes that it is disproportionately Black and Latino Americans who live in these areas of higher air pollution, often as a result of communities situated near highways and other areas of congestion where tailpipe emissions are higher and more frequent. Underscoring this, the Rhodium Group released an analysis on June 29, 2020 that found that the average Black American is exposed to 46% more diesel particulate matter emissions and 22% more air toxic respiratory hazards than white Americans. The Rhodium Group writes:

> "The point of this analysis is to demonstrate that the same communities that have borne the brunt of the impact of COVID-19 this year have borne the brunt of the impact of air, water, toxic, and hazardous waste pollution for decades prior. As Congress turns its attention to legislation to help the economy recover from a COVID-19-induced recession, there are opportunities to do so while taking a step toward correcting historical environmental injustices."

These findings underscore that historic and continuing racial health disparities are a factor that must be considered by transportation and infrastructure legislation, policy, and planning. Further, these statistics show why we so critically need NEPA and not the chopped up, legally uncertain version of the statute that the Trump administration is serving up, which will increase litigation without promoting faster project delivery. Yet the Trump administration's proposed changes to the NEPA implementing regulations would encourage conflicts of interest that undermine communities; complicate and confuse the process for community input, thereby silencing communities; and remove the requirement that agencies consider the cumulative impact of a project, thereby negating consideration of future climate change effects and exacerbating existing environmental justice issues.

If implemented correctly, and using all existing authorities, the existing NEPA process can save us time in the long run, can help avoid additional environmental injustices, and can save taxpayers money. As many members of this Committee know, but is worth stating again, only a small fraction of projects -- less than one percent -- require the more substantive Environmental Impact Statement (EIS) under NEPA, rather than a relatively quick Environmental Assessment or being covered by a categorical exclusion. Further, while there is a significant lack of data, existing information shows that the primary cause of slowed or stalled projects is not lengthy NEPA reviews, but instead a lack of funding.

And we already have the necessary tools to ensure that the NEPA process is fast, efficient, transparent and successful. But we cannot achieve these things unless we use those tools and invest in staff, basic tracking technology, and project management systems to get the work done. If there is any reason for the existing NEPA process not working as well as it should right now, it is because the Trump administration has slashed funding for agency staff and programs that implement NEPA; not invested in or implemented all of the authorities presently available; and politicized the NEPA process. But through existing legislation and authorities, the Trump administration has many options for expediting permitting that do not include gutting a critical and successful statute.

From my experience as the Managing Director of the Council on Environmental Quality (CEQ) under President Obama, I recommend the following:

- **Fully fund NEPA offices and programs at agencies** to ensure that they are fully staffed, that the staff have the training and expertise needed, and that the agencies have the resources they need to conduct successful and efficient environmental review. Over the last two decades, agencies have seen their NEPA budgets shrink, and this has been accelerated under the Trump administration. The agencies that do the NEPA work have seen their budgets curtailed in recent years, meaning fewer staff and resources--and now they are being asked to go faster. The agencies and staff cannot do more with less--if our leaders are serious about actually expediting permitting and not just gutting environmental review, they must adequately fund these agencies.
- **Further invest in coordination and transparency for NEPA projects** through additional funding and attention to the Permitting Dashboard for Federal Infrastructure Projects and data collection for project processes. The Permitting Dashboard, where major federal projects are listed for agencies and the public to see the steps and project schedule, needs more funding to build out more functional tools (e.g. Geographic Information Systems technology) and to become a true interagency collaboration tool. With enough resources and investment, the Dashboard could even

host projects before an agency publishes a Notice of Intent, allowing cooperating agencies to plan ahead and prepare for significant projects, thereby streamlining the review process. Also, agencies should be directed to standardize data collection for all environmental review processes. Right now, there is a significant lack of data on the NEPA process, despite environmental review being continually blamed for project slowdowns. This would help to identify where commonalities in stalled projects lie, and provide common-sense and actionable lessons learned for Federal agencies.

- **Remove political influence from the environmental review process.** Under the Trump administration, political staff have been afforded significant sway in the environmental review process, slowing down or halting entirely reviews for their own reasons while NEPA is still blamed for project slowdowns. For example, the Environmental Protection Agency (EPA) moved its Office of Federal Activities, which reviews EISs, away from the Office of Enforcement and Compliance Assurance and into the Office of the Administrator. Further, after rushing environmental review processes for many significant onshore oil and gas leasing decisions, the Department of the Interior (DOI) has turned the tables on offshore renewable energy development and required a lengthy and unexpected review process, in essence halting several offshore wind projects. And this political interference reaches the highest levels of government. President Trump met with Senate Minority Leader Schumer in September 2017 to address the Hudson Gateway Tunnel project in a meeting that reportedly ended in general agreement around the need for the massive modernization project. Later, however, President Trump said he would only support funding for the project if the Senate authorized funds for a border wall; the Final EIS, which was due in March 2018, is still not out. In 2018, Politico Magazine reported: "'I wouldn't say we're slow-walking it,' one administration official told me, before laughing. 'OK, maybe a little.'"

Instead of going the way of the Trump administration and gutting NEPA, particularly at a time when future considering climate impacts and community input is more critical than ever, federal agencies and their partners should instead use these existing tools to permit and construct equitable and just transportation infrastructure.

Conclusion

The climate crisis is urgent and here--and this Committee's work has set an important marker for underscoring that infrastructure policy is climate policy. We can take this a step further to acknowledge that climate justice, of the sort that would be fostered through this bill's Climate Change subtitle and the critical environmental review that accompanies it, is also racial justice. It is time - and past time - that we assess infrastructure both for its role in future climate impacts and for its contributions to our communities' ability to withstand climate change.

This bill is a good first step. Now, we must ensure that we are planning to the best of our abilities for the crisis ahead. With investment, community input, and careful planning, the climate crisis can be an opportunity to truly form a more perfect union, one built around justice, opportunity, and hope.

Senate Committee on Environment and Public Works
Hearing entitled, *"Better, Faster, Cheaper, Smarter, and Stronger: Infrastructure Development Opportunities to Drive Economic Recovery and Resiliency."*
July 1, 2020
Questions for the Record for Christy Goldfuss

Senator Whitehouse:

1. As we consider our country's infrastructure development plans, we cannot ignore the urgent needs of our coastal communities, which continue to go unaddressed. Over the past decade, the Army Corps of Engineers spent between 19 and 120 times more on inland work than on coastal work in its Flood and Coastal Damage Reduction fund. The Land and Water Conservation Fund has similarly heavily favored inland projects over coastal projects, a disparity that Congress recently missed an opportunity to address. Coastal states are also seeing shores disappearing and properties threatened due to sea level rise. Should we not be focusing on infrastructure to support our coasts as they take the beating of climate change? What policies should we focus on pushing to address this coastal issue?

Christy Goldfuss response:

Thank for this important question, Senator Whitehouse. I agree that investing in coastal restoration and resilience is a win-win-win for our economy, our frontline communities, and our environment. As sea levels rise at an accelerated rate and extreme weather events continue to increase, restoring and investing in natural coastal infrastructure will protect coastal communities, including the most vulnerable communities, by buffering the impacts of storms.

However, as you rightly point out, over the last decade funding for ocean and coastal restoration projects has failed to meet demand. In 2009, NOAA received more than $3 billion in proposals for "shovel ready" ocean and coastal restoration projects but had only $167 million to allocate to such projects from the American Reinvestment and Recovery Act (ARRA). In 2017, NOAA received more than 167 proposals for National Coastal Resilience Fund projects costing more than $135 million but was able to award funding to just 19 projects totaling $13.8 million.

The Moving Forward Act (H.R.2), which passed the House on July 1, included an $3 billion for coastal and Great Lakes resilience and restoration, as well as a separate grant program to build living shorelines--projects that use natural materials and systems to support flood resilience. H.R. 2 prioritized funding for projects that--

- Stimulate the economy, are shovel-ready, and include low income communities, communities of color, Tribal communities, and rural communities.
- Provide important tools to help communities address the impacts of adaptation to climate change, including by constructing or protecting ecological features or green infrastructure that protects coastal communities from sea level rise, coastal storms, or flooding.

- Provide marine, estuarine, coastal, or Great Lake habitat restoration benefits that will make ocean and coastal ecosystems more resilient in the face of climate change.

These measures were also supported by the 44 groups, including the Center for American Progress, who recently signed a letter to Congressional leadership supporting investments in coastal restoration.

Senator BARRASSO. Thank you for your very thoughtful testimony. We are glad to have all three of you here today.

I want to start with a question that actually goes to all three of you.

I'm going to start with Mr. Lanham first. America's Transportation Infrastructure Act requires, as we talked about, environmental reviews for major highway projects to be completed in a timely and predictable manner. The permitting reforms in this bill mirror the Administration's One Federal Decision policy.

So starting with you, Mr. Lanham, will each of you please elaborate on how the bill's bipartisan permitting reforms will help deliver these projects faster, better, cheaper, and cleaner, while not sacrificing environmental safeguards?

Mr. LANHAM. Thank you, Mr. Chairman.

As we read it, absolutely nothing has changed in what agencies review and what standards need to be—there has not been a change in any of the environmental criteria by which it is just requirement that each must run concurrently and efficiently as they move through the process. So there has been no change.

The other benefit of that is it collapses the time. Instead of being sequential, it is concurrent review and evaluation of a project. That collapses schedule, much in the same way that we as builders collapse schedule looking at concurrent construction activity to moving.

The other thing I think often goes overlooked, Mr. Chairman, is that the program itself showing relevance to public need, when the process is delayed from concept to delivery, when you hear at a public hearing, I am not worried about it; my grandchildren will. Then that project, the entire program loses relevancy to immediate public need. If we are talking about resiliency and those other issues that are of immediate concern, we need a program that moves forward, and that can address those.

Thank you, Mr. Chairman.

Senator BARRASSO. Thank you.

Ms. Goldfuss.

Ms. GOLDFUSS. One Federal Decision is not a problem in the way it is written. It is how it is administered. The whole orientation of One Federal Decision is to make clear that the client of the Federal Government is the project proponent. That is just one client. The other client that is very important is the American public.

So from my time at CEQ, I was very much in favor of FAST-41 and the permitting counsel that we have. Because I do think having guidelines, transparency, and really making sure that we are building off the data that each agency has is important. And you need transparency and predictability to move forward and build the country the way we need to build it.

The problem is, you have to allow for the community engagement. That is a key part and a key constituency that is not recognized in the One Federal Decision.

So I don't in and of itself have an issue; it is just with how it is implemented, to make sure that we are continuing to keep community voices as part of that process, and as part of the timeline and the transparency that a project proponent needs. Because if you don't engage the community, you run into all these problems

on the back end. And that actually, at the end of the day, slows down the process.

Senator BARRASSO. Thank you.

Mr. Grumet.

Mr. GRUMET. I think I will just add that we all agree that you have to have a good process and good execution. I think the premise of NEPA requires focus and coordination.

The one thing that Congress really didn't imagine when NEPA was first put in place was the variety of different Federal agencies, all who have different opinions, different views, and different processes. So I think the most important aspect of One Federal Decision is that we have to have one Federal Government that is actually working at the same purpose.

I think you can summarize NEPA as a tale of two bridges. We had the Tappan Zee Bridge, the Administration made it a priority, the community focused on it, and within 11 months, a $3.9 billion project EIS was complete, and that was an incredible success story.

Fifty miles downriver, you had the Bayonne Bridge. Just wanted to raise the bridge, same footprint. It took 5 years to get a Federal decision that there was no significant impact. Same process.

So I think Ms. Goldfuss is right; it is about execution. I think the permit provisions in this bill set the right expectations for the country.

Senator BARRASSO. Hurricane season began June 1st, puts much of the East and Gulf Coast on warning into the fall. June through early July is peak fire season across the West.

In my home State of Wyoming, we can experience natural disasters, wildfires, as well as severe flooding, rockslides. So the toll that these natural disasters take on our Nation's roads and bridges is significant.

Let me start with you, Mr. Grumet. What are the benefits that States will see from investing in building more resilient roads and bridges as this bill recommends?

Mr. GRUMET. Mr. Chairman, I think it is an incredible insight, and very important to the Nation to realize that in 2019, it was the fifth year in a row that we had over $10 billion natural disasters. The extreme weather, being driven by climate change, and the cost of extreme weather being driven by our economic development, are only going to get worse. We just have to get ahead of it.

So I think as was indicated, the focus on resilience in this title is essential. It has been determined that every dollar invested by FEMA or HUD in resilience brings back $6 in saved costs. I also think it is really essential that we think broadly about how we are going to pay for our disaster resilience going forward. I think this Committee can do a lot of good if we brought disaster relief on budget, so that we actually thought about the full costs of our natural disasters and made the right kind of investments in resilience.

Senator BARRASSO. Ms. Goldfuss, I am out of time, so if you could briefly respond, because as you talked about, the best time to do something was 20 years ago; the second best time is today. I heard the same about planting a tree; best time to plant a tree 20 years ago; second best time is today. What are your thoughts on the resilience issue, and the benefits?

Ms. GOLDFUSS. I think it is critical, as this Committee has done, to really focus on the States making this decision as well, because every State is different. The impacts of extreme weather are really regional and depend on what the conditions are in that State.

So this is really the step that needs to become the norm in the future, as we experience more and more extreme weather. We have the tools, we have the information to plan for this. It is irresponsible to not spend the taxpayer dollars in a way that accounts for that.

Senator BARRASSO. Thank you.

Senator Carper.

Senator CARPER. Thanks, Mr. Chairman.

I just sat here listening to our witnesses, Mr. Chairman, and colleagues. We usually have very, very well spoken witnesses, thought provoking testimony, and excellent responses. But I think today it is especially so.

I just wonder, have any of you been on a debate team? Seriously, a debate team, in college?

Mr. Grumet, I see you raised your hand. Where did you go to school?

Mr. GRUMET. I was at Brown University. I actually had the privilege of debating with Senator Coons.

Senator CARPER. No kidding.

Mr. GRUMET. He was even good back then.

Senator CARPER. He still talks about that.

Anybody else? Maybe anybody else in the room?

Maybe we will get Johns Hopkins. Somebody in this room that you might have come across, come up against, like Mary Frances Repko?

Mr. GRUMET. Mary Frances—you are setting me up, Senator. Yes, Mary Frances was a terror at the lectern.

[Laughter.]

Senator CARPER. I don't win many arguments with her, either.

[Laughter.]

Senator CARPER. Ms. Goldfuss, were you really?

Ms. GOLDFUSS. Yes, and I also went to Brown University.

Mr. GRUMET. We didn't get out much, so the corona crisis actually brings us back to our college experiences of basically being by ourselves in our dorms reading our debate text.

[Laughter.]

Ms. GOLDFUSS. Ranking Member Carper, you have to ask who won the debate.

[Laughter.]

Senator CARPER. You can respond for the record.

[Laughter.]

Senator CARPER. This question is for all of you, we will start with Mr. Lanham, then Jason, and then Christy Goldfuss.

Our ATIA bill includes the very first ever climate title in a highway bill. As some of you have noted, it makes $10 billion of investments in resilience of our infrastructure, recharging and refueling stations to support the use of clean vehicles and planning to reduce emissions. We added these provisions because our Committee members on both sides of the aisle saw a need for a new program to

help States respond to the extreme weather that they are regularly facing.

The House today is considering legislation that would make additional investments in similar programs, although some are structured differently than our own.

A question for each of you: What are the benefits of addressing climate risks to our transportation systems in the surface transportation reauthorization? And conversely, what are the risks to safety and the economy of failing to address the current and future impact of climate change on our roads, highways, bridges, and other transportation systems?

Mr. Lanham, would you lead us off, please?

Mr. LANHAM. Thank you, Ranking Member Carper. I think that the need to address climate change is now rather than later. We talk about the severe weather, that plays right into the need to address it.

Senator CARPER. Are you from Houston?

Mr. LANHAM. I am.

Senator CARPER. I was there, I was there right on the heels of Hurricane Harvey.

Mr. LANHAM. Yes, you talk about building, mitigating infrastructure; we had 3 feet of water over everything. It was kind of hard to go anywhere.

The States need to be able to adapt and use the grant program under your ATIA in a flexible manner to approach it. But I think this all plays to the immediate need for resiliency in our infrastructure.

But how it gets defined, leaving this broad enough so each one—is it seismic retrofit out west, or is it flood evacuation? We can't lift Houston 3 feet if that much water falls. But we can see to the safe evacuation of all because we have resilient infrastructure in place that will allow for safe evacuation of people in the event of a hurricane that strikes the Gulf Coast.

I think you have set up that mechanism of which each of the States can address that to their own devices, their own peculiar and unique needs. But it is something that needs to be pushed now.

Senator CARPER. Thank you so much.

Mr. Grumet, same question, and I'll ask you to try to be brief.

Mr. GRUMET. I will try to be brief, and it will be difficult, because this is a passion of mine, Senator.

I believe that the effort to integrate climate concerns and the facilitation of building new infrastructure is a real inflection point that has truly the potential to shift the climate debate. We have been in a terribly stalemated position in which advocates for climate change have found themselves opposing modernity, and opposing new infrastructure.

When you look at the scale of the challenge, we have to build things many, many times faster, many, many times larger, many, many times bigger than we ever have before in human history. We are going to have to do all kinds of incredible, incredible projects.

And our regulatory structure right now does not tolerate success. So rather than focusing on single projects and single pipelines and

fighting about doing brown things slow, we have to have a new coalition that comes together to build the future fast.

I think that the climate advocacy community, if it sees the Congress moving toward solutions on climate change, will get past that kind of resistance to building things and actually recognize that the thing that we need more than anything to solve the climate challenge is to figure out how to modernize and facilitate faster construction of new, modern infrastructure.

Senator CARPER. Thank you. Thank you for those words.

Ms. Goldfuss, please, same question.

Ms. GOLDFUSS. Just quickly, we have seen with coronavirus that our economic system is not immune to external shocks. And climate is going to be a huge external shock, the cost of bridges, the cost of roads, mortgages when communities are underwater and the homes aren't worth as much as they were before. This is something we have to plan for, and in building resilience into our infrastructure, we are planning to be stronger in the future.

I completely agree that the climate community has come around to the fact that infrastructure policy is climate policy, and that we must build bigger, stronger, and faster. But we have to have the tools in place, and we have to make sure that the processes work.

So resilience being baked into the equation from the beginning is essential to make sure that we have sound infrastructure and that also we protect our economy and protect communities.

Senator CARPER. Thanks.

Mr. Chairman, we might want to invite more debate team members to come before us. These folks are really exceptional.

Thank you.

Senator BARRASSO. And we don't need to limit it to Brown University, either.

Senator WHITEHOUSE. I think we should.

[Laughter.]

Senator CARPER. What has Brown done for you lately?

[Laughter.]

Senator BARRASSO. Senator Whitehouse may have a specific recommendation regarding the best of Brown.

Senator WHITEHOUSE. We Rhode Islanders are very proud of Brown.

Senator BARRASSO. Senator Capito.

Senator CAPITO. Thank you.

Thank you, Mr. Chairman.

I want to thank our panel. What a difference a year has made. We know 11 months ago we approved ATIA, and in a unanimous, bipartisan fashion it came through our Subcommittee. We worked with Senator Cardin. And of course I appreciate the Chairman and Ranking Member kind of pulling it over the finish line. I think today it is now more deserving than ever that we take it, not just from the full Committee, but up to the full Senate and enact it into law.

I think COVID-19 has hammered our national economy. All three of you talked about that. It has really carried cost.

Installing the investments, for example, in my State of West Virginia, driving on deficient roads costs West Virginia drivers $866 million per year, a hidden expense of about $754 per person, due

to vehicle wear, depreciation, extra fuel. We do have some difficult terrain at times to get around. But it can also contribute to fatalities and injuries. And that costs money and obviously lives, which is very difficult.

I think that for places like West Virginia—I am just going to mention some that I think will be particularly important in this bill. The Nitro-St. Albans Bridge, which is I–64 outside of Charleston, and completing Corridor H, which is the last really planned part of the Appalachian Development Highway System, which goes through the center of our State, which has been being built for decades. We want to see that complete.

So I was proud to work with the regulatory streamlining provisions that are in here. Getting the permitting is absolutely critical.

Mr. Lanham, I have been on transportation for many years. Obviously here, and then over in the House, I was on the House Transportation Committee.

We have had a lot of stops and starts over the years, where we have had 3 month extensions, 6 month extensions, not quite as long as even a year. I know you have been in business for a while, and I am sure your company has been held hostage by the stops and starts and the sputtering of those acts as we did that over the last several years.

What kind of impact does that have on a company like yours, on your ability to get these large projects done, if we are only extending for 6 months, or extending for 3 months? Could you make a comment on that?

Mr. LANHAM. Senator, it is devastating to the program. One, because almost all these significant projects are multi-year projects. So unless there is funding certainty, according to Federal rules, the transportation plan is fiscally constrained. So unless they have the funding in place, those significant projects fall off the immediate plan. Or they trade funding for other essential projects and bundle it into the one.

But the overall system loses. The effect to businesses like ours is we lose opportunity. Then when there is reduced opportunity, we are laying people off.

Senator CAPITO. Right. That is what I was going to ask.

Mr. LANHAM. In 2008, we laid off 30 percent of the company.

Senator CAPITO. In 2008?

Mr. LANHAM. Yes, ma'am.

Senator CAPITO. Are you back up, or were you back up?

Mr. LANHAM. We are getting close, but it took a decade.

Senator CAPITO. And those are jobs that are good paying jobs; they sustain a lot of families in Texas, and certainly across the country.

I am interested to know, too, during the COVID experience that you had, did you have to furlough some of your employees?

Mr. LANHAM. Senator, no. We were blessed in our jurisdiction to be deemed an essential and critical activity. We capitalized on that. Now, we did operate safely, and instituted all the protocols in the workplace deemed appropriate and recommended.

And we were able to advance projects and advance the schedule on projects because of the shutdown and the reduced traffic demand. Because we are strictly a road and bridge builder. So the re-

duced amount of cars, we advanced projects 2 and 3 months in the schedule because of that.

Senator CAPITO. I guess there are some hidden nuggets of good news that happened during this time.

I was interested to hear, Mr. Grumet, you mentioned pipelines. In my State, we have two major pipelines that have been stalled in the courts for years. I think it is unreasonable to think that to get to the environmental goals of some of the community who think they are all of a sudden going to be accepting of pipelines is because they fight them every step of the way. Even though they have been lawfully, the one just went to the Supreme Court, on the permitting process.

I am very pleased that the NDAA includes a bill that Senator Whitehouse and I have worked on together, from both sides of the aisle, it is called the USE IT Act. What it does is it works with the creation of pipelines to carry that CO_2 to other energy producing sites. Hopefully, that will have some impact.

But we all have to get—if we are going to modernize and build and use our own natural resources, this pipeline stalling and using legal tactics to really off the projects is deeply troubling to me and my region of the country. Certainly, it has to be troubling to the Northeast, where our resource aren't able to help those folks up there have more affordable energy costs.

Thank you, Mr. Chairman.

Senator BARRASSO. Thank you.

Senator Cardin.

Senator CARDIN. Thank you, Mr. Chairman, and let me thank all the panelists. I am sorry I have to do this through the Internet, and not be there in person to join you. But let me thank you all.

I just really want to underscore first the points that have been made by my colleagues. Senator Capito and I have worked very closely together in regard to infrastructure. I am very proud that we are able to do that in a bipartisan manner to advance infrastructure legislation. We have done that certainly on the surface transportation. We have also done it on the Water Resources Development Act.

But I think we all understand how important the COVID-19 was for us to move forward with infrastructure in this country. We are still in triage, so we are still dealing directly with the pandemic, dealing directly with the immediate economic impact. But we also need to recognize that when we come out of COVID-19, there is going to be a need for us to create jobs. Because many of the jobs that were here before COVID-19 are going to be lost, and we need to create jobs.

Investing in infrastructure helps us create jobs. And that is one of the real pluses here. We need to have a chapter this year pass that puts us on the growth for infrastructure improvement. At the end of the day, when we do that, we not only create jobs, we have a better community for the people to live in.

But here has been the key of the Environment and Public Works Committee. This is really what I want to emphasize, because I know we are having discussions about how we deal with resiliency, how we deal with a balanced program, how do we deal with issues such as transportation alternative programs. And there are dif-

ferent views in our Committee on that. And that is understandable. But we have been able to come together with a bipartisan product because we have listened to each other.

So yes, we need to build roads, and build and improve bridges. I can give you two in Maryland that need to be replaced, the Johnson Bridge, the Nice Bridge, we need to make sure we do that.

But we also have to invest in maintenance and maintain our current infrastructure. We have to invest in transit. In Maryland, the Purple Line is now under construction. The Purple Line is critically important for the traffic jams that we have in the Washington, DC, area.

So we need to invest both in roads and bridges, but also in transit. Yes, we need a very strong, robust Federal partnership, but that can't be dominant from the point of view of local decision-making. But that is why the Transportation Alternative Program is a critically important part of our Surface Transportation Act.

Bipartisan efforts; I was on the phone earlier this week with our tourism industry. Obviously, it has very much been impacted by COVID-19. But they stressed to me the importance of TAP funding in order to deal with local priorities that can help their local economy and a better quality of life for the community that they serve.

So we have to be mindful of that. We also need to have opportunities where it is appropriate for public-private partnership. These are all issues that we want to deal with.

But the issue that—I just heard the last discussion with Senator Carper, dealing with resiliency, dealing with adaptation, dealing with smart transportation alternatives for our environment, such as electric vehicles. All that needs to be part of a balanced package so that we can continue to enjoy strong, bipartisan support for a robust infrastructure program that can pass the Congress and be signed into law.

I want to ask Ms. Goldfuss a question, sort of to tail onto something you have already talked about. And that is, there is always the issue of whether it is going to be good for the environment or good for our economy. I think that is a false choice, and I want to give you an opportunity to explain how when you invest in smart environmental policies, including in transportation, it is actually a plus for our economy. I will give you an opportunity to expand on that if you might.

Ms. GOLDFUSS. Thank you, Senator. It is absolutely a false choice, and the American public believes that. If you have good governance, if you have a Federal Government that knows how to move through a process, then you can have both good community engagement and understanding of the clean water impacts, the clean air impacts that are going to come from a project. You also will understand how to use the taxpayers' money in a sound way.

But that is the bare minimum that the American public expects, that they are going to have clean air and clean water, and they are going to have safe bridges and safe roads. So to say that one has to be sacrificed for the other, or that one needs to be put aside for the other, is wrong on both sides. We have got to do them both. That is the expectation. And with the processes and a strong government that understands how to move through the process and engage the public, you can have both.

Senator CARDIN. Thank you very much.

And thank you, Mr. Chairman.

Senator BARRASSO. Thank you.

Senator Boozman.

Senator BOOZMAN. Thank you, Mr. Chairman, and thank you and Senator Carper, for holding this hearing, which is so important.

Mr. Lanham, as you know, America has a complex transportation system in dire need of repair. Without our Nation's rail network, barges, and trucks, much of our economy would become stagnant. We all agree on the importance of infrastructure investment, but if we rely too heavily on one mode of transportation, we do ourselves a disservice.

When commerce is strong, it is because of our intermodal system. I believe it is important that we invest in all of its components.

Will you explain how water, road, and rail all rely on each other in a cost effective and efficient commerce system? In fact, I think J.B. Hunt—their headquarters happens to be about 5 miles from where I live—I think they are one of the biggest customers, maybe the biggest customer, of the railroads in the sense of the ability to use containers on trucks and rails and how that works together.

Mr. LANHAM. Senator, we have a multi-faceted transportation network. It is probably a lot more complex than most people would even realize. When it comes to the movement of goods and services, rail, truck, rails out of ports to distribution centers onto trucks, just exactly as you described, Senator. With regard to much of our public infrastructure, it is also the conveyance of clean water in our water system.

So the importance of water right now, just to leave a point, is probably in—we refer to it back home in Texas, it is the new gold. Without water, we have no life. It is an essential element. It is part of our infrastructure network that we critically, critically need to take care of. It almost always occupies the public right of way that holds a road, almost always, somewhere.

So they are both so significant in purpose to when we talk about the quality of life of Americans in our infrastructure investment in the broadest sense, that is exactly what we are saying. Clean water, great transportation network, affordable goods and services to the average citizen. They can enjoy a quality of life that is unprecedented. We have grown to expect that in this Nation, and we need to continue that investment.

The challenges that we face are going to require unprecedented levels of investment.

Senator BOOZMAN. As we have on time delivery, things like that, the efficiency being so much greater than it used to be, what does that do for the environment?

Ms. GOLDFUSS. Yes, for the environment, it is important to have the information about where the projects are going to be. That allows you to understand what places should be protected, what places are necessary for clean water and clean air, and where we can actually have development that will be——

Senator BOOZMAN. As far as just moving goods and services efficiently, where you are not running your truck or your, the ineffi-

ciencies on our waterways that occur sometimes, what does that do?

All of this, again, working together, if we have system that works well, works efficiently, we get rid of the areas of congestion that we have that, again, the on time delivery system, which has been such, we have experienced some problems with that, with COVID. And we need to address that in the future.

But the system really does work very well. So getting these things right, besides being more efficient, more cost effective and things like that, it is also very helpful for the environment, too.

Ms. GOLDFUSS. Certainly, the grant programs that you have in this bill around ports and around diesel emissions reduction, anything that is more efficient reduces pollution. And that clearly reduces the impact in the environment. That is going to be essential for us to get those systems right, so that we are able to calibrate and make sure that we get those pollution reductions that we need.

Senator BOOZMAN. OK. Very good.

Thank you, Mr. Chairman.

Senator BARRASSO. Thank you very much.

Senator Whitehouse.

Senator WHITEHOUSE. Thank you, Chairman.

First, let me welcome not one but two Brown University graduates. This is a big day for Rhode Island in the Committee.

And let me thank the Chairman for his concern for bipartisanship in infrastructure. I think that the Chairman's concern for bipartisanship in infrastructure could well be met by a conference between the Republican controlled Senate and the Democratic controlled House on an infrastructure bill if we can get it through the Senate floor. So I am all for getting our bill through the floor, and moving to conference.

My question for the witnesses has to do with geography. As you know, Rhode Island is a very coastal State.

Thank you, Chairman, for mentioning hurricane season, something that does not hit landlocked Wyoming, but is a big deal for our coastal States.

I wanted to consider some of the things that we face on coasts. We oversee the Army Corps here. If you can believe it, there is a fund at the Army Corps called the Flood and Coastal Damage Reduction Fund. But if you look at how much of the money in it gets spent on coasts, on a good year, it is $1 out of $20. In a bad year, it is $1 out of $120.

So here is the Army Corps in theory having this fund for coasts, and ignoring coasts almost completely.

We have just passed, with my support, the Land and Water Conservation Fund. I am very sorry that we were not given the chance to add a bipartisan amendment that would have passed to increase funding for coasts. Because as we know, the Land and Water Conservation Fund is an upland and inland program. For every dollar that goes to inland States, only 40 cents per capita goes to a coastal State.

And in the coastal State, a lot of that 40 cents gets spent in Texas, in Pennsylvania, and New York, on projects that are not coastal. So if you dig deeper, the bias in the Land and Water Conservation Fund against coasts is far worse than the two to one that

you would think, just looking at the States themselves. Unfortunately, we weren't able to get anything for coasts until the Land and Water Conservation Fund.

On wind energy, we see in Wyoming and across the country wind energy development happening very rapidly. In our coastal States, with one exception, Rhode Island, we have offshore wind energy that is completely tangled up in siting, and we have a Trump administration that seems only to care about environmental concerns when it can put them in front of offshore wind. Because what offshore wind does is it displaces natural gas, and the people making these decisions come straight out of the fossil fuel industry.

So again, coasts are getting treated like second class citizens.

Of course, we face things that other States don't, which is that our shores will actually disappear. We are actually going to lose parts of our State to sea level rise.

I would like to put a recent article from the Providence Journal titled Rising Threat: New Study Finds Thousands More Properties at Risk of Flooding, into the record, Mr. Chairman.

Senator BARRASSO. Without objection, so ordered.

[The referenced information follows:]

PROVIDENCE Journal

Rising threat: New study finds thousands more properties at risk of flooding in 100-year storm

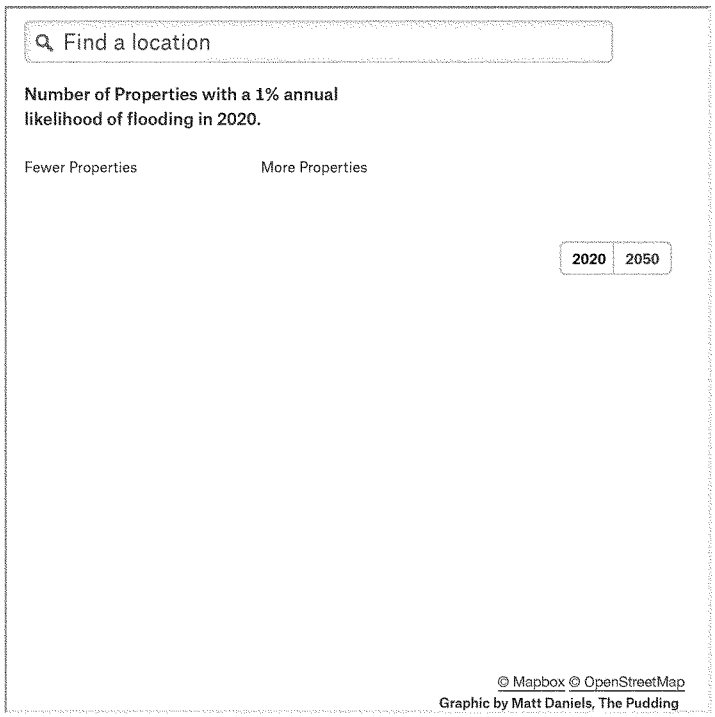
By Alex Kuffner
Journal Staff Writer
Posted Jun 28, 2020 at 1:28 PM
Updated at 9:29 AM

PROVIDENCE — Thousands more properties in Rhode Island are at risk of flooding from an extreme storm than is estimated by the federal government in maps used to determine insurance protection, according to a report released Monday by a nonprofit research organization that collaborated with dozens of scientists from around the country.

The study by the New York-based First Street Foundation found an additional 2,558 properties in the state at risk of flooding in a 100-year storm, one that has a one-in-100 chance of happening in any year. The total number of at-risk properties calculated by the organization is 26,478, an 11% increase over the number modeled by the Federal Emergency Management Agency in flood insurance maps.

And while FEMA does not incorporate climate change projections into its maps — basing its assessment only on historical data — the First Street study looked forward to the coming decades, estimating that, as sea levels rise and the atmosphere warms, the number of at-risk properties in Rhode Island would climb to 28,423 in 2035 and to 30,368 in 2050. The latter number represents 7.9% of all properties in the state.

The research projects forward to 2050 because that is when a traditional 30-year mortgage issued today would expire. Any increase in flooding risk increases the risk taken on by lenders and could have wider implications for the nation's housing markets. It could, for one, make it harder to get a loan, according to research from the Federal Reserve Bank of San Francisco.



The risks are also threatening the value of millions of coastal homes, according to the Union of Concerned Scientists. Previous research by First Street estimated that Rhode Island properties lost $44.7 million in appreciation between 2005 and 2017 because of increases in tidal flooding caused by sea-level rise.

The new flooding data for Rhode Island were released as part of a nationwide study done by First Street and more than 80 partners at Columbia University, the Massachusetts Institute of Technology, Rutgers University and other research institutions. Their model determined that 14.6

million properties nationwide are at substantial risk of flooding today — a 70% increase over the FEMA estimate. The First Street number grows to 16.2 million by 2050 because of climate- change impacts.

As part of its work, the First Street team also launched a website that allows property owners to research flooding risk. Users can enter an address to view a "Flood Factor," a score from 1 to 10 that assesses the cumulative risk over a 30-year mortgage, or the chances of some flooding at any time over the course of that time period.

The interactive tool, found at FloodFactor.com, will allow users to estimate depth of flooding, view maps to see the extent of flood waters, and look at potential remedies that may include raising structures higher off the ground. It will be updated with new data every three months.

The flood maps drawn by FEMA have been under fire for years. Critics charge that they are outdated, fail to account for changing conditions, and that the process to delineate flood zones is prone to political interference.

Matthew Eby, founder and executive director of First Street, said the new study and online tool are aimed at educating the public about the flood risks to their properties and how those risks could be affected by climate change. Until now, the data was only available to big institutional investors with the resources to pay for it, he said.

"What we're hoping to do is twofold: one is democratize this data so that everyone has it and has the ability to understand their personal flood risk," Eby said. "And two is then you have the information and you actually can protect your property."

The data for Rhode Island offer a mixed bag. While First Street found a net increase in the number of homes at substantial risk, it actually adjusted FEMA estimates downward in Bristol, Newport and Washington counties, places with extensive shorelines that are generally seen to be most threatened by flooding in Rhode Island. But increases in Kent and Providence counties outweighed those reductions, leading to a higher number of at-risk properties for the state as a whole.

Jeremy Porter, director of research and development at First Street and a professor of sociology at the City University of New York, said that as a broad rule the FEMA flood maps overestimate the number of at-risk homes in coastal areas and underestimate the number in inland areas. The FEMA maps in many instances are broadly drawn, encompassing properties or even whole neighborhoods that may not be at risk, or vice versa.

First Street's study uses laser radar data and other information from the U.S. Geological Survey and the National Oceanic and Atmospheric Administration to give their maps a higher resolution, Porter said. The differences with the FEMA maps are especially stark in places far from the coast, where flooding from rivers is the main threat.

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How **Providence** compares to nearby **counties.**

COUNTY	Properties in Flood Zone	Total properties in County	Percent in Flood Zone
Providence county, RI	11,996	192,555	6%
Kent county, RI	5,108	64,591	8%
Bristol county, RI	1,739	21,443	8%
Windham county, CT	3,714	48,123	8%
Bristol county, MA	9,160	184,090	5%
Norfolk county, MA	17,084	203,977	8%
Newport county, RI	1,481	35,445	4%
Washington county, RI	6,154	68,423	9%
Worcester county, MA	21,624	288,611	7%
Tolland county, CT	3,501	52,210	7%

Graphic by Matt Daniels, The Pudding

Rhode Island is no stranger to innovative flood maps. Because of the perceived weaknesses in FEMA's maps, the state Coastal Resources Management Council and the University of Rhode Island have collaborated for years on a project to develop alternatives.

The results so far include an interactive website called StormTools in which users can enter their address and get projections for flooding in various sea-level rise and storm scenarios. They also include the Coastal Environmental Risk Index, a series of color-coded maps that estimate flood damage to structures in the most vulnerable parts of Rhode Island.

The effort was capped this past winter with the release of a smartphone app that allows users to quantify how sea-level increases in coming decades could ramp up damage to structures in Rhode Island and in turn calculate the amount of protection that could be offered by raising structures above floodwaters.

When shown the First Street study, Malcolm Spaulding, emeritus professor of ocean engineering at the University of Rhode Island who co-led the project with the coastal council, questioned some of its findings for Rhode Island, saying that it underestimates the risks in coastal areas.

Grover Fugate, the former director of the coastal council who retired in May after more than three decades in charge, said there are instances in which FEMA has overestimated the threat of flooding. In one instance, in Bonnet Shores, in Narragansett, the FEMA map assumes waves impossibly coming around a rocky point to cause damage, he said.

But he and Spaulding both said that the federal agency also underestimates wave heights in general and underestimates the size of potential surges coming up Narragansett Bay, which would gather height as the Bay narrows. That amplification effect is one of the reasons why URI and the coastal council believe low-lying Bristol County to have some of the most vulnerable areas to flooding in Rhode Island.

In the First Street study, Providence, Warwick and Cranston have the highest numbers of at-risk properties. But the communities with the greatest proportion of properties at risk are Charlestown, Central Falls and Newport.

States | Counties | Cities

Find a location

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Graphic by Matt Daniels, The Pudding

In Charlestown, a beach community that opens onto the Atlantic Ocean, a quarter of the properties are at risk today. By 2050, a third of the properties would be at risk, according to the projections.

Doug Gablinske, owner of the real estate appraisal firm AppraiseRI, said the study bolsters the case that increasing flood risks will affect property markets, but he cautioned that in Rhode Island he and others in the industry have yet to see empirical evidence of an impact. Appraisals are based on the market value today, not what it could happen in the future, he said.

"Anecdotally, being in a flood zone has forced buyers to look more critically," Gablinske said. "But we have not been able to prove an impact by market data."

Fugate said property owners must understand the risks that will come with a higher frequency of extreme storms caused by warming of the atmosphere and oceans and with sea-level rise that will increase the height of storm surges. With two feet of sea-level rise, for example, the surge from a 20-year storm in the future would look like one from a 100-year storm today, according to a planning document written by the coastal council and URI.

But the changing conditions shouldn't only mean that everyone has to pull back from the coast, said Fugate. People can take steps to protect their properties, such as moving mechanical systems up above the ground, or, if they're building from scratch, raising the whole house up.

"There are sites that can survive, but you need to design for these conditions," he said. "Let's recognize what it is and let's build for that."

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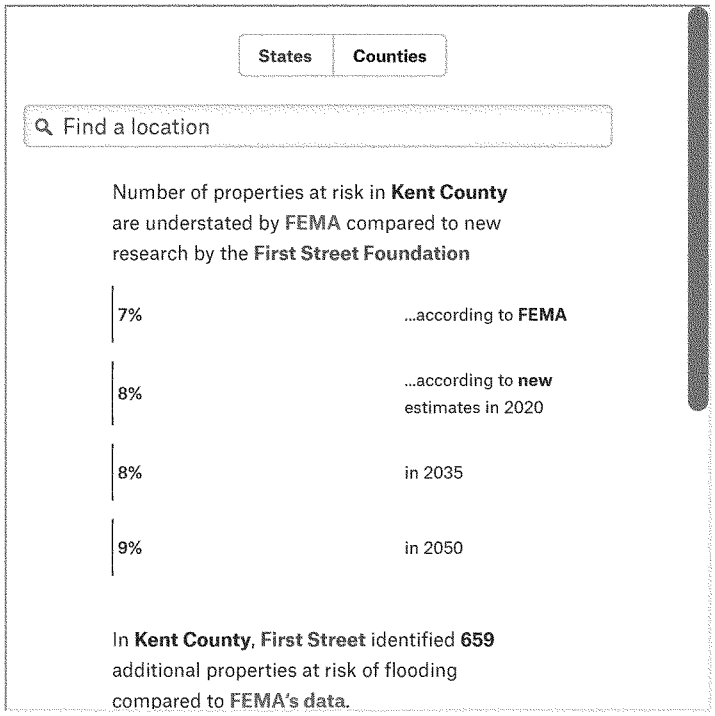
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Number of properties at risk in Kent County are understated by FEMA compared to new research by the First Street Foundation
7%
...according to FEMA
8%
...according to new estimates in 2020
8%
in 2035
9%
in 2050
In Kent County, First Street identified 659 additional properties at risk of flooding compared to FEMA's data.

Senator WHITEHOUSE. So my question to the panel is, should we not be focusing a lot in infrastructure on coasts? Not just the infrastructure that is at risk along the coast, but also the infrastructure that can support them as they take the beating that climate change has steering toward them right now.

Mr. GRUMET. Senator, on behalf of the whole panel, I can assure you that we all believe that coastal preservation and resiliency is essential.

I want to pick up quickly two points you made. You mentioned offshore wind. I think offshore wind is the poster child for what we need to do to improve our permitting structure in service of a sustainable climate. We have an incredible resource base in this country for offshore wind. They are building offshore wind in Europe.

We do not have a technological challenge in this country.; we have a bureaucracy challenge in this country. And if we can't figure out how to streamline and modernize our permitting system, we are going to lose that incredible opportunity, both economic opportunity and environmental opportunity.

I would step back and think more broadly about our disaster relief system in general. It tends to be kind of a mess. It tends to be a mess because we focus on disaster relief mostly in the middle of natural disasters, which of course the worst time to be thinking about forward looking cost-benefit analysis and planning. It is the time you have to be thinking about people who are suffering immediate harm.

I think one of the problems, as I mentioned earlier, is we don't pay for our disasters. We are surprised year over year by very predictable events. We do emergency off budget funding. And we try to raise money, but do not do the kind of rigorous planning that you are suggesting is necessary.

If we had to grapple, if this Congress had to grapple with appropriating a trillion dollars of disaster relief funds, I think that would focus the mind in a different way. I think you would start to see a more equitable resource allocation that I think would probably address some of your concerns about coastal resources.

Senator WHITEHOUSE. Mr. Chairman, I am over the time, so if I could ask the other two witnesses to respond as a question for the record, I would appreciate it.

And if I may take a Rhode Island moment, I would like to say that there is a reason that the only offshore wind located anywhere in the United States is sited in Rhode Island. It is because Rhode Island figured out how to solve the siting problem.

It really wasn't all that complicated. It begins with bringing everybody who has an interest in the location into the same room and sorting out the really obvious stupid questions, getting them off the table, getting them all sorted out before you begin the application process. And then you can use the process to sort through further details.

Unfortunately, both the other companies that came into this process, including a Massachusetts company that should have known better, and the Administration, despite having that winning program right in front of them, that process right in front of them, decided to go completely different ways. As a result, we are still all

totally bolloxed up. It is unfortunate. I hope that it is not also driven by a bad motive.

Thank you.

Senator BARRASSO. Thank you so very much.

Senator Booker.

Senator BOOKER. Thank you, Mr. Chairman. I appreciate this hearing more than you know. It really is incredible for me to see the depth and level that we have of bipartisan spirit here.

I heard a mention earlier of the Bayonne Bridge. I remember how frustrated I was to see a lot of the challenges we had in terms of getting a lot of the approvals necessary for projects that were utterly essential.

And so I just want to first and foremost ask the panel to reaffirm something that I really believe, that there is a large bipartisan sense of urgency in our country to do what is necessary in this area. We are a Nation that, this is not a left or a right issue, it is really about moving forward.

I know this was mentioned earlier, but if you could specifically talk about this false dichotomy between affirming the environmental urgencies of this moment and making sure that we also get projects done in a timely way that honors the taxpayer dollar.

I know that there are issues; the Eisenhower Highway Act would be about a trillion dollars' worth of infrastructure investment if it was done today. But we wouldn't get as far today because of a lot of the challenges of approvals and the like.

But I really do believe that there is a resonance between streamlining and looking forward and getting major projects done.

In New Jersey, there is an outrageous urgency, for example, to get the tunnels under the Hudson River, it has been at the heart, at the center of so much of my work, working across the aisle with then-Governor Chris Christie, and Democrat Chuck Schumer, to get us all on the same page, to create a streamlining process to get something done quickly that ultimately, when done, will have a massive environmental positive impact on our region.

So I just react against a lot of the gridlock, and I am really working to smooth the sort of partisan fissures to get things done. I would just love to have the panel affirm that sense of urgency I feel, and that sense of conviction I feel that this is not a left or right issue.

This is about moving our Nation forward, about seizing opportunities, about adding to our economy, and ultimately, frankly, it is about making sure that we seize the chance to show that infrastructure and the environment are not only resonant, but we cannot deal with our climate change challenges without forging ahead far more aggressively on the infrastructure projects, major infrastructure projects in our country.

If the panel would comment on that, I would appreciate it.

Mr. GRUMET. Senator, this is Jason Grumet. If I can just jump in. I think the urgency is there, and the opportunity is there, but it is going to have to be seized by this Committee.

For too long, those who have been focused on infrastructure have been disinterested in climate change. And those who have been focused on climate change have been disinterested in infrastructure. We are all losing. We are not solving the climate problem, we are

not increasing the strength of our economy, and we are not addressing our resiliency issues.

This Committee has taken a very bold, and modest, but very bold step to reconcile those two different views. I think the combination of our economic crisis, which is not going to be a V shaped recovery, and the growing bipartisan appreciation that we have a climate crisis, which we can solve with a broad based set of solutions, not just renewables and energy efficiency, but a broad based, noncarbon set of solutions that include nuclear power and CCS and battery storage. I think we are at moment now, at an inflection point, where we can get our arms around this whole debate and really push things forward.

But we are not on track toward success. We have made tremendous strides in renewable power. It is now about 10 percent of our overall on the grid. We now have to get from 10 percent to 80 or 90 percent in 30 years.

So I do not believe we will seize this moment unless this Committee leads the effort to reconcile a shared climate vision.

The climate change issue has been a proxy fight in infrastructure project after infrastructure project. It is a losing battle, because it is not solving the climate problem, and it is not solving our economic problem. So I think there is a real important accomplishment in this piece of legislation that we really need to focus on and build upon, and build upon quickly.

Senator BOOKER. Thank you.

Anybody else who would like to comment?

Mr. LANHAM. One brief comment, Senator. The environment and meeting the public need for infrastructure is not mutually exclusive. We know that and understand that. But for both sides now, what we have to have is a process where there is accountability.

We all can tell war stories on both sides of the issue. The abuse of the system and abuse of the process would either work to the detriment of the environment or work to the detriment of a public improvement. That is not what this Committee is about, and there needs to be accountability in the implementation of the vision this Committee is putting forward. Without that accountability, we are going to continue to stumble and have these problems in the execution.

Senator BOOKER. Ms. Goldfuss, before you answer, I want to throw one more question on top for you.

I was a former mayor who was in office during the Great Recession. I know firsthand that during economic downturns, like we are in right now, local governments face challenges.

Right now there is an additional need for Federal infrastructure investment to rebuild our Nation's infrastructure, frankly, and address a lot of the economic challenges we have. It is one of the best times to spend money because the cost of capital is so much cheaper.

I just want to get a little bit deeper with you on the old rail tunnels and the related infrastructure between New York and New Jersey. This literally is where the Northeast region, which is one of the greatest economic regions on the entire planet, it is among the most critical infrastructure projects we have in our country right now. I believe that our whole country really is relying upon

us, on the busiest rail corridor in all of North America, in doing something urgently.

This is a project I want you to comment on. Because if we do not act immediately to advance the Gateway Program, not only will New Jerseyans continue to suffer and see regional economic harm, but it will cause a harm to the entire Northeast region because of the countless hours of delay that we see, from affecting individual families, to regional economy. Should the tunnel shut down, it would be cataclysmic in terms of the effect on the economy, costing us about $100 million each day.

On the other hand, though, on the positive side, every dollar that we invest in the Gateway Program provides $4 in return to our economy. So in this time especially this project will create jobs, boost the economy, improve safety and the quality of life for New Jersey commuters.

So I just want to ask you, in addition to the previous question, and then I will cede my time, but can you discuss the need for, on large scale projects like this, of national significance, in the context of a comprehensive Federal plan for stimulus economic recovery?

The Gateway Program in particular, it is important to note that these tunnels are just an example of the importance and effectiveness of NEPA, the NEPA process when it comes to large scale infrastructure.

So it is incredible that we have so many stakeholders nationally in a project like this, but we are still struggling with something as simple as an environmental impact statement with the Department of Transportation. I am so frustrated that we are years into this Administration and it continues to refuse to even finalize an environmental impact statement which will allow us to go forward.

So I am just hoping that, Ms. Goldfuss, you could comment on that frustration as an example, frankly, of how the lack of efficiency within our bureaucracies, and this truly profound impact it has on economic development on jobs, on the environment as well.

Ms. GOLDFUSS. Senator, I would just speak to your project and also the offshore wind projects that Senator Whitehouse raised. In both of these cases, there was very concerning evidence that politics has come into play in the environmental review process. Secretary Bernhardt is hugely critical of the environmental review process, yet decided to slap an entirely new set of environmental reviews on the offshore wind projects. It makes no sense.

Similarly, with the Gateway Project, we have clear evidence of the Trump administration and officials joking about slowing down the environmental review for the Gateway Project.

I know this Committee does not believe that politics should be involved in these major, major infrastructure projects that would put people back to work. I am hoping that we are seizing on a moment here where we need to put people back to work. There is an understanding that we need funding and investment in communities to do that. And we will find a way to remove the politics, understanding that jobs, whether they are around New York City, jobs offshore in Rhode Island, jobs in Wyoming, in any part of this country are going to be essential to the recovery coming out of this recession.

Senator BOOKER. I will just say in conclusion, this is so utterly unacceptable, that something as simple as an environmental impact statement, which we have been waiting for for 2 years, this is clearly an example of not just bureaucracy, but playing politics with the most important infrastructure project in North America, and arguably because of its economic impact, not to mention its environmental impact.

Just to travel from Boston to Washington, DC, we now move at half an hour slower than we did in the 1960s on the busiest rail corridor in America. It is absurd. It is unacceptable.

China has built 18,000 miles of high speed rail. Our busiest rail corridor in America moves half an hour slower than it did in the 1960s.

I am tired of the politics. This is outrageous. I have been working in a bipartisan manner with people on this Committee and others, with Roger Wicker and others, to advance this project, to change legislation, to get everything done.

Now we are facing hold ups within the Trump administration that are pure politics. There is no way to deny that. You can't even get this environmental impact statement. It is frustrating.

When this whole Committee hearing is talking about smoothing, expediting, getting things done, for the sake of our Nation and patriotism, it is so offensive to me that this project is being stalled because of politics, and really unacceptably hurting this country, our economy, and the well being of families in New Jersey and beyond.

I will submit the rest of my questions for the record.

Thank you.

Senator BARRASSO. Thank you very much.

Senator Carper.

Senator CARPER. Thanks, Mr. Chairman.

I ask unanimous consent to submit into the record a letter from scholars across disciplines, which studied the National Environmental Policy Act in Federal decisionmaking. In short, the data that they have pointed to is even starker than we have been discussing.

According to the research, far less than 1 percent of projects involve lengthy delays. Moreover, factors other than NEPA will likely contribute to the overall duration of these projects as well.

Senator BARRASSO. Without objection, so ordered.

[The referenced information follows:]

June 29, 2020

Dear Chairman Barrasso, Ranking Member Carper, and Committee Members,

We the undersigned academic researchers understand that the Senate Committee on Environment and Public Works is holding a hearing on July 1, 2020, titled "Better, Faster, Cheaper, Smarter, and Stronger: Infrastructure Development Opportunities to Drive Economic Recovery and Resiliency." We comment as scholars across disciplines who study NEPA and federal decisionmaking. We are all involved in a long-term project called NEPAccess, which is described at the end of this letter.

We write to address one relevant aspect of federal decisions related to infrastructure and other projects: The time required for agencies to produce an Environmental Impact Statement (EIS) to satisfy the National Environmental Policy Act (NEPA). Any consideration of amending NEPA to speed federal projects should be data driven. The data we provide constitute an important component of understanding the NEPA process.

In summary, this letter provides the following data:

- The midpoint, or median time for an agency to complete an EIS process is 3.6 years. A few projects that involved lengthy EIS processes are not representative.
- The initial phase of the EIS process—from Notice of Intent (NOI) to Draft EIS (DEIS)—is the most significant determinant of overall time to completion. The opportunity for the public to comment on a DEIS is less of a factor.
- The final phase of the EIS process—from Final EIS (FEIS) to Record of Decision (ROD)—lasts longer than required by NEPA indicating that factors other than NEPA contribute to overall duration.

NEPA requires an EIS for "major federal actions that significantly affect the quality of the human environment."[1] The vast majority of federal actions do not require an EIS; the non-partisan Government Accountability Office has estimated that federal agencies rely on EISs to comply with NEPA for less than 1% of federal projects.[2]

Nonetheless, concerns that NEPA may unduly delay federal decisions often focus on examples of EISs that have taken many years to complete. Concerns are also sometimes raised that NEPA's public participation requirement results in undue delay.

The analysis we offer is based on data contained in a spreadsheet posted on the Council of Environmental Quality (CEQ) website providing information about all EISs published in support of RODs signed between 2010-2017.[3] The spreadsheet consists of 1,161 EISs published by 51 lead agencies.

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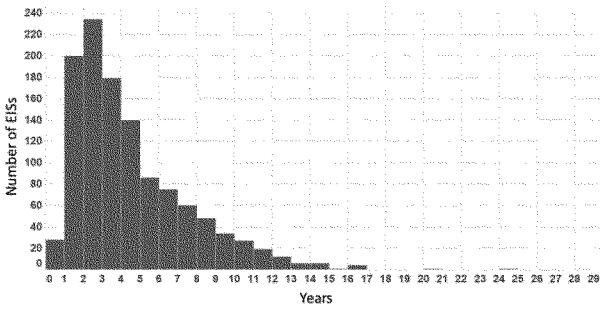
[1] 42 U.S.C. § 4332(2)(C).
[2] U.S. Government Accountability Office, GAO-14-370, *National Environmental Policy Act: Little Information Exists on NEPA Analyses* 8 (April 2014).
[3] https://ceq.doe.gov/docs/nepa-practice/CEQ_EIS_Timeline_Data_2020-6-12.xlsx

During this seven-year period, the average EIS process lasted 4.5 years—measured from NOIs to RODs. That average is, however, significantly affected by the long duration of a small number of what may be large, complex projects. The midpoint or median duration of EIS processes was 3.6 years. The duration of the EIS process was less than 2.2 years for 25% of projects and less than 6 years for 75% of projects. Figure 1 graphs these data and indicates that the distribution of projects has a long "tail" with a small number of projects requiring substantially more time than most.

Figure 1: Length of the EIS Process (in Years)

Mean	4.5
Median	3.6
25%	2.2
75%	6.0



The data in Figure 2 indicate that the initial phase of the NEPA process—from the publication of an NOI to DEIS—is the largest contributor to overall duration, accounting for 84% of the observed variation. The average time from NOI to DEIS was 2.6 years, the median time was 1.9 years, 25% of projects completed this phase within 1.1 years and 75% percent of projects completed this phase within 3.4 years.

In comparison, the time from the DEIS to the FEIS— during which agencies are required to allow the public to comment—the average was 1.4 years, the median was 1 year, 25% of projects completed this phase in 0.6 years and 75% of projects completed it within 1.7 years. During this phase of the EIS process, the CEQ regulations require that (1) the public has an opportunity to comment on the DEIS, and (2) the lead agency responds to public comments.[4]

The contrast between these two phases of the EIS process indicates that agencies' obligation to solicit and respond to public comments on DEISs is not the most important determinant of the duration of the EIS process.

The data in Figure 2 also indicate that the time required for agencies to make decisions is not always attributable to the NEPA review process itself. Federal regulations generally require that an agency must wait 30 days after publication of an FEIS to sign a ROD.[5] That pause affords the agency with

[4] 40 C.F.R. § 1503.1, 1503.4.

[5] 40 CFR 1506.10(b)(2). Agencies may be exempt from the 30-day waiting period if they have an internal process through which the public may appeal the agencies' decisions. *Id.* § 1506.10(b).

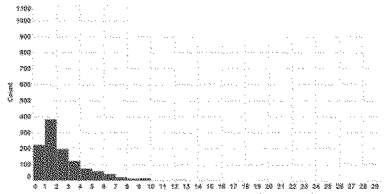
the opportunity for further internal deliberation before deciding but does not implicate any procedural obligation of NEPA.

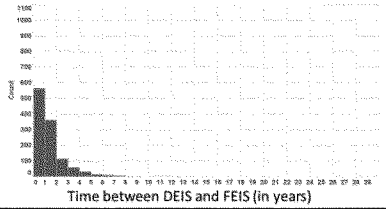
Nonetheless, this phase lasted more than 10 months for 150 projects and more than two years for 41 projects. NEPA compliance is unlikely to have caused agencies to issue a ROD more than 30 days after publishing an FEIS, indicating that considerations unrelated to NEPA account for this delay.

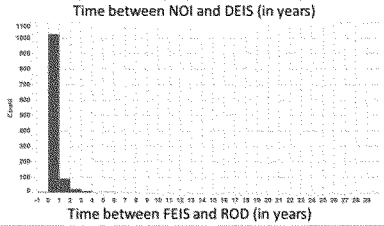
These data raise questions about the extent to which the amount of time involved in other phases of the NEPA process is influenced by considerations unrelated to NEPA compliance, and relatedly, the extent to which amending NEPA will speed agency decision-making processes.

Figure 2: Length of Major Phases of the EIS Process (in Years)

	NOI-DEIS	DEIS-FEIS	FEIS-ROD
Median	2.6	1.0	0.2
Mean	1.9	1.4	0.4
25%	1.1	0.6	0.1
75%	3.4	1.7	0.5







The data we have discussed provide a fuller picture of the time required for EISs that support the broad array of federal decisions to which NEPA applies than references to a few unrepresentative projects involving lengthy delays. Other important questions remain, however, that the data provided by CEQ do not answer. For example, a full understanding of NEPA would require, among other things, data about NEPA compliance at different federal agencies, data about different categories of projects, and data about the relationship of cooperating agencies to the duration of the EIS process.

The NEPAccess project is designed to study and inform these and other questions. NEPAccess is a multi-disciplinary research effort at the University of Arizona and funded in part by the National Science Foundation to create an integrated knowledge, discovery, and engagement platform that provides access to geo-referenced, published EISs (more than 37,000) and their supporting documents and to enable analysis using cutting-edge data science and natural language processing techniques to answer here-to-fore unanswerable questions about how NEPA has functioned.

More information about NEPAccess can be found at nepaccess.org.

Any effort to reform NEPA should be informed by data. We are committed to developing and analyzing policy-relevant data about the NEPA process and look forward to future opportunities to present our work to this Committee.

Sincerely,

(All of the following are signatories in their personal capacity only. Institutional affiliations are included for identification purposes only.)

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Senator CARPER. Thank you, sir.

One question, if I may, for Ms. Goldfuss, please. In your written testimony, you cited a report by the Rhodium Group that was released on June 29th, 2020, I guess it was just a couple of days ago. As you stated the report found that, "The average Black American is exposed to 46 percent more diesel particulate matter emissions and 22 percent more air toxic respiratory hazards than White Americans."

Given those statistics, it seems that where and how we engage with communities to build new roads in the future could help reduce this kind of pollution exposure.

My question is simply, would you discuss how the existing NEPA processes, when conducted appropriately, could help communities address environmental injustices in transportation projects as well as build infrastructure more expeditiously and save taxpayers money, please?

Ms. GOLDFUSS. Thank you. When we conduct community engagement in an appropriate way, we identify the problems before we even start to build. So what are the concerns that a community raises about pollution, about location, about impacts to the costs of their community?

In addition to that, we are able to share data about the particulate matter that is expected from a particular project, or about the other toxic pollution that could be a part of whatever development we need.

Last, we are able to look at how that is layered upon the other development and the other impacts in that community.

I always talk about Mossville, Louisiana, which is surrounded by 12 petrochemical plants. It is in Cancer Alley. This particular community, it would be insane to propose another project, another industrial project, without looking at how you are adding to the overall toxic burden of that community, rather than some place in a remote place where this would be the only facility.

So when the NEPA process has done well, when we are building off of data from different agencies, and we are incorporating the feedback from communities, you get to a place where you are able to resolve problems, so that a project can go faster, and that you are able to understand what the impact is and what the concern is going to be at a local level before you get too far down the road, and site the project in a place where you will have the least amount of conflict.

So I know that is the rosiest vision of how NEPA would work. But that is how it should work. If we have the tools, and there are tons of data tools, state of the art tools that we can use to expedite that process. And we have the will of a Federal Government that wants to listen to the people, not just the companies.

Mr. GRUMET. Senator Carper, can I just add that in addition to the project focused decisionmaking, we know we have two imperatives. We have an absolute imperative to build major projects very quickly. And we have an imperative not to exacerbate disparate impact on communities of color that have been burdened by environmental justice concerns.

We don't have to wait for a project to be proposed to understand the scope of these two challenges. What Congress tried to do in the

2005 Energy Policy Act was look forward and say, Where should we build things? What are the critical corridors? How do we step back and say, We are going to need thousands of miles of power lines and pipelines and battery storage facilities and renewables. Where are the right places to put those, and where are the wrong places to put those?

We should be getting ahead of this conversation and understand in the communities that have been unfairly imposed upon and protecting those communities, not stumble into these processes one after one after one. We have a national imperative to do both these things at once.

I think NEPA is a tool, but it is not the only tool we should be thinking about. I think we need a much more proactive national planning process that tries to reconcile these two concerns.

Senator CARPER. Thank you both very much for what you have said.

I would ask Bob Lanham, if you have a comment or thought you would like to make before we conclude? Anything else you would like to add?

Mr. LANHAM. Senator, I appreciate, again, the opportunity to be here. It is amazing.

I would leave with you, I had the pleasure and privilege about 18 months ago—and much of the dialogue was the same 18 months ago.

One thing a little bit absent that still I think is germane to our transportation network is based on what I see us do each and every day, building roads and bridges has to be one of the most sustainable construction processes in the country. Yet it is a story that we do not tell.

Between 2001 and 2009, we reconstructed 24 miles of Interstate 10 west of downtown Houston. And every bit of the concrete and base materials and pavements that were in the existing roadway was recycled and reused.

Senator CARPER. That is great.

Mr. LANHAM. Those stories around the country are not told. I think we do ourselves a disservice to not being able to explain to the greater public about what actually happens on these projects.

Senator CARPER. Good. I am glad I asked, and I am glad you answered. That was a good note to close on.

Mr. Chairman, this has been an extraordinary panel and I think quite a productive hearing.

Thank you all.

Senator BARRASSO. We thank all of you as well for being here, for joining us, and for sharing your great insights on these very important topics.

There are no other questions today, but there is going to be an opportunity for some members to submit some written questions. They may do that in the next couple of weeks, so we are going to keep the hearing record open for 2 weeks.

I want to just thank you again for being here. It was very helpful. I am glad you were able to get out of the house for the first time in 3 months. We will have to have you back again some time soon. Thank you to all three of you.

With that, I do have a unanimous consent request for materials for the record. Unanimous consent to enter into the record a statement from the American Association of State Highway and Transportation Officials, and a statement from the National Sand, Stone and Gravel Association in support of today's hearing.

Without objection, they will be submitted to the record.

[The referenced information was not received at time of print.]

Senator BARRASSO. With that, the hearing is adjourned.

Thank you very much.

[Whereupon, at 11:34 a.m., the hearing was adjourned.]

[Additional material submitted for the record follows:]

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America's Cement Manufacturers™

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July 1, 2020

The Honorable John Barrasso
Chairman
Environment and Public Works Committee
410 Dirksen Senate Office Building
Washington, D.C. 20510

The Honorable Tom Carper
Ranking Member
Environment and Public Works Committee
456 Dirksen Senate Office Building
Washington, D.C. 20510

Dear Chairman Barrasso and Ranking Member Carper:

Thank you for holding today's hearing "Better, Faster, Cheaper, Smarter, and Stronger: Infrastructure Development Opportunities to Drive Economic Recovery and Resiliency". The cement industry believes increased investment in our nation's infrastructure is critical to the nation's economic recovery.

The Portland Cement Association (PCA), founded in 1916, is the premier policy, research, education, and market intelligence organization serving America's cement manufacturers. PCA members represent 93 percent of the United States' cement manufacturing production and have facilities in all 50 states. Cement and concrete product manufacturing, directly and indirectly, employs approximately 610,000 people across the country, and our collective industries contribute over $125 billion to the U.S. economy. Portland cement is the fundamental ingredient in concrete. PCA promotes safety, sustainability, and innovation in all aspects of construction, fosters continuous improvement in cement manufacturing and distribution, and promotes sound infrastructure investment.

Annually, the United States uses approximately 260 million cubic yards of concrete to build and repair its infrastructure. This number has been significantly impacted by the economic slowdown caused by the COVID-19 virus. In April, cement consumption nationwide decreased by 8.2 percent compared to the year before, a trend that is likely to continue. Increased investment in infrastructure is critical to helping the cement industry recover from the economic downtown.

We can all agree that we can no longer defer investment in the nation's infrastructure after years of underinvestment. Critical to addressing this underinvestment is passage of a long-term surface transportation bill to provide states the long-term funding certainty to move forward with critical large infrastructure projects to improve freight movement, reduce congestion, and improve the resiliency of our nation's infrastructure. An efficient and well-functioning transportation network is essential to driving the nation's economic recovery.

PCA encourages the Senate to act on the America's Transportation Infrastructure Act, which would provide a 27 percent increase over current levels of funding, to help close the $2 trillion infrastructure investment gap to maintain our existing roads and bridges and invest in critical capacity expansion projects to meet the nation's growing needs. Passage of legislation, which provides long-term, stable funding for the nation's surface transportation program, will help states plan and build a range of much needed road, bridge, and transit projects.

Reauthorization of the surface transportation program must also address the long-term solvency of the Highway Trust Fund. Since 2008, Congress has transferred $139.9 billion in general fund revenue to cover revenue shortfalls in the Highway Trust Fund. The cement industry believes we can no longer rely on general revenue transfers to address shortfalls in the Highway Trust Fund. Reauthorization of the surface transportation program should include a long-term and sustainable funding solution to address the

solvency of the Highway Trust Fund. This funding certainty is needed for states to advance larger cost and multiyear transportation projects.

Additionally, we need to increase investment in our nation's water infrastructure. Significant investment in water infrastructure, including U.S. Army Corps of Engineers projects, drinking and wastewater systems, ports, harbors, and inland waterways will help states and communities' advance critical projects ranging from improving the movement of freight, flood risk reduction, and advancing public health projects. To invest in water infrastructure projects, PCA urges the Senate to take up and pass the America's Water Infrastructure Act and the Drinking Water Infrastructure Act to advance Corps projects and reauthorize both the Clean Water State Revolving Fund (SRF) and Water Infrastructure Finance and Innovation Act.

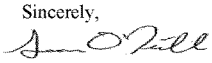
Concrete is a resilient and durable material critical to building our nation's roads, bridges, levees and dams, and drinking and wastewater facilities. The cement industry recognizes the importance of improving the resiliency of the nation's infrastructure. If a surface transportation or water infrastructure asset has been repeatedly damaged by natural disasters or extreme weather, it is important to build assets to better withstand and return to operation quickly. Concrete is a vital material to doing that. As part of this, the cement industry recognizes that both green and traditional infrastructure are used to improve the resiliency of our infrastructure assets. However, it is important that any policy to advance the resiliency of these assets allows engineers to make the decision about how to use traditional and, where appropriate, green infrastructure as opposed to dictating the use of green infrastructure. The cement industry appreciates the steps taken by both the America's Transportation Infrastructure Act and the America's Water Infrastructure Act to improve the resiliency of the nation's transportation assets.

As we look to address the backlog in investment in our infrastructure, steps should be taken to streamline the federal permitting and environmental review processes. Specifically, the cement industry supports codifying the President's One Federal Decision Executive Order. For these reasons, the cement industry supports the inclusion of provisions in the America's Transportation Infrastructure Act to set a two-year goal for completing environmental reviews, a 90 day timeline for related project authorizations, a single environmental document and record of decision to be signed by all participating agencies, and an accountability and tracking system managed by the Department of Transportation. Additionally, the cement industry supports the provision in the America's Water Infrastructure Act to set a two-year goal for the completion of Corps feasibility studies.

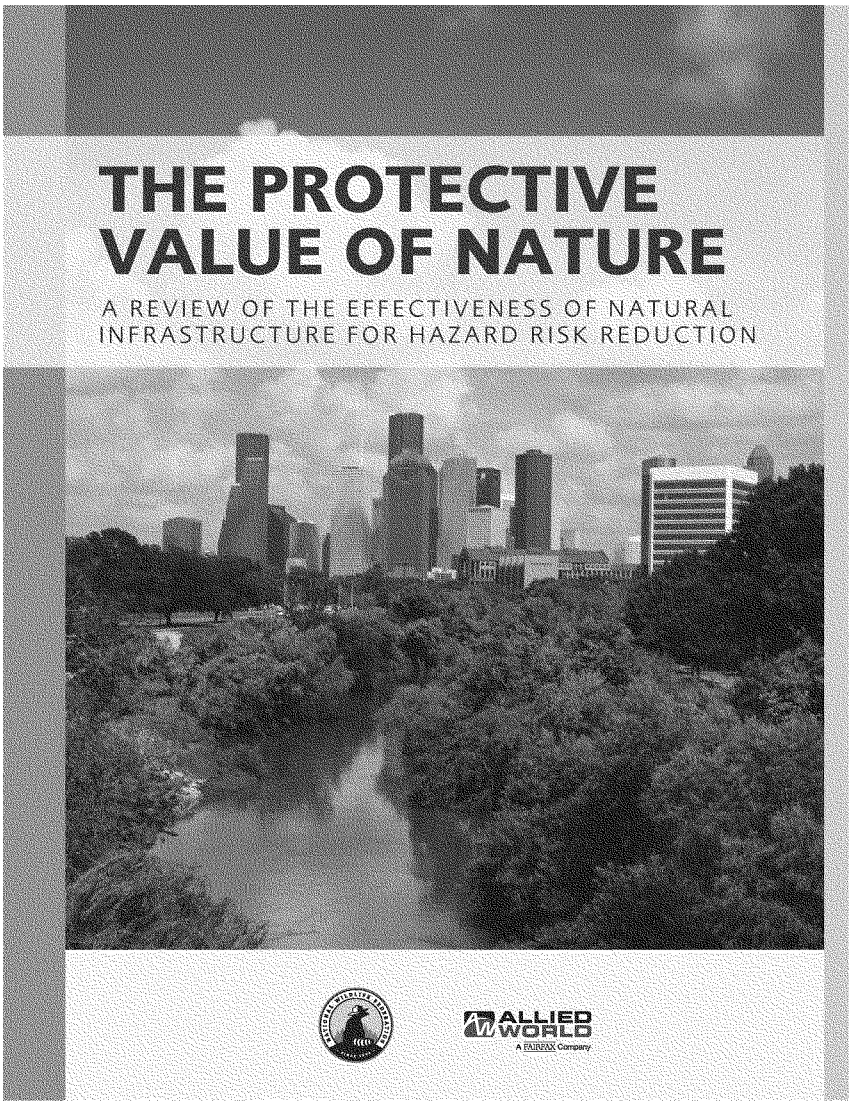
Finally, in the short-term state departments of transportation across the country are facing a significant decrease in state motor fuel tax and toll receipts as vehicle traffic declined by 50 percent in most states due to work and travel restrictions. On overage, states are estimated to face 30 percent declines in their transportation revenue through the end of fiscal year 2021. As a result, state departments of transportation are delaying projects that were previously set to move forward. Congress should provide aid to state departments of transportation to help offset the revenue declines so they can move forward with important projects to improve and maintain the nation's highways and bridges. Additionally, the state or local match on federally funded transportation projects should be waived for fiscal year 2021 to further assist in advancing much needed transportation projects.

Again, thank you for your continued leadership in moving critical infrastructure legislation. PCA looks forward to working with you to advance legislation to increase investment in our nation's infrastructure.

Sincerely,



Sean O'Neill
Senior Vice President, Government Affairs


THE PROTECTIVE VALUE OF NATURE
A REVIEW OF THE EFFECTIVENESS OF NATURAL INFRASTRUCTURE FOR HAZARD RISK REDUCTION
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This is the third in a series of reports on the use of natural defenses developed by the National Wildlife Federation in partnership with Allied World. Previous reports are Natural Defenses from Hurricanes and Floods: Protecting America's Communities and Ecosystems in an Era of Extreme Weather (2014) and Natural Defenses in Action: Harnessing Nature to Protect Our Communities (2016).

Cover image: Buffalo Bayou Park in downtown Houston, TX. Natural vegetation and streamside setbacks have reduced the impacts of urban development and flooding in Buffalo Bayou compared to nearby Brays Bayou, which was fully channelized in the 1960s (Juan et al. 2020). Photo: dave15957/iStock.

The Protective Value of Nature is available online at: www.nwf.org/protective-value-of-nature

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THE PROTECTIVE VALUE OF NATURE

A REVIEW OF THE EFFECTIVENESS OF NATURAL INFRASTRUCTURE FOR HAZARD RISK REDUCTION

Patty Glick, Emily Powell, Sara Schlesinger, Jessie Ritter, Bruce A. Stein, and Amanda Fuller

Buffalo Bayou Park, Houston, Texas. Photo: dave1957/iStock

CONTENTS

EXECUTIVE SUMMARY

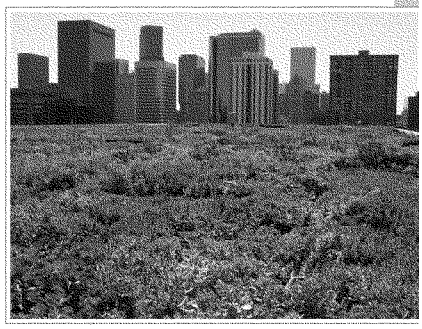
The Protective Value of Nature summarizes the latest science on the effectiveness of natural infrastructure in lowering the risks to communities from weather- and climate-related hazards—benefits that we often describe as "natural defenses." Over the past two decades, the body of research evaluating and quantifying the protective performance of natural infrastructure has increased significantly. Both model-based assessments and empirical evidence from recent floods, hurricanes, wildfires, and other natural disasters underscore the considerable risk reduction services that natural systems such as wetlands, reefs, dunes, floodplains, and forests provide. At the same time, natural infrastructure offers numerous additional benefits to society, from provision of food and clean water for people and habitat for fish and wildlife, to recreational opportunities, and cultural and spiritual fulfillment.

Long Island National Wildlife Refuge, New York. Photo: U.S. Fish and Wildlife Service

As we highlight throughout this report, evidence suggests that both natural and nature-based approaches for hazard mitigation can be equally or more effective than conventional structural approaches, and they are often more cost-effective. "Natural" approaches refer to intact or restored systems, such as wetlands, forests, and coral reefs; "nature-based" approaches mimic natural systems but are designed and constructed by people. Since healthy, intact ecosystems are often adapted to natural disturbances such as floods and wildfires, they may have the capacity to withstand or recover from extreme weather- and climate-related hazards and adjust to ongoing environmental changes. Conventional structural approaches (i.e., "gray infrastructure"), on the other hand, often require ongoing maintenance, and may need costly repairs when they fail or are damaged (Gittman and Scyphers 2017, Gray et al. 2017, Smith et al. 2017). Thus, natural defenses can play a critical role in enhancing the resilience of human and ecological systems to natural disasters and climate change.

Yet, the use of natural infrastructure for hazard risk reduction has not achieved its full potential. This is due, in part, to perceptions that conventionally engineered approaches, such as seawalls, levees, or dams, are always more effective—despite numerous instances when they have failed (Briaud et al. 2008, Gray et al. 2017, Koskinas et al. 2019). Further, national policies and programs have encouraged development in hazard-prone areas and have resulted in the degradation of existing natural systems that help to absorb floodwaters and buffer communities. As our human population continues to grow and a changing climate increases the frequency and severity of extreme weather events, risks from natural hazards will continue to escalate. Thus, there is an urgent need to dramatically scale up the application of natural infrastructure to better protect our communities.

This report, which builds on two previous publications published by the National Wildlife Federation, Allied World, and other partners (Natural Defenses from Hurricanes and Floods [Glick et al. 2014] and *Natural Defenses in Action* [Small-Lorenz et al. 2016]), is intended to synthesize and elevate the latest science to enhance awareness of the benefits of natural defenses and increase understanding of their effectiveness. The report also highlights key policy reforms needed to mainstream and increase the use of natural infrastructure in communities across the country.



A green roof in the heart of Denver, Colorado. Photo: U.S. Environmental Protection Agency

OVERVIEW

After more than two decades of increasingly severe, frequent, and costly weather- and climate-related disasters—from catastrophic wildfires and floods, to devastating hurricanes—reducing risks from natural hazards by enhancing the resilience of human communities has become a national priority (USGCRP 2018).

Natural disasters are taking an enormous ecological, social, and economic toll. Since 2010, the United States has experienced more billion-dollar disasters (i.e., events whose economic damages reached or exceeded $1 billion) than in any prior decade (NOAA 2020a). In 2017 alone, Hurricanes Maria, Irma, and Harvey killed thousands of people and caused more than $280 billion in damages. In 2018, the Camp Fire in California killed 88 people and destroyed more than 18,000 structures, with economic damages estimated at more than $16 billion. And in 2019, massive, unprecedented flooding in the Midwest inundated millions of acres of agriculture, homes, and businesses for months at a time. Unfortunately, the risks from natural disasters are expected to grow as an increasing number of people live and work in hazard-prone areas and as changing climatic conditions contribute to more frequent and severe events (USGCRP 2017).

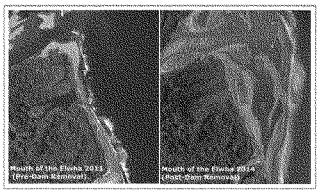
To successfully reduce risks from weather- and climate-related hazards, the nation must be proactive in implementing strategies that reduce vulnerabilities before they happen, not just respond to them afterward. Historically, most U.S. communities have relied on structural approaches, also known as "gray infrastructure," to guard against natural hazards. Examples include use of river levees to protect against flooding, seawalls to protect against coastal storm surge and erosion,

Beaver dam in the Uinta-Wasatch-Cache National Forest, Utah. Photo: Tom Kelly/Flickr

Levee breach in Columbia, South Carolina. Photo: U.S. Air National Guard

and, in the case of forests and other wildlands, firebreaks and suppression to protect against wildfires. Although structural approaches will continue to be essential for safeguarding people and property in some places, recent events have shown that conventional approaches to address natural hazards can have considerable downsides. For example, during the record 2019 Midwest flood event, dozens of levees along the Missouri River and some of its tributaries were breached or overtopped, and hundreds of miles of levees were damaged. After decades of wholesale fire suppression as the default approach for wildfire risk mitigation, overgrown forests near populated areas across much of the West have contributed to increasingly severe and deadly wildfires. In coastal North Carolina during Hurricanes Irene and Matthew, properties with bulkheads sustained more damage and experienced greater shoreline erosion compared to properties with natural shorelines (Gittman et al. 2014, Smith and Scyphers 2019). Across the country, existing hard infrastructure is aging and in poor condition: dams, levees, and inland waterways, for example, all received "D" grades on the most recent report card of the American Society of Civil Engineers (ASCE 2017). Additionally, most existing infrastructure was designed for past conditions, making it more likely that such structures will fail to protect communities in the face of increasingly severe weather- and climate-related events (e.g., Little 2012, Robinson et al. 2017, Sutton-Grier et al. 2018).

Increasingly, attention has been turning toward natural and nature-based approaches for reducing risks to people and property, either as an alternative to, or in tandem with, structural approaches. As we highlight throughout this report, evidence suggests that natural infrastructure can be just as, if not more, effective in reducing risks. In addition, natural infrastructure is often more cost-effective than built infrastructure and offers numerous additional co-benefits. Indeed, the loss of natural systems due to development, resource extraction, invasive species, pollution, and a changing climate has, in hindsight, underscored the importance of natural infrastructure to



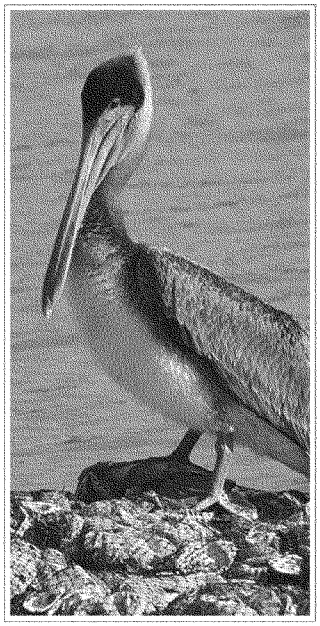
Mouth of the Elwha River, Washington, where dam removal has restored natural sediment flows. Photo: National Park Service

people on many fronts. Yet, despite the important role that natural systems play in safeguarding our communities, uptake of nature-based measures for risk reduction remains slow. Increasing awareness and understanding about the effectiveness of natural and nature-based approaches for reducing risks, along with much needed reforms to public policies and programs designed to discourage development in hazardous areas, can go a long way toward expanding their use (Langridge et al. 2014, Spalding et al. 2014b).

WHAT IS NATURAL INFRASTRUCTURE?

"Natural infrastructure" refers to natural systems—for example, wetlands, forests, and coral reefs—that provide essential services and benefits to society, such as flood protection, erosion control, and water purification. This broad definition reflects the growing recognition of the vital role that nature plays in supporting and sustaining people and their livelihoods. In the wake of recent hurricanes, floods, wildfires, and other climate-fueled disasters, the role that healthy and intact ecosystems can play in enhancing the resilience of both natural and human communities has gained particular prominence among scientists and policy-makers (e.g., Guerry et al. 2012, Jones et al. 2012, Thompson 2012, Arkema et al. 2013, Nelson et al. 2013, Langridge et al. 2014, Martin and Watson 2016, Renaud et al. 2016, da Silva and Wheeler 2017, Thorne et al. 2018, Dallimer et al. 2020, Donatti et al. 2020).

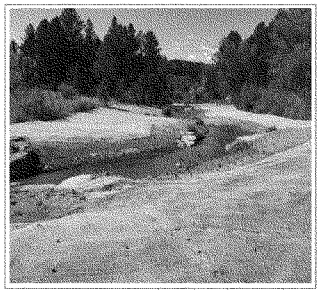
Although the use of nature to provide risk reduction benefits (among other services) has been labeled in a variety of ways in the scientific literature and in policies and programs (see Box 1), we often refer to these protective services as "natural defenses." Investing in natural defenses entails the use of both natural and nature-based approaches to reduce risks to people, property, or other valued assets. In this context, "natural" approaches are those that rely on existing or restored natural systems (e.g., wetlands, floodplains, mangrove forests, beaches, dunes, barrier islands, and riparian zones) for their risk reduction and other associated benefits. "Nature-based" approaches mimic the risk reduction functions of natural systems but are designed and constructed by people using natural and man-made materials (e.g., living shorelines, engineered oyster reefs, beaver mimicry, engineered dunes). In addition, policies and programs that limit development in hazard-prone and environmentally sensitive areas—which are examples of "non-structural" approaches for risk reduction—are also important to enable, encourage, or mandate the use of natural and nature-based features (Bridges et al. 2015). Such approaches may include regulations, zoning, buyouts, construction standards, and legal protections for natural features like streams, floodplains, and wetlands.



Pelican on oyster reef at Bayview Park, Florida. Photo: Floridadivingshorelines.com

Box 1. Various terms to describe natural infrastructure

As noted by both da Silva and Wheeler (2017) and Escobedo et al. (2019), the concept of "ecosystems as infrastructure" is a powerful metaphor that can help integrate a variety of societal goals (e.g., climate mitigation, adaptation, risk reduction, and biodiversity conservation). Increasingly, it is being considered a complement, or even an alternative to, the built environment (i.e., gray infrastructure) to reduce risks from natural hazards.



Kettle Creek restoration, Colorado Springs, Colorado. Photo: U.S. Fish and Wildlife Service

However, attaching terms such as "ecological," "natural," "green," and "blue" with "infrastructure" is often done in different contexts and with different objectives, which can lead to misunderstandings and fragmentation of the practice, making it more difficult to mainstream the underlying concept (da Silva and Wheeler 2017). The lack of a consistent typology and usage has often led to vague definitions, particularly at the policy level, which may make it challenging to apply such approaches in on-the-ground management (Cohen-Shacham et al. 2019, Martin et al. 2020, Mendes et al. 2020). Among the various terms and usages are:

Ecosystem services

Ecosystem services generally refer to the multiple benefits that people obtain from ecosystems, including but not limited to provisioning services, such as food and water; regulating services, such as flood risk reduction; cultural services; and supporting services, such as oxygen production and carbon sequestration (MEA 2003, Reid et al. 2005, Adamowicz et al. 2019). Comparable term: natural capital (Natural Capital Committee 2017).

Green infrastructure

While the concept of green infrastructure initially referred to the value and role of open space and ecosystem services broadly (e.g., Benedict and McMahon 2006, Young et al. 2014), most recent usage more narrowly focuses on urban stormwater management, including use of plant or soil systems, permeable surfaces, and other approaches to reduce flows to sewer systems or other surface waters (U.S. EPA 2019a). Comparable terms: low-impact development (Ahiablame et al. 2012); blue-green infrastructure (Novotny et al. 2010).

Natural defenses

As used in this report, natural defenses refers to the hazard risk reduction benefits of ecological systems, whether they are the natural systems themselves or nature-based systems designed to emulate natural features. Comparable terms: natural and nature-based features (Bridges et al. 2015); natural infrastructure (da Silva and Wheeler 2017); ecological infrastructure (Adamowicz et al. 2019); nature-based solutions (Hobbie and Grimm 2020).

Nature-based solutions

The International Union for the Conservation of Nature defines nature-based solutions, a term commonly used in Europe, as "actions to protect, sustainably manage and restore natural or modified ecosystems, which address societal challenges (e.g., climate change, food and water security or natural disasters) effectively and adaptively, while simultaneously providing human well-being and biodiversity benefits" (Cohen-Shacham et al. 2016). Comparable terms: natural infrastructure; ecosystem services.

Ecosystem-based adaptation

Ecosystem-based adaptation derives from the ecosystem services concept, but its primary focus is how biodiversity and ecosystems can help people adapt to the growing impacts of climate change (Colls et al. 2009, Jones et al. 2012, Roe et al. 2019, Donatti et al. 2020). Ecosystem-based adaptation is considered a subset of nature-based solutions.

Natural climate solutions

In current usage, natural climate solutions refers to the conservation, restoration, and management of natural systems (e.g., forests, grasslands, wetlands, and mangroves) and agricultural lands to sequester and store carbon (Fargione et al. 2018, Griscom et al. 2019). Comparable term: ecosystem-based mitigation (Epple et al. 2016).

Although some studies have suggested that a more consistent typology is necessary to mainstream the concept of natural infrastructure, we argue that being clear about the underlying goals of using natural and nature-based approaches (e.g., their effectiveness in reducing risks, or their provision of climate protection benefits) is likely to be more important than the specific terminology used (Spalding et al. 2014c, Nesshöver et al. 2017, Escobedo et al. 2019, Mendes et al. 2020).

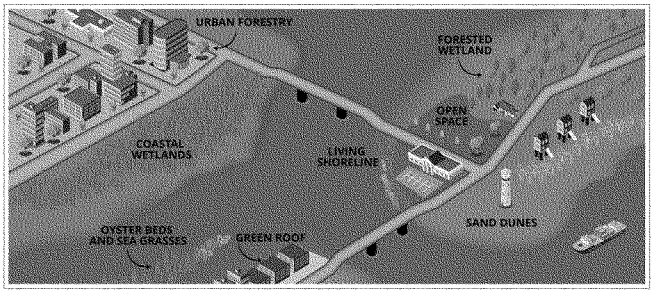
Conventional structural approaches for community protection will remain necessary in some places, but wherever possible, communities should prioritize the use of natural infrastructure given the many additional benefits it provides. This entails determining where natural approaches can be used either instead of, or in combination with, structural approaches to reduce the vulnerability of natural and human communities. Importantly, the efficacy of various natural defenses depends on a range of factors, including site-specific environmental conditions, the vulnerability of communities, and the type and severity of natural hazards to which they may be exposed (Ruckelshaus et al. 2016). Just as standards and guidelines are important for the engineering and application of gray infrastructure, guidance for the appropriate use of natural infrastructure is emerging (see Box 2) (The World Bank 2017).

Box 2. Evaluating the effectiveness of natural infrastructure for hazard risk reduction

As interest in natural infrastructure has grown, so too has the development of guidance and tools to support its application, including by enhancing transparency and quantifying its effectiveness. Indeed, the numerous studies highlighted in this report demonstrate a variety of approaches for evaluating the performance of natural and nature-based features, including indices, numerical models, field-based experiments, and empirical evidence. Evaluation tools and approaches have been developed by government agencies, nongovernmental organizations, academic institutions, and private entities alike.

Looking just at resources offered by U.S. federal agencies, the Engineering with Nature (EWN)® initiative of the U.S. Army Corps of Engineers initiative advances both technical and communication practices to align natural processes with engineering design, and includes a framework to support evaluation and implementation of natural and nature-based features in coastal areas (Bridges et al. 2014, Bridges et al. 2015). The U.S. Environmental Protection Agency's Green Infrastructure Modeling Toolkit (U.S. EPA 2019b) offers a range of models and tools to help project managers model and evaluate the performance of natural and engineered systems for stormwater management. The Federal Emergency Management Agency's report, *Innovative Drought and Flood Mitigation Projects* (FEMA 2017), describes a range of technical considerations and approaches for project design and evaluation, including ways to measure benefits and costs and ensure compliance with relevant federal, state, and local environmental and historic preservation requirements. The U.S. Department of Agriculture's Conservation Effects Assessment Project website (USDA, n.d.) provides links to a wide array of resources and tools from both governmental and nongovernmental entities offering guidance and tools for evaluating natural infrastructure.

In addition, the National Oceanic and Atmospheric Administration provides a range of tools for natural infrastructure, from data and visualization tools to job aids and trainings. The agency also maintains a searchable Green Infrastructure Effectiveness Database, which compiles information from a range of literature sources focused on the effectiveness of natural infrastructure approaches to reduce the impacts of coastal hazards (NOAA, n.d.). And the Joint Fire Science Program, a collaborative effort between the U.S. Forest Service and the Department of the Interior, works with partners across the country to assess the potential effectiveness of fuel treatments, improved community planning, and other approaches to reduce wildfire risks (JFSP, n.d.). These federal resources represent just a subset of a large and growing body of science to support the design and evaluation of natural infrastructure projects for hazard risk reduction.



Types of natural infrastructure. Graphic: National Oceanic and Atmospheric Administration

As highlighted in Table 1 and elaborated throughout this report, numerous types of natural infrastructure approaches for hazard risk reduction are now in use across the country. In addition to protective benefits, natural infrastructure provides communities with a wealth of other ecosystem services, such as improving water quality and helping recharge groundwater, supporting habitat for a multitude of fish and wildlife species, sequestering carbon, and providing aesthetic and recreational opportunities—all of which contribute to enhancing a community's resilience to a range of threats. Globally, the estimated value of ecosystem services provided by natural systems, as a whole, ranges from $125–$145 trillion per year (Costanza et al. 2014). In the United States alone, coastal habitats provide estimated benefits valued at over $100 billion annually (Sutton-Grier et al. 2018).

Table 1. Examples of natural infrastructure for hazard risk reduction

Natural hazard	Conventional approaches	Natural or nature-based approaches	Examples
Inland flooding and erosion	Dams, dikes, levees, stream channelization, stormwater sewers, combined sewers, pumps	• Floodplain and watershed restoration • Green stormwater management • Protecting floodplains from development	• Levee setbacks • Wetland, forest and watershed restorations • Rain gardens and natural infiltration systems • Minimizing stream alterations • Permeable pavement • Voluntary buyouts • Avoiding new development in floodplains • Open space acquisition and protection
Coastal flooding and erosion	Seawalls, bulkheads, dikes, breakwaters, levees	• Coastal habitat protection and restoration • Living shorelines • Protecting sensitive coastal areas from development	• Intact or restored shoreline systems (e.g., wetlands, mangroves, beaches, dunes, and barrier islands) • Coral and oyster reefs • Restored/constructed marsh with sills or breakwater structures • Constructed oyster reefs • Voluntary buyouts • Coastal land acquisition and easements
Extreme heat and drought	Dams and reservoirs, air conditioning	• Watershed protection and restoration • Urban green infrastructure • Water conservation	• Forest and watershed restoration • Beaver restoration • Urban trees and other vegetation • Green roofs and cool pavement • Rain barrels • Xeriscaping
Wildfire	Wholesale suppression of wildfires, clearing firebreaks	• Ecological forest management • Helping communities live with fire • Managing wildfires (when possible) to benefit ecosystems	• Combined fuel reduction treatments • Prescribed fire • Post-fire restoration • Fire-adapted communities, such as through Firewise USA® neighborhood mitigation • Collaborative risk management • Avoiding new development in high-fire-risk areas

KEY CLIMATE CONSIDERATIONS

One of the primary reasons communities are increasingly turning to natural defenses against extreme weather- and climate-related hazards is that many natural systems already are well adapted to natural disturbance regimes and have the capacity to withstand or recover from the impacts (Feagin et al. 2010, Spalding et al. 2014b). For example, the natural deposition of sediments from upstream or upland sources can provide sufficient levels of soil for marshes in deltas and estuaries to rebuild after storms and keep pace with rising sea levels through a process called accretion (Batker et al. 2010). Beaches and other coastal habitats can migrate landward and seaward in response to both acute and gradual changes over time, particularly in the absence of man-made or natural barriers such as seawalls or bluffs (Spalding et al. 2014b, Leo et al. 2019). And in many forest ecosystems, periodic wildfires are essential for forest health by clearing dense undergrowth and contributing to habitat complexity.

Unfortunately, the combination of changing climatic conditions and other anthropogenic stressors have degraded ecosystems in many areas and significantly reduced their natural adaptive capacity (Stott et al. 2016, Seddon et al. 2020). In parts of the West, for example, a combination of increasingly intense, drought-enhanced wildfires and invasive species have reduced the potential for forests to regenerate on their own (Jones et al. 2016, Dey et al. 2019). Along the Gulf Coast, construction of levees and navigation channels, oil and gas operations, and other activities have contributed to land subsidence and starved coastal wetlands of sediments. And around the world, coral reefs are in rapid decline due to a combination of development, pollution, overfishing, storms, climate-related bleaching, and ocean acidification (Hoegh-Guldberg et al. 2017, Beck et al. 2018, Gibbs and West 2019). Climate change is likely to further push these and other systems to their limits as sea levels rise and weather events become more frequent and severe. Of particular concern is the fact that multiple threats are occurring at the same time. For example, while extreme heat and drought on their own pose considerable risks to communities, they are also exacerbating wildfires. In turn, severe wildfires can lead to flooding and erosion, sediment loading, and long-term changes in forest water yield (Hogue et al. 2018). Ultimately, this results in a vicious cycle that threatens the health and sustainability of human and natural communities alike.

Because of these man-made stresses, nature needs our help for it to provide, or continue providing, its protective services. It is important to think not only about the vulnerability of human communities and livelihoods to the impacts of extreme weather and climate-fueled natural disasters, but also the vulnerability of the natural systems on which we depend. Doing so in parallel will allow communities to identify when and where existing and intact natural systems can provide these protective functions, and where it is necessary to restore ecosystems or design adaptation strategies that can enhance the capacity of those systems to provide risk reduction benefits. Thus, managers must consider these complexities in both the design and management of natural infrastructure. This will entail conducting climate vulnerability assessments that consider a range of future scenarios to inform project development and management. It also necessitates investing in consistent, long-term monitoring and evaluation of those projects to keep track of changing conditions and determine whether and how much they are achieving risk reduction benefits and other desired outcomes (Walles et al. 2016, Zellner et al. 2016, Emilsson and Sang 2017, Marsooli et al. 2017, Rosenzweig et al. 2018, Leo et al. 2019, Morris et al. 2019, Reynolds et al. 2019, Sun et al. 2019, Hobbie and Grimm 2020).

2017 La Tuna fire, Los Angeles, California. Photo: Scott L/Flickr

INLAND FLOODING

UNDERSTANDING FLOOD RISKS

Floods are among the most frequent and expensive natural hazards in the United States, often reaching billions of dollars a year in damages (Kousky 2010, Michel-Kerjan and Kunreuther 2011, Pralle 2019, Truhlar and Bergstrom 2019). While flooding occurs naturally and can be beneficial for some ecosystems, floods become "hazards" when they have adverse effects on people and the environment. Floods can have a wide range of impacts, including loss of life, destruction of property and infrastructure, spread of pollutants, and disruption to agriculture and other sources of livelihood.

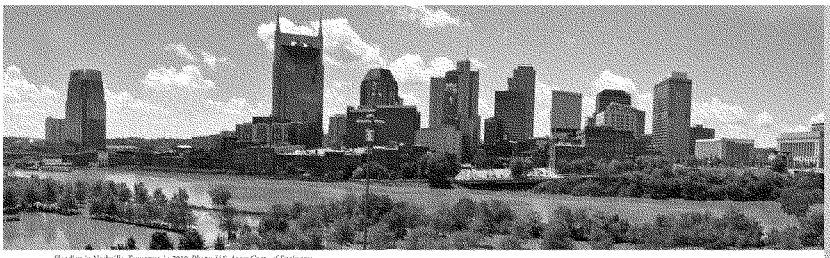
To identify the best ways to reduce flood risks, it is important to recognize that there are three different types of floods: riverine, surface, and coastal. Riverine floods, also known as fluvial floods, occur when the water in rivers, streams, or lakes overflows and/or erodes their banks. Surface, or pluvial, floods can occur away from existing water bodies. They occur when rainfall exceeds the capacity of drainage systems, such as urban stormwater infrastructure. In general, coastal floods are associated with storm surge, but increasingly also from extreme high tides even in the absence of storms. In this section, we highlight risks and management approaches associated with riverine and surface floods, also referred to as "inland flooding." Coastal flooding is addressed in the next section, although it is important to recognize that coastal communities may simultaneously be affected by coastal, riverine, and surface flooding, sometimes during the same storm.

Risks from flooding are exacerbated by development and other human activities (Mondal and Patel 2018). Urbanization, in particular, can considerably alter flood hydrology (Ntelekos et al. 2010). An increase in paved roads, parking lots, and other impervious surfaces, for instance, contributes to greater runoff into rivers, streams, and low-lying areas, which may lead to flooding and fluvial erosion during both moderate rainfall and heavy downpours (Ogden et al. 2011, ASFPM Riverine Erosion Hazards Workgroup 2016). In addition, construction of levees and the placement of fill materials into areas such as wetlands to allow for development in one part of a floodplain can lead to "increased flooding downstream (Heine and Pinter 2011). Stream straightening, ditching, and armoring to protect streamside investments at one location can lead to increased riverine erosion downstream (Christin and Kline 2017). In addition, construction of wing dikes and related structures intended to improve navigability of rivers can also lead to significant upstream flooding by constricting river channels and blocking flows (e.g., Pinter et al. 2008, Remo et al. 2009, Huthoff et al. 2013). On a broader watershed scale, activities such as clearcutting and conversion of forest land to agriculture

At a Glance

- Floods are among the most frequent and expensive natural hazards in the United States; a combination of historic stream and river channelization, increased development, and heavier rainfall due to changing climatic conditions is exacerbating flood inundation and erosion risks across the country.
- The use of natural infrastructure for stormwater and flood management can effectively reduce risks from flooding, in addition to providing other benefits, such as improved water quality, recreational opportunities, and habitat for fish and wildlife.
- Natural infrastructure approaches for reducing flood risks range from floodplain and watershed restoration and green stormwater infrastructure, to policies and programs that prevent new development in hazard-prone areas and encourage people to move out of harm's way.

Widespread flooding in Port Arthur, Texas, caused by record rainfall from Hurricane Harvey. Photo: South Carolina National Guard



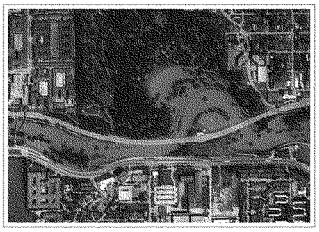
Flooding in Nashville, Tennessee, in 2010. Photo: U.S. Army Corps of Engineers

and urban development can exacerbate flooding by reducing filtration and increasing runoff (Harman et al. 2012).

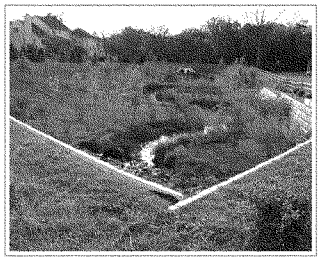
In the coming decades, the risks and associated damages for both types of inland flooding (surface and riverine) are expected to grow due to a combination of human population growth, land-use changes, and an increase in the frequency and intensity of heavy rainfall (AECOM and FEMA 2013; Wobus et al. 2013, 2017). Heavy precipitation events (i.e., the most intense 1% of rainfall events) have already increased across much of the conterminous United States (Kunkel et al. 2013, USGRP 2017, Hayhoe et al. 2018). Such events have contributed to historic flooding. For example, Louisiana experienced a devastating flood in August 2016 as a slow-moving storm dumped more than 20 inches of rain across the region over a three-day period (Kunreuther et al. 2019). Tens of thousands of homes were affected by the flood, which scientists have attributed at least in part to climate change (van der Wiel et al. 2017). In 2019, which was the second wettest year on record in the United States, massive, long-lasting flooding devastated much of the Midwest (NOAA 2020b). The Missouri River basin experienced more than a year's worth of runoff from snowmelt and rainfall from March through May 2019, causing an estimated $20 billion in damage and economic losses—nearly half the total cost for all 14 of the billion-dollar disasters that year (NOAA 2020b).

NATURAL DEFENSES FOR FLOODS

Despite increasing risks, local governments continue to allow for unwise development in flood-prone areas, and reliance on conventional or outdated flood management practices—such as construction of levees and dredging—remains common across the country. There is growing recognition that the use of natural infrastructure for stormwater and flood management can effectively reduce risks from flooding and riverine erosion, in addition to providing other benefits, such as improved water quality, recreational opportunities, and habitat for fish and wildlife (e.g., Kousky and Walls 2013, U.S. EPA 2014, Eckart et al. 2017, Moore et al. 2016, Frantzeskaki et al. 2019, Venkataramanan et al. 2019). Further, evidence suggests that investing in natural infrastructure to reduce flood risks makes economic sense (e.g., Baumgärtner and Strunz 2014, Green et al. 2016, Denjean et al. 2017, Martin et al. 2020). Natural infrastructure approaches for flood risk reduction range from floodplain and watershed restoration and green stormwater infrastructure, to policies and programs that help restore and protect natural systems to reduce flood risks (Carter and Lipiec 2020, Hobbie and Grimm 2020). This may include preventing new development in hazard-prone areas or encouraging people to move out of harm's way.



Buffalo Bayou effectively capturing flood waters in downtown Houston, Texas, after Hurricane Harvey. Photo: National Oceanic and Atmospheric Administration



Anacostia Creek floodplain restoration. Photo: Montgomery County Planning Commission

FLOODPLAIN AND WATERSHED RESTORATION

Restoring streams, floodplains, and watersheds to reestablish their natural flows, ecological processes, and functions is one of the most important and beneficial strategies to reduce flood risks to communities, while providing considerable additional ecological and economic benefits. There are numerous techniques for restoring the ecological integrity of streams and floodplains, the most appropriate of which will depend on the unique characteristics and conditions of the area being restored, as well as the desired management outcomes.

2017 Oroville Dam spillway failure in California. Photo: William Croyle/California Department of Water Resources

Levee Setbacks and Dam Removal

In the wake of disastrous floods, many communities across the country have invested in efforts to make "room for the river" through levee setbacks, dam removal, and floodplain restoration. According to the U.S. Army Corps of Engineers (USACE), the additional floodplain storage provided by levee setbacks reduces flood height and slows peak flows, while also providing additional ecosystem and recreation benefits (Dahl et al. 2017). In Washington State, for example, a project involving the reconnection of side channels, moving 1.5 miles of levees farther from the Puyallup River, and installing logjams has dramatically reduced flood risks to the nearby city of Orting (Floodplains by Design 2014). In Yuba County, California, the Three Rivers Levee Improvement Authority worked with the USACE to set back 9,600 feet of levees along the confluence of the Bear and Feather rivers, reconnecting 600 acres of flood-prone agricultural land to the floodplain (River Partners 2014). The project proved successful in capturing floodwaters and reducing flood risks to nearby communities after the Oroville Dam crisis in 2017, when damage to the main and emergency spillways during an extreme rainfall event prompted the evacuation of more than 180,000 people living downstream (Stork et al. 2017, Hollins et al. 2018). In addition, the land has since been restored into riparian and grassland habitat that supports numerous species of fish and wildlife, provides a variety of recreational opportunities, and helps buffer the release of pollutants from nearby agricultural operations into the rivers. A study along the Middle Mississippi River found that a combination of levee setbacks and voluntary buyouts of the resulting unprotected structures would reduce flood losses from both large/infrequent and small/frequent flood events (Dierauer et al. 2012). And in Massachusetts, a Department of Fish and Game Division of Ecological Restoration (DER) project to remove three dams proved to be 60% less expensive than repair and maintenance would have been over the next 30 years by restoring floodplains and removing the risk of dam failure. In addition, the removal significantly reduced flood risk to the surrounding areas. Other benefits cited from the dam removals in the DER report include avoided travel delays, infrastructure damage, and costs of emergency response, in addition to increases in nearby property value, added recreational value, and improved quality and availability of stream habitat (MDFG 2015).

Bear River setback levee in California. Photo: California Department of Water Resources

Wetland and Forest Restoration

Wetlands act as natural sponges, storing and slowly releasing floodwaters after peak flood flows have passed (Antolini et al. 2019, Krasowski 2019). Research suggests that a single acre of wetland can store up to 1.5 million gallons of floodwater (U.S. EPA 2002). A meta-analysis of economic valuation literature for a number of countries around the world suggests that wetlands in agricultural areas provide an estimated $2,802 per acre per year in flood control services (Brander et al. 2013). Here in the United States, an assessment of flood reduction potential of wetlands in the Eagle Creek watershed of central Indiana found that they reduce peak flows from rainfall by up to 42%, flood area by 55%, and maximum stream velocities by 15% (Javaheri and Babbar-Sebens 2014).

Certain forest and other wildland management practices may also reduce risks to nearby communities from flooding and debris flows following high-severity wildfires, which can burn away much of the vegetation that holds soil in place and slows runoff (Garfin et al. 2016). Flood risk can remain significantly higher in severely burned areas until vegetation

is restored, which can take years to decades (Floyd et al. 2019). As discussed further in the section on Wildfires (page 24), ecological forest management, including targeted thinning, prescribed fire, and long-term rehabilitation and restoration activities can reduce the severity of future wildfires and help minimize associated risks to communities. In the near term, post-fire treatments, such as application of mulch and erosion barriers and aerial seeding with native grasses and other plants, also may be necessary to mitigate runoff and erosion (Napper 2006, Robichaud 2009, Robichaud et al. 2020). For example, an evaluation of post-fire treatment after the 2012 High Park Fire in the Poudre River basin of Colorado found that areas seeded with a native perennial grass mix had greater vegetation cover one year after the fire than unseeded control areas. In addition to helping reduce erosion, the seeded areas had significantly fewer weeds than the control areas (Miller et al. 2017). However, it is important to recognize that the appropriateness and effectiveness of post-fire treatments will vary, depending on local conditions and the severity of the fire. For instance, tradeoffs may exist between use of seeding to reduce erosion and recovery of natural plant diversity. Ongoing monitoring is essential following treatment to evaluate their effectiveness and help ensure that short-term mitigation benefits do not come at the expense of long-term ecosystem restoration goals (Robichaud 2009).

GREEN STORMWATER MANAGEMENT

Green infrastructure is an integrated approach to stormwater management that uses features such as rain gardens, green roofs, bioswales (i.e., vegetated trenches), and permeable pavement in strategic areas to capture stormwater runoff as close as possible to where it is generated. Conventional stormwater management approaches focus on speeding passage of water downstream, which can result in flooding and degraded water quality. In contrast, green infrastructure approaches are specifically designed to slow the flow of runoff to facilitate absorption in soil and vegetation and take pressure off over-capacity sewage treatment plants. This is particularly important in cities that have older "combined sewer systems," in which one piping system conveys both sanitary sewage and stormwater. Not only does green infrastructure help improve water quality by diverting and filtering pollutants, it can help mitigate surface flooding during storms, often at a significant cost savings.

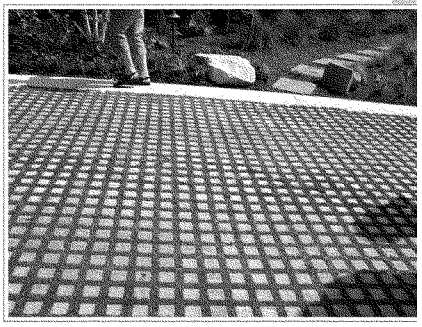
The following are a few examples of green infrastructure approaches:

Rain Gardens and Natural Infiltration Systems

The use of rain gardens, which are planted depressions designed to allow runoff from nearby impervious areas to soak into the ground, has grown in popularity in communities across the country. Research has shown that rain gardens can significantly reduce runoff into storm drains, thereby increasing the capacity of existing drainage systems to handle higher rainfall volumes (Mahler et al. 2019). For example, a study of a rain garden constructed in the Bronx, New York, found that the system retained an average of 78% of inflows during 26 storms over the period between October 2014 and July 2015 (Feldman et al. 2019). The Capitol Region Water District in Ramsey County, Minnesota, has installed a suite of green infrastructure projects, including rain gardens, underground infiltration trenches, and a stormwater retention pond, to address both localized flooding and polluted runoff into nearby waterways. Together, the network of green infrastructure can capture drainage from more than 10% of the watershed area and can filter an estimated 94% of stormwater volume from the sub-watershed (CRWD 2012, Small et al. 2019).

Permeable Surfaces

Increasing the area of pervious, or permeable, surfaces in urban and suburban areas, whether through enhancing vegetated areas or installing gravel or other porous materials, can significantly reduce localized flooding. In natural areas, as much as 85% of rainfall will infiltrate into the ground (FEMA 2005). According to FEMA, the amount of runoff from a five-year storm (i.e., a heavy rainfall event that has a 20% chance of occurring each year) on a developed parcel can be greater than the runoff from a 50-year storm if the parcel had not been developed (FEMA



Permeable paver patio can increase infiltration and reduce stormwater runoff. Photo: ECY-OnTheRoad

2005). In Portland, Oregon, investments in "green streets" (i.e., the use of pervious surfaces in streets and alleyways), along with rain barrels and tree planting, have been estimated to be 3–6 times more effective in managing stormwater per $1,000 invested compared with conventional, gray infrastructure methods (Foster et al. 2011). The city's investment of $8 million in the green infrastructure projects saved an estimated $250 million in avoided hard infrastructure costs. In addition, the city's green street projects retain and infiltrate nearly 43 million gallons per year and have the potential to manage as much as 8 billion gallons—40% of Portland's average annual runoff volume (Foster et al. 2011).

PROTECTING FLOODPLAINS FROM DEVELOPMENT

Keeping people out of harm's way is an important strategy for reducing the costs of major floods and enhancing the natural ability of floodplains to absorb floodwaters and lessen their destructive force.

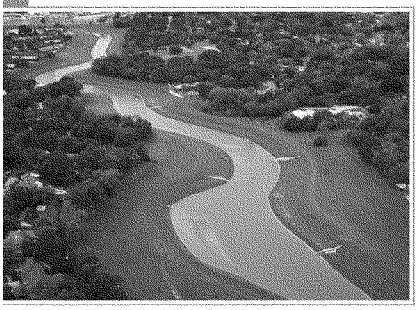
Open Space Acquisition and Protection

Protecting open space from development can significantly reduce flood damage to nearby communities. For example, instead of being sold to developers, an abandoned golf course in Clear Lake, Texas, was purchased by the Clear Lake City Water Authority and converted to a 178-acre park and wetland, which protected 300 residents and 150 homes from significant flooding during Hurricane Harvey (FEMA 2019, GBF 2019). At the time Harvey came through, the system collected 100 million gallons of water, even with only 80% completion of the first of five phases. Later phases of the project, which are expected to be finished by 2022, include creating detention ponds, wetlands, a nursery for native trees, miles of hike/bike trails, areas of native bushes and grasses, and athletic fields. When fully completed, the project is expected to drain half a billion gallons of stormwater and protect 2,000 homes (FEMA 2019). Preserved floodplain and wetlands around Otter Creek upstream of Middlebury, Vermont, helped reduce the damage from Tropical Storm Irene by 84–95% and provide between $126,000 and $450,000 in annual flood mitigation services. The wetlands are mainly composed of forested swampland and span 18,000 acres (Watson et al. 2016). Additionally, Kousky et al. (2014) estimate that the Meramec Greenway, which comprise 28,000 acres of forest and other conservation lands along the Meramec River in southern Missouri, contributes about $6,000 per acre in avoided flood damages annually.

For the conterminous United States as a whole, scientists estimate that preventing development in the more than 100,000 square miles of remaining unprotected natural lands that lie within the current 100-year floodplain would avoid as much $397 billion in potential flood damages to new development by 2050 (Wing et al. 2018). Although the cost of purchasing land may outweigh the potential flood mitigation benefits in some areas, targeting investments based on preservation costs and expected flood damages could yield significant net benefits (Kousky et al. 2013, Kousky 2014). Indeed, Wing et al. (2018) found that the benefit of avoiding flood damages associated with future development exceeds the cost of acquiring undeveloped land in the majority (70%) of the counties they studied.

Voluntary Buyouts

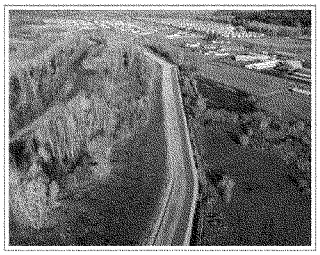
In places where properties have been extensively and repetitively damaged by flooding, voluntary buyouts—the acquisition and removal of properties in hazard-prone areas—can be a cost-effective response to reduce risks from future flooding (Siders 2019). A number of communities across the country have engaged in buyout programs in response to major flooding events. For example, after a massive flood in 2008 that dislocated 18,000 people, damaged more than 7,000 properties, and caused billions of dollars in losses, Cedar Rapids, Iowa, undertook a major buyout and relocation program, purchasing 1,300 damaged properties (Carter 2009). Many of the properties were commercial, and owners used the funds to relocate their businesses elsewhere within the city. Cedar Rapids is now moving forward in creating a system of parks and open space along its riverbanks that will be designed to accommodate floods. In Charles County, Missouri, a buyout program following the major flooding of 1993 is estimated to have prevented losses of nearly $97 million from flooding events that occurred between 1999 and 2008. This represented a 212% rate of return on the $44 million dollars that Missouri and FEMA had spent on the properties (FEMA 2009). Since



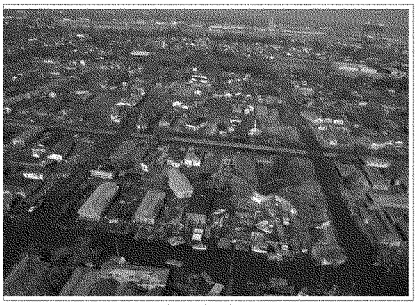
Restoration of Sims Bayou in Houston, Texas consisted of earthen channels and tree plantings to reduce flood risks. Photo: SWA Group

1999, the City of Charlotte and Mecklenburg County in North Carolina have overseen a voluntary buyout program that has combined the relocation of families and businesses from flood prone areas with subsequent stream and wetland restoration. As of September 2019, the program has spent $67 million to acquire more than 400 properties and has restored 185 acres of the floodplain to public open space. The effort has helped communities avoid approximately $25 million in property damage, and it is expected to prevent an estimated $300 million in future losses (City of Charlotte 2019).

Although buyout programs have been implemented for decades, they have often been done through piecemeal approaches that leave a patchwork of remaining structures and vacant lots, which do not offer the flood reduction benefits that larger green space could provide (Mach et al. 2019). Further, it is important that buyout programs be founded on sound social and ecological principles (Kousky and Kunreuther 2010, Kousky and Walls 2013, Berke et al. 2014). First, the community as a whole must be truly engaged in decisions (Verchick and Johnson 2013). Without full community participation, not only would the benefits of such buyouts for flood risk reduction over a large scale be minimized, but there could be animosity among remaining property owners toward participating households if such buyouts are perceived to lower property values (Glick et al. 2014). Second, decision-makers must incorporate the needs of the socially vulnerable into buyout programs, such as by taking measures to ensure that affordable homes and jobs are available in areas where people will be relocated (Siders 2019).



Calistoga Reach floodplain restoration in Washington. Photo: CSI Drone Solutions and Washington Rock Quarries, Inc.



Disadvantaged communities are often particularly vulnerable to natural disasters. Social equity issues are important to address in flood risk reduction programs and buyout policies. Photo: Jocelyn Augustino/ Federal Emergency Management Agency

Farmland with wetland buffer, prairie potholes region, Iowa. Photo: Mark Vandever/U.S. Geological Survey

COASTAL HAZARDS

UNDERSTANDING COASTAL HAZARD RISKS

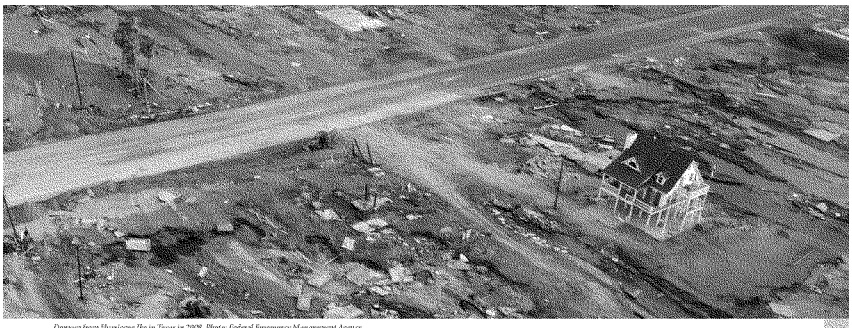
The coastal zone is a naturally dynamic place. Beaches, barrier islands, marshes, and other coastal systems change over time as storms, erosion, sedimentation, and other natural forces shape these landscapes. Coasts are also magnets for population centers due to their natural beauty and rich, biodiverse ecosystems that support vibrant economic, recreational, and cultural activities. As of 2017, about 94.7 million people in the United States live in coastline counties, an increase of 15.3% since 2000 (U.S. Census Bureau 2019). Those living in the coastal zone know, however, that the benefits also come with risks from storms, coastal flooding, and shoreline erosion. These existing threats are compounded by urbanization, aging infrastructure, and changing climatic conditions, including warming oceans and rising sea levels (Fleming et al. 2018). Recent studies suggest that climate change is contributing to an increase in tropical cyclone activity, which scientists have linked to warmer oceans and an accompanying increase in atmospheric moisture content. In the coming decades, both wind and rainfall intensity associated with these storms are projected to increase, which could translate into a greater proportion of storms reaching Category 4 and 5 (IPCC 2014, Knutson et al. 2019).

In addition, sea-level rise is exacerbating storm surge and contributing to more frequent flooding during high tides (Tebaldi et al. 2012, Marsooli et al. 2019). During the past century, the average global sea level rose about 8 inches, and since the early 1990s the rate of sea-level rise has been accelerating (Nerem et al. 2018). In some areas, such as along parts of the Gulf and Atlantic coasts, relative sea levels have increased even more due to land subsidence and other factors. As global temperatures increase with continued greenhouse gas emissions, further sea-level rise is inevitable due to the thermal expansion of oceans and increased melting of land-based ice, placing areas farther inland at increased risk (Sriver et al. 2012, Bamber and Aspinall 2013, Miller et al. 2013, Kopp et al. 2014, USGCRP 2017).

At a Glance

- Coastal communities face considerable risks from storms, coastal flooding, and shoreline erosion; as climate change contributes to rising sea levels and an increase in the intensity of tropical cyclones, the frequency and severity of these hazards will continue to grow.
- Although hard armoring, such as seawalls and bulkheads, continues to expand along populated coastal areas, people are increasingly embracing natural infrastructure to reduce risks; coastal communities have been important test beds for demonstrating the efficacy of natural infrastructure to address a range of natural hazards.
- Coastal natural infrastructure approaches range from protection and restoration of natural systems and use of living shorelines, to voluntary buyouts and protection of coastal open space.

Berm and dune restoration in Louisiana. Photo: Coastal Protection and Restoration Authority



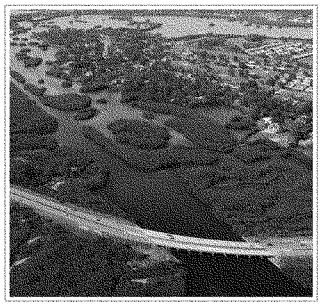
Damage from Hurricane Ike in Texas in 2008. Photo: Federal Emergency Management Agency

NATURAL DEFENSES FOR COASTAL HAZARDS

Following two decades of particularly destructive tropical storms and hurricanes, coastal communities are expanding their tools for keeping people safe and protecting property and infrastructure. Although hard armoring continues to expand along populated coastal areas across the country (Gittman et al. 2016), communities are increasingly embracing natural infrastructure as part of the solution. Approaches range from protection and restoration of natural systems and use of living shorelines, to voluntary buyouts and protection of coastal open space. Indeed, coastal communities have been important test beds for demonstrating the efficacy of natural infrastructure for reducing risks from a range of natural hazards (Spalding et al. 2014b, 2014c).

COASTAL HABITAT RESTORATION

Coastal habitats, such as freshwater and salt marshes, mangrove forests, beach and dune complexes, and coral and oyster reefs, can provide significant risk reduction benefits to coastal communities (Rezaie et al. 2020). For instance, field-based studies from around the world reveal that coastal habitats can reduce wave heights by 35–71% (Narayan et al. 2016).



Florida mangroves. Photo: National Oceanic and Atmospheric Administration

Coastal Wetlands

A recent analysis of all 88 tropical storms and hurricanes that impacted the United States between 1995 and 2016 found that affected counties with greater areas of wetland coverage experienced significantly less property damages than those with little or no wetlands (Sun and Carson 2020). Although the expected economic value of the protective benefits provided by wetlands varies from one region and storm to the next, wetlands can provide an average value of about $700,000 per square mile annually (Sun and Carson 2020). During Hurricane Sandy in 2012, coastal wetlands prevented an estimated $650 million in direct flood damages (Narayan et al. 2017). Along the Gulf Coast, the benefit–cost ratio of wetland restoration for flood risk reduction is estimated to be 8:1, compared with only 0.99:1 for local levees in high-risk areas (Reguero et al. 2018).

Scientists estimate that mangrove forests around the world reduce property damage by more than $65 billion and protect more than 15 million people per year from coastal flooding (Menéndez et al. 2020). Evidence has shown that mangroves can reduce wind- and swell-driven waves by 13–66% per 328 feet of mangrove (Mazda et al. 2006, Quartel et al. 2007, Spalding et al. 2014a). In southern Florida, for instance, research found that intact mangroves and riverine mangrove habitat reduced peak storm surge heights by as much as 3 inches for per half mile

during Hurricanes Charley (2004) and Wilma (2005) (Krauss et al. 2009). In addition, mangrove forests in the region were found to slow the rate of Hurricane Wilma's storm surge and reduce inundation of inland wetlands by an area of nearly 700 square miles (Zhang et al. 2012).

Beaches, Dunes, and Barrier Islands

The broad range of benefits to communities from ecologically-sound beach and dune restoration projects can significantly outweigh the costs, even when considering that beaches and dunes may require periodic sand nourishment and plantings to persist and keep pace with rising sea levels and more intense storms (Taylor et al. 2015). Recent storm events have demonstrated the effectiveness of beach and dune restoration from a risk reduction perspective. Following a nor'easter in 1992 that flattened dunes and caused major flooding to coastal communities in New Jersey, dunes in some areas were restored to a height of 25 feet and a width of 250 feet using snow fencing and dune plantings. When Hurricane Sandy hit the region in 2012, the dunes suffered some damage, but adjacent beachfront communities avoided severe flooding and damages. A neighboring community without restored dunes suffered major losses (Barone et al. 2014).

As their name implies, barrier islands can also play a significant role in buffering the mainland coastline against waves and storm surge (Oliver and Ramirez-Avila 2019). A study of Hurricane Ike's storm surge along the Texas–Louisiana coast found that both Bolivar Peninsula and Galveston Island deflected much of the surge waters eastward, reducing its impact on Galveston Bay (Rego and Li 2010). Research also suggests that large-scale restoration of barrier islands in Louisiana and Mississippi can reduce wave heights by up to 90% and slow peak storm surge by up to two hours relative to a degraded system (Grzegorzewski et al. 2009).

Coral and Oyster Reefs

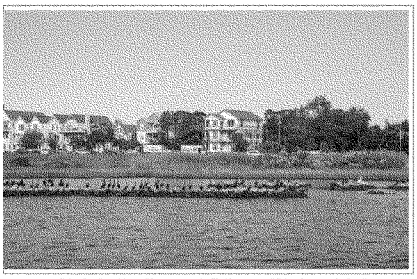
Coral and oyster reefs act as breakwaters that reduce shoreline erosion and attenuate wave height and energy as waves move landward (Ferrario et al. 2014, Manis et al. 2014, Beck et al. 2018). A meta-analysis of risk reduction benefits provided by coral reefs around the world suggests that they can reduce wave energy by an average of 97% compared with areas without coral reefs (Ferrario et al. 2014). Using process-based flood models, Beck et al. (2018) estimate that, across the world's reef-lined coasts, coral reefs reduce annual expected damages from storms by more than $4 billion. Without reefs, annual damages would be more than double that amount. In the United States, Storlazzi et al. (2019) estimate that coral reefs would reduce flood risks for more than 18,000 people and save more than $1.8 billion in avoided damages under a range of potential coastal storm scenarios. Restoration of natural

Breaking wave over coral. Photo: U.S. Geological Survey

oyster reefs also has become increasingly popular as a measure to reduce coastal erosion, while providing a range of other ecosystem services (Scyphers et al. 2011). In San Francisco Bay, for example, a project that included restoration of both native oysters and eelgrass was found to reduce wave energy by 30% compared with unrestored areas, in addition to increasing habitat, food resources, and biodiversity (Newkirk et al. 2018). Healthy, growing oyster reefs may also have the ability to keep pace with rising sea levels naturally, particularly in intertidal zones, which would help maintain their protective benefits over time (Rodriguez et al. 2014).

LIVING SHORELINES

Living shorelines refer to a range of shoreline stabilization techniques to reduce erosion through the use of ecological approaches, as opposed to strictly gray infrastructure (NOAA 2015, Hilke et al. 2020). A living shoreline generally incorporates natural materials, such as vegetation, rocks, and shells, either used alone or in combination with engineered structures for added stability. Commonly used structural components include constructed reefs, sills, revetments, and biologs (e.g., coir or fiber logs). Living shorelines typically serve to reduce shoreline erosion in ways that enhance habitat value and support natural coastal processes, while also providing added storm protection. The application of living shorelines spans the full range of approaches—from completely natural ("soft") approaches like newly placed vegetation, to hybrid ("green-



A living shoreline with an offshore oyster reef in Florida attracts wildlife and protects the shoreline. Photo: Kaila Drayton, NWF.

gray") approaches. Like other forms of natural defenses, living shorelines have the capacity to adapt to changing conditions and self-repair following storms, and they are often more cost-effective for shoreline stabilization compared to conventional forms of shoreline armoring like bulkheads.

Vegetation Only

In some areas, enhancing vegetation in degraded areas or creating vegetative cover in non-vegetated tidal areas can be sufficient to reduce wave height and erosion (Subramanian et al. 2008). Field observation research in the Chesapeake Bay, for example, found that areas planted with *Spartina alterniflora* demonstrate significant wave attenuation capacity during storms (Garzon et al. 2019). During a 100-year storm, the marsh was found to reduce wave height by 70% (Garzon et al. 2019). In addition, for every dollar spent to construct vegetative shoreline stabilization, as much as $1.75 is returned to the economy in the form of improvements to ecological resources, including submerged aquatic vegetation, fish, benthic organisms, shellfish, waterfowl, and wetland habitat (Subramanian et al. 2008). Further, Gittman et al. (2016) found that shorelines hardened with seawalls support 23% lower biodiversity and 45% fewer organisms than natural shorelines. Importantly, monitoring may be necessary in the early stages of project implementation to ensure that newly planted areas have conditions sufficient to enable the establishment, survival, and growth of associated plants (Shao et al. 2020).

Combined Vegetation and Structural Approaches

Hybrid approaches that blend vegetation and other natural structural materials may offer greater protective benefits than vegetation alone, and at a lower cost than conventional hard armoring. A comparative cost analysis of ten shoreline protection measures in the Hudson River estuary, for instance, found that, under a scenario of rapid sea-level rise, sites with ecologically enhanced features such as vegetated geogrids (i.e., successive layers of soil wrapped in geotextile fabric) and rock sills would have significantly lower maintenance, damage, and replacement costs when compared with those with hard armoring (Rella and Miller 2014). In addition, property owners with bulkheads in North Carolina have reported paying more for installation, annual maintenance, and storm-related repairs compared with those with revetments and natural shorelines (Gittman and Scyphers 2017, Smith et al. 2017). Recent analysis of 17 living shoreline sites with sills along the coast of North Carolina found that shoreline change rates at 12 of the sites exhibited a significant reduction in the rate of erosion compared to control sites, and six of those sites were observed to be accreting (Polk and Eulie 2018). During Hurricane Matthew in 2016, a living shoreline project on the Outer Banks composed of restored salt marsh and rock sills proved more effective at reducing shoreline erosion than bulkheads (Smith et al. 2018). Based on monitoring data from five fringing oyster reef projects in coastal Louisiana, La Peyre et al. (2015) found that the reefs reduced the rate of marsh edge erosion by an average of 3.2 feet per year along moderate- and high-exposure shorelines. In addition, a project to construct and restore more than 3.5 miles of oyster reefs in Mobile Bay, Alabama, to protect a natural vegetated shoreline is expected to reduce wave heights by 51–90% and reduce wave energy at the shore by 76–99%, while also supporting the local fishery and improving coastal water quality (Kroeger 2012).

Living shorelines with rock sills can enhance salt marsh resilience to erosion and storms. Photo: Carter Smith.

PROTECTING COASTAL AREAS FROM DEVELOPMENT

Protecting and restoring natural open space offers one of the best opportunities to reduce risks to coastal communities. Strategies can include voluntary buyouts and restoration of acquired lands, as well as policies and programs to protect coastal open space from new development in current and future hazard-prone areas.

Voluntary Buyouts

As is the case in areas where properties have been heavily damaged from inland floods, some coastal areas are engaged in voluntary buyouts and property relocation to protect both people and assets—steps that will likely become unavoidable in some areas along the U.S. coastline as sea-level rise increases risks from erosion, storm surge, and tidal inundation (Fleming et al. 2018). Several communities have already begun removing properties damaged or destroyed by erosion and flooding and investing in habitat restoration efforts to enhance coastal resilience. For instance, the City of Pacifica in San Mateo County, California, has been partnering with local land trusts and other nongovernmental organizations to purchase and remove vulnerable structures and invest in marsh restoration to address worsening erosion and flooding along the community's beach (Estuary News Magazine Team 2013). Although the project required considerable upfront investment to implement, it had widespread support from local government leaders and the public and will ultimately save the community money in avoided losses. The City of Ventura, California, has completed a managed retreat project at Surfer's Point, which has experienced frequent damage from erosion. Key public infrastructure, including a parking lot, pedestrian path, and path bikeway were relocated, and sand dunes and bioswales have been maintained with native vegetation to reduce stormwater runoff and provide protection from waves. Success of the project was credited to collaboration across all major stakeholders and strong grassroots support (Kochnower et al. 2015).

Coastal Open Space Protection

There are a number of lands in both current and projected future high-risk areas that could be protected from further development, which not only would avoid risks to people who otherwise might inhabit those areas, but would also provide natural buffers for existing communities and support the preservation of wildlife habitats (Smith 2009, Brody and Highfield 2013, Berke et al. 2014). For example, a 2009 study of "intermediate lands" (i.e., areas characterized as low-density development, such as some agricultural lands, but with expected future development) found that conservation easements, land acquisitions, zoning regulations, transfer of development rights, and other non-structural measures could effectively limit development and reduce risk along the Atlantic coast for areas below 3.2 feet in elevation (Titus et al. 2009). Indeed, existing policies that have encouraged open space protection in hazard-prone coastal areas have proven successful in reducing risks. The Coastal Barrier Resources Act (CBRA), which established the John H. Chafee Coastal Barrier Resources System (CBRS), helps protect undeveloped areas on the coast by prohibiting federal subsidies and services for developments in environmentally sensitive areas (Milleman 2010). Today, the CBRS covers nearly 3.5 million acres of coastal land, including islands, beaches, wetlands, and associated aquatic habitat. Recent analysis estimates that, between 1989 and 2013, the CBRA reduced federal coastal disaster expenditures by $9.5 billion from what otherwise would have occurred had the lands included in the CRBS been developed at a rate comparable to other coastal areas (Coburn and Whitehead 2019).

EXTREME HEAT AND DROUGHT

At a Glance

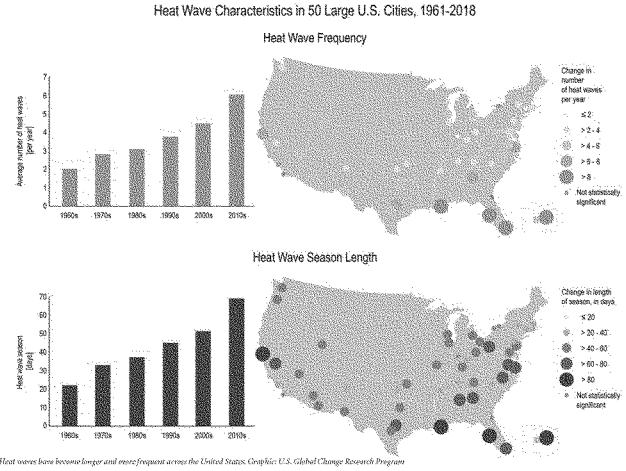
- Together, extreme heat and drought are contributing to a range of challenges, including water shortages, crop losses, damage to aquatic and terrestrial habitats, and severe wildfires; together, drought and heat waves were responsible for the second-highest number of deaths among all of the billion-dollar weather and climate disasters from 1980 to 2019, behind tropical cyclones.
- A number of natural infrastructure approaches are effective in mitigating extreme heat and drought, often in tandem. Strategies range from watershed protection and restoration and urban green infrastructure—such as planting trees and installing green roofs—to water conservation at a variety of scales.

UNDERSTANDING RISKS FROM EXTREME HEAT AND DROUGHT

While many weather- and climate-related disasters are caused by too much water, natural disasters can also result from too little water. Extreme drought conditions across the Southwest and Plains in the summer and fall of 2018, for instance, contributed to more than $3 billion in damages to the agricultural sector. From 1980 to 2019, economic losses from drought amounted to nearly $250 billion, compared with just under $147 billion from inland flooding (NOAA 2020b). Further, drought and heat waves were responsible for the second-highest number of deaths among all of the billion-dollar weather and climate disasters over this same period, behind tropical cyclones (NOAA 2020b).

Climate change is contributing to an increase in both extreme heat and drought conditions across much of the United States (USGCRP 2018). Heat waves are occurring more often than they used to in major cities across the United States, from an average of two heat waves per year during the 1960s to more than six per year during the 2010s. In addition, the average heat wave season across 50 major cities is 47 days longer than it was in the 1960s (USGCRP, n.d.). Over the past two decades, there have been twice as many high-temperature records as low-temperature records across the country, and the number of new highs has surpassed the number of new lows in 15 of the past 20 years (USGCRP 2017). If climate change continues unabated, scientists project twice as many days per year with a heat index over 100°F, and four times as many days with a heat index above 105°F by the 2050s (UCS 2019). In addition, a combination of higher air temperatures and altered precipitation patterns are contributing to increasingly severe droughts, which are compounded by increasing human demand for water (AghaKouchak et al. 2015).

Together, extreme heat and drought are contributing to water shortages, crop losses, public health risks, damage to aquatic and terrestrial habitats, and severe wildfires. Across much of the United States, there has been a substantial increase in concurrences between both heat waves and meteorological drought (i.e., drought associated with dry weather) over the past 50 years (Mazdiyasni and AghaKouchak 2015). Such combined events can have considerable social and ecological implications. For example, the 2011–2016 drought in California, which was characterized by both low precipitation and high temperatures, killed more than 125 million trees (AghaKouchak et al. 2015, Diffenbaugh et al. 2015, USFS 2019).



Heat waves have become longer and more frequent across the United States. Graphic: U.S. Global Change Research Program

NATURAL DEFENSES FOR EXTREME HEAT AND DROUGHT

A number of natural infrastructure approaches are effective in mitigating extreme heat and drought, often in tandem. Strategies range from watershed protection and restoration and urban green infrastructure, to water conservation at a variety of scales. In cities, for instance, increasing pervious surfaces through vegetation cover can reduce localized air and surface temperatures and help replenish groundwater by capturing and filtering rainfall. In addition, urban forest canopies can keep localized temperatures lower through shading and evaporative cooling, reducing the so-called "urban heat island effect"—an increase in air temperature in cities relative to surrounding areas (Levinson et al. 2019). In rural areas, strategies such as beaver restoration and riparian vegetation restoration can help store water and keep nearby streams cooler. And forest restoration efforts across the country help safeguard water resources for people and wildlife alike.

Sign rendered pointless by drought. Photo: Peripitus/Wikimedia Commons

WATERSHED PROTECTION AND RESTORATION

Restoring wetlands, forests, and other natural systems can offer considerable drought mitigation benefits.

Watershed Restoration

Because of their connection to groundwater, wetlands, and subsurface water flows, headwater streams are particularly important for maintaining base flow in larger streams. In the conterminous United States, headwater streams comprise 79% of total river length, and they directly drain more than 70% of the land area (Colvin et al. 2019). In addition, forested areas within watersheds support the hydrologic system by collecting and filtering rain and snow and releasing water into rivers, streams, and groundwater aquifers. Protecting and restoring natural watersheds is essential for sustaining plentiful water resources. Indeed, forests alone provide about 50% of the surface water supply in the West, and up to 35% of consumed water in the South (Brown et al. 2008, Caldwell et al. 2014). In California, so-called "source watersheds"—the forests, meadows, and streams that supply water to its reservoirs—are considered, by law, as an integral part of the state's water system infrastructure (Pacific Forest Trust 2017). Scientists estimate that restoring natural water infrastructure through activities such as mechanical thinning, prescribed fire, and restoration of natural stream channels in five of the state's major watersheds could yield an average of 300,000 acre-feet, or almost 100 trillion gallons of water, annually (Pacific Forest Trust 2017). In addition, several studies have investigated how various forest thinning techniques might help forests accumulate more snow, which is an essential source of summer water in many parts of the West (Bales et al. 2011a, 2011b; Heffelfinger 2012). For example, a study of three unique canopy types in an Arizona ponderosa pine forest found significant differences in snowpack accumulation, with the more open areas that received treatment accumulating 50–70% more snow than the areas of dense (untreated) canopy (Heffelfinger 2012). In the southeastern United States, research suggests that restoring more than 4,600 square miles of agricultural land along the Altamaha River basin to loblolly pine would have a positive impact on surface water supplies by providing 11.4% water yield for 46-inch average annual precipitation (Hallema et al. 2019).

Beaver Restoration

North American beavers are ecosystem engineers. Prior to their near extirpation in the early 1900s, beavers helped create and maintain wetlands and riparian ecosystems across much of the United States (Dittbrenner et al. 2018, Bailey et al. 2019). In addition to supporting numerous species of fish and wildlife, beaver-created wetlands can recharge groundwater, sustain summer water flows, provide natural firebreaks, and reduce downstream flood risk by slowing and retaining floodwaters (Norman et al. 2019). Given this, there has been growing interest in restoring beavers to portions of their former range to enhance stream conditions and help mitigate drought (Pilliod et al. 2018). In some cases, beavers have been relocated into formerly occupied habitats or encouraged to recolonize on their own by enhancing attractive habitat features. In others, managers have implemented "beaver mimicry" by installing instream structures that play a similar role in stream geomorphology and hydrology. A number of studies have

demonstrated the increased water storage benefits provided by beaver restoration projects. For example, a study of wetlands and beaver activity over a 54-year period in eastern Alberta, Canada, found that during wet and dry years, the presence of beaver populations was associated with a 9-fold increase in open water when compared with a period when the animals were absent from those sites (Hood and Bayley 2008). In Colorado, research suggests that the presence of beavers in wide river valleys can create a physically complex hydrologic environment that buffers the impacts of high and low flows (Wegener et al. 2017). Further, beaver dams have been found to raise the water table and flood surrounding areas, recharging nearby water sources (Westbrook et al. 2006).

URBAN GREEN INFRASTRUCTURE

In addition to helping communities address risks from inland flooding, urban green infrastructure can help reduce temperatures or provide relief during heat waves.

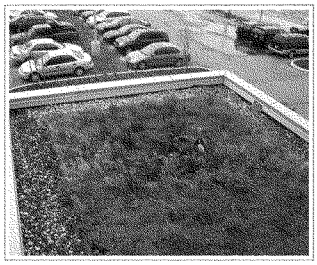
Urban Trees and Other Vegetation

Expanding the area of trees and other vegetation in cities is considered to be one of the most effective and least costly approaches to reducing the urban heat island effect (Livesley et al. 2016). Establishing a tree canopy, in particular, can reduce local temperatures by providing shade. In addition, trees, grass, and other vegetation can reduce heat through the process of evapotranspiration, which draws heat from a surface when liquid moisture is converted into vapor (Peters et al. 2011, Coutts et al. 2013, Bounoua et al. 2015, Feng 2018). A review of multiple studies found that vegetation in urban areas can reduce the surrounding air temperature by 0.9–7.2°F (Qiu et al. 2013). Research by Loughner et al. (2012) found that expanding vegetated areas throughout a city can reduce surface air temperatures by as much as 7°F. Further, Zölch et al. (2016) suggests that planting trees can reduce heat stress by as much as 13%, particularly if plantings occur strategically in heat-exposed areas.

A study of the surface temperature–reduction benefits of ten different species of trees found that asphalt in shaded areas ranged from 24.8° to 41°F cooler than areas exposed to sun (Napoli et al. 2016). In addition, shade provided by trees can reduce surface temperatures on exterior walls and rooftops by as much as 45°F, and it can reduce a building's interior temperature by reducing the amount of sunlight that passes through windows (U.S. EPA 2008). A study in Phoenix, Arizona, also found that vegetated surfaces provided as much as a 45°F surface cooling compared with bare soil on low-humidity summer days (Jenerette et al. 2011).

Beaver activity can improve the capacity of watersheds to hold water during dry periods. Photo: Pat Gaines/Flickr

Green Roofs and Cool Pavement



Green roofs can help moderate the urban heat island effect. Photo: S. Woodside/Flickr

A "green roof" consists of a waterproofing membrane, a growing medium such as soil, and vegetation on a structure's rooftop to provide a range of environmental benefits (GSA 2011). Using green roofs in urban areas can help moderate the urban heat island effect, particularly during daytime hours (U.S. EPA 2008). For example, research has shown that the temperatures on green roofs can be 30–40°F lower compared with conventional roofs (e.g., DeNardo et al. 2005, U.S. EPA 2008, GSA 2011, Sailor et al. 2011, Berardi et al. 2014, Santamouris 2014, Sun et al. 2016). A comparison of temperature data collected at a green roof site and nearby black roofs in the New York City area found that a green roof offers a demonstrable cooling benefit (Gaffin et al. 2010, Culligan et al. 2018). In particular, peak temperatures on green roofs were, on average, 60°F cooler than black roofs during summer. And a study of green roofs from around the world shows that, compared with the ambient temperature, the cooling effect of a green roof on surface temperature can

range from 1.4° to 54°F, with the variation reflecting different study approaches, localized conditions, and other factors (Qiu et al. 2013). On a broader scale, researchers have found that the use of green roofs could provide ambient cooling of as much as 5°F across entire cities (e.g., Liu and Bass 2005, Rosenzweig et al. 2006, Santamouris 2014). Not only will such projects help reduce risks to vulnerable populations, but they can help communities reduce energy consumption for both winter heating and summer air conditioning (Castleton et al. 2010).

The use of "cool pavement" as an alternative to conventional materials, such as impervious concrete and asphalt, has also been shown to reduce outdoor air temperatures, often at a lower cost than green roofs. Conventional pavement can reach peak summertime temperatures of 120–150°F due to factors such as low solar reflectance (i.e., the percentage of solar energy reflected by a surface) and thermal emittance (i.e., how readily a material sheds heat) (Pomerantz 2000, U.S. EPA 2008, Sen and Roesler 2017). Current cool pavement approaches, which may entail using lighter-colored and permeable materials, can moderate both factors by reducing the amount of heat that is absorbed and stored (Liu et al. 2018, Sen and Roesler 2019). For example, research suggests that if pavement reflectance throughout an urban area were increased by 10–35% through use of alternative materials, air temperatures could be reduced by 1°F, depending on the city geography and climate (Pomerantz 2018).

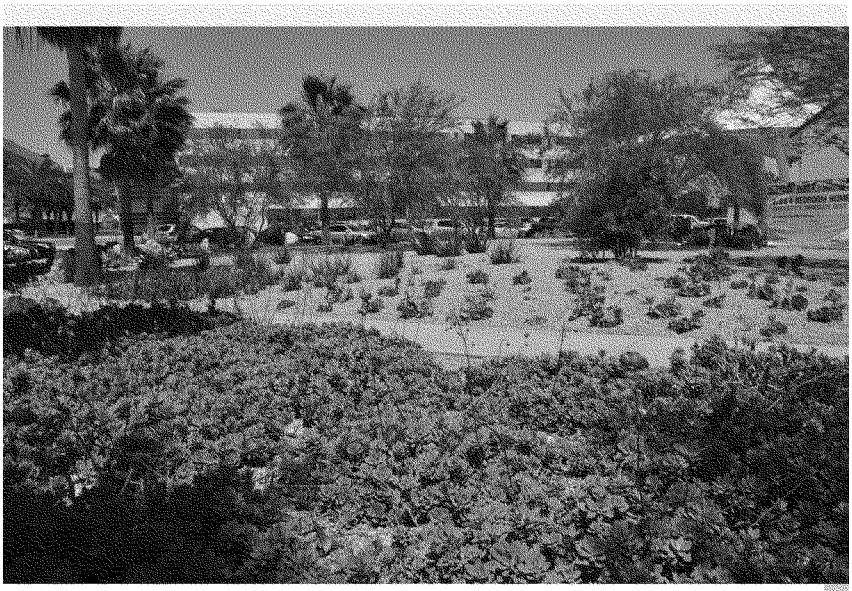
WATER CONSERVATION

Reducing water consumption is an important approach to improve water security in communities faced with frequent drought (Reeve and Kingston 2014). For example, reducing urban outdoor water use, which includes limiting the amount of water that is used for landscaping in yards, parks, and other green spaces, can help communities meet their water consumption goals. Strategies may include conserving water by capturing rainfall for reuse, using less water in landscape management, and encouraging landowners to replace lawns with native, drought-resistant plants. In addition, farmers across the country have found that certain practices, such as no-till farming and use of cover crops, can reduce their annual water requirements.

Rainwater Harvesting

In response to worsening droughts and a desire to enhance water conservation, interest in rainwater harvesting has grown in many areas (Ennenbach et al. 2018, Radonic 2018). In general, rainwater harvesting involves collecting runoff from impervious surfaces such as roofs, driveways, and parking areas, and putting it into systems such as rain barrels and cisterns. Although results vary by rainfall levels, the size of the drainage area, and water use patterns, in some regions, a single 50-gallon rain barrel installed at a residential parcel has been estimated to provide as much as a 50% water-saving efficiency for non-potable indoor water demand (Steffen et al. 2013). Ennenbach

Cover crops on dryland wheat field. Photo: Garrett Dwyer/Natural Resources Conservation Service



Los Angeles Air Force Base uses xeriscaping to conserve water. Photo: Sarah Corrie/U.S. Air Force

et al. (2018) assessed the viability of rainwater harvesting at the county level across the conterminous United States and found that residential water demand could be met with greater than 90% reliability over much of the country from rainwater collected from the typical roof area. In particular, low-population-density counties have the potential to meet as much as 100% of their annual residential water needs, compared with about 20% of needs in high-density counties.

Xeriscaping

Outdoor irrigation is the single largest residential end use of water in the United States. Thus, water utilities across the country are seeking ways to reduce outdoor water use through a variety of programs. Xeriscaping, which is the practice of replacing lawns and other irrigation-dependent landscapes with drought-tolerant plants, mulch, and efficient irrigation, is being incentivized through innovative programs by a number of utility providers (Nolon 2016). In southern Nevada, a five-year study showed that homes that had converted turf lawns to xeriscaped landscapes saw a 30% annual reduction in total household water use, equating to nearly 100,000 gallons annually (Sovocool et al. 2006). In California, average annual turf-replacement water savings for among programs at ninewater agencies range from 18% to as much as 83%, depending on geographic climate differences, programmatic variability in landscape and irrigation replacement options, and other factors (Seapy 2015).

Water-saving Agricultural Practices

As droughts have continued to worsen across much of the country, farmers are seeking cost-effective ways to manage water resources. Practices such as no-till farming and using certain types of cover crops, for instance, have proven to have significant water-saving benefits. Plot studies at a wheat farm in Akron, Colorado, during a severe 2011 drought showed that the conventional tillage production system employed prior to wheat planting resulted in 3.4 inches less available soil water at planting compared with the no-till system (Lal et al. 2012). Following the extensive 2012 drought, which affected more than 80% of agricultural lands nationwide, farmers using cover crops with corn experienced about 79% of typical yields, more than 10% more than those not using cover crops (O'Connor 2013, Bergtold et al. 2019). In an analysis of potential changes in agricultural practices in Iowa, Basche (2017) found that continuous cover systems make an average of 9% more water available to plants than do annual crop systems.

WILDFIRES

UNDERSTANDING WILDFIRE RISKS

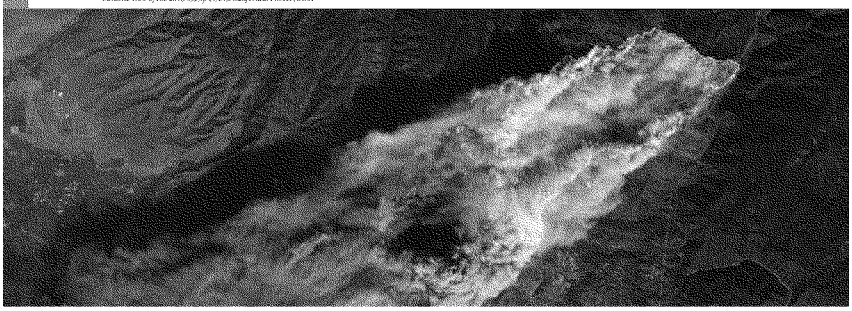
Wildfires are a natural and integral part of many forest ecosystems. By contributing to shifts in ecosystem structure, composition, and function, fires can create heterogeneity across the landscape and enhance biodiversity (Brown and Smith 2000, Thom and Seidl 2016). Over the past few decades, however, the severity and extent of wildfires have grown considerably, as have the impacts to human communities and the natural ecosystems themselves (McKenzie et al. 2004, Running 2006, Westerling et al. 2006, Hicke et al. 2016, Westerling 2016, Seidl et al. 2017, Stephens et al. 2018). This trend is due to a combination of factors, including overly dense forests due to historical and present-day fire suppression, the expansion of highly flammable invasive species in places, and changing climatic conditions, which have led to intense droughts and altered hydrology (Millar and Stephenson 2015). In California, for instance, higher average temperatures and a 30% decline in fall precipitation over the past four decades have doubled the number of days with extreme (95th percentile) fire risk (Goss et al. 2020). Across much of the West, the occurrence of so-called "mega-fires"—those with areal extents greater than 100,000 acres—has increased considerably (Adams 2013, Heyck-Williams et al. 2017).

A growing concern is the significant increase in people living in the so-called "wildland–urban interface" (WUI), which is the area where houses are in or near wildland vegetation (Radeloff et al. 2018). As of 2010, the WUI of the conterminous United States contained about 44 million houses, with the highest concentrations in California, Texas, and Florida (Martinuzzi et al. 2015). These areas are often at higher wildfire risk due the proximity of structures to flammable vegetation as well as the potential for human-caused ignitions.

At a Glance

- Although wildfire is a natural process in many forest, shrubland, and grassland systems, wildfires have posed heightened risks to human communities in recent decades, owing in part to historical and current land-use practices and suppression of natural fire regimes, development in fire-prone areas, expansion of invasive species, and changing climatic conditions.
- Ecological forest management, such as restoring natural fire regimes, targeted thinning, prescribed fire, and post-fire restoration, can help ameliorate the threat of wildfire while providing co-benefits that include increased water quantity and quality and improved habitat for fish and wildlife.
- Helping communities prepare for fires and adapt to fire-prone surroundings in a variety of ways (including creating "defensible space" around structures, retrofitting structures to be more fire-resistant, and engaging in collaborative community planning) is essential to addressing wildfire risk in communities and will also improve fire managers' ability to increase the use of managed wildfires and prescribed fire.

Satellite view of the 2018 Camp Fire in California. Photo: NASA



NATURAL DEFENSES FOR WILDFIRES

Wildland fire management in an era of climate change can have several objectives, including reducing risks to people and property and enhancing the health and resilience of ecosystems. Although fire management may achieve both objectives simultaneously, the ability to do so depends on a number of factors (Vaillant and Reinhardt 2017). In areas where the risks to public safety, property, and natural resources are particularly high, options skew toward fire prevention (e.g., reducing ignitions) and suppression (e.g., incident response), in addition to fuels management (e.g., mechanical thinning and prescribed fire). Yet, management efforts must also account for the effects of more frequent and severe wildfires on forest ecosystems more broadly. Natural and nature-based approaches for wildfire risk reduction range from ecological forest management practices, such as restoring natural fire regimes (including letting fires burn where safely possible) thinning, prescribed fire, and post-fire restoration, to policies and programs that help communities adapt to a fire-prone landscape.

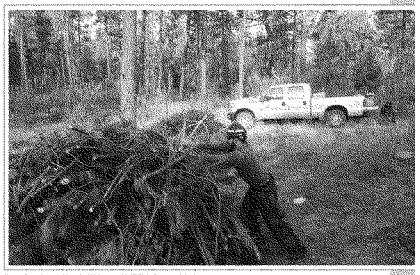
ECOLOGICAL FOREST MANAGEMENT

Ecological forest management has emerged as an important concept for addressing wildfire risks as well as enhancing the health of forest ecosystems (D'Amato et al. 2011, 2018; Kelsey 2019). Specifically, ecological forest management may include a combination of strategic thinning, prescribed fire, and managed wildfire to reduce the risk of high-severity wildfire and promote healthier, more resilient forests (Stephens et al. 2016, Kelsey 2019). Done thoughtfully, the approach can help balance tradeoffs between short-term impacts of treatment with long-term benefits of reduced risks of large, high-severity fires (Kelsey 2019, Krofcheck et al. 2019). Further, restoring ecological functions and processes of forest systems can protect water resources and reduce flooding in communities within the watershed.

Treatment prescriptions vary depending on treatment objectives (which should be clearly established up front) and forest type. Different forest types have different natural fire regimes. There is a body of literature showing that treatments can modify wildfire behavior and result in better wildfire outcomes (e.g., Johnson et al. 2011, Kerhoulas et al. 2013, Stevens-Rumann et al. 2013, Loudermilk et al. 2014, Kalies and Kent 2016, Walker et al. 2018). The following are examples of ecological forest management to reduce wildfire risk:

Combined Fuel Reduction Treatments

A post-fire assessment of the high-severity Angora Fire, which destroyed 254 homes in the Lake Tahoe Basin, California, in 2007, found that areas that received fuel reduction treatments (including thinning and burning of slash piles) prior to the fire experienced considerably lower degrees of damage and tree mortality than those that had not been treated, with the exception of areas where slope steepness led to lower levels of fuel removal due to local standards for erosion prevention (Safford et al. 2009). A study by Waltz et al. (2014) similarly found that areas that received fuel reduction treatments experienced lower burn severity during the 2011 Wallow Fire in Arizona, which covered more than 469,000 acres to become the largest wildfire in the state's history. On average, trees killed in untreated units numbered six times as many as those killed in treated units. In addition to providing firefighters with opportunities to protect residences during the fire, treatments that allowed for clumps of trees and buffers for wildlife habitat were even more effective in reducing fire spread than those that resulted in evenly distributed trees with complete removal of ladder fuels (Kennedy and Johnson 2014). A combination of thinning and prescribed fire in eastern and southern California was found to have significantly reduced burn severity in trees during 12 wildfires that occurred between 2005 and 2011 (Safford et al. 2012). In 2018, the Golf Course Fire caused the evacuation of 300 homes as it burned west of Grand Lake, Colorado; but no lives or structures were lost due to the success of strategic fire management planning and risk-reduction measures (Colorado State Forest Service 2018). Since 2015, the Colorado State Forest Service and its partners conducted fuel treatments, including removal of beetle-killed trees and creation of fuelbreaks, on more than 200 acres of land adjacent to subdivisions that were ultimately impacted by the fire.



Forest thinning on Turnbull National Wildlife Refuge, Washington.
Photo: Ken Meinhart/U.S. Fish and Wildlife Service

Both firefighters and emergency responders praised those efforts as significantly aiding their ability to protect the community (Colorado State Forest Service 2018).

Prescribed Fire

Prescribed fire, which entails the deliberate application of fire in ecological systems to achieve a variety of management goals, has proven to be an effective tool in reducing the areal extent and severity of wildfires across a range of forest types (Fernandes and Botelho 2003, Calkin et al. 2014, Fernandes 2015). Indeed, as noted by Kolden (2019), prescribed fire is one of most widely advocated management practices for mitigating wildfire risk and restoring the ecological health of fire-adapted systems. The U.S. National Cohesive Wildland Fire Management Strategy, for instance, specifically identifies prescribed fire as the most cost-effective solution over the largest potential area of the United States, when compared with both non-fire vegetation treatment and managed wildfire (Wildland Fire Leadership Council 2014).

Prescribed fire-treated forest stand, Fremont-Winema National Forest. Photo: U.S. Forest Service

In the southeastern United States, prescribed fire has been a long-standing practice. In Fort Benning, Georgia, for example, researchers evaluated a 30-year record of wildfire, prescribed fire, and drought to determine how prescribed fire has affected wildfire incidence in the region (Addington et al. 2015). From 1982 to 2012, there was an overall increase in the area burned by prescribed fire corresponding with Fort Benning's increased use of fire for meeting both fuel reduction and ecosystem management objectives. Over the same period, wildfire incidence declined, and annual wildfire incidence appears to have stabilized at or below 100 wildfires per year, in contrast to the 300–500 annual wildfires earlier in the record. Although the authors acknowledge that the effects of prescribed fire in managing wildfire in the future may be undermined by prolonged drought and a changing climate, managers may be able to continue to take advantage of its effectiveness in reducing wildfire activity when weather conditions are favorable. In Florida's Osceola National Forest, evidence suggests that a program of regular prescribed burns (every 2–5 years) between 1998 and 2008 reduced the likelihood of high-burn severity up to five years after treatment (Malone et al. 2011). Although prescribed fire has also been an effective management strategy in the West, the practice has lagged due to a variety of factors, including public health concerns about smoke, narrow burn windows, and lack of capacity (Melvin 2018, Kolden 2019, Schultz et al. 2019). Recent policy changes and greater reliance on collaborative governance have the potential to create greater opportunities for use of prescribed fire across the region (Schultz et al. 2019).

Post-fire Restoration

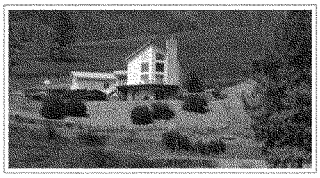
Post-fire management can provide an important opportunity to implement climate-informed forest restoration at a large scale (Millar et al. 2007, Peterson et al. 2011, Halofsky et al. 2018, Schumann et al. 2020). However, forest managers will need to consider where and when to prioritize active reforestation (including planting and control of understory vegetation and removing snags), versus allowing passive recovery following a major wildfire (White and Long 2019). Indeed, active management may be increasingly important in some areas, as the impacts of climate change and other stressors, such as invasive species, have reduced the potential for forests to regenerate on their own (Davis et al. 2019; Dey et al. 2019; Kemp et al. 2019; North et al. 2019; Parks et al. 2019a, 2019b; Stevens-Rumann and Morgan 2019). Uncharacteristically large and severe fires in dry forest ecosystems eliminate seed sources of dominant tree species. Without active restoration these areas may never return to forests. To ensure that post-fire restoration efforts maximize the resilience of the recovering forests to changing climatic conditions, scientists recommend that approaches focus on enhancing habitat complexity and heterogeneity, planting fire-adapted species, and minimizing removal of organisms, organic material, and other elements of a post-fire disturbance forest system that are important for forest regeneration (Leverkus and Castro 2017, Leverkus et al. 2018, Thorn et al. 2018, Donovan et al. 2019).

LEARNING TO LIVE WITH FIRE

From a risk management perspective, Calkin et al. (2014) note that neither pre-fire fuel treatments nor post-fire management stop fire—they only change fire behavior. Thus, if the goal is to keep wildfire out altogether, it is likely to be unobtainable (Calkin et al. 2014). Accordingly, there is growing recognition of the need for communities to learn to live with and adapt to fire (Schoennagel et al. 2017, McWethy et al. 2019). Better community planning, including building codes and zoning regulations as well as proactive evacuation planning, can improve public safety and reduce property damage in the event of wildfire. Strategies may include creating "defensible space" through development of firebreaks (i.e., areas cleared of vegetation) and fuelbreaks (i.e., areas where vegetation is reduced), and "home hardening," which consists of renovating existing structures using fire-resistant materials and designs and ensuring that new structures are built with fire-resistance in mind. It will also be necessary to allow some wildfires to burn, particularly where the risks to human communities are low.

Community Planning and Collaborative Risk Management

Across the country, efforts aimed at helping communities live with fire have been driven by both regulations (e.g., codes and ordinances) and voluntary, incentive-based approaches. It's widely recognized that there is no one-size-fits-all solution because every community has its own unique ecological and socioeconomic contexts. Regulatory approaches to encourage mitigation may or may not work in all cases (Edgeley and Paveglio 2019). In highly rural areas, for example, residents are often more receptive to options that strengthen community identity and allow for community-based oversight rather than to regulatory approaches (Edgeley and Paveglio 2019, Paveglio et al. 2019). Since 2003, thousands of communities have developed and implemented community wildfire protection plans (CWPP), as recommended under the Healthy Forests Restoration Act of 2003 (Evans et al. 2013, 2015). This success is due, in part, to the fact that the CWPP process allows communities to develop plans that best fit their local and ecological contexts (Jakes et al. 2011). The Firewise USA® recognition program, a collaborative effort between state and federal agencies and nongovernmental organizations, has been working with communities across the country to reduce wildfire risks by encouraging homeowners to work together and improve defensible space in their neighborhoods. Recent fires have demonstrated the program's success in some areas. For example, in 2017, two consecutive fires in the community of Indian Lake Estates, Florida, spared numerous homes and structures due to risk reduction preparations that homeowners made under the program (NFPA 2018).



Home protected by defensible space during the 2010 Nathaham Canyon Fire, Washington. Photo: Sarah Foster/Washington Department of Natural Resources

Effective wildfire risk reduction strategies need to focus not just on strategies to reduce impacts to property and infrastructure, but also on wildfire emergency response to reduce risks, such as identification of effective evacuation routes and emergency shelters (Steelman and Nowell 2019). This requires effective collaboration and communication across a range of stakeholders, as well as integrated efforts to prioritize appropriate risk reduction measures. Dunn et al. (2020), for instance, present a novel risk science approach that combines a range of tools, including quantitative wildfire risk assessment, mapping of suppression difficulty, and atlases of potential control locations, to provide a foundation for collaborative and adaptive governance in fire management. To minimize future risks, it will also be important to discourage new development in areas where the wildfire hazard is high (Schoennagel et al. 2017). Doing so can offer a variety of benefits. For instance, a simulation of housing growth in San Diego County, California, suggests that purchasing conservation lands to prevent development would offer both fire risk reduction and biodiversity benefits, regardless of whether those lands were chosen because of high fire hazard or high species richness (Syphard et al. 2016).

Managed Wildfire

Allowing wildfires to burn naturally, with suppression only under defined management conditions, is increasingly being considered as an important approach to restoring natural fire regimes in parts of the West. This approach differs from prescribed fire in that it relies on natural ignition events, with suppression done only in instances where other management goals, such as community safety, are jeopardized (Boisramé et al. 2017, Schoennagel et al. 2017). Indeed, recognizing the importance of fire in many ecosystems, the 1995 Federal Wildland Fire Management policy led to the reintroduction of more wildfire in national parks and other public lands. In parts of Yosemite National Park, for instance, 40 years of managed wildfire has contributed to increased landscape heterogeneity, and evidence suggests that it has helped improve the resilience of habitats to drought and fire (Boisramé et al. 2017). As with prescribed fire, gaining public acceptance of more wildfire as both inevitable and potentially beneficial will require education and community engagement.

RECOMMENDATIONS TO ADVANCE NATURAL INFRASTRUCTURE SOLUTIONS

As detailed above, nature can play a significant role in reducing risks from a variety of weather- and climate-related hazards. In many places, protection and restoration of natural systems can enhance community resilience in the face of increasing risks from inland flooding, coastal hazards, extreme heat and drought, and wildfires.

Despite the clear and growing body of evidence demonstrating that natural defenses are both effective and cost-effective solutions for risk reduction, deployment of these solutions by communities remains relatively low. Not only are the risk-reduction benefits nature offers underutilized, but recent federal policy changes threaten to degrade remaining natural systems and damage their capacity to buffer communities.

Federal policy-makers have an important role to play in bolstering the use of natural infrastructure across the country and across different societal sectors. Below we outline some approaches that would help ensure that as a nation we successfully expand the use of—and receive the greatest benefit from—our natural defenses.

PROTECT & RESTORE EXISTING FEATURES PROVIDING NATURAL DEFENSES

Oftentimes the most effective hazard risk reduction comes in the form of undisturbed and healthy natural systems. As aptly noted by the Reinsurance Association of America: "One cannot overstate the value of preserving our natural systems for the protection of people and property from catastrophic events" (Restore America's Estuaries 2011).

Nevertheless, intact ecosystems continue to face pressure from population growth and development, destructive water and land resource management practices, and new stresses linked to rapid climate change. By protecting or restoring existing natural features, we can maintain their ability to provide protective benefits to communities.

Rain over the U.S. Capitol. Photo: Architect of the Capitol

- Support conservation programs like the Land and Water Conservation Fund that acquire, protect, and/or restore environmentally sensitive natural systems and open space.
- Identify where natural systems provide hazard protection and other critical services to communities, including through robust mapping and planning efforts at the local, state, and federal levels. Prioritize protection or restoration of these systems in appropriate plan updates and revisions (e.g., State Hazard Mitigation Plans, Coastal Zone Management Plans, etc.).
- Allow floodplain ecosystems to better serve their natural functions by adopting policies that encourage new or reconstructed levees to be set back from the water's edge to sustain and enhance wetlands and riparian habitat, reduce erosion and scour, and lower flood levels.
- Defend and strengthen bedrock environmental laws and regulations that support healthy ecosystems and guarantee communities a voice in decisions that may harm the natural systems that protect their communities. Recent rollbacks to Clean Water Act protections threaten over half the nation's wetlands and millions of stream miles, and should be rescinded. Similarly, recently proposed changes to implementation of the National Environmental Policy Act would dramatically weaken environmental protections by allowing projects to advance without full disclosure of foreseeable impacts, and suppressing meaningful public engagement in decisions impacting public health and the environment.

MAINSTREAM USE OF NATURAL INFRASTRUCTURE ACROSS SECTORS

Improving the nation's resilience to natural disasters will require preparedness and planning across governmental agencies and societal sectors. Most communities historically have relied on gray infrastructure to provide protection from flooding and other natural hazards, even where natural or hybrid solutions might be equally or more effective and provide a suite of ancillary benefits. There is an urgent and compelling need to integrate, or mainstream, the use of natural infrastructure in sectors ranging from flood mitigation and stormwater management to transportation. To do this, we must remove existing barriers to the adoption of natural solutions and ensure that such approaches are an equally accessible option for communities from both regulatory and funding perspectives. At minimum, natural and nature-based projects should be both eligible and competitive for federal dollars across sectors. Ideally, these solutions should be the first option considered to reduce hazard risk, and used whenever practicable and appropriate to address the resilience needs of the community.

- Ensure that natural infrastructure is an eligible use of the Surface Transportation Block Grant program as part of the next surface transportation reauthorization bill. Congress should also invest additional resources specifically to help states improve the resilience of their surface transportation infrastructure, including through the use of natural features. This would complement recent efforts at the Federal Highway Administration to provide technical assistance to help transportation agencies improve transportation systems using natural infrastructure (FHWA 2018).
- Codify a 20% set-aside of Clean Water State Revolving Loan Fund dollars for the Green Project Reserve to invest in green infrastructure solutions ranging from floodplain restoration to green roofs and permeable pavement.
- Ensure that the U.S. Army Corps of Engineers (USACE) fully complies with its existing mandates to evaluate natural infrastructure project alternatives where practicable for flood and storm damage risk reduction. Additionally, Congress should create new incentives for the use of natural infrastructure solutions for flood protection, including by lowering the nonfederal sponsor cost-share for such USACE projects.
- Thoroughly value and account for ecosystem services in federal and state agency decision-making. Ensure that the USACE, Federal Emergency Management Agency (FEMA), and other agency cost–benefit analyses account for both the ecological services lost and gained as a result of a project.
- Improve the tools available through FEMA for assessing the cost-effectiveness of nature-based projects, such as living shorelines. Currently, many such projects are disadvantaged in the mitigation grant application process because of challenges applicants face in meeting benefit–cost analysis requirements using available data and tools.
- Ensure that natural infrastructure projects are not subject to longer permitting timelines or more complicated permitting processes than structural alternatives. For example, despite the creation of USACE Nationwide Permit 54 for living shorelines, in many states, environmentally damaging structural shoreline stabilization projects, like bulkheads and seawalls, are still faster and easier to permit than more ecologically friendly living shorelines (Hilke et al. 2020).

Yolo Bypass Wildlife Area in California, part of the Sacramento River flood control system. Photo: Dave Feliz/Yolo Bypass Wildlife Area

IMPROVE RISK ASSESSMENT AND ENCOURAGE SMART DEVELOPMENT

Over time, the United States has experienced a considerable increase in the number of people living in hazard-prone environments, from coastlines and floodplains to the fire-prone wildland–urban interface. People in these environments often have an incomplete understanding of their actual risk level, and some government programs even provide incentives that encourage people to live in harm's way.

For example, the National Flood Insurance Program (NFIP), although well-meaning, has inadvertently encouraged development in flood-prone areas by masking true risks through subsidized insurance rates. This has resulted in a program deeply in debt to taxpayers that promotes continued development in risky areas, which in turn contributes to loss of the very natural systems, like functioning floodplains, that could reduce flood damages. Outdated and incomplete national flood maps and insufficient real estate disclosure requirements have exacerbated the problem, blinding property owners and communities to their actual risk levels and denying them the information they need to make decisions to mitigate that risk.

Federal programs must be reformed to improve mapping and communication of natural hazard risks, to increase incentives that promote smart development and pre-disaster mitigation, and to actively discourage new development in the most hazardous areas.

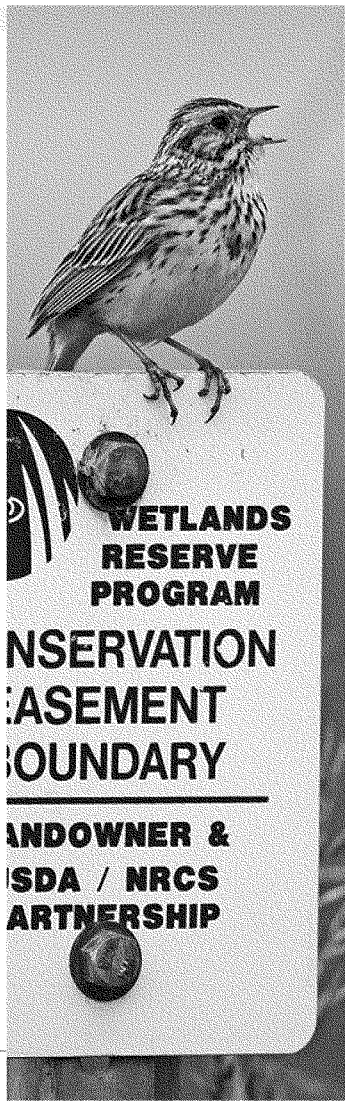
- Significantly increase resources to swiftly complete new national flood maps, particularly in data-sparse regions, and to maintain accurate maps thereafter. It is estimated that only one-third of the river and stream miles in the nation have flood hazard information available (ASFPM 2020). FEMA must be required to update its maps using the best available technology, such as Light Detection and Ranging (LiDAR), to get property-level elevation data, and to account for the latest climate modeling, including precipitation, sea-level rise, and flood projections.
- Reauthorize and reform the NFIP, breaking the chain of short-term program extensions. Any reform bill should keep communities on a glide path to risk-based rates for all properties, with means-tested assistance for those who cannot afford to pay actuarial rates. Instead of perpetuating widespread subsidies, the program should be reformed to promote increased proactive and pre-disaster mitigation to lower risk, and thereby lower flood insurance rates. Community-wide, natural, and nature-based mitigation should be used and encouraged wherever possible.
- Fully support programs providing other critical data inputs for accurate flood maps. For example, both the U.S. Geological Survey stream gauge network and the National Oceanic and Atmospheric Administration's (NOAA) rainfall frequency modeling efforts must be fully resourced to ensure that up-to-date information feeds into flood models.
- Advance development and amplification of up-to-date digital map products depicting local and regional hazards, such as NOAA's Digital Coast tools, which help coastal communities visualize sea-level rise and flooding.
- Continue the process of updating Coastal Barrier Resources System (CBRS) maps, to ensure that federal subsidies do not provide incentives for new development in these environmentally sensitive and hazard-prone areas. Strategically expanding the CBRS shoreward, in consideration of anticipated sea-level rise scenarios, would make good fiscal, environmental, and public safety sense and would enable migration of natural protective features like salt marsh.
- Support continued development of fire risk assessment mapping efforts by the U.S. Forest Service for use in communicating risk levels and mitigation needs to communities in key firesheds, and to inform timely decisions regarding fire prevention and mitigation campaigns, fire suppression responses, active wildfire management, and forest restoration including use of prescribed fire.
- Enhance collaborative efforts to build community resilience to wildfires in high-risk areas, including support for improved Community Wildfire Protection Plans, Firewise USA®, the Fire Adapted Communities Learning Network, and other programs to facilitate locally driven wildland fire risk management, planning, and mitigation.

DRAMATICALLY SCALE UP INVESTMENTS IN COMMUNITY RESILIENCE AND SUPPORTING RESEARCH

We can accelerate the adoption of natural infrastructure solutions by increasing their prevalence in communities, including through federal funding opportunities. More on-the-ground applications of natural infrastructure also provide an opportunity to expand efforts to monitor and evaluate the performance of these features during different types of extreme weather events and across different geographies. Such work can help create or refine design and engineering standards, and

increase the comfort level and social acceptance of natural and nature-based features among decision-makers, communities, and contractors. There is also a need to ensure that social equity considerations are a component of community resilience strategies. Climate impacts are unevenly distributed across society, and frontline communities directly impacted by climate change and natural disasters should be engaged in resilience planning to help ensure durable and shared benefits.

- Expand targeted research on the performance and effectiveness of various forms of natural defenses for meeting risk reduction objectives; continue to improve specifications on when, where, and how these approaches can be used most reliably.
- Ensure the design and implementation of natural infrastructure solutions, including activities such as forest restoration, takes future precipitation patterns, sea-level rise, and other climatic factors into account; encourage designs that are functional across multiple scenarios of future change.
- Boost research, monitoring, and evaluation to identify the most appropriate ecological fire management options within diverse forest systems.
- Ensure that robust allocations for enhancing ecosystem resilience and deploying nature-based risk reduction measures are a part of major funding programs, such as disaster recovery and mitigation efforts (e.g., FEMA's Hazard Mitigation Assistance programs and the U.S. Department of Housing and Urban Development's Community Development Block Grant Disaster Recovery and Mitigation funds), as well as water resource development programs.
- Support competitive grant programs for implementation of natural and nature-based features, and require project monitoring and data reporting as a condition of the grant. Grant opportunities can spur and cultivate innovative resilience-building approaches. In addition, they often create incentives for private investment and result in leveraging of dollars. For example, the National Coastal Resilience Fund leverages federal and private sector funds for projects that reduce risks to people and wildlife.
- Increase the U.S. Forest Service budget for proactive and climate-informed pre- and post-fire restoration and management activities, based on principles of ecological forest management. Identify new sources of federal funding to support climate-informed restoration on both public and private forest lands.
- Create a national revolving loan fund for community resilience. This fund could provide low- to zero-interest loans for communities to invest in projects and programs that improve disaster preparedness and long-term resilience in the face of increasingly severe storms, flooding, drought, wildfires, and other natural hazards, with an emphasis on use of natural infrastructure to achieve those goals. To support efforts in lower-income communities, the revolving loan fund should be administered alongside a grant program with aligned goals, or should include a mechanism to ensure access to the program for communities that otherwise would not have the resources available to participate and allow for near-term implementation of solutions.



Savannah sparrow in the Willamette Valley, Oregon.
Photo: Tim Leonard/Natural Resources Conservation Service

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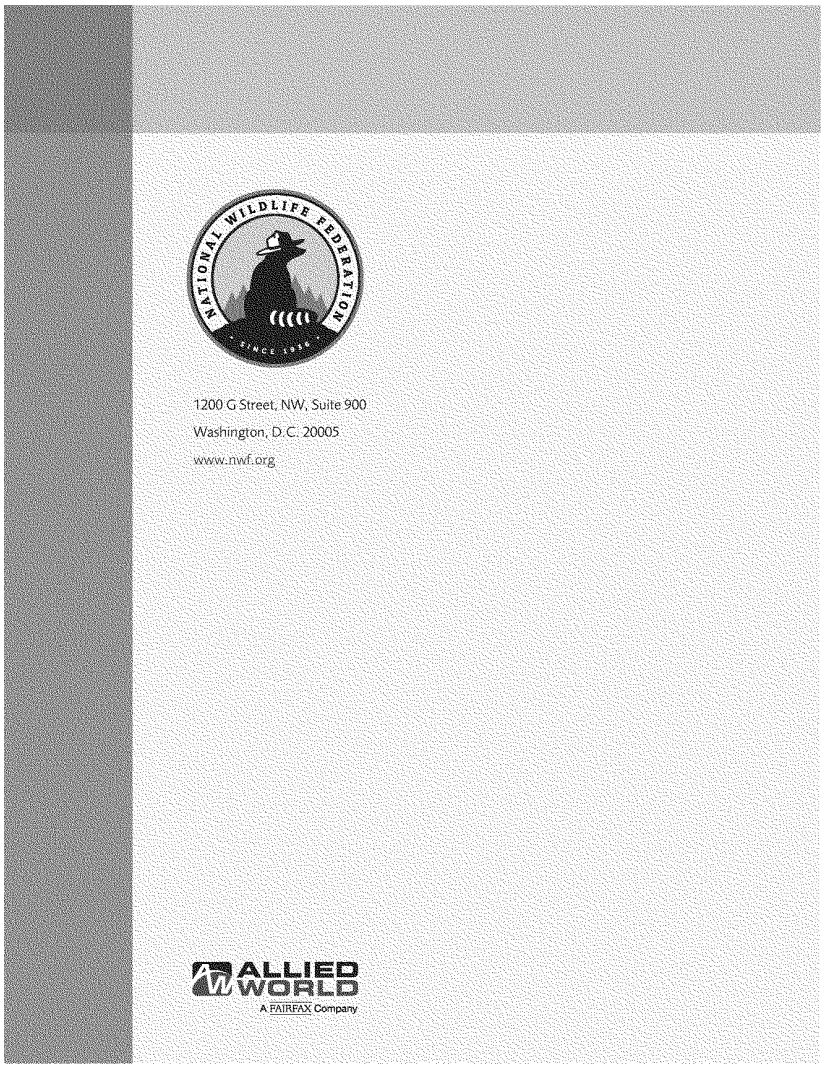
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