

**BORROWED TIME: THE ECONOMIC COSTS OF
CLIMATE CHANGE**

HEARING
BEFORE THE
COMMITTEE ON
BANKING, HOUSING, AND URBAN AFFAIRS
UNITED STATES SENATE
ONE HUNDRED SEVENTEENTH CONGRESS
SECOND SESSION
ON
EXAMINING CLIMATE CHANGE AND ITS EFFECTS ON OUR NATION AND
OUR ECONOMY

AUGUST 4, 2022

Printed for the use of the Committee on Banking, Housing, and Urban Affairs



Available at: <https://www.govinfo.gov/>

U.S. GOVERNMENT PUBLISHING OFFICE

COMMITTEE ON BANKING, HOUSING, AND URBAN AFFAIRS

SHERROD BROWN, Ohio, *Chairman*

JACK REED, Rhode Island	PATRICK J. TOOMEY, Pennsylvania
ROBERT MENENDEZ, New Jersey	RICHARD C. SHELBY, Alabama
JON TESTER, Montana	MIKE CRAPO, Idaho
MARK R. WARNER, Virginia	TIM SCOTT, South Carolina
ELIZABETH WARREN, Massachusetts	MIKE ROUNDS, South Dakota
CHRIS VAN HOLLEN, Maryland	THOM TILLIS, North Carolina
CATHERINE CORTEZ MASTO, Nevada	JOHN KENNEDY, Louisiana
TINA SMITH, Minnesota	BILL HAGERTY, Tennessee
KYRSTEN SINEMA, Arizona	CYNTHIA LUMMIS, Wyoming
JON OSSOFF, Georgia	JERRY MORAN, Kansas
RAPHAEL WARNOCK, Georgia	KEVIN CRAMER, North Dakota
	STEVE DAINES, Montana

LAURA SWANSON, *Staff Director*

BRAD GRANTZ, *Republican Staff Director*

ELISHA TUKU, *Chief Counsel*

DAN SULLIVAN, *Republican Chief Counsel*

CAMERON RICKER, *Chief Clerk*

SHELVIN SIMMONS, *IT Director*

PAT LALLY, *Hearing Clerk*

C O N T E N T S

THURSDAY, AUGUST 4, 2022

	Page
Opening statement of Chairman Brown	1
Prepared statement	31
Opening statements, comments, or prepared statements of:	
Senator Toomey	3
Prepared statement	32
WITNESSES	
Joe Flarida, Executive Director, Power a Clean Future Ohio	6
Prepared statement	34
Responses to written questions of:	
Chairman Brown	84
Senator Van Hollen	86
Senator Sinema	87
Dan K. Eberhart, CEO, Canary, LLC	7
Prepared statement	47
Responses to written questions of:	
Senator Van Hollen	88
Senator Sinema	88
David Butterworth, Northeast Regional Business Agent, Pipeliners Local Union 798	9
Prepared statement	50
Responses to written questions of:	
Senator Van Hollen	89
Senator Sinema	89
Shalini Vajjhala, Founder and CEO, re:focus partners	11
Prepared statement	51
Responses to written questions of:	
Chairman Brown	90
Senator Van Hollen	92
Senator Sinema	94

BORROWED TIME: THE ECONOMIC COSTS OF CLIMATE CHANGE

THURSDAY, AUGUST 4, 2022

U.S. SENATE,
COMMITTEE ON BANKING, HOUSING, AND URBAN AFFAIRS,
Washington, DC.

The Committee met via Webex and in room 538, Dirksen Senate Office Building, Hon. Sherrod Brown, Chairman of the Committee, presiding.

OPENING STATEMENT OF CHAIRMAN SHERROD BROWN

Chairman BROWN. The Committee on Banking, Housing, and Urban Affairs will come to order. Welcome to the three witnesses in person and our fourth witness online, and thank you for that.

Climate change is here, and the country knows it. It is here for Ohio teachers and students forced to work in schools without air conditioning in 90-plus degree heat, for more and more days at both ends of the school year.

It is here for Ohio cities and towns, like the one Mr. Florida comes from, that draw their drinking water from Lake Erie, and face higher and higher costs from harmful algal blooms.

It is here for Ohio farmers, many of whom lost an entire growing season in 2019 because of extreme rain, and who will soon be forced to learn to grow crops that used to be better suited to Arkansas than to Ohio.

And it is here for our neighbors in Kentucky, who watched their homes and communities wash away in devastating floods this week, the kind that scientists warn are becoming more common. We have all seen the pictures, pretty much probably all of us in this room. The flooding could be in many of our States.

Ask mayors, ask school superintendents, ask county commissioners about the increasing costs they deal with already because of climate change, costs we know will only get worse.

And we know who will be forced to pay for those costs. It is not the oil companies that make record profits: \$8.5 billion last quarter for BP, and that is only 3 months. \$12 billion for Chevron—that is \$4 billion in profits a month. \$12 billion for Shell—that is \$1 billion in profits per week. \$18 billion for Exxon Mobil—that is \$200 million in profits a day.

It is not these corporations that will pay the bill. It is local taxpayers. The likely impacts of climate change could cost people in my State \$6 billion a year.

These corporations and their executives have been getting rich by price gouging consumers and polluting our communities for dec-

ades. And taxpayers in Ohio, taxpayers around the country, will be left to pick up the pieces. Taxpayers are always left to pick up the pieces.

It is why we have to act now to grow the renewable energy economy and to make our communities more resilient to climate disasters. If we delay it will only get more expensive to fix.

In previous hearings, we have examined the threat of climate change to our financial system, the economic opportunities for good-paying jobs in the low-carbon economy, the role of insurance in protecting the economy from the coming impacts, and how we can reduce carbon emissions as we improve our housing.

In each hearing, too many have treated the looming catastrophe of climate change as just kind of a non-issue, or as something so far out in the future that there is no need to spend time on it in this Committee.

That just makes no sense.

As the Committee tasked with overseeing the stability of our financial system—that is what we are doing—we have a responsibility to do all we can to prevent obvious risks from wrecking our local communities and our financial stability.

No one on this Committee questions the need to prevent cybercrimes by asking how many banks have failed because of it. We do not dismiss financial scams because they do not pose a systemic risk to the financial system at the moment. Our towns and our taxpayers cannot afford for us to treat climate risk any differently, not when the effects on the economy are so clear.

With almost the entire country under excessive heat warnings, with floods and wildfires and droughts and extreme storms threatening Americans' lives and livelihoods, we know that communities in every State are about to be hit with massive bills, bills many of them just will not see coming.

And we know there is tremendous economic opportunity if we address these threats in the right way.

Ohio, Pennsylvania, and South Carolina can create good-paying jobs in the industries of the future. And if we do not lead, we know China will be all too happy to lead.

This morning, we will hear from four witnesses, including the executive director of one of the Ohio groups that published a report called "The Bill is Coming Due". It features some eye-opening figures detailing costs that will be borne by Ohio towns and cities, and as a result, Ohio taxpayers, because of climate change. What I hope to hear from our witnesses is a recognition of the risk to our communities—and to the lives and livelihoods of our fellow citizens—from these real and present and looming and growing threats.

I hope we will hear honest assessments of the state of the world we are in, and constructive suggestions about how we can make it better. And I hope we will come away from this hearing thinking about how we can help towns and cities in Ohio and Rhode Island and North Dakota and Pennsylvania, that are living, frankly, on borrowed time, and how they can prepare for what is coming.

Let us create the jobs for the 21st century. Let us make sure the workers—and I hope union jobs, Dave—the workers who will drive

the 21st century economy can still live in the towns and cities we were sent here to represent.

Senator Toomey.

OPENING STATEMENT OF SENATOR PATRICK J. TOOMEY

Senator TOOMEY. Thank you Mr. Chairman and thank you to all of our witnesses here today, especially those who traveled a long way to be with us. I appreciate you taking the time and going through the effort to join us.

Every month seems to bring more bad news about energy. Gas prices still remain at near-record highs, despite modest declines in the last month.

The CPI's energy index was up over 41 percent over the past year as of June. This includes gasoline, fuel oil, electricity, and utilities.

Meanwhile, prices are rising across the economy and paychecks certainly are not keeping up. After adjusting for inflation, wages have declined 5 percent since President Biden took office. In fact, unless you got a 12 percent raise in the last 18 months, you have effectively gotten a pay cut. Working Americans are becoming poorer every day.

And our Democratic colleagues' wasteful spending, coupled with over a decade of ultra-easy monetary policy, caused the 40-year high inflation and now the contraction in our economy.

You know what is the last thing Americans need? Policies that are explicitly designed to reduce American energy production, and therefore make the cost of energy even more expensive, under the guise of addressing climate change. But that is exactly what the Administration and many of my congressional allies have been doing. They have been eager to find any culprit—other than themselves—to explain the rising cost of energy. They have tried blaming supply chains, Vladimir Putin, and my personal favorite, “corporate greed.” How dare businesses be motivated by profit.

My colleagues on the other side of the aisle should really be doing a little self-reflection. But instead they are trying to jam through a 700-page tax-and-spend bill that will throw fuel, presumably of the carbon-neutral kind, on this fire: \$385 billion in corporate welfare for politically favored “green” energy, including \$9 billion in generous subsidies for wealthy people to buy Teslas, \$1 billion to fund electric garbage trucks and school buses, even though the infrastructure bill provided \$5 billion for this purpose, \$1.5 billion for State and local government tree planting, even though we sent State and local governments \$500 billion in funding over the last 2 years while they were having record-high tax revenue collections. Then there is \$1 billion to install solar panels in Government-assisted housing, while we are in the middle of a housing affordability crisis.

And how do our Democratic colleagues propose to pay for all these? By raising taxes by \$326 billion on employers, with half of that burden falling on U.S. manufacturing companies, all of which will be passed on to workers, shareholders, and consumers in the form of still higher prices. This “pay for” will exacerbate a recession we are very likely already likely in.

The massive tax-and-spending spree is really just the tip of the iceberg for the Biden administration's costly energy policy. In less than 2 years, they have halted the Keystone XL Pipeline, erected onerous regulatory barriers to natural gas pipeline construction, mandated the highest ethanol blending requirement in the history of the Renewable Fuel Standard, issued a moratorium on oil and gas drilling on Federal lands and offshore, and nominated for critical Federal positions individuals who are openly hostile to the oil and gas industry.

In our Committee's jurisdiction, the SEC has reached far outside its statutory authority to get in on the action. In March, the SEC proposed a rule that would require all public companies to report every greenhouse gas emission in their entire supply chain and among their customers, even though this data has nothing to do with the company's financial performance and is likely irrelevant to investors.

In addition to hijacking the democratic process with its breathtaking scope, the SEC proposal would impose enormous costs on public companies. The SEC itself estimated that the compliance costs, the paperwork burden to these public companies to be an extra \$6.4 billion annually, for this rule alone. And that amount dwarfs the current annual compliance paperwork burden from all other SEC regulations combined, which is about \$3.8 billion.

Obviously, the costs of the policies I have described so far are quite high. Businesses which will shrink, jobs that will be lost, less energy produced. But there are second-order effects as well: higher prices for consumers, failures on the electrical grid, less economic growth, and a lower standard of living. The great irony of all this is that even for their extraordinarily high costs, none of these policies is going to make a dent in slowing climate change.

I am not denying global warming. It is undoubtedly real. What I am denying is that these policies will have any meaningful effect. Think of this. If tomorrow the United States of America, the second-largest carbon emitter in the world, went completely carbon-neutral—in other words, from a carbon point of view it would be equivalent to America ceasing to exist—then global temperatures 80 years from now will have been reduced by $\frac{3}{10}$ of one degree Fahrenheit, relative to what they otherwise would be. This is not my analysis. This is according to the U.N. climate model. So feel free to estimate the impact of a few more rich people buying Teslas.

I know my Democratic colleagues sincerely want to reduce greenhouse gas emissions anyway. Well, there is a way we can do that. There is one thing that has made a dramatic reduction in U.S. greenhouse gas emissions already. It is American energy production. Between 2005 and 2019, the U.S. led the world in emissions reductions, largely due to transitioning from coal to natural gas.

David Butterworth is with us today. He is a business manager for the Pipeliners Local Union 798, representing 6,400 union pipeline workers. He has been a member of the union for 25 years. Mr. Butterworth will testify to the importance of traditional energy for grid reliability, as well as the direct challenges his members face from hostility toward their chosen industry and profession.

Dan Eberhart is with us today. He is the CEO of Canary, an oilfield services company employing roughly 400 people from New Mexico to Pennsylvania. Mr. Eberhart will testify to the consequences of consistent under-investment in traditional energy, including policies that chill investment like the SEC climate proposed rule.

I hope my colleagues on both sides of the aisle listen to what they have to share today. I thank you, Mr. Chairman.

Chairman BROWN. Thank you, Senator Toomey. Of course we will.

I will introduce today's witnesses. I appreciate Senator Toomey mentioning two of them.

Joe Flarida is the Executive Director of Power A Clean Future Ohio, a native of Lima, Ohio. He leads the group, a nonpartisan coalition working with local leaders across Ohio to develop and implement economical and equitable climate solutions.

He worked on energy policy here in Washington with the Bosch Foundation in Germany and in Ohio. He earned a bachelor's in political science from Ohio State.

Welcome, Mr. Flarida.

Mr. Dan Eberhart, CEO of Canary, an oilfield services company. Under his leadership, Canary has become one of the largest corporations in that sector. He is a frequent commentator on energy policy in various media outlets.

He is a Georgia native, as is my mother, a cum laude graduate of Vanderbilt, and has a law degree from Tulane.

Mr. Eberhart, welcome.

Mr. David Butterworth is the Northeast Regional Business Agent for Pipeliners Local Union 798, associated with UA, with the Plumbers and Pipefitters. He is a veteran of the U.S. Army. He worked his first pipeline job as a welder helper a year after he was discharged. He has been business agent for 6 years.

While working as a welder he earned a B.S. in journalism—like my wife—from West Virginia University.

I look forward to your testimony. I hope you will also discuss, Mr. Butterworth, how the Infrastructure Bill and the CHIPS Act and the Inflation Reduction Act that we are about to pass will create thousands of good-paying jobs for union workers, an emphasis on this side of the aisle, on union workers.

Dr. Shalini Vajjhala, the Founder and CEO of re:focus partners. She joins us remotely from the West Coast. She is the CEO of re:focus partners, which develops sustainability solutions for municipal and private sector clients around the world. She was educated at Carnegie Mellon, in the Ranking Member's home State, in western Pennsylvania. Before assuming her current role she has been a visiting professor of environmental policy at Johns Hopkins and an official in the Obama administration, the EPA, and the CEQ.

Welcome, Dr. Vajjhala.

Mr. Flarida, you may proceed. Thank you for joining us.

**STATEMENT OF JOE FLARIDA, EXECUTIVE DIRECTOR, POWER
A CLEAN FUTURE OHIO**

Mr. FLARIDA. Chairman Brown, Ranking Member Toomey, and Members of the Committee, thank you for the opportunity to testify on this most pressing issue, the economic costs of climate change. My name is Joe Flarida and I serve as the Executive Director of Power A Clean Future Ohio. In a moment, I will share more about our work and our incredible partners in Ohio, but I want to start today with two brief observations on the topic.

First, I want to recognize that climate change is not a math problem, and the impacts that we will face as human beings are far more complex than we can put into simple economic or financial terms. The most vulnerable in communities in my home State of Ohio and around the world will experience the most harm on the shortest timeline as a result of severe climate impacts. Health consequences already impacting vulnerable populations will get worse.

Access to clean air, clean water, and healthy green space will become more scarce. And despite the false narrative we hear often, stable, good-paying jobs for workers will be sacrificed if we ignore the environmental challenges in front of us.

Second, year in and year out, local governments are burdened with the most challenging public problems we face. They are the eyes that see these problems first, the voices that raise the alarm when we reach a tipping point, and the hands that are asked to implement the solutions we identify. Today I am here to lift up Ohio's local elected leaders and the tireless staff that are indeed raising the alarm on the financial costs of climate change. They both see these costs coming and in some cases are experiencing them now.

In the face of a complex challenge, one way to wrap our heads around it is to look at the numbers and determine how much it will cost us to act and how much it will cost us to do nothing. My main point today is that we cannot afford not to act. We must act now.

Power A Clean Future Ohio was launched in February 2020, by an incredible group of policy experts, advocates, and local government leaders. We built this organization to do one thing, provide direct support to Ohio's local governments to help them identify and adopt clean energy solutions. We support them in pursuing carbon reduction goals in big and small ways. We have learned that the right solution is the one that works best for that community, be it economically, environmentally, culturally, or even, yes, politically.

Power A Clean Future Ohio, the Ohio Environmental Council, and our technical partner, Scioto Analysis, recently issued a report titled "The Bill is Coming Due: Calculating the Financial Cost of Climate Change to Ohio's Local Governments". This report assessed key climate impacts for local governments in Ohio. For just 10 of these impacts we estimate that local governments in the State of Ohio will need to increase municipal spending between \$1.8 billion and \$5.9 billion per year by midcentury. For context, a \$5.9 billion increase would equate to an 82 percent increase over 2019 local government spending levels for environment and housing programs in Ohio. Not one of the local governments Power A

Clean Future Ohio works with knows how they will pay for these increased costs, whether they are on the low end or the high end.

There are the traditional approaches of increased taxes, bonds, and Government grants, all financed by taxpayers. Alternatively, cities, States, and the Federal Government could hold accountable the corporations that caused this problem to start with.

So what are the specifics of these costs? By 2050, Ohio cities could see spending increases of over \$2.2 billion to contend with harmful algal blooms and drinking water treatment; \$1.7 billion to elevate roads that will be flooded due to changes in precipitation and severe storms; \$1 billion for road repair due to damage as a result of increased freeze-thaw cycles; and \$590 million to establish and operate new cooling centers during the summer months.

Our analysis provides a conservative estimate of additional costs that municipalities can expect. We know, in most cases, these costs are already starting to accumulate and will steadily increase until they reach their midcentury targets. The monetized amounts in our report represent only 10 of the 50 different impacts identified. Had we accounted for all 50 impacts or additional impacts beyond that, the total increase in annual spending by municipal governments due to climate change is certainly higher.

While this report seems to be full of bad news, all hope is not lost. While we are very likely to incur considerable costs due to climate change, the worst of this crisis can be averted. Local governments are leading the way in transitioning to clean energy. They are adopting carbon reduction goals and putting into place bold climate action plans, but they need your support.

My recommendation to Congress is to, one, elevate this issue in every aspect of what you do, and two, further invest in local governments.

There is no doubt that the costs and impacts we face are daunting, but I firmly believe that if we can do it locally, we can solve it globally.

Thank you for the opportunity and I look forward to your questions

Chairman BROWN. Thank you, Mr. Florida.

Mr. Eberhart, you are recognized for 5 minutes.

Thank you for joining us.

STATEMENT OF DAN K. EBERHART, CEO, CANARY, LLC

Mr. EBERHART. Chairman Brown, Ranking Member Toomey, and Members of the Committee, thank you for inviting me to testify today on the economic costs of climate change. Climate change is one of the most significant issues of our time, and I am proud of the continuing role of the energy sector in reducing the carbon intensity of the energy Americans rely on every day to power their communities and their lives.

As CEO of Canary, one of the largest privately held oilfield services companies in the United States, I am very familiar with the positive impact business can have on communities, providing good-paying jobs and benefits to the hundreds of workers who are proud to call us their employer. We have about 400 employees currently. These are folks who proudly come to work every day committed to

building our reputation of trust, quality service, and commitment to excellence, as well as safety.

Today, however, we are increasingly challenged by the mountains of red tape imposed by regulators, both local and Federal, which has disproportionately impacted our industry, which is already one of the most heavily regulated in the country.

As CEO, I also understand the important role of business in addressing the environmental impacts of energy production and helping to mitigate climate change. Canary is already required to operate in a manner that protects the environment and human health, both of which are responsibilities we take very seriously. We are one of the Nation's most innovative industries, with billions of dollars invested industrywide in research and development, in improving our efficiency, and in trying to mitigate our impact on the climate, to develop technologies that allow us to produce the abundant and affordable energy that Americans have come to depend on every day.

I firmly believe the oil and gas industry can be our Nation's most formidable ally in the fight against climate change. This view may be controversial, but we are what could provide the transition to a cleaner and brighter future. But to do so, we need the Government as a partner, not as an adversary in this process.

That is why I am concerned that the U.S. Securities and Exchange Commission's proposal mandating public companies report their emissions and exposure to climate risks is a major move in the wrong direction.

Proponents argue the SEC's proposed rule on "The Enhancement and Standardization of Climate-Related Disclosures for Investors" will provide investors with useful information on a company's exposure to climate risks, but the practical effect, as Senator Toomey mentioned in his opening statement, is to drive capital away from badly needed conventional energy and from infrastructure projects. This makes energy more expensive and denies America of a natural competitive advantage against other countries, and will drive up costs for consumers, thereby making their everyday lives more difficult.

In a parallel trend in the capital markets, the growing popularity of environmental, social, and governance investment funds, ESGs, are steadily strangling domestic oil production, which now sits at around 11.6 million barrels per day compared to its peak in 2019, of 13 million per day when the economy was not as strong as it today and the price of oil was lower than it is today.

A report last year from the International Energy Regulatory Forum estimates that 2021 oil and gas production remained 23 percent below the prepandemic level of \$525 billion, while investment slumped by more than 30 percent in the industry in 2020. The report identified ESG as one of the three principal drivers of underinvestment. That is a predictable result of the nearly \$2.7 trillion in ESG funds that restrict investment in conventional energy-producing companies.

As Committee Members are undoubtedly aware, our economy faces an historic energy supply challenge right now. We are in an energy crisis and energy costs are too high. After a decade of underinvestment in the oil and gas sector, particularly since

COVID, current domestic output sits well below prepandemic levels while demand continues to return and even climb. Unfortunately, much of this shortage is driven by domestic energy policy, not economics, that has frozen new Federal leasing and prohibited pipeline construction, discouraging the investment necessary to explore, develop, and produce the energy America needs to prosper.

In fact, our energy that we purchase from overseas has gone from 0 percent in 2019, on a net basis, to about 25 percent in 2022. I would argue that we would rather spend that money on domestic energy production, not on buying it from sending dollars overseas to the Middle East and elsewhere.

Our industry requires capital—it is very capital intensive—and investor confidence to thrive. Investor confidence follows from reasonable and predictable regulation. Without these prerequisites, companies will not risk the capital needed to ensure we have a secure supply of energy. We are already starting to see the results of that, and this is partially why the energy costs have spiked this year. Decapitalizing the oil and gas industry in the fight against climate change is the wrong approach. This will increase energy prices even more than it already has, restrict innovation, and shrink our economy as well as send dollars overseas.

Structural underinvestment has hampered capital-intensive industries across the upstream, midstream, and downstream sectors of our industry. Less than a decade ago, there were 1,600 active drilling rigs in the country. Today, there are barely 500.

While the SEC rule and adjacent policies undermine U.S. energy security and destabilize the economy, the Administration has done little to nothing to address consumer demand for the underlying products. As an industry, we are responsible to the market, the shareholders, and to our stakeholders and projected increases in demand. By comparison, the mixed signals coming out of the Biden administration are clearly discouraging new investment and acting as a chilling effect on growing production, which is what we need to do to lower prices to help consumers.

Regulatory burdens carry real costs that effect everyday Americans. As prices rise across energy categories that consumers rely on, I strongly urge the Committee to reconsider its current reliance on regulations, and especially duplicative ones, and instead pursue a viable and durable path forward on climate policy that allows a reasonable transition time as well as protecting the environment, consumers, the economy, and our national security.

Thank you.

Chairman BROWN. Thank you, Mr. Eberhart.

Mr. Butterworth, you are recognized for 5 minutes. Thank you.

**STATEMENT OF DAVID BUTTERWORTH, NORTHEAST
REGIONAL BUSINESS AGENT, PIPELINERS LOCAL UNION 798**

Mr. BUTTERWORTH. Chairman Brown, Ranking Member Toomey, and Members of the Committee, thank you for the opportunity to testify today about climate change. My name is David Butterworth, and I am from Clendenin, West Virginia. I am employed as a Business Agent for Pipeliners Local Union 798. I represent approximately 6,400 welders, helpers, and journeymen who build pipelines in the United States. My jurisdiction extends from Virginia to

Maine, and 904 of our members live throughout the Northeast. I welded and worked on pipelines from 1998 until 2015, and was hired to my current position in January 2016.

I am here today to speak about how climate change and energy policies affect grid reliability, the country, our towns, and my membership. Local 798 has attended and spoken at just about every Federal and State pipeline hearing that has taken place in the Northeast from 2016 until today.

Some of these pipelines are the Atlantic Sunrise, Atlantic Coast, Mariner East, Mountaineer Express, Mountain Valley, Northeast Supply Enhancement, Northern Access, and Penn East, just to name a few. We attended and spoke at each of these hearings because we know the massive work opportunities these projects provide our membership. Our job prospects have dwindled significantly since the summer of 2018, when we peaked at 8,300 members due to Mountain Valley pipeline and Atlantic Coast being in full swing. When completed, the Mountain Valley Pipeline will provide a natural gas backup generator system to Carilion Hospital in Roanoke, Virginia, and will also lead to increased manufacturing and jobs in the South.

I come from a town in West Virginia where good-paying jobs are intertwined with the fossil fuel industry. My father and many others from my town helped build the Alaska Pipeline. Local 798 is made up of members from towns like this spread across our great Nation. Towns like Mifflintown, Pennsylvania; Olive Hill, Kentucky; Bald Knob, Arkansas; Oak Grove, Louisiana; and Durant, Oklahoma, are towns you have probably never heard of, but if you traveled to them, you stand a good chance of meeting a pipeliner.

We were once fortunate enough to be out of the national spotlight and had to explain to people exactly what we did, and quite frankly, nobody really cared. Unfortunately for us, those days are over, and we find ourselves thrust into national politics.

This is not where we want to be. We are in the middle. Middle-class union workers are feeling the squeeze between opposing sides. I find myself asking questions like, “Do the policymakers and those against fossil fuels truly believe we can shut down all fossil fuels tomorrow and not fall into utter chaos?”

I ask this because during the “Texas Freeze,” where all forms of energy failed, and sadly people perished, we were shown a snapshot of the disorder that accompanies a broken grid. I also witnessed the gas hoarding that began to happen at my local gas station when the Colonial Pipeline was hacked. American citizens were filling large containers of gasoline in preparation for a nationwide gas shortage without thinking about how this would affect the next person who simply wanted to fill up their tank.

This brings me to my next point. A report published by the Columbia University Center on Global Energy Policy shows a “future continued use of natural gas for at least the next 30 years” and that “there is no quick replacement for gas in the U.S. energy mix.”

Switching from coal to natural gas power generation has dropped emission levels. According to the Energy Information Administration, from 2005 to 2017, U.S. natural gas production increased by 51 percent, and CO2 emissions decreased by 14 percent.

The Nation's pipeline system guarantees a safe, efficient, clean energy transition. I support efforts to curb climate change, but I do not support curbing climate change when the cost is grid reliability.

We can achieve climate goals by using common sense and American ingenuity while imploring all the above energy approaches that include carbon capture and hydrogen blending. Both methods use the existing pipeline system and will bring climate change levels down. These new techniques will be protested, and this Committee, along with the rest of Congress, has the power to support agendas that keep my members working, provide grid reliability, and align with the new strategies that address the current climate situation. I ask that you tune out the 10 percent of American citizens that protest literally everything, and instead listen to a person who has played a part in building the power grid.

We have the energy here, and we need to use it so that we do not end up like Germany, whose citizens will be introduced to warming houses and natural gas rationing this winter. Please consider the plight of the grid builders stuck in the middle. We might have a better idea of how we can conquer our dilemma. This problem can be solved through hard work and the implementation of moderate policies that benefit the whole rather than the far-right and far-left fringes that continue to divide us.

I would be happy to answer any questions you may have.

Chairman BROWN. Thank you, Mr. Butterworth.

Dr. Vajjhala, you are recognized from California.

**STATEMENT OF SHALINI VAJJHALA, FOUNDER AND CEO,
RE:FOCUS PARTNERS**

Ms. VAJJHALA. Thank you. Thank you, Chairman Brown, Ranking Member Toomey, and Members of the Committee. I am so pleased with the opportunity to testify today.

My name is Shalini Vajjhala. I am an architect and engineer, specializing in the design and finance of resilient infrastructure solutions. For the past 10 years, my firm, re:focus partners, has been working with cities and regions across the United States to develop projects to address both the physical and financial risks of climate change.

These issues have only grown more urgent over the last decade. The costs of climate change are already being felt across the country. This is not some distant future. The effects of more severe storms, heat, and droughts are visible in public budgets today.

Climate change will impact all parts of our economy. But counterintuitively, the costs of most climate-related events are site-specific not economywide. A hurricane or wildfire does not hit the whole country at once. At the end of the day, the physical and financial impacts of disasters will be felt first and worst at the community level.

Recent OMB estimates put the potential Federal fiscal impacts of climate inaction at up to \$2 trillion dollars per year. This is staggering. Having a better understanding of the total economic costs is essential, but we also need better ways of disaggregating these costs by peril, sector, and region to motivate local action to protect against the worst overall outcomes.

Three areas where this Committee can help break down the problem into more actionable pieces is by looking more closely at three types of costs: local revenue losses, reductions in asset lifetimes, and deferred infrastructure maintenance.

Revenue losses due to climate change cut across all sectors. Public utilities, including power, transportation, and water systems, are already experiencing disruptions and losses due to climate-related events.

The EIA estimates that severe drought conditions here in California could reduce hydropower generation by up to 48 percent this year. Recent heat waves have resulted in operating restrictions and losses for passenger and freight rail systems nationwide and costly structural damages, including derailments due to buckling tracks and melted power cables in places with typically mild climates, like Portland, Oregon.

In the water sector, sea-level rise has increased the risk of salt-water intrusion. This has costly implications for coastal agriculture and drinking water systems from Rhode Island to Alabama, with financial risks that extend into the healthcare sector. These same acute and chronic stresses have resulted in property and income tax base losses with the potential for municipal bond downgrades and defaults.

I want to be clear. This is not all bad news. Focusing on where we are losing money today offers an entry point for identifying where losses and liabilities are likely to increase. This also opens the door to new ways of financing cost-saving infrastructure investments, such as coastal protection projects and power and transportation system weatherization measures, that can be funded through direct savings, reduced insurance costs, and risk pooling.

Climate impacts are already reducing infrastructure asset lifetimes. In many cases, the same events that result in revenue losses also have longer-term financial consequences. The impacts of flash floods and wildfires can result in damage to infrastructure systems that reduce their replacement lifetime. This poses major budgeting challenges for public works departments across the country who might see a road planned to last for 25 years become unusable in half that time. In the worst cases, this can result in the collapse of private insurance markets in specific sectors and regions. Work by the Arizona Department of Transportation on lifecycle planning for extreme weather and climate events offers a national model for better risk management.

Deferred maintenance backlogs can also highlight where to intervene to prevent cascading failures. The devastating toll of both winter and summer power grid failures in Texas highlights where seasonal maintenance and timely infrastructure upgrades can prevent catastrophic failures down the line. Investing hundreds of millions of dollars now can prevent billions in losses in future, but these investments must be well coordinated.

The naval bases in Norfolk and San Diego offer excellent examples of how military installations can better protect against sea level rise and storm surge. At the same time, these facilities show where resilience measures can be undermined if adjacent roads and bridges are not also upgraded so essential personnel can reach high-priority sites during severe storms and floods. Better informa-

tion about critical infrastructure weak links can help identify where short-term local tradeoffs, like prioritizing emergency repairs over more robust upgrades, can have long-term national costs and consequences.

No single individual, family, or region is concerned with the total economic costs of climate change. Everyone is concerned with their own physical and financial security. We need better frameworks to translate the big picture costs of climate inaction into levers for avoiding losses and reducing suffering.

The Infrastructure Investment and Jobs Act holds tremendous promise for addressing these challenges, as does the Inflation Reduction Act. Physical protections and financial protections from the worst economic impacts of climate change must go hand-in-hand. Breaking down the total economic costs can help identify opportunities to shape the next generation of infrastructure and make sure we move quickly to build what we need, not just what we had.

Thank you and I look forward to your questions.

Chairman BROWN. Thank you, Dr. Vajjhala.

I will start, Mr. Flarida, with you. Every American watched in horror this summer as severe weather and flash flooding devastated communities across our country in Kentucky, Missouri, and Montana. As we witness this devastation we are moved to help the victims. We worry also that our communities could be next.

What are the costs, if you could delineate them, that Ohio communities should anticipate due to climate change?

Mr. FLARIDA. Chairman Brown, the costs that we estimate in our report are very conservative. I want to start with that, and just note here that what we are seeing is anywhere between a \$1.8 billion and a \$5.9 billion estimate by 2050, and that is on an annual basis.

The biggest share of that, in those 10 impacts that we identified, is drinking water treatment and treatment for harmful algal blooms. We also see significant investment to elevate roads due to increased precipitation and flooding.

But there are also costs outside of that, that are not recognized in just the numbers. These are lives lost. These are days missed of school for children because we are having severe heat events.

Chairman BROWN. Dr. Vajjhala, listening to what Mr. Flarida said about one State, a large State but one State only, would you expect similar costs for communities across the country? I know you work both in the U.S. and internationally. Would you expect similar kinds of problems and costs in communities that you work with and serve?

Ms. VAJJHALA. Absolutely. We are seeing many of the same challenges—roads being washed away, water systems being degraded, and the costs are worse in places where infrastructure has been least well maintained. So the places that are furthest behind in being able to keep up their infrastructure are also the ones that are likely to suffer most.

Chairman BROWN. And give me a couple of examples.

Ms. VAJJHALA. I think deferred maintenance of water systems. In Michigan, for example, we have seen the case of Flint and places where water systems are overbuilt. It is incredibly costly for local governments to maintain these systems, to keep pressure, and to

absorb the costs of climate impacts in places where they are essentially overburdened with their current infrastructure and do not have the budget and the resources to replace with something that is more appropriate for their current needs. This is true also in the South.

Chairman BROWN. So those communities that already struggle with their budgets, that are already not able to keep up with costs, communities that generally have a weaker or lesser tax base are the ones that are hit the hardest and, in a sense, will maybe perhaps never catch up.

Mr. Flarida, back to you. When local budgets are strained communities have few options. They can cut essential services like police and fire or they can raise taxes, or obviously, in some cases do both. Share some examples of how local governments in Ohio are already seeing climate change affect their budgets, if you would.

Mr. FLARIDA. I think one notable example that we have seen in Cincinnati, Ohio, is the Columbia Parkway hillside project. I was in Cincinnati last week and spoke with Mayor Aftab Pureval, which was really enlightening and illuminating to see, as Cincinnati has experienced a 137 percent increase in rainfall in recent years. Cincinnati is a hilly city, and as a result this is destabilizing roads and destabilizing hills.

And so they have had to invest \$18 million in this project, which was taken out of their operating budget. And Mayor Pureval said, "Out of the blue, an \$18 million investment, and for cities our size, \$18 million is a massive hit to our operating budget." And they had to take money out of a police station of District 5, they were planning to spend on that station, and put it toward the hillside stabilization project.

So I think it is a perfect example of essential city services that they had to redirect to account for the damage due to climate change.

Chairman BROWN. And that his Ohio's third-largest city, and the hilliest of the three, but certainly the others face those kinds of problems.

Back to you, Dr. Vajjhala. Your testimony highlighted issues, and to answer your first question, with legacy infrastructure. How does taking action to reduce the costs of climate change also help how these communities address historic inequities in infrastructure investment?

Ms. VAJJHALA. I think many of the communities that have faced the greatest environmental harms have either been divided by infrastructure, have been underserved by infrastructure, and being able to make investments in bringing this infrastructure up to a state of good repair and making sure it meets current needs can help us reach those folks who have often been last in line for infrastructure dollars and investments, and helps us deal with climate challenges.

And the city of Hoboken is an excellent example of this, where the city was able to move to create a six-acre urban park that is also a flood protection measure, that repurposed a major contaminated site.

Chairman BROWN. Thank you. Senator Toomey.

Senator TOOMEY. Thank you, Mr. Chairman.

Many of us probably remember an incident from 2018, not that long ago, when demand for natural gas in New England during a cold snap ended with a Russian LNG tanker docked in Boston Harbor, supplying gas. And the irony is incredible to me because this happened despite the fact that my State of Pennsylvania is sitting on enormous—enormous—reserves of natural gas. We have a huge glut of natural gas. We have a tremendous amount of natural gas that we just do not take out of the ground because we have got nowhere to put it.

The U.S. is now the world's leading LNG supplier, as of this year, but we have not been able to complete a single pipeline to take this huge glut of gas we have in Pennsylvania and bring it to New England. And we cannot because New York and New Jersey will not let us build the pipelines.

My understanding is the last new interstate pipeline completed from Pennsylvania into New York was in 2011. The Marcellus Shale boom had barely begun.

So let me start with Mr. Butterworth. Does it make any sense at all to you that we leave gas in the ground in Pennsylvania instead of piping it New England, as a result, New England occasionally has to buy large quantities from countries like Russia? Does that make any sense to you?

Mr. BUTTERWORTH. The Constitution Pipeline was supposed to take gas from Pennsylvania to the New England States. When I got this job in 2016, we were meeting with contractors to pre-job the Constitution. It got scrapped.

Also, I go to public hearings where—I have been to public hearings in New York and Buffalo where a lady got up there and said, "We do not want your Pennsylvania fracked gas." That is the type of stuff we are dealing with.

Also, the NESE, which was going to take 1.8 people off of heating oil in Brooklyn, we know heating oil is a worse emitter than natural gas, but it never got through because they said AOC sent a rep there that said that if you approve this project the city will be underwater in 10 years.

Senator TOOMEY. Just to address the obvious, if it were possible to build these pipelines, among other things, would it likely result in more work for your members?

Mr. BUTTERWORTH. Heck, yes. Heck, yes.

Senator TOOMEY. Mr. Eberhart, I am not sure if you have any expertise to share with us on this particular, but in case you do it is my understanding that American energy extraction, oil and gas extraction, is generally held to a much higher standard of environmental quality than many other places in the world, including Russia. So substituting Russian gas for American gas, or probably gas from other places, not only accomplishes nothing in terms of reducing gas consumption but it is actually worse for the economy because it is a lower standard.

Is that your understanding?

Mr. EBERHART. Yeah, I can speak to this, Senator. I will tell you that the only country remotely close to us in terms of specifications for drilling onshore would be Canada. No one else is even close in terms of OPEC, the Middle East, Russia, Africa, Asia, to the environmental standards we have.

So in terms of the condition we leave the ground in after completion of the jobsite, in terms of how much carbon is emitted during the drilling process, in terms of—you know, the natural gas from Russia or the Middle East or wherever is going to have to be transported, so there is carbon emitted in it being transported, you know, when it is obviously much more efficient if it is transported via pipeline.

So the conclusion is that harvest the gas in America and transporting in inside America is vastly better for the environment because our standards are higher and the carbon emitted during the transportation is much, much lower. So to me it is a no-brainer if you are concerned about the carbon emitted during the drilling process or the transportation process.

Senator TOOMEY. Thank you. Let me go back to Mr. Butterworth. There is a population notion among some that the job losses from traditional energy projects, like Keystone Pipeline or other pipelines, they will be made up for with good, clean energy jobs. Case in point, at a White House press conference this past January, John Kerry famously said that laid-off pipeline workers, quote, “can be the people who go to work to make the solar panels,” end quote.

What do you think about that? Can your guys who cannot find work making pipelines, because we cannot approve pipelines, can they just pack up and make solar panels?

Mr. BUTTERWORTH. Every welder who comes to a pipeline project has to take a destructive test. These are highly skilled jobs that take years to develop those skills. And like I say, I am an all-of-the-above guy, but I do not know where the skill would be in building solar. I do not think you can compare them on the skill level.

Senator TOOMEY. It is not that easily transferrable.

Mr. BUTTERWORTH. No, I do not think so. And I have never been contacted by anybody wanting to put my folks on these types of jobs.

Senator TOOMEY. You have never gotten a job offer from a solar panel company?

Mr. BUTTERWORTH. No, I have not.

Senator TOOMEY. I see. Thank you.

Mr. BUTTERWORTH. Thank you.

Chairman BROWN. Senator Reed, of Rhode Island, is recognized.

Senator REED. Thank you very much, and interesting testimony. I have got some personal observations about green energy and jobs. Rhode Island is the first State in the country to have offshore wind farms. The labor unions were involved in that process from the very beginning. In fact, just five turbines—a very small project off Block Island—created 300 jobs. And the Administration estimates that there will be nearly 80,000 similar jobs, and they do involve welding and sheet metal work and all traditional trades.

Indeed, Orsted, one of the biggest wind developers in the Northeast, has already signed a PLA—a Project Labor Agreement, you know—with the building trades union for all its future wind farms. So alternate energy is not the end of good-paying union jobs. It is the beginning. And it also satisfies the demands of climate change.

There has been a lot of discussion here about the shift by the market from coal to natural gas, is wonderful. That feeling, I do not think, is shared by the United Mine Workers.

So let us be realistic. We have to deal with this climate change issue and we have to deal with good, solid jobs, and we can do both, if we are determined to do that, rather than just being rhetorical about all of this.

Dr. Vajjhala, how would the economic benefits of the SEC's Climate Disclosure Rule outweigh any costs? Could you answer that, please?

Ms. VAJJHALA. Yes. I think what you are hearing from me and a number of the witnesses is the importance of investing in the infrastructure and the jobs that provide the connective tissue to keep our economy strong and resilient in the face of risk.

I think the SEC's requirements, particularly on risk management and strategy, offer us a window into being able to see where these risks have implications for cascading failures outside of a single business, and where public investments can help strengthen the economy.

Senator REED. Is the premise of those who object to this rule that most companies or all companies, public companies, do not have any material risk of climate change? How accurate would that assumption be?

Ms. VAJJHALA. I do not personally believe that that is an accurate assumption. I believe that information, in this case, well used, could be tremendously valuable.

Senator REED. And should be made available to investors, both shareholders and bondholders?

Ms. VAJJHALA. Correct. Climate impacts will impact shareholders.

Senator REED. You mentioned coastal property values, and I represent the Ocean State, so we are acutely sensitive to this issue. First Street Foundation reported that between 2005 and 2017, Rhode Island lost \$44.7 million in relative property values due to the impacts of sea level rise, and it is only going to continue. In fact, it will probably accelerate.

So Dr. Vajjhala, can you talk about what climate change means to the huge coastal real estate market?

Ms. VAJJHALA. I think this is an enormous problem, Senator, and it is one where there are not obvious or good solutions, and we need better information about where we can help communities protect themselves, where we can take measures to ensure that there are smooth transitions for areas that are at the greatest risk, and to make sure that we do not leave people behind. Many, many people, especially older homeowners, the majority of their wealth is locked up in their homes. And in the absence of solutions that address both the physical and the financial risks, we are going to leave individual communities to suffer.

So I think this is an area for incredible innovation around infrastructure, but also work with the insurance industry to make sure that we are dealing with both the physical and the financial risks.

Senator REED. And once again, for major insurance companies that have extensive coverage of oceanfront properties, this financial

risk is obvious right now and should be acknowledge and disclosed by the companies? Would that be appropriate?

Ms. VAJJHALA. It should.

Senator REED. Thank you. Thank you very much, Mr. Chairman. Chairman BROWN. Thank you, Senator Reed.

Senator Cramer, from North Dakota, is recognized.

Senator CRAMER. Thank you, Chairman Brown. Thank you, Ranking Member Toomey. Thanks to all of our witnesses.

I have been writing a lot of notes, and the first thing I want to say, in response to the question earlier about the emissions of ships bringing natural gas from Russia to the Northeast rather than piping it from Pennsylvania, let me just tell you this gets to the heart of one of your issues, Mr. Eberhart, and that is, let us produce more American natural gas and American energy. Because according to the National Energy Technology Labs at the Department of Energy, according to their data, Vladimir Putin's natural gas emits about 50 percent more greenhouse gas emissions than American natural gas. If we did nothing but displaced Russia's natural gas with America's we would be doing a lot for workers, a lot for our country, and a lot for reducing greenhouse gas emissions.

Second, I want to get to this issue, the real issue of the moment, and that is the cost of climate change overreaction, which I think stems from the first point. Chairman Brown talked about the awful CEOs of American companies that are making record profits. If the price signals coming from the Administration and from liberals in charge of this place were different, if they were different, would not those profits instead be investments in creating jobs and cleaner energy here in the United States, Mr. Eberhart?

Mr. EBERHART. Absolutely, Senator. You know, to your first point about the Russian natural gas, I would just like to add that the carbon intensity of oil from Venezuela is twice what it is from American oil, and there are various other countries like that. The carbon intensity from the U.S. oil is lower than nearly anywhere else in the world. So again, in addition to the environmental costs and the transportation costs, the carbon intensity is lower.

So if the ultimate goal is to reduce carbon intensity and we are going to have the energy demand anyway and we are not going to affect supply—or we are not going to affect energy, we are going to affect supply, we want to use American energy first anyway.

Second, to your point, I think that we want more investment in America. We want more jobs in America. And we do it better, cleaner, safer, and it is closer. So to me the logic would just dictate to focus on doing the best we can with the natural resources we have in America and trying to do it in the cleanest way possible, Senator.

Senator CRAMER. Well, and let me follow up then with this question. Because Chairman Brown also, in his opening statement, referenced if America does not lead, China will, to which I say, "Exactly. That is my concern."

And so if we do not lead—if we lead with SEC regulations, for example, that further burden American energy, are we to assume that China is going to also increase their regulatory scheme, or is Russia going to increase its regulatory scheme so that they can fol-

low the lead of the United States of America? I mean, is that how global markets work?

Mr. EBERHART. Absolutely not, Senator, and I think to think that would be naive.

Look, all this ESG investment scoring and whatever, we are handicapping the international competitiveness of American companies, and I think it is ill-advised.

Look, these companies in charge, they do not have an ESG score that is going to negatively impact their banking relationship, their relationship with the Government or anything. You know, China, Iran, Saudi Arabia, Venezuela, these countries care about profits and they care about bringing in hard currency. They do not care one iota about the environmental impact of what they are doing, nor do they care about what it does to their local consumers.

We have higher standards in America and we have a better outlook on balancing the environmental damage and the environmental costs with the jobs and the economy of what we are doing.

Again, the only country even close to the same standards as us is Canada. Places that you mentioned, Senator, have absolutely no incentive to focus on the environment while extracting their natural resources.

Senator CRAMER. Since we are talking about discrepancy of standards, Mr. Butterworth, do you think that the workers in China and the workers in Russia are treated as well as workers in the United States?

Mr. BUTTERWORTH. I would have to look at their agreement. That is a joke.

No, really, I cannot answer that. But I know we follow agreements and our folks are treated well, in this country.

Senator CRAMER. Well then, let me help you. The labor standards in Russia and the labor standards in China are not as good as the labor standards in the United States of America. So I am for an all-of-the-above, like many have said, and I am for an America First, not an America Only but an American First agenda that takes care of workers and the environment, and I think we do it better than anybody.

Thank you, Mr. Chairman.

Chairman BROWN. Thank you, Senator Cramer. Thank you for taking notes from my opening statement. It is a whole new concept.

Senator Menendez, from New Jersey, is recognized.

Senator MENENDEZ. Thank you, Mr. Chairman. You know, I just want to say the suggestion that the Chairman's statements, or that those of us who are concerned about climate change is an over-reaction, well, look at the wildfires in the West. How many acres have to go up in smoke? Look at the flooding in Kentucky. How many lives have to be lost? Look at the droughts in the Midwest, where farmers are producing a fraction of the crop that they would normally produce. Our colleague, Senator Tester, was talking about how, on his farm, he cannot produce as much as he used to because of climate change.

Look at the cattle ranchers who are selling their cattle prematurely because they do not even know if they can keep them alive. And look at the Nor'easters that we get on the East Coast. And I could go on and on.

These are tectonic shifts that are affecting our very lives and livelihoods, and that is an overreaction? I think Mother Nature is not overreacting. She is sending us a message.

Flooding is one of the most expensive and most frequent natural disasters in the United States, and climate change is only going to intensify these events, and it is critical that our communities are prepared for the challenges that lie ahead.

In New Jersey, we are leveraging Federal resources from Community Development Block Grants to build state-of-the-art, resilient infrastructure like Hoboken's Rebuild By Design. This \$230 million mitigation initiative, which I helped secure funding for, will help alleviate repetitive flooding and protect against damage from storm surges. And for every \$1 we invest in mitigation the Federal Government saves \$6 in disaster relief spending.

So Dr. Vajjhala, should not the Federal Government be investing more in innovative, large-scale, flood resilience projects like the Rebuild By Design and, in general, on mitigation to reduce damages for the costly disaster aid that subsequently comes forth?

Ms. VAJJHALA. Absolutely, Senator. I think the costs of inaction far outweigh the costs of any overreaction. And the Hoboken example is an excellent one. The work in Hoboken to reinforce the coast, the water system, and to build public infrastructure like beautiful new parks is also going to protect the local hospital that was under many feet of water after Hurricane Sandy.

And so I think we are failing to make the connections to where the positive benefits spread through the rest of society in reducing costs, in the health care system, for example.

Senator MENENDEZ. Well I appreciate that. You know, 6-to-1. I would be willing to make investments that give me a 6-to-1 rate of return, and that is what mitigation does. That is why I introduced the bipartisan NFIP Re Act, which supercharges billions of dollars for pre-disaster mitigation and resilience in the Nation's most flood-prone areas. And I hope we can get to that because that is going to not only save us money and save lives, but it is also going to create a lot of jobs along the way.

I have long been a vocal advocate for mass transit in my home State of New Jersey and across the country, and I am proud of the work the Committee has done, and the leadership of Chairman Brown to advance Federal investments in our transit systems, including the historic Bipartisan Infrastructure Bill signed into law last year. And as a former mayor, I have seen first-hand the transformational effect that access to transit can have on a community.

But transit impacts go beyond just economics. The fact is every transit dollar we spend is also, in my view, a climate dollar.

Mr. FLARIDA, what role do you see transit playing in our communities as we decarbonize our economy?

Mr. FLARIDA. Senator Menendez, as a former mayor you know that transit systems can be the lifeblood of a city. They help us become more connected, give workers access to jobs, and bring together economies in areas that did not have bridges connecting each other before.

As we work with Ohio communities, one of the key recommendations we have is to invest in mass transit. As you know, mass transit, as you said, every investment we make there is a climate dol-

lar. Every dollar we invest there is a climate dollar. Mass transit is a far less carbon-intensive way of transportation than single-occupancy vehicles, and as we also know, transportation is now the largest emitter of greenhouse gasses, the largest economic sector emitting greenhouse gas emissions in the United States.

Senator MENENDEZ. Yeah. So taking off from that, how will creating more livable, walkable communities help not only to lower greenhouse gas emissions and promote sustainability but also reduce costs for consumers and promote affordability? This is the essence of something I call the Livable Communities Act, where we try to look at both the housing needs that exist—we had a hearing the other day—in our country, and at the same time create the linkages to existing infrastructure on transit, and then create access to jobs. What is your view on that?

Mr. FLARIDA. One of the key areas we work with Ohio communities on is to make their communities more livable and walkable, and this means central planning, as you discussed. It helps ensure that we are preserving public health and have access to green space. It is a critical piece of our sustainability future.

But I think I want to point to your example of reducing costs, because I think this is a really important one and one that you all are considering with the Inflation Reduction Act.

The technology and the economics have now aligned where we have opportunity to invest in technologies that will reduce our emissions and save us money, save consumers money. But this is not as easy as it sounds. We are fighting up against incumbent industries that have been at it for generations, and in order to do that we have to make sure that they have that barrier to entry lowered and that they can get into the market. So I think this is a really important point that you all are investing in, and I encourage that.

Senator MENENDEZ. Thank you. Thank you, Mr. Chairman.

Chairman BROWN. Thank you, Senator Menendez.

Senator Warren, from Massachusetts, is recognized.

Senator WARREN. Thank you, Mr. Chairman.

So with the Inflation Reduction Act, Democrats have announced an historic downpayment in the fight against the climate crisis. This bill will cut our carbon emissions by 40 percent in just 8 years. It is also going to cut both the immediate and long-term costs of energy, create American jobs, raise American wages, and most importantly, save American lives.

Today I want to talk about how the Inflation Reduction Act would tackle two of the major costs that fossil fuels inflict on American families and on the Federal budget. First, the cost to public health, and second, the cost of natural disasters. So let me start with public health costs.

Burning fossil fuels pollutes our air, with low-income communities and communities of color being hit the hardest. And one of the biggest causes of emissions is from diesel vehicles, like buses and trains.

Mr. Florida, you are an expert on climate and environmental issues so let me ask you, if these vehicles, buses and trains, ran on electricity rather than fossil fuels what impact would that have on public health?

Mr. FLARIDA. Senator Warren, one of the major benefits of transitioning to electric vehicles is the simple fact that they have zero tailpipe emissions. So every day we have cars, trucks, buses driving up and down our streets, driving through our neighborhoods, taking our kids back and forth to school, and they are emitting pollutants every time they drive on our roads.

And I think one important point, which a recent assessment showed and I am happy to submit this for the Committee, is that as a result of transitioning that entire fleet—if we were to take our entire bus fleet, our entire railroad fleet, and transition it to electric-drive motors, we would see 4,200 fewer deaths annually, many of which are from children and elderly who are especially susceptible to ambient air pollution.

Senator WARNER. Wow. So 4,200 deaths, and presumably a lot of people who just would not get as sick, right—

Mr. FLARIDA. Correct.

Senator WARNER. —but do not die from this. Thank you.

You know, this is the reason that Congressman Levin and I introduce the Build Green Act and Buy Green Act to purchase American-made electric vehicles and clean energy products for Federal, State, and local use, and for export.

Fortunately, parts of our bill were included in the Infrastructure bill and now in the Inflation Reduction Act, which puts \$4 billion toward electrifying our Federal fleet as well as school and transit buses. This is going to help with public health and help reduce public health costs and advance environmental justice by ensuring that our most vulnerable Americans are breathing cleaner air. In fact, estimates suggest that the IRA will result in as many as 3,900 fewer premature deaths due to pollution in 2030.

Now in addition to making us sicker, fossil fuels are exacerbating extreme weather events, as Senator Menendez just noted. They harm local communities, harm communities all around the world. A storm surge of 40 inches in South Boston could displace more than 35,000 people, and recovery would be massively expensive.

Dr. Vajjhala, your organization works on issues such as addressing sea level rise and fire risks. Would the climate investments in the Inflation Reduction Act lower the cost of disaster relief for the Federal Government?

Ms. VAJJHALA. Thank you, Senator Warren. The answer is 100 percent absolutely yes. Investing in prevention is far more cost effective than relief and recovery. And the recent OMB study that highlighted that climate change could lead to an annual Federal revenue loss equivalent to \$2 trillion per year noted that it could also cost to the Government \$25 to \$128 billion more a year just for dealing with coastal disaster relief, flood insurance, crop insurance, health care, and wildfire suppression, and flooding of Federal facilities.

So there is no doubt that the Inflation Reduction Act would help address these costs.

Senator WARREN. Thank you very much. You know, tackling climate change is a bargain compared to the alternative. According to the National Institute of Building Sciences every dollar spent on mitigating natural hazards saves society about \$13 in expenses we do not incur.

The Inflation Reduction Act will help us avoid the cost in both dollars and in lives, lives lost from pollution and from climate change, and it is essential that Congress pass this legislation immediately.

Thank you, Mr. Chairman.

Chairman BROWN. Thank you, Senator Warren.

Senator Smith, from Minnesota, is recognized from her office.

Senator SMITH. Thank you, Mr. Chair, and thanks to our panelists for being here today.

I want to start by taking a look at this from the perspective of local governments, as several of you have done. You know, I used to be the Chief of Staff for the Mayor of Minneapolis, and I know first-hand the challenges that the cities have trying to balance their budgets. Start from the perspective of where we are with the Inflation Reduction Act, this bill is going to go a long way toward, one, cleaning up our electric power grid, two, helping us to make everything that we do as energy efficient as possible, and third, electrifying as much as we can. All of that, as Senator Warren just said, is going to result in significant emissions reductions, it is going to result in significant job growth, and it is going to improve the health of Americans everywhere, especially in community that have been most impacted by fossil fuel pollution, poor communities and communities of color.

But if you think about what this means in terms of local governments that are trying to run cities in the midst of the incredible expense of the climate crisis, that is sort of what I want to dive into a little bit.

Mr. Florida, we know that local communities are already taking action around climate. You talked about what that looks like in Ohio, and I know that in Minnesota many of our communities are doing the same thing. There was just a great story in the *New York Times* about Morris, Minnesota, and what that community is doing to address the climate crisis.

So could you talk to us a little bit about how these things that we are accomplishing in the Inflation Reduction Act, cleaning up the grid, improving energy efficiency, and helping people to electrify home appliances and other things like that, could you talk to us a little bit transportation? Could you talk to us a little bit about how that is going to help local governments as they are trying to figure out how to balance their budgets every year?

Mr. FLARIDA. Thank you for the question. When we did this report to assess the costs of climate change to local governments we estimated it at \$6.9 billion annually by 2050. And I think one important point here is that all of these costs do not reflect the private sector and the costs that will fall on everyday citizens, homeowners, renters, that need to contend with these changing costs due to climate change.

I think the Inflation Reduction Act is a great example of how we can invest and ease that burden on everyday Americans that are going to feel these impacts. They are going to feel the heat in their cities and have to contend with that. They are going to have to install new air conditioning systems. They are going to have to find ways to adapt to a changing climate that they were not used to. And so I think this is an opportunity for local governments to work

alongside their residents to plan comprehensively to address this issue.

Senator SMITH. Thank you. I could not agree more with that.

Dr. Vajjhala, let me just follow up on this question. As we think about who ends up experiencing the worst impacts of the climate crisis it is often, as I said, poor communities, communities of color, communities that do not have the resources to often make the investments they need and then are bearing the health costs of fossil fuel pollution.

Could you just address a little bit for us, as you think about what is in the Inflation Reduction Act, on the climate policy, how that is going to help communities, for example, communities that have older housing stock, less efficient homes, and people who do not necessarily have thousands of dollars sitting in their checking accounts to make the improvements in energy efficiency and electrification that are going to make a big difference to their bottom line and save them money.

Ms. VAJJHALA. Thank you, Senator. I think the Inflation Reduction Act coupled with Infrastructure Investment and Jobs Act has the potential to absolutely transformational for the communities that are already suffering, and going to suffer even more with the impacts of climate change.

When I think about transit systems and heat, for example, who suffers most when our transit systems fail? It is the elderly. It is transit-dependent workers who are left out waiting for that train that is not coming because a track has melted or buckled. And they are faced with being outside more often and for longer on the hottest days of the year. These same communities are also majority renters and they do not have the luxury of making upgrades to whole buildings.

The types of energy efficiency investment opportunities that are in both IJA and the Inflation Reduction Act have the potential to be absolutely transformational for household budgets, where energy costs are a wildly increasing portion of total budgets.

And so I think this is a way of splitting the problem, to not just look at who loses money when we do not address climate change but to really put in front who suffers, and make sure that we do not let that individual suffering translate to economywide health and unemployment impacts.

Senator SMITH. Exactly. And when we pass this legislation, this means that it is going to be saving money for people who live in communities all across the country. Rewiring America estimates that this will save Americans who take advantage of these rebates and tax incentives, it is going to save them \$1,800, not \$1,800 in total but \$1,800 a year in terms of their energy costs. And that is going to make a very, very big difference. It looks like a good deal to me.

Thank you, Mr. Chair.

Chairman BROWN. Thank you, Senator Smith.

Senator Cortez Masto, from Nevada, is recognized from her office.

Senator CORTEZ MASTO. Thank you, Mr. Chair. I appreciate the hearing, and to the panelists. I too, like Senator Menendez, have to respond to this idea that somehow there is an overreaction to

the climate crisis. I would invite some of my colleagues who believe that to come to Nevada, and maybe come visit the western States, because I can guarantee you everybody that I talk to in my State and in the western States are dealing with some form of extreme weather because of the climate crisis.

I know 50 percent of the country, and 100 percent of Nevada, are in some sort of drought mode. We have a historic declaration that was made by the Bureau of Reclamation along the Colorado River, restricting water usage to Nevada and Arizona. And please know 90 percent of the water comes from the Colorado River, drinking water for folks in southern Nevada, where the majority of the population is.

So you just have to come visit the western States and understand that people are taking this very seriously, and we should too. There is a way to really focus on addressing the climate and having smart policies in place.

And let me just talk a little bit about smart policies, because I am very proud, in Nevada, in southern Nevada, we have done a really good job, recognizing we get a small proportion of water off the Colorado River, how to conserve, how to reuse that water, how to ensure that we are not only conserving our water but recognizing that the population continues to grow as well.

And so Dr. Vajjhala, let me ask you this. How can the best practices of cities like Las Vegas help inform how other cities can improve their water usage? Know this: Nevada, in the early 2000s, actually paid people to take up their laws, because we know a lot of watering on grass is where we lose that water to evaporation, and does not go back into the drains where we can reuse it and recycle it. We actually paid people to take up the majority of the grass, so much so that the sod that we have taken up since early 2000, if you actually put it in a line, it would be a ring around the Earth. That is how much grass we have taken up. And there are still more restrictions we are putting in place.

So I am curious, Doctor, best practices. Can we learn from one another? Are there other things that we should be thinking about when it comes to if we want to focus on extreme weather and the climate crisis, that it is challenging to our water usage now and the drought that we are seeing?

Ms. VAJJHALA. I greatly appreciate this question, Senator. I am from San Diego, where we also rely on water from the Colorado River. And we depend on the best practices of all the communities that are upstream from us, being at the end of the pipe here. And I think what Las Vegas and other towns have done to really reward and create incentive programs for avoiding lock-in to behaviors that could lead to worse outcomes, where a small thing at the individual level but when you add it up you end up with a system-wide program when it comes to water efficiency and water use.

So I think best practices are going to be tremendously important, and making sure that we follow what flows from the Infrastructure Investment and Jobs Act at the ground level in cities, I am particularly interested in where maintenance and emergency repair best practices can help translate to cost savings for local governments and help with budget stabilization.

In a lot of cases, when we do this work well, success is something that does not happen. The flash flood hit by the community road did not get washed out. And so we have to be following and monitoring these best practices to be able to know what we prevented and what the value of that is, and Las Vegas is an excellent model for that.

Senator CORTEZ MASTO. Thank you. I appreciate that. And, you know, talking about the Bipartisan Infrastructure package that we passed, there was \$800 billion for water infrastructure needs in the West. I know that personally because I fought for some of that money so that we could build large-scale water recycle projects, a relationship and I know a cooperation between southern Nevada and California to do just that, to augment the water along the Colorado River, which will absolutely have a positive impact on so many of our homeowners. We have to be thinking outside the box.

But we also need the Federal Government working with our local governments, working with our private partners. Everybody should be focused on this and not just rely on one Government agency or another, or relying on corporations, thinking that they are going to help us get out of this.

You talked about local governments. Let me just touch on one thing. I know across the country municipalities are working to harden their infrastructure from extreme heat or flooding, like you have talked about. However, some have highlighted the difficulty of raising enough capital due to climate change, since credit rating agencies are unsure of the community's long-term fiscal stability.

Can you speak on the issues facing the municipal bond market for climate-vulnerable communities and what needs to be done?

Ms. VAJJHALA. This is a tremendous challenge, Senator, and it is one that requires a lot more thoughtfulness and work. The implications for the municipal bond market are varied. Communities that have been completely leveled by wildfires are still holding debt that they have to pay back, and that is obstructing their ability to rebuild better. So for those communities you have to think about solutions that actually enable thoughtful transitions.

For protecting the bond market itself, all of the investments that we are discussing make bonds more secure. It makes communities more reliably able to pay back the debt that they are already holding and ensure that the investments last as long as they are intended, that we do not pay for a road for 20 years that only lasts for 10.

Senator CORTEZ MASTO. Thank you. I know my time is up, Mr. Chairman. Thank you.

Chairman BROWN. Thank you, Senator Cortez Masto.

We are going to change things a little. Senator Toomey will have one question, I will have one question, we think Senator Van Hollen will come back and do his 5 minutes, and then we will wrap, whether or not he is back. Senator Toomey.

Senator TOOMEY. Thank you, Mr. Chairman.

So let me just tee this up, and this is going to be for Mr. Eberhart. We know that we have, mistakenly in my view, we have given so much discretion and power to financial regulators that we do not actually have to pass a law, and often they do not even have to pass a rulemaking to be able to effect the outcome they want

with respect to the institutions they regulate, such as their power over these institutions.

So, Mr. Eberhart, I wonder if you would comment on whether or not, and if so to what extent, you have seen a decline in the availability of credit, and specifically capital in general, for the oil services, for exploration and development of oil and gas, and if there is a decline in the availability and access to capital for these purposes, for whatever reason, from whatever sources, has that contributed to the decline in energy production that you referenced during your comments? Has that contributed to higher prices for consumers? If you could share your thoughts on that I would appreciate it.

Mr. EBERHART. Sure. So I have kind of a couple of different points. First of all, in speaking about Canary specifically, I would say that since the Biden administration has come into office there has been a chilling effect on access to capital for us as an oilfield service company. So folks that we have had long-term relationships with have said—and these are big banks, banks that people would know, that have said, “Look, we are under order to shrink our energy portfolio, to not make new energy loans to the oil and gas base, to reallocate from oil and gas to renewable energy.” I would say that is a theme, not something I have heard, but something I have heard probably four times. So that is on Canary specifically.

With respect to the larger industry I would say that it is very peculiar for me. I have been doing this 20 years, and normally when you have a price spike like this, when oil hits \$80, \$90, \$100, I am seeing a lot of startups from, you know, private equity financed startups in this space, and I am seeing zero of that right now with the elevated price level. And I attribute that to kind of this Green New Deal cloak on energy investment, oil and gas investing as a 5- or 10-year time horizon is going to be replaced by renewables. And so this is having a chilling effect on investment. I think that is the pointy end of the spear.

The more general conclusion is the medium and larger E&P companies are reducing their investments in this space. That is why you see reduced drilling rig count. The drilling rigs are less than a third of what they were 5 years ago. And you are seeing less bond offerings and less IPOs, all as a result of this kind of sense that oil and gas investing is going to reach a terminal point.

Senator TOOMEY. And in your view does that translate to higher costs for energy for consumers?

Mr. EBERHART. Yeah. The second part of your question. Absolutely, because less investment means less competition, which means higher costs for the oil companies to complete the stuff if there are less oilfield service companies. Also if there is less access to capital, the capital costs are higher, they are going to do less drilling. All of this leads to less production, which leads to higher energy costs for consumers.

Senator TOOMEY. Thank you. Thank you, Mr. Chairman.

Chairman BROWN. Thank you, Mr. Eberhart. Thank you, Senator Toomey.

My last question for Mr. Florida. The fossil fuel industry knew decades ago that we would need to transition to cleaner energy sources to avoid what they called “globally catastrophic effects,” but

instead of leading that transition they misled the public. They especially misled their own workers about the future of fossil fuels. The energy workers deserve support as the industry changes, not more lies, not more empty promises from executives.

That is why I introduced the American Energy Worker Opportunity Act last year to provide wage supplements and education and training and other benefits to workers who are impacted by the energy transition.

So talk about the next step there. If we can do that, how will supporting energy workers in our State, in Ohio, help communities address the cost of climate change?

Mr. FLARIDA. Mr. Chairman, there are over 100,000 workers in the clean energy sector, in Ohio alone, and today now 3½ times more Americans work in the clean energy sector than with fossil fuels. And so to hear today some of the hand-wringing around access to capital while there are record profits for the oil and gas industry I think is frustrating. It is frustrating to hear, especially when these oil and gas companies have known for decades about the problem they were creating and chose not to disclose that to the public.

For our own health, for our own well-being, for our own economic futures, we have an opportunity to invest in clean energy, see good-paying jobs, and we are seeing that in Ohio. I think we have got a lot of really good news to think about with Ford investing in EV manufacturing. We are seeing electric vehicle manufacturing and battery manufacturing in Ohio. Intel is going to be investing in a semiconductor facility that is going to help enable the digitalization and clean energy technologies that we need. We have the largest solar manufacturer, soon to be the largest solar manufacturer in the entire country.

There are incredible opportunities for clean energy jobs in Ohio, and in the energy efficiency space, which is the largest employer in the clean energy sector.

My dad has been a member of the Plumbers and Pipefitters Local 776 in Lima, Ohio, for years and has worked as a journeyman HVAC professional, and I am proud to see him being able to support and grow and build an incredible life for his family and for my siblings. And part of that is because we are seeing incredible investments in that space, and as I talk to him, he sees more and more work coming as a result of the challenges we are facing.

So it is not necessarily something we should think about as a major challenge but also an opportunity.

Chairman BROWN. Thank you. Your dad the same UA union as Mr. Butterworth's parent union, if you will.

Senator Van Hollen, from Maryland, is recognized from his office.

Senator VAN HOLLEN. Thank you, Mr. Chairman, and that is a great place to kick off for my question, because I have a question about the costs and harm of doing nothing in response to accelerating climate change, but also one related to the opportunities of doing something to accelerate our transition to a clean energy economy.

On the costs and harm side, since 1982, which is about a 40-year period, we have had 69 what we call billion-dollar climate disasters impacting the State of Maryland. Nearly half of those 69 have oc-

curred in the last decade, with 19 occurring in the last 5 years. NOAA Center for Environmental Information estimates that those events have cost up to \$20 billion in damages to Maryland.

Mr. Florida, are these estimates consistent with the kind of impacts you are seeing in other parts of the country, including the acceleration of these impacts, and what would you say with respect to the likelihood of these costs increasing in an accelerating way in the years to come?

Mr. FLARIDA. Thank you for the question, Senator. Without a doubt we are going to see these costs increase as temperatures increase. We often think about climate change on the coasts, and we are trying to raise this issue in the State of Ohio to say this is going to impact us in the State of Ohio. Oftentimes we think about this with hurricanes and wildfires, but every day Ohioans are also experiencing this on a day-to-day basis, and certainly the floods in Kentucky are a notable example of late, in America's heartland.

So we will see these costs increase. They will go up. I think one important number to think about is the savings opportunity and the economic growth if we are able to keep global warming below 1.5 degrees C, which will result in a \$20 trillion increase in global GDP by 2100.

Senator VAN HOLLEN. Well, thank you for putting a number on it. That is obviously a big number, and that is the cost of doing nothing. But there is also the benefits in terms of GDP and jobs and good-paying jobs of doing something to accelerate the clean energy economy. And that is what the legislation that we will be voting on, I hope soon, the Inflation Reduction Act, will do with respect to accelerating the reductions of emissions of greenhouse gases as well as helping deploy more clean energy that will make it cheaper to heat your homes and cool your homes.

I do just want to say in the State of Maryland we are fortunate to have a budding wind energy, offshore wind energy, deployments. Two companies, Orsted and U.S. Wind, have projected together that they will create 10,000 jobs in the State of Maryland. And we just had an announcement yesterday from the Deputy Secretary of Commerce in Maryland about an apprenticeship program that will go hand-in-hand with that, to make sure that we have the workforce to do the job.

So obviously big benefits. You spoke to some in Ohio, Mr. Florida.

Dr. Vajjhala, can you just expand on some of the estimates of the job opportunities if we accelerate the deployment to a clean energy economy?

Ms. VAJJHALA. Absolutely, Senator Van Hollen. Thank you for the question. I would like to highlight the job opportunities in the energy sector not just for offshore wind but for grid modernization, so that we invest in the jobs that help build out the connective tissue.

The Infrastructure Investment and Jobs Act is going to enable thousands of jobs related to grid modernization, and these are high-quality jobs where we know how to do this well. We know how to weatherize the grid in places like Minnesota and North Dakota. We are not doing it in places like Texas. And those are

transferrable skills. That is not taking something from one sector and trying to port it over into another.

These types of jobs I think are not limited to the energy sector, and there is a model in Maryland that I would like to highlight that I think could help create some cross-sector innovation, and that is the Clean Water Partnership for managing stormwater and the costs of disasters.

The Clean Water Partnership was a public-private partnership designed to help deal with stormwater and pollution in the Chesapeake Bay, and the way the partnership was structured it was specifically designed to train local workers. And the county resident workforce utilization of this project is 78 percent. That is massive compared to many of these projects that often bring in outside employers and employees.

And so I think this is an opportunity for place-based investment in high-quality jobs and retaining those jobs.

Senator VAN HOLLEN. I appreciate your raising that Maryland example, and those are important stories in Maryland and around the country. I should underscore the fact that the 10,000 jobs I mentioned associated with offshore wind here in Maryland are going to be good-paying union jobs. Both companies have signed agreements with respect to the nature of the jobs.

So I do see a lot of opportunity here, and I just want to make sure that as we talk about the costs of doing nothing we also talk about the benefits of action. Thank you, Mr. Chairman.

Chairman BROWN. Thank you, Senator Van Hollen.

Mr. Butterworth, this is just a statement, and then we will close. Mr. Butterworth talked about pipelines we have not seen built. He mentioned a couple of specifically. I want to let everyone know that the Inflation Reduction Act will require the Mountain Valley Pipeline to be built by a specific date. It also requires permitting legislation to pass before the end of the current fiscal year next month. I absolutely am committed to working on that and working with Senator Toomey on that, if he so chooses.

Of course, we would rather have energy produced here rather than under the weak environmental standards of the rest of the world. I think all of the panel made that clear. We are not trying to get off oil and gas cold turkey. I share Mr. Butterworth's fears of unreliability, disorder, and unstable work in the energy sector, and appreciate the workers, the hourly good paid union hourly wage earners in that sector.

If we do not address, however, these climate-related costs nobody will be investing in new energy infrastructure, period. Accounting for the costs of climate change now can help us avoid the worst outcomes later, and I think there is general agreement and understanding of that.

Thanks to the witnesses today. For Senators who wish to submit questions they are due 1 week from today, Thursday, August 11th. To witnesses, per our Committee rules, we ask that you respond to any questions we send to you within 45 days of receipt. Thank you again. With that the hearing is adjourned. Thank you so much.

[Whereupon, at 11:40 a.m., the hearing was adjourned.]

[Prepared statements and responses to written questions supplied for the record follow:]

PREPARED STATEMENT OF CHAIRMAN SHERROD BROWN

Climate change is here—and the country knows it.

It's here for Ohio teachers and students forced to work in schools without air conditioning in 90-plus degree heat, for more and more days at both ends of the school year.

It's here for Ohio cities and towns that draw their drinking water from Lake Erie, and face higher and higher costs from harmful algal blooms.

It's here for Ohio farmers, many of whom lost an entire growing season in 2019 because of extreme rain, and who will soon be forced to learn to grow crops that used to be better suited to Arkansas than to Ohio.

And, it's here for our neighbors in Kentucky, who watched their homes and communities wash away in devastating flash floods this week—the kind that scientists warn are becoming more common.

We've all seen the pictures. The flooding could be any of our States.

Ask mayors, ask school superintendents, ask county commissioners about the increasing costs they deal with already because of climate change—costs we know will only get worse.

And we know who will be forced to pay for those costs.

It's not the oil companies that are raking in record profits: \$8.5 billion last quarter for BP—that's only 3 months. \$12 billion for Chevron—that's four billion a month. \$12 billion for Shell—that's a billion dollars a week. \$18 billion for Exxon Mobil—that's \$200 million a day.

It's not these corporations that will pay the bill—it's local taxpayers.

The likely impacts of climate change could cost Ohioans nearly \$6 billion a year.

These corporations and their executives have been getting rich by price gouging consumers and polluting our communities for decades. And taxpayers in Ohio and around the country will be left to pick up the pieces—taxpayers are always left to pick up the pieces.

It's why we have to act now to grow the renewable energy economy, and to make our communities more resilient to climate disasters.

If we delay, it will only get more expensive to fix.

In previous hearings, we have examined the threat of climate change to our financial system, the economic opportunities in the low-carbon economy, the role of insurance in protecting the economy from the coming impacts, and how we can reduce carbon emissions as we improve our housing.

In each hearing, too many have treated the looming catastrophe of climate change as a non-issue—or as something so far out in the future that there's no need to spend time on it in this Committee.

That makes no sense.

As the Committee tasked with overseeing the stability of our financial system, we have a responsibility to do all we can to prevent obvious risks from wrecking our local economies and our financial stability.

No one on this Committee questions the need to prevent cybercrimes by asking how many banks have failed because of it.

We don't dismiss financial scams because they don't pose a systemic risk to the financial system at the moment.

Our towns and our taxpayers can't afford for us to treat climate risk any differently—not when the effects on the economy are so clear.

With almost the entire country under excessive heat warnings, with floods and wildfires and droughts and extreme storms threatening Americans' lives and livelihoods, we know that communities in every State are about to be hit with massive bills—bills many of them won't see coming.

And we know there is tremendous economic opportunity if we address these threats.

Ohio and Pennsylvania and South Carolina can create good-paying jobs in the industries of the future. And if we don't lead, we know China will be all too happy to.

This morning, we will hear from four witnesses, including the executive director of one of the Ohio groups that published a report called "The Bill is Coming Due".

It features some eye-opening figures detailing costs that will be borne by Ohio towns and cities—and as a result, Ohio taxpayers—because of climate change.

What I hope to hear from all our witnesses is a recognition of the risk to our communities—and to the lives and livelihoods of our fellow citizens—from these real and present threats.

I hope we'll hear honest assessments of the state of the world we're in, and constructive suggestions about how we can make it better.

And I hope we'll come away from this hearing thinking about how we can help towns and cities in Ohio and around the country, that are living on borrowed time, prepare for what's coming.

Let's create the jobs for the 21st Century, and make sure the workers who will drive the 21st Century economy can still live in the towns and cities we were sent here to represent.

PREPARED STATEMENT OF SENATOR PATRICK J. TOOMEY

Thank you Mr. Chairman and all of our witnesses here today.

Every month seems to bring more bad news about energy. Gas prices still remain at near-record highs, despite declines in the last month.

The CPI's energy index was up over 41 percent over the past year as of June. This includes gasoline, fuel oil, electricity, and utilities.

Meanwhile, prices are rising across the economy but paychecks aren't keeping up. After adjusting for inflation, wages have declined 5 percent since President Biden took office.

In fact, unless you got a 12 percent raise in the last 18 months, you've effectively gotten a pay cut. Working Americans are becoming poorer every day.

Democrats' wasteful spending coupled with over a decade of ultra-easy monetary policy caused 40-year high inflation and contracted our economy. You know what is the last thing Americans need? Policies that are explicitly designed to reduce American energy production—and therefore make the cost of energy more expensive—under the guise of addressing climate change.

That's exactly what the Administration and congressional allies have done. They've been eager to find any culprit—other than themselves—to explain the rising cost of energy. They've tried blaming supply chains, Vladimir Putin, and my personal favorite, "corporate greed." How dare businesses be motivated by profit!

My colleagues on the other side of the aisle should really be doing a little self-reflection. But instead, they're trying to jam through a 700-page tax-and-spend bill that will throw fuel, presumably the carbon-neutral kind, on this fire: \$385 billion in corporate welfare for politically favored "green" energy, including \$9 billion in generous subsidies for the wealthy to buy Teslas, \$1 billion to fund electric garbage trucks and school buses, even though the infrastructure bill provided \$5 billion, \$1.5 billion for State and local government tree planting, even though we sent State and local governments \$500 billion in emergency funding over the last 2 years, and \$1 billion to install solar panels in Government-assisted housing—while we're in the middle of a housing affordability crisis.

And how do Democrats propose to pay for these goodies? By raising taxes by \$326 billion on employers, with half the burden falling on U.S. manufacturing companies. This "pay for" will exacerbate a recession we're already likely in.

The massive tax-and-spending spree is really just the tip of the iceberg for the Biden administration's costly energy policy. In less than 2 years, they've halted the Keystone XL Pipeline, erected onerous regulatory barriers to natural gas pipeline construction, mandated the highest ethanol blending requirement in the history of the Renewable Fuel Standard program, issued a moratorium on oil and gas drilling on Federal lands and offshore, and nominated for critical Federal positions individuals who are openly hostile to the oil and gas industry.

In our Committee's jurisdiction, the SEC has reached far outside its statutory mandate to get in on the action. In March, the SEC proposed a rule that would require all public companies to report every greenhouse gas emission in their supply chain—even though this data has nothing to do with the company's financial performance and is likely irrelevant to investors.

In addition to hijacking the democratic process with its breathtaking scope, the SEC proposal would impose immense costs on companies. The SEC itself estimated the paperwork burden to public companies to be an extra \$6.4 billion annually. This amount dwarves the current annual paperwork burden from all other SEC regulations combined, which is \$3.8 billion annually for this rule alone.

Obviously, the costs of the policies I've described so far are quite high. Businesses shut down. Jobs are lost. Less energy is produced.

Then there are second order effects: higher prices for consumers, failure of the electrical grid, less economic growth, and a lower standard of living. The great irony of all this is that, even for their extraordinarily high costs, none of these policies will make so much as a dent in slowing climate change.

I'm not denying global warming, which is undoubtedly real. What I'm denying is that these policies will have any meaningful effect.

If tomorrow the United States, the second-largest carbon emitter in the world, went carbon-neutral—which, from a carbon point of view, is equivalent to America not existing—global temperatures 80 years from now will have been reduced by $\frac{3}{10}$ th of a degree Fahrenheit.

This is according to the United Nations' climate model. Feel free to estimate the impact of a few more rich people buying Teslas.

I know my Democratic colleagues sincerely want to reduce greenhouse gas emissions anyway. Well, there's a way we can do that.

There is one thing that has made a dramatic dent in reducing U.S. greenhouse gas emissions: American energy production. Between 2005 and 2019, the U.S. led the world in emissions reductions—largely due to transitioning from coal to natural gas.

David Butterworth is a business manager for the Pipeliners Local Union 798, representing 6,400 union pipeline workers. He has been a member of the union for 25 years. Mr. Butterworth will testify to the importance of traditional energy for grid reliability, as well as the direct challenges his members face from hostility toward their chosen industry and profession.

Dan Eberhart is the CEO of Canary, an oilfield services company employing roughly 400 people from New Mexico to Pennsylvania. Mr. Eberhart will testify to the consequences of consistent under-investment in traditional energy, including policies that chill investment like the SEC climate proposed rule.

I hope my colleagues on both sides of the aisle listen to what they have to share today. Thank you.

PREPARED STATEMENT OF JOE FLARIDA
EXECUTIVE DIRECTOR, POWER A CLEAN FUTURE OHIO
AUGUST 4, 2022



Written Testimony before the
U.S. Senate Committee on Banking, Housing, and Urban Affairs

"Borrowed Time: The Economic Costs of Climate Change"
Full Committee Hearing
August 4, 2022; 10:00 AM

Joe Flarida, Executive Director
Power A Clean Future Ohio

Chairman Brown, Ranking Member Toomey, and Members of the Committee, thank you for the opportunity to testify on this most important issue: The Economic Costs of Climate Change. My name is Joe Flarida and I serve as the Executive Director of Power A Clean Future Ohio. In a moment, I will share more about our work and our incredible partners in Ohio, but I want to start with two brief observations.

First, I want to recognize that climate change is not a math problem, and the impacts that we will face as human beings are far more complex than we can put into simple economic or financial terms. Those most vulnerable in communities in my home state of Ohio and around the world will experience the most harm on the shortest timeline as a result of severe climate impacts. Health consequences already impacting vulnerable populations will get worse. Access to clean air, clean water, and healthy green space will become more scarce for those who don't already have these in abundance. And despite the false narrative we hear often, stable, good-paying jobs for workers will be sacrificed if we ignore the environmental challenges in front of us. However, when it comes to complex problems, one way to wrap our heads around the challenge is to look at the numbers and understand how much it will cost us to do nothing versus how much it will cost to act. My main point today is that we cannot afford to ignore climate change. We must act now.

My second observation is that year in and year out, local governments are burdened with the most challenging public problems we face. They are the eyes that see these problems first, the voices that raise the alarm when we reach a tipping point, and the hands that are asked to implement the solutions we identify. Today, I am here to lift up those Ohio elected leaders and the tireless staff in cities and counties across Ohio that are raising the alarm on the financial costs of climate change that they see coming.

Power A Clean Future Ohio was launched in February 2020 by an incredible group of policy experts, advocates, and local government leaders, and we are fortunate to have the strong support of many voices in the Ohio business community as we work in collaboration to grow our state's clean energy economy.

We built this organization to do one thing - provide direct support to Ohio's local governments to help them identify and adopt clean energy solutions. We support them in pursuing carbon reduction goals in



big and small ways. We have learned that the right solution is the one that works for that community, be it economically, environmentally, culturally, or even, yes, politically. On this topic, any progress is good progress. We encourage local governments to plan comprehensively to account for the economic development opportunity, potential cost-savings, and the considerable environmental implications of this work in the near and long-term.

Power A Clean Future Ohio, the Ohio Environmental Council, and our technical partner Scioto Analysis recently issued a report titled: "The Bill is Coming Due: Calculating the Financial Cost of Climate Change to Ohio's Local Governments." This report assessed key climate impacts for local governments in Ohio. We estimated costs for the year 2050, however we know that these costs will not instantly appear in 30 years, but in most cases they are already starting to accumulate and will steadily increase until they reach the projected midcentury estimates.

For ten key climate impacts, we estimate that local governments in the state of Ohio will need to increase municipal spending **between \$1.8 billion and \$5.9 billion per year** by midcentury in order to adapt to the challenges of a worsening climate crisis. For context, a \$5.9 billion increase would equate to an 82 percent increase over 2019 spending levels for environment and housing programs for local governments in Ohio.

Power A Clean Future Ohio works with 34 cities and local governments across our state of every size and in every region; and not one of these local governments knows how they will pay for the increased costs they will incur. Municipal officials are already grappling with difficult budget decisions and now they have an additional challenge to add to their strained financial resources.

By 2050, Ohio cities could see spending increases of over \$2.2 billion to contend with harmful algal blooms and drinking water treatment; \$1.7 billion to elevate roads that will be flooded due to changes in precipitation and severe storms; \$1 billion for road repair due to damage as a result of increased freeze-thaw cycles; and, \$590 million to establish and operate new cooling centers in the summer months.

Unless we see significant changes to address carbon emissions in the next few years, these impacts will only continue to worsen — and the cost to address them will continue to climb.

Our analysis provides a *conservative* estimate of the additional costs that municipalities can expect to incur due to climate change. These costs are expressed in 2021 dollars, which means that simple inflation alone will result in much higher amounts by 2050. The monetized amounts in our report represent only 10 of the 50 different impacts identified. Monetization of the other 40 impacts as well as additional climate impacts beyond these 50 would significantly increase the overall climate costs reflected in the report. In other words, the total increase in annual spending by municipal governments due to climate change is certainly higher, and likely much higher than what is reflected in the scope of this report. I want to emphasize that this report *only* covers municipal government spending and does not reflect the major cost burdens that will fall on residents – renters, homeowners – and businesses of all sizes.

While this report seems to be full of bad news, the final point that I would like to share is that all hope is not lost. While we are very likely to incur considerable costs due to climate change, the worst of this



crisis can be averted. Local governments are leading the way in transitioning to clean energy. They are adopting carbon reduction goals and establishing bold climate action plans, but they need your support.

We are seeing local government leaders in Ohio acting swiftly in response to climate change. We are proud to support Cincinnati, Columbus, Cleveland, and Dayton who will all procure 100% of their residential power from renewable energy. Dayton's 100% renewable energy purchasing program will save residents 30%, an average of \$300 per year per household. A long list of other communities in Ohio are also adopting 100% clean energy programs. This work is not reserved for just large cities either. We are working with over 20 cities and villages with less than 50,000 people, each looking to invest in and plan for a clean energy future.

Cities are adopting carbon reduction goals, establishing climate action plans, decarbonizing buildings, and purchasing electric vehicles. They are leading, and I am inspired every day to work with Ohio's elected leaders on these issues.

My recommendation to Congress is to (1) elevate this issue in every aspect of what you do and (2) invest in local governments.

There is no doubt that the costs and impacts we face are daunting, but I firmly believe that if we can do it locally, we can solve it globally.

Thank you again and I look forward to your questions.



ANALYSIS

Calculating the Financial Cost of Climate Change to Ohio's Local Governments

Our analysis provides a conservative estimate of the additional costs that municipalities can expect to incur due to climate change. Many of the costs of climate change are expressed in 2021 dollars, which means that simple inflation may drive these costs up on their own. The monetized amounts in our analysis represent only 10 of the 50 different impacts addressed. Monetization of the other 40 impacts would significantly increase the overall climate costs reflected here, but are hard to calculate on a statewide basis. In other words, the total increase in annual spending by municipal governments due to climate change is certainly higher, and likely much higher than our analysis reflects.

Annual costs of climate change for 10 major impacts on Ohio local governments expected by midcentury:

Impact	Low-End Estimate	High-End Estimate
Drinking Water Treatment	\$580 million	\$2.2 billion
Elevating Roads	\$860 million	\$1.7 billion
Road Repair	\$170 million	\$1 billion
Cooling Centers	\$52 million	\$590 million
Stormwater Management	\$140 million	\$150 million
Electrical Costs	\$5.4 million	\$79 million
Storm Recovery	\$35 million	\$78 million
Power Lines	\$140,000	\$18 million
A/C Installation	\$1.4 million	\$6.8 million
Cool Roofing	\$0	\$4.6 million
Total	\$1.8 billion	\$5.9 billion

Protecting Drinking Water from Harmful Algal Blooms

Harmful algal blooms, or blooms that produce toxic cyanobacteria, have increased dramatically over the past decade, particularly in the eastern United States.¹ These blooms have disrupted drinking water supplies in Ohio and elsewhere and have cost municipalities across the country millions to monitor, treat, and manage.²

¹Herman, Rob, "Toxic Algae Blooms Are on the Rise," Scientific American, September 7, 2016, Available Online: <https://blogs.scientificamerican.com/guest-blog/toxic-algae-blooms-are-on-the-rise/>

² Schechinger, Anne, "The High Cost of Algae Blooms in U.S. Waters: More Than \$1 Billion in 10 Years," Environmental Working Group, August 26, 2020, Available Online: <https://www.ewg.org/research/high-cost-of-algae-blooms/>



University of Toledo Economist Kevin Egan has found algae blooms cost the state of Ohio millions of dollars a year in lost tourism activity since tourism in the state is concentrated in its northern lakefront counties.³

In October 2010, the City of Celina, Ohio, estimated it had spent \$13 million to install treatment controls and set up toxic algae testing due to widespread algae blooms in Grand Lake St. Marys, the largest inland lake in Ohio and drinking water supply for the City of Celina and Village of St. Marys.⁴

The statewide additional cost to protect water supplies from toxic algae blooms in Lake Erie is estimated to reach \$580 million to \$2.2 billion per year by midcentury. The estimated cumulative cost for water treatment in the four largest Ohio cities that abut Lake Erie is \$37 million to \$140 million per year.

This table estimates additional annual costs of protecting water supplies from hazardous algae blooms by midcentury.

Area	Baseline Cost	Best-Case Additional Climate Cost	Likely Additional Climate Cost	Worst-Case Additional Climate Cost
Cleveland	\$26 million	\$19 million	\$34 million	\$71 million
Toledo	\$19 million	\$13 million	\$24 million	\$51 million
Lorain	\$4.4 million	\$3.2 million	\$5.7 million	\$12 million
Sandusky	\$1.7 million	\$1.2 million	\$2.2 million	\$4.6 million
Ohio	\$820 million	\$580 million	\$1 billion	\$2.2 billion

Additional Considerations

While hotter temperatures will likely impact harmful algal bloom growth in Ohio, increased runoff from heavy precipitation will likely also increase the presence of algal blooms. This is particularly true in Ohio due to the significant amount of farmland in the state. This means that the cost estimates in this analysis may underestimate the true cost to treat harmful algal blooms associated with climate change for Ohio municipalities if increased precipitation and runoff leads to more frequent bloom occurrences.

Elevating Roads

Climate change is expected to cause more frequent concentrated, intense storms with heavier rainfall, which will lead to increased flooding. Climate change-driven flooding can lead to traffic disruptions, construction activity delay, and weakening and washing out of soil and culverts that support roads, tunnels, and bridges.⁵ Volatility of flood levels may prompt local governments to raise the height of roads and bridges to exceed the base flood elevation in order to ensure public safety in the face of these new climate-driven flooding challenges.

³ Egan, Kevin, Invited Presentation, Ohio Association of Economists and Political Scientists Annual Conference, Tiffin, Ohio, 2017.

⁴ "A compilation of cost data associated with the impacts and control of nutrient pollution." United States Environmental Protection Agency, Reports and Assessments 3 (2015): 1-25.

⁵ "Climate Impacts on Transportation," Environmental Protection Agency, January 19, 2017, Available Online: https://19january2017snapshot.epa.gov/climate-impacts/climate-impacts-transportation_.html



Ohio would need to spend between an estimated \$860 million and \$1.7 billion per year over 30 years to raise the state's roads above base flood elevation. The following table shows the estimated miles of roads falling below base flood elevation as well as low- and high-end annual cost estimates for raising these roads above base flood elevation in select Ohio cities and statewide.

This table estimates the additional miles of roads below base flood elevation for select Ohio cities and the annual cost to raise them above base flood elevation

Community	Est. Miles of Roads Falling Below Base Flood Elevation	Annual Cost - Low	Annual Cost - High
Dayton	65	\$11 million	\$23 million
Washington County	13	\$2.2 million	\$4.4 million
Lima	9	\$1.5 million	\$3 million
Youngstown	7	\$1.3 million	\$2.5 million
Marion	6	\$1.1 million	\$2.1 million
Ohio	5,000	\$860 million	\$1.7 billion

Road Repair

Roadways in the U.S. are vulnerable to a range of climate impacts. Road damage is caused not only by the wear and tear of vehicle travel, but also by weather impacts. Frequent extreme heat events, higher temperatures, more rapid freeze/thaw cycles, and increased flooding from heavy rains can significantly affect the safety and longevity of major roadways.

We estimated how future changes in temperature, precipitation and freeze-thaw cycles will affect roads in Ohio and in the following Ohio localities: Dayton, Lima, Marion, Washington County, and Youngstown. Low- and high-end repair and rehabilitation costs were estimated for the RCP 4.5⁶ future climate scenario. Statewide, Ohio will be facing costs of \$170 million to \$1 billion per year with a likely value of \$410 million per year for road repair related to climate change by midcentury.

⁶ RCP 4.5 climate scenario is explained in detail in the general methodology section on page 13 of this testimony and more details on this climate scenario and the models for each climate impact can be found in the full report. <https://www.powercleanfuture.org/s/OH-MunicipalCostsOfClimateChange.pdf>



This table shows the estimated annual costs expected to incur by midcentury for road repair and rehabilitation associated with future changes in temperature, precipitation, and freeze–thaw cycles.

Area	Low-Cost	Expected Cost	High-Cost
Dayton	\$1.1 million	\$2.6 million	\$6.5 million
Youngstown	\$710,000	\$1.7 million	\$4.2 million
Washington County	\$220,000	\$530,000	\$1.3 million
Lima	\$97,000	\$230,000	\$570,000
Marion	\$86,000	\$210,000	\$510,000
Ohio	\$170 million	\$410 million	\$1 billion

Cooling Centers in Cities

Cooling centers are air-conditioned public buildings designated as safe locations during times of extreme heat.⁷ Cooling centers may be government buildings like libraries or schools, public-oriented buildings like community centers, religious centers, or recreation centers, or even private businesses like coffee shops, malls, and movie theaters. Cooling centers are used as part of a larger heat health warning system, designed to reduce deaths from heat exposure. They are considered a best practice for reducing heat-related deaths.^{8,9}

A literature review conducted by the Centers for Disease Control and Prevention (CDC) found that even a few hours spent in a cool environment reduces the risk of vulnerable populations to heat exposure-related illness.¹⁰ Socially vulnerable populations such as the elderly or unemployed are more likely to utilize the services provided by cooling centers.

As temperatures in Ohio continue to rise as a result of climate change, Ohio cities will incur additional costs to support and expand new and existing cooling center capacity during times of extreme heat. Such costs could include staff capacity, supplies such as bottled water, utilities, and implementation of systems for tracking high-risk individuals.¹¹

We used a 2015 study by researchers at Carnegie Mellon University of cooling centers in Pittsburgh to estimate current cooling center coverage and project the need for new cooling centers in Ohio cities. In the Carnegie Mellon University study, researchers found the city was operating 19 cooling centers at the time of publication.¹² The study found that Pittsburgh would need 127 cooling centers to provide maximum coverage to Pittsburgh residents, about a 600 percent increase in cooling center coverage.

⁷ Widerynski, Stasia et al, "The Use of Cooling Centers to Prevent Heat-Related Illness: Summary of Evidence and Strategies for Implementation," Climate and Health Technical Report Series, Climate and Health Program, Centers for Disease Control and Prevention, Available Online: <https://www.cdc.gov/climateandhealth/docs/UseOfCoolingCenters.pdf>

⁸ "Heat Alert and Response Systems to Protect Health: Best Practices Guidebook," Government of Canada, Available Online: <https://www.canada.ca/en/health-canada/services/environmental-workplace-health/reports-publications/climate-change-health/heat-alert-response-systems-protect-health-best-practices-guidebook.html#a351>

⁹ Widerynski, Stasia et al, "The Use of Cooling Centers to Prevent Heat-Related Illness."

¹⁰ Widerynski, Stasia et al, "The Use of Cooling Centers to Prevent Heat-Related Illness."

¹¹ Berisha, Vjolca et al, "Assessing adaptation strategies for extreme heat: a public health evaluation of cooling centers in Maricopa County, Arizona." *Weather, climate, and society* 9, no. 1 (2017): 71-80.

¹² Bradford, Kathryn et al, "A heat vulnerability index and adaptation solutions for Pittsburgh, Pennsylvania." *Environmental science & technology* 49, no. 19 (2015): 11303-11311.



Across Ohio, municipalities will need to expand the number of days that cooling centers are open by an average of 30 days per year due to rising temperature and more frequent days of extreme heat in order to keep services at current level. We estimate this will cumulatively cost Ohio municipalities an additional \$52 million per year in additional operating expenses. Local governments will also need to expand the number of existing cooling centers to provide maximum coverage to residents. We estimate that the state of Ohio would need to operate an additional 5,900 cooling centers by midcentury to provide this coverage, which would cost Ohio municipalities an additional \$590 million per year to operate.

This table shows the estimated annual costs of operating cooling centers expected by 2050.

City	Additional days of operation	Annual cost for additional days of cooling center operation	New centers needed for full coverage	Full coverage total annual cost
Dayton	37	\$480,000	44	\$5.5 million
Toledo	31	\$480,000	54	\$5.4 million
Akron	28	\$390,000	48	\$3.9 million
Youngstown	29	\$180,000	21	\$1.8 million
Canton	29	\$120,000	14	\$1.2 million
Ohio	33	\$52 million	5,900	\$590 million

Stormwater Management

With climate change causing heavier and more frequent precipitation, Ohio municipalities will need to make upgrades to their stormwater management systems to provide the same quality of service as in the past. This could mean adding extra culverts or installing detention or retention basins, rain gardens, infiltration trenches, and other stormwater management techniques to address more frequent and severe rainfall.

The U.S. Environmental Protection Agency (EPA) lists retention basins and other strategies as effective strategies for dealing with changes in rainwater frequency.¹³ However, increased frequency and intensity of rain caused by climate change is impacting the design of retention basins all across the world.¹⁴ In particular, a recent study found that the biggest threat for flooding comes not from the total rain during a storm, but the total rain at the heaviest point during the storm.¹⁵ This is because detention and retention basins can adequately drain during the course of a storm but are most threatened for overflow and failure when storming is worst. More heavy rains or more intense weather events could

¹³ Clar, Michael L., "Stormwater Best Management Practice Design Guide - Volume 3: Basin Best Management Practices," National Risk Management Research Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, OH 45268, September 2004, Available Online: https://cfpub.epa.gov/si/si_public_record_Report.cfm?Lab=NRMRL&dirEntryID=99760

¹⁴ Sanches Fernandes, Luis F. et al., "Influence of climate change on the design of retention basins in northeastern Portugal." *Water 10*, no. 6 (2018): 743.

¹⁵ Elshorbagy, Amin, Kelsea Lindenas, and Hossein Azinfar. "Risk-based quantification of the impact of climate change on storm water infrastructure." *Water Science* 32, no. 1 (2018): 102-114.



thus require not only installation of new basins or spillways, but a combination of different stormwater management technologies.

Of the 10 technologies studied, three technologies — rain gardens, infiltration trenches, and sand filters — were effective at reducing runoff at a similar low cost across municipalities. The annual construction, maintenance, and rehabilitation costs expected by midcentury for each strategy in the selected Ohio municipalities are below. The statewide cost to implement a given stormwater management technology is estimated to reach \$140 million to \$150 million per year by midcentury.

These estimates assume a single technology is used to manage stormwater. Mixing and matching technologies may increase or decrease costs depending on the watershed coverage of the technology within the municipality. These numbers also assumed that construction costs were capitalized over 30 years.

This table shows the estimated annual costs for stormwater management infrastructure for select Ohio municipalities expected by midcentury.

Municipality	Rain Gardens	Infiltration Trenches	Sand Filters
Toledo	\$10 million	\$10 million	\$11 million
Youngstown	\$3 million	\$3 million	\$3.2 million
Lima	\$1.5 million	\$1.4 million	\$1.5 million
Marion	\$1.3 million	\$1.7 million	\$1.3 million
Marietta	\$590,000	\$570,000	\$620,000
Ohio	\$140 million	\$140 million	\$150 million

Increased Electricity Costs for City Operations

Once installed, air conditioning systems require recurring costs to operate and maintain. Hotter days and longer summers mean that new and existing units will be used on a more consistent basis. In addition to creating more cooling capacity, Ohio municipalities must also consider higher electricity costs associated with increased air conditioning usage for all publicly owned and operated buildings.

For example, according to the Center for Climate Integrity and Resilient Analytics's 2021 analysis, Ohio schools will have to spend an additional \$56 million annually to operate and maintain new air conditioning systems, once installed.¹⁶ In addition to schools, other public buildings will also be running their air conditioning systems more regularly.

Future utility costs related to increased air conditioning usage in public buildings were estimated for five municipalities in Ohio: Marion, Lima, Toledo, Marietta, and Youngstown.

Toledo will incur the highest increase in spending with additional cooling costs estimated between \$44,000 and \$670,000 per year by midcentury. Cumulatively, these cities are facing between \$75,000 and \$1.1 million per year in additional utility costs in order to cool public buildings. Statewide, Ohio can expect increased cooling costs to run from a total of \$5.4 million to \$78 million per year.

¹⁶ LeRoy, Sverre et al, "Hotter Days, Higher Costs."



The table reflects the annual increase in utility spending by cities in Ohio by 2050, due to additional air conditioning usage in public buildings.

City	Current Estimated Annual Utility Budget	Low-End Increase	High-End Increase
Toledo	\$8.8 million	\$44,000	\$670,000
Youngstown	\$2.8 million	\$14,000	\$210,000
Lima	\$1.7 million	\$8,000	\$130,000
Marion	\$940,000	\$5,000	\$71,000
Marietta	\$220,000	\$1,000	\$16,000
Ohio	\$1 billion	\$5.4 million	\$79 million

Storm Recovery and Adaptation to Heavy Precipitation

As climate change increases the frequency and severity of storms and heavy precipitation events, Ohioans will be forced to confront increased costs for storm recovery, clean-up, and stormwater management, as well as costs to adapt critical infrastructure to high incidence flooding events. According to the EPA, average annual precipitation in the Midwest has increased by 5 to 10 percent over the last 50 years.¹⁷

Particularly, the frequency and intensity of heavy precipitation events are increasing. According to the Great Lakes Integrated Sciences and Assessments team (GLISA) at the University of Michigan, total annual precipitation has grown by 14 percent in the Great Lakes region since 1951 and the amount of rain falling in the heaviest one percent of storms in the region has grown by 35 percent.¹⁸ The team also projects average annual precipitation will grow by two to six inches by the end of the 21st century and that higher levels of water vapor in the air combined with rising temperatures will create conditions for more intense storms in the future.

Statewide costs associated with recovery and clean up from increased frequency and severity of extreme weather events are expected to reach \$35 million to \$78 million per year by midcentury. Below are the midcentury estimates for annual costs associated with increased frequency of four distinct extreme weather events. The range of estimates is mainly driven by the range of historical estimates of costs associated with extreme weather events.

¹⁷ "What Climate Change Means for Ohio," United States Environmental Protection Agency, August 2016, Available Online: <https://19january2017snapshot.epa.gov/sites/production/files/2016-09/documents/climate-change-oh.pdf>

¹⁸ "Climate Changes in the Great Lakes region and Dayton, Ohio," Great Lakes Integrated Sciences and Assessments: A NOAA RISIA Team, University of Michigan, Available Online: <https://glisa.umich.edu/wp-content/uploads/2021/03/Dayton-Climate-Summary.pdf>



This table reflects the estimated statewide annual costs in Ohio by 2050 associated with an increase in severe weather events.

Event	Low	High
Drought	\$21 million	\$44 million
Hurricane Winds	\$11 million	\$28 million
Severe Storm	\$1.5 million	\$3.4 million
Flooding	\$1.3 million	\$3 million
Total	\$35 million	\$78 million

Protecting Power Lines with Increased Storm Severity

With increased storm severity and frequency, Ohio communities will face increased maintenance costs to protect power lines from damaged trees.

Statewide municipal power costs for pruning of trees are estimated to increase by about \$140,000 per year by midcentury to adapt to increases in storms, and up to \$18 million per year if municipal utilities who have not chosen to adopt full enhanced pruning programs begin the programs in response to the threat of climate change. Our analysis shows the increased annual costs of pruning trees for select municipal power companies by comparing their relative customer base to statewide customer base. It also includes cost estimates for implementing an enhanced pruning cost program, should local officials see that as an appropriate response to the increased risk of storms resulting from climate change. These cost estimates do not include the cost to consumers in investor-owned utility territory, which makes up the vast majority of electricity consumers in Ohio.

This table shows the estimated annual costs incurred by midcentury for pruning for select municipal power distributors.

Distributor	Additional Cost	Full Enhanced Pruning Cost
Cleveland	\$29,000	\$3.9 million
Cuyahoga Falls	\$8,700	\$1.2 million
Wadsworth	\$4,700	\$630,000
Piqua	\$3,900	\$520,000
Oberlin	\$1,100	\$150,000
Ohio	\$140,000	\$18 million



Installing Air Conditioning in Ohio's Schools

The threshold at which schools typically install air conditioning is 32 school days above 80 degrees Fahrenheit, according to a 2021 analysis from the Center for Climate Integrity and Resilient Analytics, which examined engineering protocols, peer-reviewed studies on the relationship between heat and learning, and actual practice in school systems across the country.¹⁹ The report found that by 2025, school districts across Ohio are expected to experience between 11-15 additional days above 80 degrees while still in session compared to a baseline of 25-31 days in 1970.²⁰

Air conditioning installation costs were estimated for urban, high poverty school districts in Ohio, which include Akron, Cincinnati, Cleveland, Columbus, Dayton, and Toledo. We estimated the upfront cost to install new air conditioning in urban, very high poverty districts, assuming those districts lack air conditioning at the same rates as Columbus City Schools. Assuming these are paid over a 30-year window like many capital investments and that installation will begin on or before 2050, the total cost by midcentury would be \$1.4 to \$6.8 million per year.

This table reflects the estimated annual payments for new air conditioning system installation needed in urban, very high poverty districts by midcentury.

District	Low	High
Columbus	\$12 million	\$60 million
Cleveland	\$7.3 million	\$36 million
Cincinnati	\$7.1 million	\$35 million
Toledo	\$6.2 million	\$31 million
Akron	\$4.9 million	\$25 million
Dayton	\$3 million	\$15 million
<i>All Urban Very High Poverty Districts</i>	<i>\$41 million</i>	<i>\$200 million</i>

Cool Roof Construction for Public Sector

Cool roofs reduce the need for air conditioning, and in some cases serve as an alternative to air conditioning systems. They are designed to reduce the temperature within a building by installing material that reflects more sunlight, decreasing the need to install or run expensive air conditioning systems.²¹ For example, the City of Cincinnati has already started to encourage the use of cool roofs with the 2018 Green Cincinnati Plan recommending deployment of cool roofs on new construction in the city.²²

¹⁹ LeRoy, Sverre et al, "Hotter Days, Higher Costs: The Cooling Crisis in America's Classrooms," The Center for Climate Integrity, Resilient Analytics, May 2021, Available Online: <https://coolingcrisis.org/uploads/media/HotterDaysHigherCosts-CCI-May2021.pdf>

²⁰ "Ohio," Hotter Days, Higher Costs: The Cooling Crisis in America's Classrooms, Center for Climate Integrity, Available online: <https://www.coolingcrisis.org/uploads/media/CCI-StateReport-Ohio.pdf>

²¹ "Cool Roofs," Energy Saver, Available Online: <https://www.energy.gov/energysaver/cool-roofs>

²² "Heat Island Community Actions Database," United States Environmental Protection Agency, January 8, 2022, Available Online: <https://www.epa.gov/heatislands/heat-island-community-actions-database>



Ohio is unlikely to require all new construction to have cool roofing. But if new roofing accounts for just one percent of new public sector construction by midcentury, the additional cost to install cool roofing statewide would be roughly \$4.6 million per year in 2021 dollars.

This table shows the estimated costs of cool roofing per year per city if 1 percent of new construction includes cool roofing by 2050.

City	Potential annual cost of cool roofing construction
Toledo	\$110,000
Youngstown	\$26,000
Marion	\$14,000
Lima	\$14,000
Marietta	\$5,200
Ohio	\$4.6 million

METHODOLOGY

The cost estimates in this testimony are derived using different cost models for each climate impact outlined. Please reference the full "The Bill is Coming Due" report for information on the methodology for each monetized climate impact.

Unless otherwise noted, all estimates in the report's analysis are based on the RCP 4.5 scenario.²³ RCP stands for Representative Concentration Pathway and describes different future scenarios based on the concentration of greenhouse gas emissions in the atmosphere. Described by the International Panel on Climate Change as an "intermediate" projection,²⁴ the RCP 4.5 climate scenario predicts that temperature will rise between 2 to 3 degrees Celsius before 2100 assuming a range of technologies and strategies for reducing greenhouse gas emissions are employed.

²³ National Oceanic and Atmospheric Administration, "Climate Model: Temperature Change (RCP 4.5) - 2006 - 2100" <https://sos.noaa.gov/catalog/datasets/climate-model-temperature-change-rcp-45-2006-2100/>

²⁴ IPCC, 2014: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp. https://ar5-syr.ipcc.ch/topic_futurechanges.php

PREPARED STATEMENT OF DAN K. EBERHART

CEO, CANARY, LLC

AUGUST 4, 2022

Introduction

Chairman Brown, Ranking Member Toomey, and Members of the Committee, thank you for inviting me to testify today on the economic costs of climate change. Climate change is one of the most significant issues of our time, and I am proud of the continuing role of the energy sector in reducing the carbon intensity of the energy Americans rely on every day.

As CEO of Canary, one of the largest privately held oilfield services companies in the United States, I am familiar with the positive impact business can have on communities, providing good paying jobs and benefits to the hundreds of workers who are proud to call us their employer. These are folks who proudly come to work every day committed to building our reputation of trust, quality service, and commitment to excellence. Today, however, we are increasingly challenged by the mountains of red tape imposed by regulators, which has disproportionately impacted our industry, one of the most heavily regulated in the country.

As CEO, I also understand the important role of business in addressing the environmental impacts of energy production and helping mitigate climate change. Canary is already required to operate in a manner that protects the environment and human health, responsibilities we take seriously. We are also one of the Nation's most innovative industries, with billions of dollars invested industrywide to develop technologies that allow us to produce the abundant and affordable energy that Americans have come to depend on every day.

I firmly believe the oil and natural gas industry can be our Nation's most formidable ally in the fight against climate change. But to do so, we need the Government as a partner, not an adversary.

That is why I am concerned that the U.S. Securities and Exchange Commission's proposal mandating public companies report their emissions and exposure to climate risks is a major move in the wrong direction.

Proponents argue the SEC's proposed rule on "The Enhancement and Standardization of Climate-Related Disclosures for Investors" will provide investors with useful information on a company's exposure to climate risks, but the practical effect will be to drive capital away from badly needed conventional energy and infrastructure projects, making energy more expensive and denying America of a natural competitive advantage against other countries.

In a parallel trend in the capital markets, the growing popularity of environmental, social, and governance (ESG) investment funds, are steadily strangling domestic oil production, which now sits at around 11.6 million barrels per day compared to its peak in 2019 of 13 million per day.

A report last year from the International Energy Forum estimates that 2021 oil and gas production remained 23 percent below the prepandemic level of \$525 billion, while investment slumped by 30 percent in 2020. The report identified ESG as one of three principal drivers of underinvestment. That is a predictable result of the nearly \$2.7 trillion in ESG funds that restrict investment in conventional energy producing companies.

As Committee members are undoubtedly aware, our economy faces an historic energy supply challenge. After a decade of underinvestment in the oil and gas sector, current domestic output sits well below prepandemic levels while demand continues to return. Unfortunately, much of this shortage is driven by domestic energy policy that has frozen new Federal leasing and prohibited pipeline construction, discouraging the investment necessary to explore, develop, and produce the energy America needs to prosper.

Our industry requires capital and investor confidence to thrive. Investor confidence follows from reasonable and predictable regulation. Without those prerequisites, companies will not risk the capital needed to ensure we have a secure supply of energy. Decapitalizing the oil and gas industry in the fight against climate change will increase energy prices, restrict innovation, and shrink our economy.

Structural underinvestment has hampered capital-intensive activities across the upstream, midstream, and downstream sectors of our industry. Less than a decade ago, there were 1,600 active drilling rigs in the country. Today, there are roughly 500.

And while the SEC rule and adjacent policies undermine U.S. energy security and destabilize the economy, the Administration has done little to nothing to address consumer demand for the underlying products. As an industry, we are responding

to the market and projected increases in demand. By comparison, the mixed signals coming out of the Administration are clearly discouraging new investment.

Regulatory burdens carry real costs that affect everyday Americans. As prices rise across energy categories that consumers rely on, I strongly urge the Committee to reconsider its current reliance on regulations, and instead pursue a viable and durable path forward on climate policy that protects the environment, consumers, the economy, and our national security.

Authority

Perhaps the most significant concern raised by the proposed rule is that the SEC is exceeding its statutory authority.

The SEC's rules, as clarified in its 2010 interpretative guidance, already require publicly traded companies to disclose a wide range of climate information to the extent that it is financially material.

These rules are principles-based and grounded in the materiality standard, which has long underpinned U.S. capital markets and ensured that Federal securities regulation fulfills the Commission's tripartite mission. That standard, which is generally defined by Congress and the courts as requiring disclosure of information necessary to protect investors from inflated prices and fraud, has long instilled confidence, promoted market efficiency, and competition and is thus tied to advancing the goals of Federal securities laws, as reflected in the SEC's mission.

Furthermore, much of the emissions data the Commission seeks is already publicly available under the Environmental Protection Agency's (EPA) Greenhouse Gas (GHG) Reporting Program, which captures roughly 90 percent of U.S. GHG emissions from the largest emitters.¹ Combined with the U.S. Inventory of GHG emissions, investors have more than enough data about a companies' emissions profile to make informed investment decisions.

Like other service companies, Canary adheres to the EPA's regulations on this topic and encourages regulation from just one agency to limit duplicative rules, or worse, inconsistencies that increase costs and the risk of unintended consequences.

Unfortunately, the SEC's proposal goes well beyond requiring information that provides an objective picture of a company's financial situation. Instead, it seeks to impose an unnecessarily burdensome and costly reporting structure that requires disclosure of a wide range of information, much of which is non-investor-oriented, and that is largely immaterial to a company's financial health.

Compelling public companies to report different kinds of costly environmental data, including Scope 1, 2, and 3 emissions data, climate scenario analyses, transition plans, climate-related financial impacts on corporate financial statements, and emissions reductions plans will have a practical effect on markets beyond just "disclosure."

If there is concern regarding companies' disclosures, they might be more readily, and cost effectively addressed through updated guidance regarding its materiality standards and by cross referencing EPA's GHG Reporting Program.

The Scope 3 reporting requirement proposed in the rule will place the responsibility and pressure to mitigate economywide emissions solely on the oil and gas industry.

For many companies, those costs are significant and could contribute to a decision to forego participating in public markets. On an annual basis, companies are projected to spend more than \$10 billion cumulatively and burn more than 43 million work hours to meet the demands of this proposal. These direct compliance costs are likely underestimated, however, and say nothing of the broader costs to the economy, due to the proposal's impact on capital allocation, markets, and energy prices.

Notwithstanding the SEC's stated goal of establishing a reporting framework that provides more "consistent, comparable, and reliable information," the Commission should not attempt to expand its authority simply because a subset of investors is interested in compelling corporate adherence to aspirational policy objectives, regardless of their merit. In fact, given the well documented political opposition the proposal has already garnered, it is likely that the rule will result in market instability and confusion, as the rules become a continued source of controversy and subject to repeal once a new Administration takes office or the complexion of the Commission itself changes.

Excessive Costs

Most important to companies like Canary is the impact this proposal will have on the bottom line. In this regard, the proposal fails to reasonably arrive at an accurate assessment of the cost for companies to comply. The SEC provides its first-year

¹ <https://www.epa.gov/ghgreporting>

cost of compliance estimate at \$640,000 for non-SEC registrants and \$490,000 for SEC registrants. But on page 372, the SEC admits that these estimates may be “limited in scope and may not directly reflect registrants’ compliance costs.” From my vantage point as a CEO, I find this estimate suspect given the immense financial, account, and legal hours that the proposal will require. This compels me to question if the SEC has arrived at a reasonable estimate for companies to comply with the full scope of the rule. One economist from the University of Wisconsin, found that “by the late 2020s, the enduring economic impact will be approximately \$25 billion in U.S. GDP foregone each year and 200,000 fewer jobs.”²

Mandatory disclosure will drive the shift in investment flows by providing ESG funds regulatory cover to prioritize “environmental sustainability” over economic returns for investors when ranking funds.

The proposed rule will further cripple the oil and gas sector and our ability to meet the energy needs of consumers. The requirement that a company accounts for greenhouse gases emitted anywhere along its supply chain, called Scope 3 emissions, and the use of its products is a burdensome standard that will disproportionately affect domestic energy producers, including the financial institutions that underwrite the sector.

As CEO of a private company, this Scope 3 requirement amounts to one of my biggest concerns with the proposal. As an oilfield services company, Canary’s Scope 1 emissions would be the Scope 3 emissions for a company who procures our services. This unprecedented mandate for Scope 3 has rightly concerned many private companies, as many lack the capability to collect this data. This is particularly the case for smaller companies, like Canary, who will be required to expend a disproportionate amount of resources to comply. While it may be true that certain large incumbent firms might have sufficient resources to begin a Scope 3 data collection process—that will only involve those large firms asking smaller companies, like Canary, for their emissions estimates, which are much too costly for us to collect.

In addition, the industrial sector has expressed concern about increased liability for companies that must suddenly predict risks 10 to 20 years into the future as global temperatures rise. Chevron, ConocoPhillips and the American Petroleum Institute were among those asking the SEC to stipulate so-called “safe harbor” protections to shield them from legal or regulatory penalties related to the new climate-risk disclosures.

Conclusion

Throughout my testimony, I’ve described in detail the various reasons why companies like Canary are concerned about this proposal. If implemented as proposed, the rule will severely impact the ability of the oil and gas sector to meet present energy demand. The energy crisis facing the country today will be further exacerbated as costs pile onto energy producers and present difficulties to find labor, materials, and capital needed for exploration and production efforts.

A weakened U.S. oil and gas sector will not, however, stop forthcoming rising global energy demand, which the EIA projects will rise nearly 50 percent by 2050. Instead, current policy initiatives look more likely to bring about scenarios in which the U.S. settles into a role as a net importer of petroleum and natural gas products despite our abundant resources here at home.

Financial regulators’ shift toward prioritizing climate change over returns will end badly for the U.S. economy and consumers. It’s bound to restrict investment into finding and producing conventional energy supplies and usher in a more extreme version of the demand shock we’re experiencing today. Regulators make poor capital allocators. Free markets that can react to sudden supply and demand changes are much better at channeling investment.

The proposed rule’s prescriptive regime for emissions disclosures for public companies is unnecessary, will weaken our country’s energy security, and undermine our climate goals. As prices rise across energy categories that consumers rely on, the SEC, in its role as a financial regulator, cannot and should not move forward with a major environmental initiative without the direction of elected policymakers and agencies with environmental and energy expertise.

With two quarters of negative economic growth, and alarming inflationary trends in our future, I implore Congress to save American energy independence and oppose this rule.

² <https://www.sec.gov/comments/s7-10-22/s71022-20132304-302836.pdf>

PREPARED STATEMENT OF DAVID BUTTERWORTH
NORTHEAST REGIONAL BUSINESS AGENT, PIPELINERS LOCAL UNION 798
AUGUST 4, 2022

Chairman Brown, Ranking Member Toomey, and Members of the Committee, thank you for the opportunity to testify today about climate change. My name is David Butterworth, and I am from Clendenin, West Virginia. I am employed as a Business Agent for Pipeliners Local Union 798. I represent approximately 6,400 Welders, Helpers, and Journeymen who build pipelines in the United States. My jurisdiction extends from Virginia to Maine, and 904 of our members live throughout the Northeast. I welded and worked on pipelines from 1998 until 2015 and was hired to my current position in January 2016.

I am here today to speak about how climate change and energy policies affect grid reliability, the country, our towns, and my membership. Local 798 has attended and spoken at just about every Federal and State pipeline hearing that has taken place in the Northeast from 2016 until today. Some of these pipelines are the Atlantic Sunrise, Atlantic Coast, Mariner East, Mountaineer Express, Mountain Valley, Northeast Supply Enhancement, Northern Access, and Penn East, just to name a few. We attended and spoke at each of these hearings because we know the massive work opportunities these projects provide our membership. Our job prospects have dwindled significantly since the summer of 2018 when we peaked at 8,300 members due to Mountain Valley and Atlantic Coast being in full swing. When completed, the Mountain Valley Pipeline will provide a natural gas backup generator system to Carilion Hospital in Roanoke, VA, and will also lead to increased manufacturing and jobs in the South.

I come from a town in West Virginia where good-paying jobs are intertwined with the fossil fuel industry. My father and many others from my town helped build the Alaska Pipeline. Local 798 is made up of members from towns like this spread across our great Nation. Mifflintown, PA, Olive Hill, KY, Bald Knob, AR, Oak Grove, LA, and Durant, OK, are towns you have probably never heard of, but if you traveled to them, you stand a good chance of meeting a pipeliner. We were once fortunate enough to be out of the national spotlight and had to explain to people exactly what we did, and quite frankly, nobody really cared. Unfortunately for us, those days are over, and we find ourselves thrust into national politics.

This is not where we want to be. We're in the middle; middle-class union workers are feeling the squeeze between opposing sides. I find myself asking questions like, "do the policymakers and those against fossil fuels truly believe we can shut down all fossil fuels tomorrow and not fall into utter chaos?" I ask this because during the "Texas Freeze," where all forms of energy failed, and sadly people perished, we were shown a snapshot of the disorder that accompanies a broken grid. I also witnessed the gas hoarding that began to happen at my local gas station when the Colonial Pipeline was hacked. American citizens were filling large containers of gasoline in preparation for a nationwide gas shortage without thinking about how this would affect the next person who simply wanted to fill up their vehicle tank.

This brings me to my next point. A report published by the Columbia University Center on Global Energy Policy shows a "future continued use of natural gas for at least the next 30 years" and that "there is no quick replacement for gas in the U.S. energy mix." Switching from coal to natural gas power generation has dropped emission levels. According to the Energy Information Administration, from 2005 to 2017, U.S. natural gas production increased by 51 percent, and CO2 emissions decreased by 14 percent. The Nation's pipeline system guarantees a safe, efficient, clean energy transition. I support efforts to curb climate change, but I do not support curbing climate change when the cost is grid reliability.

We can achieve climate goals by using common sense and American ingenuity while imploring all the above energy approaches that include carbon capture and hydrogen blending. Both methods use the existing pipeline system and will bring down climate change levels. These new techniques will be protested, and this committee, along with the rest of Congress, has the power to support agendas that keep my members working, provide grid reliability and align with the new strategies that address the current climate situation. I ask that you tune out the 10 percent of American citizens who protest literally everything, and instead listen to a person who has played a part in building the power grid.

We have the energy here, and we need to use it so that we don't end up like Germany, whose citizens will be introduced to warming houses and natural gas rationing this winter. Please consider the plight of the grid builders stuck in the middle. We might have a better idea of how we can conquer our dilemma. This problem can be solved through hard work and the implementation of moderate policies that ben-

efit the whole rather than the far-right and far-left fringes that continue to divide us. I would be happy to answer any questions you may have.

PREPARED STATEMENT OF SHALINI VAJJHALA

FOUNDER AND CEO, RE:FOCUS PARTNERS

AUGUST 4, 2022

Chairman Brown, Ranking Member Toomey, and Members of the Committee: Thank you for the opportunity to testify today.

My name is Shalini Vajjhala. I am an architect and engineer, specializing in the design and finance of resilient infrastructure solutions. For the past 10 years, my firm re:focus partners has been working with cities and regions across the United States to develop projects to address both the physical and financial risks of climate change.

These issues have only grown more urgent over the last decade. The costs of climate change are already being felt across the country. This is not some distant future. The effects of more severe storms, heat, and droughts are visible in public budgets today.

Climate change will impact all parts of our economy. But counterintuitively, the costs of most climate-related events are site-specific not economywide.¹ A hurricane or wildfire doesn't hit the whole country at once. At the end of the day, the physical and financial impacts of disasters will be felt first and worst at the community level.

Recent OMB estimates put the potential Federal fiscal impacts of climate inaction at up to \$2 Trillion dollars per year.² This is staggering. Having a better understanding of the total economic costs of climate change is essential, but we also need better ways of disaggregating these costs by peril, sector, and region to motivate local action to protect against the worst overall outcomes.

Three areas where this Committee can help break down the problem into more actionable pieces by looking more closely at three types of costs are: local revenue losses, reductions in asset lifetimes, and deferred infrastructure maintenance.

Revenue losses due to climate impacts cut across all sectors. Public utilities, including power, transportation, and water systems, are already experiencing disruptions and operational losses due to climate-related events.

The EIA estimates that severe drought conditions in California could reduce hydropower generation by up to 48 percent this year.³ Recent heat waves have resulted in operating restrictions and losses for passenger and freight rail systems nationwide and costly structural damages, including derailments due to buckling tracks and melted power cables in places with typically mild climates, like Portland, OR.⁴

In the water sector, sea-level rise has increased the risk of salt-water intrusion. This has costly implications for coastal agriculture⁵ and drinking water systems from Rhode Island to Alabama⁶ with financial risks that extend into the health care sector. These same acute and chronic stresses have resulted in property and income tax base losses with the potential for municipal bond downgrades and defaults.^{7 8}

This is not all bad news. Focusing on where we are losing money today offers an entry point for identifying where losses and liabilities are likely to increase. This approach also opens the door to new ways of financing cost-saving infrastructure investments, such as coastal protection projects and power and transportation system weatherization measures, that can be funded through direct savings, reduced insurance costs, and risk pooling.⁹

¹ <https://www.ncei.noaa.gov/monitoring-content/billions/docs/2021-us-billion-dollar-weather-and-climate-disasters-hazard-and-socioeconomic-risk-mapping-ams-washington-forum.pdf>

² <https://www.whitehouse.gov/wp-content/uploads/2022/04/OMB-Climate-Risk-Exposure-2022.pdf>

³ <https://www.eia.gov/todayinenergy/detail.php?id=52578&src=email>

⁴ <https://www.bloomberg.com/news/articles/2022-07-21/-the-us-is-not-prepared-hot-temperatures-stress-transit-systems#xj4y7uzkg>

⁵ <https://www.climatehubs.usda.gov/index.php/hubs/northeast/topic/saltwater-intrusion-growing-threat-coastal-agriculture>

⁶ <https://www.nature.com/articles/s41467-020-17038-2>

⁷ <https://www.wsj.com/articles/paradise-the-wildfire-ravaged-california-town-warns-of-municipal-bond-default-11658493581>

⁸ <https://reader.elsevier.com/reader/sd/pii/S0264275118314100?token=&originRegion=us-east-1&originCreation=20220802175120>

⁹ <https://hbr.org/2017/08/how-the-insurance-industry-can-push-us-to-prepare-for-climate-change>

Climate impacts are already reducing infrastructure asset lifetimes.¹⁰ In many cases, the same events that result in revenue losses also have longer-term financial consequences. The impacts of flash floods and wildfires can result in damage to infrastructure systems that reduce their replacement lifetime. This poses major budgeting challenges for public works departments across the country who might see a road planned to last for 25-years become unusable in half that time. In the worst cases, this can result in the collapse of private insurance markets in specific sectors and regions.¹¹ Work by the Arizona Department of Transportation on life-cycle planning for extreme weather offers a national model for risk management.¹²

Deferred maintenance backlogs can also highlight where to intervene to prevent cascading failures. The devastating toll of both winter and summer power grid failures in Texas highlight where seasonal maintenance and timely infrastructure upgrades can prevent catastrophic failures down the line.¹³ Investing hundreds of millions of dollars now can prevent billions in losses in future, but these investments must be well coordinated. The Norfolk, VA, and San Diego, CA, naval bases offer excellent examples of how military installations can better protect against sea-level rise and storm surge. At the same time these facilities show where resilience measures can be undermined if adjacent roads and bridges are not also upgraded so essential personnel can reach high-priority sites during severe storms and floods.¹⁴ Better information about critical infrastructure weak links can help identify where short-term local trade-offs, like prioritizing emergency repairs over more robust upgrades, can have long-term national costs and consequences.¹⁵

No single individual, family, or region is concerned with the total economic costs of climate change. Everyone is concerned with their own physical and financial security. We need better frameworks to translate the big picture costs of climate inaction into levers for avoiding losses and reducing suffering.

The Infrastructure Investment and Jobs Act (IIJA) holds tremendous promise for addressing these challenges, as does the Inflation Reduction Act. Physical protections and financial protections from the worst economic impacts of climate change must go hand-in-hand. Breaking down the total economic costs can help identify opportunities to shape the next generation of infrastructure and make sure we move quickly to build what we need, not just what we had.

Thank you and I look forward to your questions.

Supporting Documents

1. Kane, J.W., and S.P. Vajjhala (2020). “Prioritize People, Not Projects: Addressing the Harms of Legacy Infrastructure in the COVID–19 Recovery”. The Brookings Institution. <https://www.brookings.edu/research/prioritize-people-not-projects-addressing-the-harms-of-legacy-infrastructure-in-the-covid-19-recovery/>

2. Vajjhala, S.P., and J.W. Kane (2020). “Four Steps To Undo the Harms of Legacy Infrastructure in the COVID–19 Recovery”. The Brookings Institution. <https://www.brookings.edu/research/four-steps-to-undo-the-harms-of-legacy-infrastructure-in-the-covid-19-recovery/>

3. Vajjhala, S., and J. Rhodes (2019). “Insurance Innovation and Community-Based Adaptation Finance”. Community Development Innovation Review: Strategies To Address Climate Change Risk in Low- and Moderate-Income Communities. Federal Reserve Bank of San Francisco, Volume 14(1): 47–53. <https://www.frbsf.org/community-development/wp-content/uploads/sites/3/05-Vajjhala-Rhodes.pdf>

4. Vajjhala, S., and J. Rhodes (2018). “Resilience Bonds: A Business-Model for Resilient Infrastructure”. The Veolia Institute Review FACTS Report 2018, pp. 58–63. <https://journals.openedition.org/factsreports/4562?file=1>

5. Vajjhala, S.P., and E. Monks (2018). “Investing in Better Procurement Processes Can Enable Better Infrastructure Outcomes”. The Brookings Institution. <https://www.brookings.edu/blog/the-avenue/2018/11/26/investing-in-better-procurement-processes-can-enable-better-infrastructure-outcomes/>

¹⁰ <https://www.mckinsey.com/business-functions/sustainability/our-insights/will-infrastructure-bend-or-break-under-climate-stress>

¹¹ <https://www.americanprogress.org/article/regulators-should-identify-and-mitigate-climate-risks-in-the-insurance-industry/>

¹² <https://azdot.gov/sites/default/files/2019/07/Asset-Mgmt-Extreme-Weather-and-Proxy-Indicators-Pilot-Project.pdf>

¹³ <https://thehill.com/opinion/energy-environment/542067-texas-has-lessons-for-all-of-us-on-infrastructure-resilience/>

¹⁴ <https://www.defense.gov/News/News-Stories/Article/Article/2703096/dod-navy-confront-climate-change-challenges-in-southern-virginia/>

¹⁵ <https://www.brookings.edu/blog/the-avenue/2017/06/05/legacy-infrastructure-and-the-challenge-of-procuring-urban-resilience/>

BROOKINGS

Report

Prioritize people, not projects: Addressing the harms of legacy infrastructure in the COVID-19 recovery

Joseph W. Kane and Shalini Vajjhala Thursday, December 17, 2020

Editor's Note:

This brief is the first of a two-part research series. [Click here](#) to read the second research brief.

As the COVID-19 pandemic and recession drag on, millions of households are looking to Washington for answers. State and local leaders have led their own recovery efforts, but there is still desperate need for another federal relief package. But even if another short-term federal relief package materializes, there remains a need for a long-term recovery agenda that can provide greater economic certainty and promote more widespread economic opportunity.

Infrastructure investment offers one way to stimulate the economy that continues to elicit bipartisan support. Upgrading roads, ports, pipes, and other facilities can boost capital spending and create jobs now, plus support long-lasting career pathways and durable economic growth. These improvements also stretch across all types of regions, from urban to suburban to rural communities. The recent election of Joe Biden (aka "Amtrak Joe") has further raised hopes for action despite a likely divided Congress.

But to truly improve the country's infrastructure and help the most vulnerable households, federal leaders cannot simply throw more money at shiny new projects. Instead, they must invest with purpose and undo the harms of our legacy infrastructure systems. Too often, households have struggled to afford water and energy bills, to physically reach jobs, or to plug into the internet. This is no accident: Systematic disinvestment, environmental injustices, and racial and economic exclusion have led to infrastructure systems that have posed barriers to opportunity for decades. COVID-19 has only brightened the spotlight on these legacy failures.

Building back better should not only mean building more; sometimes it should also open the door to building less or building differently to better meet the needs of communities. Above all, leaders should prioritize people over projects in our infrastructure plans. In practice, that means defining, measuring, and addressing our infrastructure challenges based on the needs of users of new *and* existing systems.

This brief explores the country's legacy infrastructure needs in greater depth by defining the types of inequities that have emerged over time, the escalating costs households face, and considerations for future policy action. A [second brief](#) highlights specific federal, state, and local strategies that can mobilize action during the COVID-19 recovery.

Defining legacy infrastructure

Legacy infrastructure systems include roads, pipes, telephone lines, power plants, and transmission lines that were originally designed to provide greater capacity and connectivity, but have also perpetuated inequities in our built environment. In other words, they leave a legacy of harm—threatening health and safety, acting as barriers to economic opportunity, and introducing environmental hazards. These systems include infrastructure that is already in place as well as new infrastructure expansions—bigger highways, for instance—that further cement historic inequities and continue to fail to meet the needs of underserved residents.

Policymakers, planners, developers, and other leaders have frequently overlooked or intentionally disregarded the needs of lower-income households and communities of color when building and maintaining our infrastructure. For example, our transportation and land use policies continue to value highways and low-density, car-centric development, which have long divided and segregated communities based on income and race. Mid-20th-century highways sliced through historic urban cores from Syracuse, N.Y. to San Francisco, and stretched distances for reaching jobs, housing, and other services. Exclusionary zoning of various kinds widened these divides, preserving wealth and opportunity for predominantly white, upper-income neighborhoods while creating additional spatial hurdles for residents who struggled to afford cars and lacked other safe, reliable options to get around.

These inequities continue to pervade many regions. Robert Moses, New York City's master builder from the 1920s to 1960s, is perhaps the most well-known example of a leader who delivered major projects but prioritized designs that displaced and divided many communities in the process. Since those highways are still in operation and lost family wealth has not been restored, the legacy of Moses' projects is still with us. While leaders in other states and localities have not followed the exact same path as Moses, they continue to build and maintain infrastructure that leaves many people behind or puts them in harm's way. North Carolina is still expanding highways through communities and sensitive habitats; Houston is still constructing homes in vulnerable floodplains; and Los Angeles still depends on port traffic that generates enormous air pollution for nearby low-income neighborhoods.

Over time, the result has been a widening infrastructure gap within and across regions, where individuals may experience drastically different realities depending on where they live. Our infrastructure fails to provide reliable and equitable service, especially in localities faced with changing populations, growing climate threats, economic divides, and technological demands. While metro areas such as Seattle, Atlanta, and Boston have many infrastructure challenges, their sustained economic growth and fiscal capacity (pre-COVID-19) have allowed them to invest in more accessible transit options, cleaner water, and digital services. The same cannot be said for slower-growing, fiscally constrained regions.

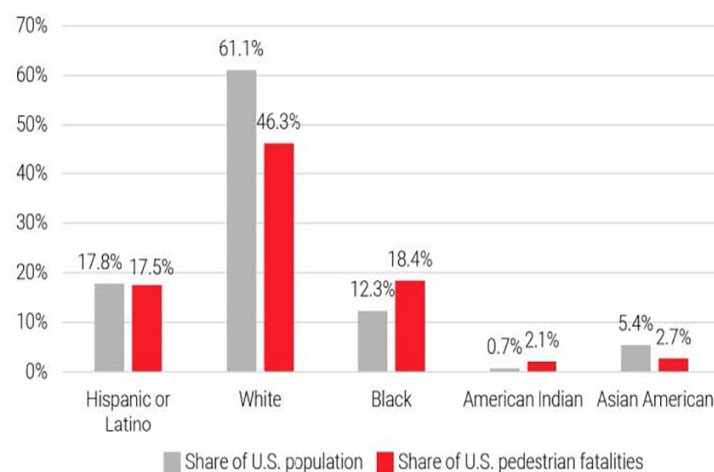
Flint, Mich. embodies many of these concerns. An older industrial city that has seen its population and economy plummet over the last few decades, Flint depends on aging, inefficient infrastructure that is not only costly to maintain, but jeopardizes the well-being of its lower-income residents. Nearly five years have passed since Flint's water crisis rippled nationally. Lapses in state oversight and infrastructure maintenance resulted in thousands of lead poisonings, eventually leading Michigan to finalize a \$600 million settlement with victims. The significant and lasting health, environmental, and economic impacts to residents and businesses left no real winners.

Our infrastructure systems have failed the residents of Flint and continue to leave a legacy of harm in other communities across the country. And the costs—to our health, environment, and economic livelihood—are only increasing.

Recognizing legacy infrastructure costs

Infrastructure is designed to be long-lived. As a result, both the benefits and harms of major projects are also long-lasting. Since we still typically do not plan or measure our infrastructure needs around broad or rapidly evolving sets of concerns—from transportation access to utility bill affordability to climate resilience—many people are bearing higher health, economic, and environmental costs of legacy infrastructure. The COVID-19 pandemic has simply highlighted the higher dangers and costs some of us face, which have been decades in the making.

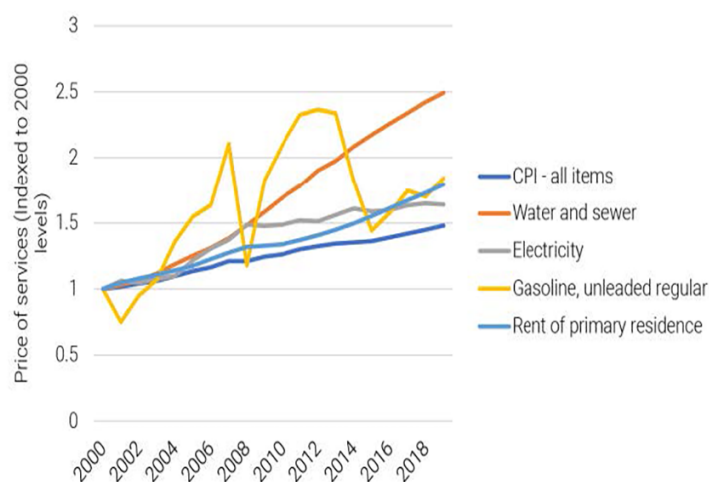
Legacy infrastructure's dangers to our health and safety are widespread, with our transportation systems producing some of the costliest and deadliest outcomes. Inequitable access to transportation—including a lack of transit and walkable options—forces households to buy and maintain cars, which pose a variety of health hazards. Widespread injuries and death are a daily reality in lower-income communities where a mix of elderly and younger residents must navigate streets that are dangerous by design. Black pedestrians often live in neighborhoods without sidewalks, bike lanes, or other street improvements, putting them at heightened risk of death: They account for 18.4% of all pedestrian fatalities, despite making up 12.3% of the U.S. population. Native Americans also face significantly higher pedestrian fatality rates (2.1%) compared to their population share (0.7%).

Figure 1. Share of pedestrian fatalities, by race, 2014 to 2018

Source: Brookings analysis of Census Bureau and National Highway Traffic Safety Administration data.

B Metropolitan Policy Program
at BROOKINGS

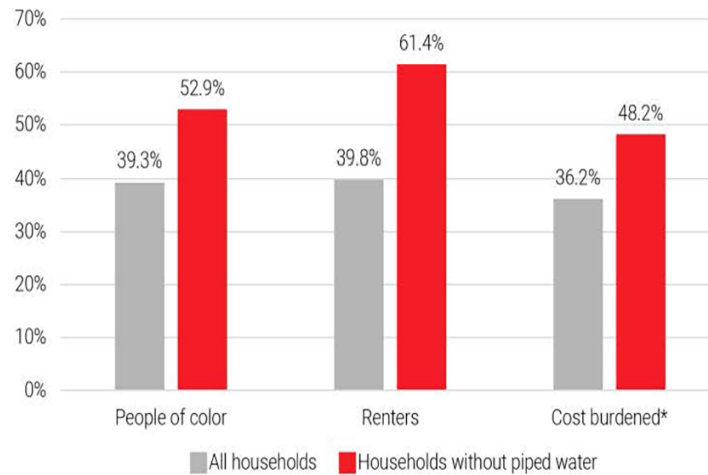
It is not just an inaccessible and dangerous built environment that perpetuates inequities; the lack of affordability prevents many people from drinking clean water, getting reliable electricity, and depending on other essential services too. Since 2000, water and sewer prices have more than doubled in relative terms, while electricity prices have surged 64%—both surpassing the 48% increase across all items according to the Consumer Price Index. Although harder to measure, the price of wireline and wireless broadband has also been a concern. When combined with increases in housing, gasoline, and other infrastructure-related expenses, households—particularly lower-income households—are struggling to keep up.

Figure 2. Indexed change in the price of selected infrastructure services, 2000 to 2019

Source: Brookings analysis of Consumer Price Index data, seasonally adjusted. Prices are based on monthly changes.

B Metropolitan Policy Program
at BROOKINGS

Lower-income households and communities of color have also faced disinvestment, displacement, and outright destruction amid the COVID-19 pandemic and a changing climate. Home values in majority-minority neighborhoods have historically lagged behind those in white neighborhoods, perpetuating decades of property devaluation, neglected infrastructure, and environmental injustices. In addition to greater air and water pollution, these neighborhoods also tend to face more intense heat and flooding, while a lack of parks and green space—combined with extensive pavement and impervious surfaces—worsen these dangers. And increasingly, lower-income households of all races and in all places are the most vulnerable to losses in jobs, wages, and properties due to destructive floods and other sudden economic shocks. Even the lack of basic services remains an ongoing challenge; more than 1 million people—including many people of color, lower-income households, and renters—lack secure water access and are in “plumbing poverty,” making it hard to maintain good health and hygiene during the pandemic.

Figure 3. Selected characteristics of households without piped water, 2013 to 2017

Source: Analysis of Census Bureau data in *Geographies of insecure water access and the housing–water nexus in US cities* by Katie Meehan et al.

Note: Percentages include households in the 50 largest U.S. metropolitan areas. *Cost-burdened households pay more than 30% of their gross income to housing costs.

B Metropolitan Policy Program
at BROOKINGS

These costs are only a sampling of the wide harms of our legacy infrastructure. For example, lower-income rural localities and tribal nations continue to face the most serious drinking water quality issues due to a lack of funding and attention. Wastewater, stormwater, and flooding challenges hit both lower-income rural and urban areas hard as well. Rising energy costs—including electric bills—remain a burden on lower-income households, which struggle to avoid shutoffs and get assistance. And broadband gaps are not only prevalent in lower-income, difficult-to-reach rural localities and tribal nations that lack available service, but are increasingly seen as a form of digital redlining in urban areas as well.

Laying the groundwork for more equitable infrastructure investment

Now more than ever, we need to address the inequities of our legacy infrastructure systems. This is not to say that we do not need significant new infrastructure investment—we do. But we’ve seen how making opportunistic cost-cutting infrastructure upgrades that rely on the same underlying designs can create further harm, as in the case of Flint.

Any national infrastructure plan during the COVID-19 recovery should not just look to build more of the same or perpetuate existing inequities. Federal leaders need to partner with state and local leaders to better define what systems should stay, what should improve, and what should go altogether. There is no such thing as a “shovel-ready project,” and the temptation to focus on quick wins may compel us to overlook our legacy infrastructure needs—leaving more people and places behind. Addressing our legacy infrastructure will require new ways of talking about local infrastructure needs and ultimately acting on them at both a local and national level.

- ***A new way of talking about infrastructure needs and investments:*** Our national infrastructure discussions are largely fragmented by sector and federal budget categories. Taking a place-based and people-first approach will require an overhaul of how we engage communities around local infrastructure needs and priorities. No one needs a highway—they need to get to work or school. Re-centering conversations around needs, outcomes, and services rather than projects or assets—especially in this time of rapidly changing needs—is an essential first step.

Current infrastructure development processes are mostly reactive. Project developers—public and private—take on the risk of doing early design development and feasibility studies, sometimes at great cost, and then present “alternatives” to communities and residents. The result is often a stand-off: Developers are compelled to defend the alternatives offered based on their investment to date, and communities are left with few options but to accept or reject projects wholesale. Breaking this vicious cycle will take new systems for engagement beyond traditional town hall presentations or reactive public comment periods, especially post-COVID-19.

- ***A new pathway to equitable infrastructure investment and action:*** In parallel to changing conversations about infrastructure, there are also several opportunities for

federal, state, and local leaders to generate more equitable infrastructure outcomes. Recognizing the high and distributed costs of failing to act—especially for and in chronically underserved communities—is an important starting point for reframing how we tackle existing assets and invest in new solutions.

We need to create new incentives—not just new projects—that encourage greater regional experimentation and shared learning. For example, removing outdated highways and enhancing underutilized assets like parks and green space shouldn't be ad hoc efforts in only a few regions; these efforts should feed into a larger national infrastructure strategy in which state and local leaders have the financial and technical capacity to drive more accessible, resilient designs. Additional federal funding and programmatic guidance around equitable infrastructure upgrades can raise visibility of the issue and, most importantly, prompt action.

The second brief in this series builds off these ideas and lays out four strategies that can help undo the harms of our legacy infrastructure systems. Better defining and measuring our legacy infrastructure needs is a start, but federal, state, and local leaders have a long way to go to address these needs. Even though COVID-19 has exacerbated many of these challenges—limiting our fiscal ability to plan and launch even ordinary infrastructure investments—we have an opportunity to plot out a new recovery agenda. Our current and long-standing infrastructure inequities demand it.

Report Produced by **Brookings Metro**

BROOKINGS

Report

Four steps to undo the harms of legacy infrastructure in the COVID-19 recovery

Shalini Vajjhala and Joseph W. Kane Thursday, December 17, 2020

Editor's Note:

This brief is the second of a two-part research series. [Click here](#) to read the first research brief.

Across the U.S., millions of people lack reliable and affordable water, transportation, energy, and broadband access. Now, the COVID-19 pandemic has brought these underlying infrastructure failures into sharp relief; for Americans who can't afford their bills, electricity and water shutoffs have become an immediate public health hazard.

In some cases, these critical infrastructure gaps are the result of decades of underinvestment and poor maintenance. In others, they represent a much more direct legacy of harm and deliberate racial and economic exclusion. As the first brief in this series on legacy infrastructure highlights, many of our existing infrastructure systems—originally designed to foster growth—are now limiting economic opportunity, damaging the environment, and hurting our health. This is especially true for lower-income households and communities of color.

However, within our current pandemic-induced economic crisis is an opportunity to address these structural inequities. In this brief, we propose a four-part national infrastructure stimulus program that not only drives new projects, but also enables the removal of old assets that no longer serve their intended purpose.

Take, for example, cities with declining populations. Water and sewer utilities are faced with the impossible balancing act of keeping an oversized system safely in operation with a declining user and tax base from which to fund repairs and upgrades. Often, the only

option is to raise rates. This shifts the burden to residents, who themselves are dealing with the direct impacts of economic decline due to population loss, deteriorating public services, and unaffordable rate increases.

Funding the strategic removal or decommissioning of harmful, divisive, aging, and failing infrastructure can enable communities to invest more productively in services they need and want most. No one *needs* a highway or water main—they need affordable options to travel to work or school and get clean water.

Dealing with our legacy infrastructure assets will require a sequential approach. First, Congress should include dedicated funding for local and state governments in a short-term relief package to support expanded public engagement, strategic planning and analysis, and community-led infrastructure experiments and temporary installations. This funding can both fill major state and local capital planning budget gaps and help communities—the end users of infrastructure—drive the discussion around what should stay and what should go in a post-COVID-19 future. The second phase should provide larger-scale project capital as part of a medium- to long-term federal investment agenda to enable the removal of legacy assets and clear the way for community-led, equitable, and climate-smart redevelopment.

Below are the four key funding areas that can form the building blocks of the proposed approach. The first three are targeted toward short-term relief allocations to state and local governments, while the fourth is intended to be a dedicated source of federal project capital or a new program, like the Department of Housing and Urban Development's (HUD) [National Disaster Resilience Competition](#). All four activities, in sequence, can help policymakers and planners move away from the knee-jerk instinct to seek shovel-ready projects and instead jump-start a sustainable recovery.

- **Conduct strategic analyses on the costs of inaction on legacy systems:**

Underinvesting in infrastructure has consequences. Rather than looking only at future infrastructure needs, federal and state agencies can create significant investment opportunities by also identifying major risks and liabilities to their own budgets and operations. Specifically, this approach looks to minimize losses; for example, who loses money if we leave a deteriorating bridge, tunnel, dam, or water

system in place? The answer is rarely only the local or adjacent community. Delayed maintenance can lead to cascading failures that ultimately cost more than removing or replacing an asset. Recognizing the high and distributed costs of failure—especially for chronically underserved communities—is an important starting point for reframing how we handle legacy infrastructure assets, better maintain a state of good repair, and invest in new projects.

Recommendation: Fund a national study to identify the top 10 infrastructure liabilities for each major federal agency and critical cross-agency gaps. Examples of potential liabilities (and federal cost-saving opportunities) include large-scale projects (e.g., the Oroville Dam prior to its repair), categories of assets (e.g., deteriorating bridges or access roads to military installations), and populations facing major infrastructure-related environmental health risks (e.g., households affected by lead pipes, urban air pollution, or lack of safe wastewater infrastructure). Provide funding for similar state-level assessments of at-risk infrastructure with significant state and local budget implications, in order to set priorities for future federal funding applications to address the most significant legacy infrastructure problems in each state.

- **Fund greater virtual public engagement:** The COVID-19 pandemic has disrupted the standard public engagement processes on infrastructure, but there is a real opportunity to transform how local governments gather feedback on infrastructure priorities and from whom. The channels for digital outreach and input developed in response to the pandemic can play a key role in drawing in residents who do not typically have the time, resources, or caretaking support to participate in multihour public meetings or design charrettes. Providing actionable information to planners before larger construction funds are available can help both public and private project developers design for what people need now—not only what was important in a past decade or what is deemed “fundable.” Participatory budgeting models can initiate community engagement processes that have real financial “teeth” and make a meaningful link between community input and infrastructure investment. Consider the difference between asking residents how they would divide and spend \$100

million dollars on critical services versus soliciting reactions to a pre-cooked \$100 million project proposal.

Recommendation: Create a funding set-aside with competitive and formula-based federal funding allocations for participatory infrastructure planning workshops with dedicated resources to compensate low-income and minority residents for their participation. Reward effective engagement by adding scoring criteria to larger follow-on infrastructure funding opportunities, similar to how the Federal Emergency Management Agency's new Building Resilient Infrastructure and Communities (BRIC) program criteria include extra points for applications generated from previous "advance assistance" awards.

- **Support interim uses and enable infrastructure experiments:** Major infrastructure projects can take years to plan and build, but community needs are often far more urgent. Federal and state funding programs can do a better job of creating a runway of investment in megaprojects by offering resources for interim installations to make spaces usable and meet service needs while those megaprojects take shape. Several cities have experimented with "pop-up" projects that offer residents a chance to experience and provide input on longer-term development decisions. Hoboken, N.J.'s Northwest Resiliency Park is an excellent example of how temporary infrastructure installations can be part of a successful public engagement process. This approach can have the added benefit of creating spaces to test, demonstrate, and expand investment in green, distributed infrastructure solutions that reduce locking communities into long-term infrastructure.

Recommendation: Create a new pilot program within short-term relief and recovery funding packages for community-supported infrastructure experiments to support major transportation, water, energy, and telecom system upgrades. Examples include bus rapid transit corridors, bike lanes and pedestrian plazas, flood control installations, and distributed energy and telecom systems. Funded pilots can complement these expanded public engagement projects and be rewarded in follow-on funding application scoring criteria.

- **Reward the removal of legacy harms:** Federal tax and investment incentive programs should consider how to incorporate provisions for removing failing infrastructure as part of enabling new investment. Federal [brownfields funding](#) programs have done this for decades with contaminated lands. The city of Detroit's [blight removal bond](#) is another example that demonstrates how getting rid of failing assets can increase property values and reduce fire hazards. We need a similar approach for infrastructure. Successful infrastructure removal projects that have created space for major redevelopment include [San Francisco's Embarcadero Freeway](#), [Portland, Ore.'s Harbor Drive Freeway](#), and [Milwaukee's Park East Freeway](#). A key caveat is that any incentives for clearing the way for new infrastructure and development should always be carefully balanced with provisions to preserve affordability and protect current residents. [New Orleans' Claiborne Corridor](#) and [Oakland, Calif.'s I-980](#) offer lessons on the importance of putting residents first rather than focusing on a piece of infrastructure.

Recommendation: Similar to the HUD National Disaster Resilience Competition, create new competitive agency-specific federal funding programs to encourage the development of projects that reduce sector-specific liabilities identified in the national and state studies proposed above. Funding applications should require cost-benefit analyses that clearly demonstrate how and how much projects will reduce federal and state liabilities and/or risks. The resulting cost savings can be captured for program cost-recovery or directed to a revolving fund to support additional projects.

As we look to the long-term recovery from COVID-19, federal infrastructure efforts should not only account for what we need, but also for what we no longer need. Stimulus funding needs to be quick and responsive to be effective; however, hasty infrastructure investment is unlikely to serve anyone well in the long term.

The Biden-Harris Transition Team has already identified [climate change and racial equity](#) as two of its top priorities. Unless COVID-19 economic stimulus and recovery funding efforts enable the types of activities outlined above, the new administration runs the risk of missing the chance to address those priorities, and instead entrenching new kinds of generationally unequal investments.

8/3/22, 2:29 AM

Four steps to undo the harms of legacy infrastructure in the COVID-19 recovery

In a few short months, COVID-19 has reshaped how we use many types of public infrastructure. It would be a failure of imagination if we didn't use this opportunity to reimagine our legacy infrastructure systems and fund a more equitable, climate-smart future.

Report Produced by **Brookings Metro**

Insurance Innovation and Community-Based Adaptation Finance

Shalini Vajjhala and James Rhodes

Governments traditionally act as “insurers of last resort.” When disaster strikes, vulnerable communities turn to local, state, and federal government agencies for support and recovery assistance. More recently, as the frequency and severity of various disasters—from severe storms and floods to wildfires—have grown,¹ the gap between who has financial protection in the form of insurance and who does not has also grown. For example, in California, only 13 percent of homeowners carry earthquake insurance,² and after recent wildfires, other homeowners’ properties could become entirely uninsurable in the future.³

This “protection gap” is particularly challenging to address in low-income and marginalized communities, where risk awareness and insurance affordability can be major barriers.⁴ As a result, many government agencies have found themselves being expected to act as insurers of *first* resort. This is an unsustainable situation for both budget-constrained public entities and vulnerable communities and residents who face years of delays in getting assistance to get back on their feet after a disaster.

This article highlights how insurance can be a catalyst for implementing both engineering and social-ecological adaptation measures.⁵ The following sections describe why insurance innovation is unlikely to occur on its own and offer three ideas for how local governments can work with the insurance industry to craft integrated resilience solutions that promote community-scale adaptation, measurably reduce risk, and improve long-term physical and financial protection for at-risk communities.

Insurance as a Catalyst for Climate Adaptation: Barriers

Insurers have long championed investments in physical risk reduction. Examples include seat belts to reduce the human and economic costs of automotive accidents, fire codes for

1 Walsh, J. et al. “Ch. 2: Our Changing Climate,” *Climate Change Impacts in the United States: The Third National Climate Assessment* (Melillo, J.M., Terese, R. [T.C.], and Yohe, G.W. [eds.]), U.S. Global Change Research Program (2014), pp. 19-67. doi: 10.7930/J0KW5CXT

2 Fuller, T. “In Quake-Prone California, Alarm at Scant Insurance Coverage,” *The New York Times* (August 31, 2018).

3 Walsh, M.W. “How Wildfires Are Making Some California Homes Uninsurable,” *The New York Times* (November 20, 2018).

4 Calvesbert, G. “Why does the protection gap exist?” AIR Worldwide (2016), available at <https://www.air-worldwide.com/Blog/Why-Does-the-Protection-Gap-Exist/>.

5 Davidson, J.L. et al. “Interrogating resilience: toward a typology to improve its operationalization,” *Ecology and Society*, 21(2):27 (2016). doi: 10.5751/ES-08450-210227

urban buildings, and workplace safety standards, among other measures.⁶ Common features of these cases are that clear and effective measures were available to reduce risk (and rising insurance industry losses), the measures were affordable for consumers and property owners, and advancing these measures aligned well with the established business models and financial interests of insurance industry firms.

The insurance industry has recognized that climate change poses similar industry-wide challenges. Many insurance companies have become active participants and leaders in global discussions and initiatives on building resilience, promoting adaptation, and reducing the protection gap in recent years.⁷ However, advancing projects on the ground that deliver meaningful risk reductions has been elusive, for a number of reasons.

First, the terms adaptation and resilience encompass an enormous diversity of potential activities and risk-reducing measures, and there is no clear consensus on which solutions to implement. Projects range from hard engineering solutions—such as seawalls and flood barriers—to ecological interventions, like protecting and expanding wetlands and mangroves, to planning exercises and social capacity building.⁸ The effectiveness of many of these measures for delivering quantifiable risk reductions has yet to be demonstrated for insurance purposes. For example, life-insurers have copious amounts of data available on the effect of smoking on life expectancy and can adjust premiums accordingly. The same is not yet true of green infrastructure measures designed to reduce flood risk. This challenge is made even more complex with climate change, since historical data is not a reliable predictor of future impacts. There are some emerging firms, such as MyStrongHome,⁹ that are filling these types of data gaps and standardizing the process of capturing insurance savings to support resilience measures; however, the market is far from developed.

Second, many resilience projects have distributed beneficiaries and few existing mechanisms for coordinating the kinds of collective action required for effective implementation. Consider a coastal protection project that reduces surge and flood risk for hundreds of property owners in a protected area. Individual property owners generally don't have the capacity or authority to develop such large-scale projects on their own, and from an insurance perspective, property-level policies are generally provided by many different carriers. No single insurer has the incentive to invest time and resources in finding collective solutions when the benefits would also accrue to its competitors. Further, individual insurers often have a hard time setting premiums that reflect the full value of risk reduction measures due to a lack of visibility on projects, lack of standards for implementation, and lack of data on the resulting benefits (reductions in expected losses).

6 Ben-Shahar, O. and Logue, K.D. "Outsourcing Regulation: How Insurance Reduces Moral Hazard," *Michigan Law Review*, 111, 197 (2012), available at <http://repository.law.umich.edu/mlr/vol111/iss2/2>.

7 InsuResilience Global Partnership (2018), available at <https://www.insuresilience.org/>.

8 Davidson, J.L. et al. "Interrogating resilience" (2016); Meerow, S., Newell, J.P., and Stults, M. "Defining urban resilience: A review," *Landscape and Urban Planning*, 147 (2016), pp. 38–49.

9 MyStrongHome (2018), available at <https://www.mystronghome.net/>.

Cases where the insurance industry has effectively championed risk reductions for distributed beneficiaries have focused on sector-wide codes and standards rather than local projects or protection measures.¹⁰ Risk modelers can help bridge the gap between insurers and project developers to quantify the (financial) benefits of resilience projects using industry-trusted models, but data alone is not enough to enable the coordinated investments required to deliver projected benefits. New business models are required to coordinate beneficiaries and consolidate benefits if they are going to help advance project implementation.¹¹

Third, there is a mismatch in timing where adaptation is long-term and insurance is short-term. Most insurance contracts are renewed annually, while most risk reduction projects have far longer lifetimes and payback periods. This makes it difficult for insurers to amortize upfront costs even when risk reduction measures can help them meet their own longer-term financial objectives, such as reducing potential losses or diversifying their portfolio. This is an area ripe for new product development in the insurance industry. In 2015 the Canadian insurance firm, The Co-operators, created a new retail insurance policy called “Comprehensive Water” to provide coverage for climate change-related storm surge and riverine flooding, as well as more standard types of water damage.¹²

Fourth, the market structure of the insurance industry poses particular challenges for innovation. Complex regulatory obligations and large capital requirements make it difficult for innovative start-ups to enter the market, and the insurance sector doesn’t benefit from the intellectual property protections available in other industries. As a result, insurance companies have limited incentives to pioneer new financial mechanisms that can take significant time and resources to develop when competitors can easily copy the resulting products.

Fifth, and finally, insurers do not have incentives to reduce premiums. Stated another way, every private insurer’s profit motive creates a natural disincentive for them to advance initiatives that reduce their top-line revenue. Fostering competition across the whole industry is the only way to overcome these last two disincentives.

The result of these barriers to insurance innovation is that local governments and at-risk communities face significant challenges in aligning physical protections, like resilient infrastructure, with financial protection, including private insurance. Investing in cost-effective adaptation and economic development projects is hard. In most of these projects success is something that does not happen—a storm hits, but the community isn’t flooded. The lack of transparency in insurance pricing and the uncertainties created by annual changes in

¹⁰ Ben-Shahar, O. and Logue, K.D. “Outsourcing Regulation” (2012).

¹¹ Kahn, M.E., Casey, B., and Jones, N. “How the Insurance Industry Can Push Us to Prepare for Climate Change,” *Harvard Business Review* (August 28, 2017), available at <https://hbr.org/2017/08/how-the-insurance-industry-can-push-us-to-prepare-for-climate-change>.

¹² Staff Report. “The Co-operators Offers Storm Surge Insurance to Homeowners in Atlantic Canada,” *The Insurance Journal* (August 27, 2018), available at <https://www.insurancejournal.com/news-international/2018/08/27/499165.htm>.

pricing for policy renewals makes it challenging for any individual policyholder to negotiate to reduce premiums and capture insurance benefits. (Picture calling your health insurance company to negotiate a premium discount for going to the gym more often.) Despite the many obstacles above, insurance is one of the best ways to monetize benefits that are realized in the form of “avoided losses.” So how can local governments work with the insurance industry to improve physical and financial protection for at-risk communities?

Opportunities for Insurance-Linked Finance for Community-Based Adaptation

Resilience Bonds are a new mechanism to link catastrophe insurance with infrastructure projects—serving both engineered and socio-ecological resilience functionality—that are designed to measurably reduce expected losses.¹³ The aim is to translate insurance savings into a revenue stream that helps communities tap new sources of project capital for adaptation and economic development and get major resilient infrastructure projects off the drawing board and into the ground. This insurance product works best when there is a large risk (high expected losses), existing insurance coverage (from which to capture savings), and a significant risk reduction solution—like seat belts. These are ideal conditions for monetizing and capturing insurance benefits. But most communities across the U.S. are not dealing with ideal conditions, so this article offers three complementary ways that communities can take a proactive approach to using insurance-linked finance for adaptation.

Financing Large-Scale Protection Projects

In January 2016, the U.S. Department of Housing and Urban Development (HUD) awarded nearly one billion dollars for resilience projects in 13 communities across the country as part of the National Disaster Resilience Competition.¹⁴ Most of these communities’ proposals included large-scale engineering solutions to protect areas that were previously devastated by disasters. Although a billion dollars is an enormous sum, many communities still need to fill significant project funding gaps. One example is the city of Minot, ND.

In 2011, the Souris River flooded at unprecedented levels, leading to evacuations of approximately 11,000 residents and causing hundreds of millions of dollars in infrastructure damage in Minot. Since then, the city has developed plans for a comprehensive \$800 million flood protection project. Funding from HUD and other federal sources is expected to cover part of the total project cost, but the city and state are working with FEMA, the Army Corps of Engineers, and others to explore options for financing the remainder.

¹³ Vajjhala, S.P. and Rhodes, J.S. “Leveraging Catastrophe Bonds as a Mechanism for Resilient Infrastructure Project Finance,” re:focus partners (2015), available at <http://www.refocuspartners.com/wp-content/uploads/2017/02/RE.bound-Program-Report-December-2015.pdf>; Kahn, M.E., Casey, B., and Jones, N. “How the Insurance Industry Can Push Us to Prepare for Climate Change” (August 28, 2017); and Vajjhala, S.P. and Rhodes, J.S. “A Guide for Public-Sector Resilience Bond Sponsorship,” re:focus partners (2017), available at <http://www.refocuspartners.com/wp-content/uploads/pdf/RE.bound-Program-Report-September-2017.pdf>.

¹⁴ U.S. Department of Housing and Urban Development. “National Disaster Resilience Competition” (2018), available at https://www.hud.gov/program_offices/economic_development/resilience/competition.

Insurance-linked finance offers a pathway to help smaller communities like Minot that have spent years designing comprehensive protection projects to get those projects financed and built. The key steps include:

- Design a large-scale resilient infrastructure project to optimize reductions in expected losses and deliver insurance benefits. Project developers should engage risk modelers and analysts early in the design process to help set design criteria (minimum thresholds) based on the optimal level of financial protection.
- Establish contractual or administrative mechanisms to consolidate and transfer risk, such as:
 - (i) Develop risk pooling agreements to bring together large asset holders with shared insurance coverage and loss mitigation priorities;
 - (ii) Create a new special district to pool distributed property risks by requiring property owners to purchase specified insurance coverage or pay an assessment to cover the cost of a new protection project; and
 - (iii) Establish a pooled reinsurance program that requires property insurers providing coverage in a designated area to purchase reinsurance linked to specific risk reduction projects.
- Engage private finance partners and structure the project finance based on the projected future insurance savings captured through the loss mitigation project. Just as private investors in a toll road use forecasted toll revenue as the basis for investing in the project, investors in a protection project would provide the upfront capital to implement a protection project based on the forecasted insurance savings.
- Build the project and capture the insurance benefits over time to cover finance payments.

Aggregating Distributed Property-Level Interventions

Unlike Minot, many small- and medium-sized communities do not have the option to design and build comprehensive engineering projects to protect a single at-risk area. In these communities, coordinated action by individual property owners that opt-in to programs to meet higher levels of protection can deliver more scalable and replicable community-wide resilience benefits.

Communities that could benefit from this approach include California residential communities devastated by wildfire, cities like Houston with large-scale residential flood damages from events like Hurricane Harvey, and smaller West Coast cities facing serious earthquake risks. Examples of administrative approaches that can help motivate, align, and capture the benefits of distributed household and property-level resilience retrofits and improvements include:

- Develop a program modeled on Property Assessed Clean Energy (PACE) programs for residential and small commercial adaptation measures and resilience upgrades. Capital for property-level interventions could be provided from public or private sources and payments could be coupled to property insurance and property taxes similar to PACE.
- Establish a special district with finance and taxing authority to implement area-wide risk reduction in collaboration with a private loss mitigation partner (such as MyStrongHome). Payment shortfalls from insurance savings (e.g., due to failure of property owner to renew coverage with participating carrier) can be added to property taxes/assessment reflecting the “special benefit” for each participating property-owner.

Capturing Network Benefits of Resilience Upgrades

A third area where local governments and authorities can work with the insurance industry to enable community-scale adaptation is by focusing on network improvements, such as transit, transportation infrastructure, and water system upgrades. Weather-related events (such as heavy rainfall and heat waves) can both disrupt daily system operations and pose major long-term financial liabilities. For example, heat has been attributed as a cause in major train derailments and service disruptions from Washington, DC and Chicago to Los Angeles.¹⁵ Because transit disruptions have the greatest impact on low- to moderate-income (LMI) riders with limited alternatives, engineering adaptation projects to improve system performance can have the greatest benefits for LMI communities.

Designing projects that can reduce climate- and weather-related revenue and cost impacts can also help create new sources of project funding for risk-reduction and resilience projects and facilitate reinvestment in a virtuous cycle of adaptations and system improvements. Some steps that transit and utility leaders can take include:

- Conduct a rapid assessment of recent budget documents to identify key downstream costs created by weather and climate risks, such as extreme temperature and rainfall. Examples include increased operations and maintenance costs, business disruption, asset depreciation, and reduced revenue. Benchmark the potential for savings and value capture.
- Identify relevant ongoing, planned, and underfunded projects and programs in current capital plans, strategic plans, and resilience strategies that have the potential to significantly address the risks identified above.

¹⁵ Schwartz, H.G. et al. “Ch. 5: Transportation, Climate Change Impacts in the United States: The Third National Climate Assessment” (Melillo, J.M., Terese, R. [T.C.], and Yohe, G.W. [eds.]), U.S. Global Change Research Program (2014), pp. 130-149. doi: 10.7930/J06Q1V53

- Develop an insurance-linked project finance and risk transfer program to make payouts to the relevant authority when pre-designated events or system failures occur and capture value from ongoing and planned projects that measurably reduce risks (in a revolving fund) and fill funding shortfalls for other priority projects.

Conclusion

Often the most cost-effective solutions to reducing disaster risk are the ones available to communities prior to a disaster that protect against a loss occurring in the first place. Yet cities are struggling to fund even basic infrastructure projects, let alone more complex investments in resilient systems. Public cash reserves and budgets for insurance are increasingly constrained, and the capital cost of large-scale resilient infrastructure, such as coastal protection projects or flood barriers, is often too high to be absorbed by local governments or utilities. Too often the benefits are diverse, diffuse, long-term, and non-monetary, making the same types of infrastructure investments unattractive to private investors.

Local governments have both the means and the opportunity to redefine how communities invest in adaptation and engage with the insurance industry to reduce risk, make resilient economic development investments, accelerate recovery—if and when disaster strikes—and more effectively manage the volatility and uncertainty associated with our evolving exposure to both natural hazards and the broader financial risks of climate change. This article offers three new ways of approaching the problem to empower local governments and communities to tap into innovative insurance solutions for adaptation finance. None of the pathways in this article are simple or easy. But together they offer new solutions that can help local governments bring in experts, including risk modelers and project finance firms, to deliver adaptation projects that would otherwise remain on the drawing board.

Shalini Vajjhala is founder and CEO of re:focus partners and James Rhodes is director of insurance-linked finance at re:focus partners.

www.refocusports.org

RESILIENCE BONDS: A BUSINESS-MODEL FOR RESILIENT INFRASTRUCTURE

By Shalini Vijhala,
Founder and CEO of re: focus partners

and James Rhodes,
Senior Fellow of re: focus partners



Before starting re: focus partners, Shalini Vijhala served as Special Representative in the Office of Administrator Lisa Jackson at the U.S. Environmental Protection Agency. In this position, she led the U.S.-Brazil Joint Initiative on Urban Sustainability (JIUS) announced in March 2011 by presidents Obama and Rousseff. Shalini received her Ph.D. in Engineering and Public Policy and B.Arch in Architecture from Carnegie Mellon University.

James (Jamie) Rhodes joined re: focus partners as a Senior Fellow in 2014 to co-lead the RE.bound Program and develop a new portfolio of insurance-linked finance projects. He is an entrepreneur who holds multiple patents and has founded and built several successful enterprises across diverse industry segments. Jamie earned a Ph.D. in Engineering and Public Policy from Carnegie Mellon University, and worked as a Post-Doctoral Researcher at Scripps Institution of Oceanography and then as a Staff Researcher at U.C. Davis.

KEYWORDS

- RESILIENCE BONDS
- CATASTROPHE BONDS
- BUSINESS MODEL

58

When natural disasters occur, governments are often considered as “insurers of last resort” and are expected to help with losses not covered by traditional insurance and to coordinate and fund reconstruction efforts.

As the frequency and severity of natural disasters (storms, floods, wildfires) increase, this becomes financially unsustainable for budget-constrained governments.

Catastrophe bonds are one mechanism designed to transfer these types of risks to the capital market. They work as an insurance policy in which the holder of the policy receives a pay-out when a disaster reaches a predetermined threshold. re: focus partners came up with the idea of Resilience Bonds to complement catastrophe bonds.

Resilience Bonds create incentives for cities to invest in resilience so as to reduce the human and financial cost of catastrophes when they strike. Resilience Bonds are designed to fund risk reduction projects via a resilience rebate that turns avoided losses in to a revenue stream.

INTRODUCTION

As the frequency and intensity of extreme weather events increase due to climate change, local and national governments are increasingly expected to step up to cover the damages and pay for reconstruction. Often considered as “insurers of last resort” public authorities are more and more often being called upon as the first resort, and they need to find sustainable business models to fund resilience. Still, it remains difficult for a public authority to pay for something when the cost is high, the benefits are diffuse, and the probability of extreme losses is low. To find financial resources and transfer the risks of such catastrophic events to financial markets, cities and utilities are investigating new financial and insurance mechanisms such as Catastrophe Bonds and Resilience Bonds.

re: focus developed the mechanism of Resilience Bonds in 2015 with the ambition of building more integrated resilience solutions and innovative public-private partnerships for vulnerable communities. Based on the same financial modeling as Catastrophe Bonds, Resilience Bonds are designed to fund both proactive risk reduction projects and reactive disaster recovery actions.

1. THE MAIN ISSUE UNTIL NOW: FINANCING RESILIENCE IS NEITHER POLITICALLY NOR FINANCIALLY REWARDING

When a disaster strikes, communities generally expect governments to pay for the losses not covered by traditional insurance and to coordinate and fund reconstruction efforts. As the frequency and severity of natural disasters (storms, floods, wildfires) increase this becomes financially unbearable for budget-constrained governments. Even more so as the gap between insured losses and total losses is increasing. Between 2005 and 2015, the United Nations counted 335 climate related disasters every year, twice as many as between 1985 and 1994¹. And the cost of each catastrophe grew six-fold from around \$30 billion per year to \$182 billion². Moreover, in 2016, only 26% of economic losses due to natural disasters were insured³.

In heavily urbanized areas of developed countries, additional challenges arise and increase the cost of each weather-related disaster. For example, older cities have to factor in aging infrastructure systems that are increasingly vulnerable and at risk of cascading failure. A storm can damage a power system and cut production for weeks, dramatically increasing the cost of an extreme event. In developing countries, municipalities are also struggling to keep up with informal urbanization and the extreme vulnerability of their inhabitants.

Planning ahead could dramatically reduce the cost of each extreme weather event. But cities are often budget constrained and faced with stretching limited funding to address many competing priorities. It is difficult to pay for something when up-front costs are high, benefits are diffuse and extend far into the future, and the

probability of extreme losses is low. On top of that, success in well-designed resilient infrastructure is often invisible. In other words, success happens when nothing happens. While investing early in resilience saves lives and money, it is often neither politically nor financially rewarding. To create incentives for cities to invest in resilience, re-focus created Resilience Bonds to transform avoided losses into revenue flows, and to make invisible successes visible and economically capturable.

2. THE MODEL OF RESILIENCE BONDS: FUNDING BOTH PROACTIVE RISK REDUCTION AND REACTIVE RECOVERY ACTIONS

2.1. GENESIS OF CATASTROPHE BONDS: TRANSFERRING RISKS TO CAPITAL MARKETS

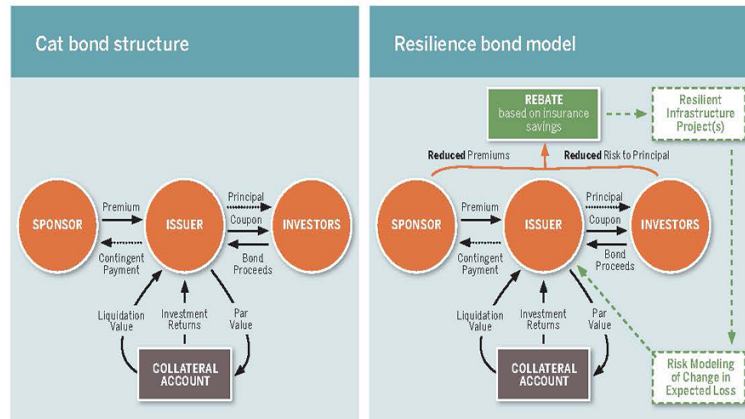
Catastrophe Bonds (also called Cat Bonds) emerged in the 1990s after Hurricane Andrew hit the State of Florida in the United States⁴. There was tremendous financial devastation because of the large real estate market and major tourism industry. The insurance industry came together to create an instrument to protect itself against extreme losses: Catastrophe Bonds. These instruments are insurance policies and not traditional municipal bonds that you use to build a road or a seawall. Each policy typically has a short term, between three and five years. What makes

1 United Nations Office for Disaster Risk Reduction.

2 Swiss Re. Closing the protection gap. Disaster smart solutions for the public sector 2016.

3 Aon. Impact Forecasting. Annual global climate and catastrophe report, 2017.

4 Michael Lewis, In Nature's Casino, The New York Times, 2007.



“CAT BONDS ARE SIMILAR TO LIFE INSURANCE POLICIES THAT ONLY PAY OUT WHEN THE WORST DISASTERS STRIKE. RESILIENCE BONDS ARE MORE LIKE PROGRESSIVE HEALTH INSURANCE THAT PROVIDE INCENTIVES TO MAKE HEALTHY CHOICES THAT REDUCE LONG-TERM RISKS.”

them unique is that when a disaster reaches a predetermined threshold, the holder of the policy receives a pay-out, the same way a life insurance holder would, and investors lose part or all of their principal invested. The purpose of Catastrophe Bonds (and Resilience Bonds) is to transfer risk to capital market. Nowadays the market for Cat Bonds is around \$30 billion and growing rapidly.

2.2. THE DIFFERENCE BETWEEN CAT BONDS AND RESILIENCE BONDS

Resilience Bonds are a form of Catastrophe Bond that link insurance premiums to resilience projects in order to monetize avoided losses through a rebate structure. The “resilience rebate” is a source of funding for measurable risk reduction projects. If Catastrophe Bonds are similar to life insurance policies that only pay out when the worst disasters strike, then Resilience Bonds are more like progressive health insurance programs that provide incentives to make healthy choices—quitting smoking or exercising regularly—that reduce long-term risks and the cost of care.

The difference between a Resilience Bond and a Catastrophe Bond is that it uses the same financial modeling as in a Catastrophe Bond, but it models two scenarios: business-as-usual and a world with a protective infrastructure project. It estimates the difference in the expected losses when the catastrophe happens with and without the project. That difference is captured as a resilience rebate and this rebate can be used to fund the project itself.

There are two main advantages of a Resilience Bond.

(1) The first is that it expands financial protections for communities vulnerable to a catastrophic event. When the predefined threshold is hit, the sponsor receives a rapid payout, which makes post-disaster reaction quicker.

(2) The second advantage is to leverage new project finance for resilient infrastructure that offers a measurable risk reduction. Resilience bonds are therefore designed to fund proactive risk reduction projects and reactive disaster recovery actions.

The major innovation is that it initiates infrastructure projects with resilience in mind. It helps cities design new solutions instead of building more of the same, because resilience is about systems, not just one-off projects.

2.3. AN ECOSYSTEM OF MULTIPLE SPONSORS

The process of designing and issuing a Resilience Bond generally involves an ecosystem of players ranging from local and state government officials who are responsible for disaster prevention, to insurers who will pay for the losses, utility operators who are at risk, and the engineering and construction companies that can reduce risk as part of their businesses.

In most cases, a city government is rarely the largest asset-holder affected by a catastrophe. If you take the case of Norfolk, Virginia, the city does not hold most of the assets at risk, even though it has the ability to build comprehensive coastal protections and the responsibility to do so in specific areas. This is the reason why Resilience Bonds were designed to engage multiple sponsors⁵, the same way you would have a cooperative or homeowners association in a building in order to have all the affected players in the scheme.

re: focus collaborates with many engineering and construction companies, which reduce risk as part of their business to offer a wide range of technical solutions to a given problem encountered in one place. In some cases, operating engineering firms are able to see more sides of a client’s exposure to risk than a client itself, and these firms have the best vantage point to design comprehensive and cost-effective system solutions rather than one-off projects that are limited by a single agency or department’s authority or budget.

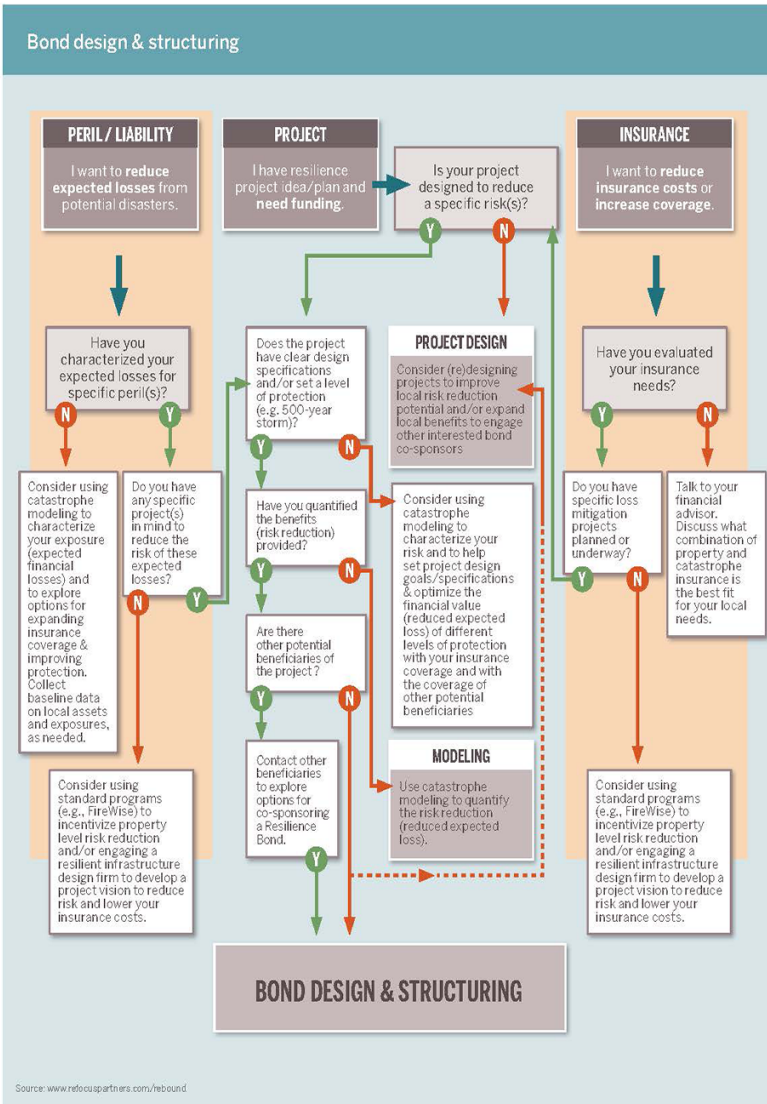
2.4. A FINANCIAL TOOL FOR RESILIENCE PROJECTS

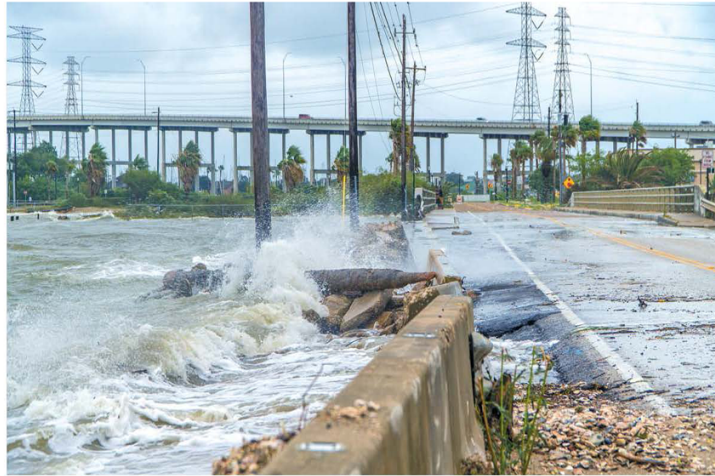
re: focus serves as an agent for loss mitigation, aligning risk reduction projects with insurance benefits on behalf of both public and private entities.

To serve the best interest of all of these entities, it is important to make very clear where Resilience Bonds can be appropriate and where they are not the right tool. Not all projects are a good fit for a Resilience Bond approach. Some projects are too difficult to model, and some are too small to create quantifiable or meaningful risk reductions. Some projects are too diffuse, such as capacity building programs or emergency preparedness plans, and some projects have high operational uncertainty which makes benefits hard to estimate. It is worth noting that Resilience Bonds are designed for catastrophic events not chronic stress like water scarcity. re: focus works with clients and partners on alternative insurance-linked project finance solutions for these other types of hazards as well.

Timing is also very important. Public entities often need technical assistance to go from where they are now to where they need to be to start a Resilience Bond project (cf. figure below). For example, if a city has a concept for coastal protection but does not know what level of protection it needs, it means that there is still preliminary design work that needs to be completed before exploring if and to what extent a Resilience Bond can help finance the project.

⁵ The sponsor is the one who pays the premium and receives the payout in the event of a disaster.





3. ACHIEVEMENTS AND REMAINING CHALLENGES FOR RESILIENCE BONDS

3.1. ACHIEVEMENTS AND MAIN PROSPECTS FOR THE UPCOMING YEARS

re:focus released a framework for Resilience Bonds in December 2015. The mechanism has since been validated by multiple partners in the insurance industry and capital markets over the course of 2016 and 2017 to set the stage for the first wave of transactions. Since then, re:focus has been working with both private partners and public sector entities toward the first Resilience Bond issuance. The process of developing public-interest Resilience Bonds is slower than issuing a conventional Catastrophe Bond because it is necessary to align the timing of a Resilience Bond issuance with the timing of major infrastructure projects. A Resilience Bond is designed to be issued when a resilience project comes into effect. In the case of a seawall, it can be up to a decade from design going through construction. Public sector Resilience Bond projects will mainly be driven by project design timelines not insurance industry timelines.

So far, the priority has been large public infrastructure projects in North America, largely because this is where the Catastrophe Bond market has sparked the greatest interest. For example, the New York Subway System and

Amtrak both issued their own Catastrophe Bonds after Hurricane Sandy in 2013. There is also a straightforward path between high value assets and major resilience projects in cities like San Francisco, Houston, and Miami.

Another line of work is being investigated in collaboration with major insurance players as part of the Center for Global Disaster Protection. This work focuses on extending the Resilience Bond model to developing countries. In these countries, when a disaster strikes damages are often more devastating to people and homes than large assets or commercial industries. As part of a collaboration with Risk Management Solutions (RMS) and Vivid Economics, DfID, and Lloyds of London through a new Innovation Lab⁶, re:focus has been developing variations of Resilience Bonds that can better leverage humanitarian aid and international development funding for disaster risk reduction projects around the world.

Overall, both private and public actors are enthusiastic about the possibilities offered by Resilience Bonds. But public-sector projects are much harder to develop. Unlike private actors that can mitigate losses for their own covered assets, public sector projects are often far broader. Private actors have specific expectations; the asset owner is the one at risk, and the one able to implement the project and enjoy the benefits of the investments. Therefore, it is a much more contained conversation and resilience projects are easier to move forward. In the public sector, the conversation requires many more stakeholders, they move at a slower pace and the stakeholder with the authority to implement a large infrastructure project is not always the greatest beneficiary even though they are responsible for the process.

⁶ RMS. *Enter the Center*, 2018.

**“NOT ALL PROJECTS ARE A GOOD
FIT FOR A RESILIENCE BOND. SOME
PROJECTS ARE TOO DIFFICULT
TO MODEL, OTHERS ARE TOO
SMALL OR DIFFUSE TO CREATE
QUANTIFIABLE RISK REDUCTIONS.”**

3.2. REMAINING CHALLENGES AND THE NEXT FRONTIER

Designing major resilient infrastructure projects and systems is time-consuming and complex work. Making sure the design process generates meaningful and measurable risk reductions adds another layer of complexity. However, this is essential for avoided losses to be monetized. That can mean considering different technologies, construction methods, or other design solutions to increase the level of protection and create greater financial value. This is counterintuitive for most designers and engineers who are typically presented with a scope of work and/or budget at the outset of a project. They then work to design the best solution at the lowest cost.

The first challenge is engaging and collaborating with design and engineering firms that are willing to shift from this very narrow path to a more flexible and innovative approach. This allows both designers and clients to zoom out and identify where projects can be scaled up to capture greater financial value rather than downsized to match currently available funds. Most infrastructure projects are generally imagined based on what an agency can buy and not necessarily based on the desirable level of protection. Or ideas are too abstract. Enormous resilience solutions are envisioned, but without any practical path to implementation. A middle ground of a project pipeline of large scale and pragmatic risk reduction projects is essential for creating meaningful change.

The second element is to find the right point of intervention in a project design so that the financing can inform the design and the design can integrate the financing solution. Both in the private and public sectors, people who manage risk and insurance and understand how resilience projects could be translated into financial rebates are not the same as the staff who do capital planning for infrastructure or project implementation. This lack of communication or a common language or approach means that project opportunities to reduce risk are sometimes missed altogether. Risk managers need to understand how projects in their city or utility's capital and strategic plans can reduce overall system risk and project-level people need to understand the potential insurance benefits (and funding sources) created by their project. To put it differently, if your life insurance company does not know that you quit smoking, you will not see a change in your rates. Sometimes it is difficult to reach that alignment. Framing the discussion to engage departments with complementary priorities can also help build broader support with communities and local stakeholders so that they also understand the benefits from such projects.

Finally, our next frontier is to meaningfully model risk reduction and price the value of these reductions for a wider variety of infrastructure project types and perils. Resilience Bonds work very well for some projects and not for others. For example, modeling the risk reduction from a coastal protection project is very straightforward, but doing the same for a city-wide green stormwater infrastructure system is not. The real value of our work will be in extending models to more diffuse resilience projects and capturing benefits that are harder to model and spread across more beneficiaries over time. This is the case of housing reconstruction in Nepal after recent earthquakes or in the Caribbean following Hurricanes Irma and Maria. There are dramatic socio-economic consequences of disasters and great interest in resilient reconstruction, but a lot of challenges remain in aligning cost and benefits between international development project funding agencies and the insurance industry.

CONCLUSION

Resilience Bonds have been designed with the conviction that planning ahead of catastrophes is more cost-effective than post-disaster reconstruction. Resilience Bonds are designed to monetize avoided losses to help governments invest in proactive risk reduction infrastructure projects. The potential for local governments to fund resilience projects, to share the burden with other stakeholders and to transfer the risk of a catastrophe to capital markets using this mechanism are significant. While today Resilience Bonds only work for some projects where risk reductions are readily measurable and targeted, the ultimate objective is to extend the types of projects for which Resilience Bonds can work and serve a broader range of vulnerable communities around the world.

BROOKINGS

The Avenue

Investing in better procurement processes can enable better infrastructure outcomes

Shalini Vajjhala and Elory Monks Monday, November 26, 2018

Editor's Note:

This post is the first in a two part [series](#) about how procuring infrastructure systems, technologies, and services can be an entry point to resilience in cities, rather than an obstacle to it.

Many cities across the United States are home to legacy infrastructure systems. These older water, transportation, and communications systems are not only poorly suited to current needs, but they are also nearing (or well past) the end of their usable lives after [decades of underinvestment and deferred maintenance](#).

The motivation for investing in resilience—taking measures to adapt and modernize systems amid rising environmental and social pressures—could not be greater, [especially at a local level](#).

However, local government resources for infrastructure transformation are limited at best. As a result, local leaders are caught in a tug-of-war. On one side are high-priority incremental repairs to keep critical services up-and-running. On the other side is all the up-front planning required to invest in long-term capital projects. Both are costly. Both are necessary. In the coming years, more places will inevitably be confronted with a stark choice: keep making short-term fixes or find the resources to make major upgrades and replacements.

As grim as this decision can be from a budget perspective, it is also an opportunity. Cities across the U.S. have a once-in-a-generation chance to shift toward cleaner, greener technologies and build more resilient communities.

To seize this opportunity, cities must be able to buy things differently in order to buy different things. And that's where procurement processes can be a hurdle to achieving greater resilience.

The term *procurement* encompasses all the steps that governments or public authorities take to obtain goods, such as computers or desks, or services like healthcare or construction of a water treatment plant. Most existing procurement processes make it easiest for government agencies to buy what they already have, provided by companies they've already worked with before. This bias toward the familiar can keep decisionmakers trapped in a "pieces-and-parts" replacement approach. This is true, even when more cost-effective upgrades, replacements, or wholesale transformations are readily available.

Picture the difference between replacing failing water mains and transitioning to city-wide green infrastructure solutions. The process for buying pipes and repair services is a well-trodden path, but figuring out how to buy and maintain thousands of street trees or miles of porous pavement is often uncharted territory.

The unfortunate consequence of this type of procurement "lock-in" is two-fold. Every day, cities miss opportunities to leapfrog to smarter, more sustainable, and more resilient infrastructure. And innovative companies and urban solutions simultaneously struggle to scale. This is a solvable problem, but pouring money into developing new technologies or better plans doesn't necessarily lead to project implementation or better outcomes.

Investing in better procurement processes up front can enable better outcomes, but knowing when and how to shift from the incremental to the transformational is an enormous challenge for cities of every size. Bigger cities often have more resources and expertise to dedicate to long-term planning for these transitions. But even smaller cities with fewer resources need the tools to design, procure, and build entirely new types of infrastructure solutions to make progress on big picture goals, including improving water and resource-efficiency, building resilience to climate change, and advancing social equity.

In recent years, several cities and counties have begun to experiment with how procurement can enable better outcomes.

One of the most compelling examples in the water sector is the Prince George's County Clean Water Partnership in Maryland. Rather than relying on a traditional procurement approach to address its stormwater challenges, the County pursued a 30-year public-private partnership. As part of a performance-based contract—with the aim to deliver more extensive green infrastructure—the County worked with Corvias, an engineering firm, to improve stormwater management and build a more equitable and diverse local workforce for project implementation. In other words, the County did not simply request proposals from potential vendors to get the project done, but it instead looked to break free from this traditional process and engage more directly with Corvias to aim for improved performance overall. And so far, nearly three years later, the County has met or exceeded all of its economic, social, and environmental objectives on time and under budget.

The Clean Water Partnership is a shining example of how procurement innovation can allow local governments to tap into new ideas, new partners, and new resources. But clearly, not all places have been able to pursue the same types of innovations—or realize more resilient outcomes. Investing in better procurement processes up front can enable better outcomes for taxpayers, residents, and businesses alike in cities across the United States. Moving forward, local leaders need to stop thinking about procurement as the end point of a process, and start looking at procurement as an entry point to spark new ideas, attract new partners, and generate new resources.

**RESPONSES TO WRITTEN QUESTIONS OF CHAIRMAN BROWN
FROM JOE FLARIDA**

Q.1. Power a Clean Future Ohio’s recent study, “The Bill is Coming Due”, listed 10 climate impacts that were analyzed for additional costs to Ohio communities.

What other environmental or financial impacts is climate change having, or will be likely to have, on these communities? What would be the consequences of communities just choosing not to deal with them?

A.1. Our report lays out 50 climate impacts that are forecasted to have negative financial impact on local government budgets in Ohio. We developed cost estimates for 10 of those 50 impacts that we identified. The remaining 40 climate impacts, however, are not necessarily less severe or less costly. On the contrary, some of these impacts may result in much higher costs than some of the 10 that we estimated. Appendix A in our report lays out the full list of potential costs, although this list is not exhaustive.

One notable set of climate impact that was not modeled is public health costs associated with climate change. These future costs will be considerable and also an area that will further strain local governments’ capacities and resources. They will also disproportionately harm vulnerable individuals and populations. As detailed by a 2019 report from the Ohio Environmental Council and Policy Matters titled “Climate Change is Hazardous to Ohio Children’s Health”, we know that children are at greater risk of climate-related health effects. The report states:

Climate change is hazardous to children’s health. Heatwaves degrade air quality, exacerbating symptoms of asthma, one of the most common chronic childhood illnesses. Heavy rains and flooding can contaminate public water supplies with bacteria to which children are especially susceptible. Warmer average temperatures allow insect populations to multiply, and with them the incidence of insect-borne diseases like West Nile Virus. Here in Ohio, children are already being hurt by climate change, and the harm is projected to get worse . . .

Erosion is another environmental impact that will be exacerbated by climate change due to extreme precipitation and more frequent severe weather events. Damage due to erosion in parts of Ohio and certainly in large portions of the United States will be a key cost facing local governments in the coming decades, made worse by climate change. One subset of costs due to erosion is going to be from local planning and regulation. Local governments will need to identify, map, and track erosion hazard areas; develop and enforce an erosion management plan; and develop site and building design standards.

Communities and every level of Government supporting them need to both mitigate their emissions to curb the impacts of climate change on a global scale, but also do comprehensive resilience planning locally and make smart investments now to avoid higher costs in the future.

Those communities that do not have the resources, capacity, or technical expertise to do these critical planning exercises will be

more vulnerable and less prepared to deal with the costs and impacts on the lives and well-being of residents.

Q.2. How are the costs in the report conservative estimates, and how did the consultant build defensibility in the modeling? Was the increased cost of insurance included in the analysis?

A.2. The analysis behind our report, “The Bill is Coming Due” provides a conservative estimate of the additional costs that Ohio municipalities can expect to incur due to climate change. Many of the costs of climate change are expressed in 2021 dollars, which means that simple inflation may drive these costs up on their own. The monetized amounts represent only 10 of the 50 different impacts addressed in the report. Monetization of the other 40 impacts would significantly increase the overall climate costs reflected here, but are hard to calculate on a statewide basis. In other words, the total increase in annual spending by municipal governments due to climate change is certainly higher, and likely much higher than this report reflects.

The models we used to provide estimates for each of the 10 climate impacts are also conservative in the scope of the analysis. As an example, the cost estimate for air conditioning in schools only estimates the cost for urban high-poverty districts. Statewide costs for air conditioning installation are likely much higher, because installation in small town, rural, suburban, high poverty, and low poverty districts are excluded from this analysis. While installation will require a single upfront investment from school districts, municipal governments and school boards should also consider additional future costs incurred by energy use, operation, and maintenance of these units.

Each cost estimate that is detailed in the report also includes detailed methodology. The cost of insurance was not included in our analysis.

Q.3. You looked at how climate change would impact large urban Ohio cities as well as much smaller rural jurisdictions.

What size of Government does your analysis suggest will suffer the most from climate change?

Will smaller Governments need technical assistance to address these impacts? What about underserved populations?

Acknowledging that a one-size-fits-all approach is rarely the most effective way to tackle problems across a diverse set of actors, are there still general guidelines communities should consider in addressing climate impacts?

A.3. Climate impacts will touch every community regardless of size. Extreme heat, increased precipitation, flooding, and severe storms will impact the largest urban communities, rural regions and towns, and everywhere in between. Some of these financial impacts will vary based on the type of community and the infrastructure that is at risk as a result. For example, urban heat islands will be felt acutely in city settings where the infrastructure and built environment paired with extreme heat create the conditions for the dangerous urban heat island effects to arise. Harmful algae blooms will impact communities that abut bodies of water that are at risk. While this issue often stems from rural regions where extreme precipitation events lead to fertilizer runoff from nearby ag-

ricultural land into drinking water sources and recreational bodies of water, the impacts can be felt downstream by urban and suburban communities. According to the U.S. Environmental Protection Agency, warming water temperatures, increased freshwater salinity, and increased carbon dioxide levels in the air and water, all of which can be tied to climate change will exacerbate the growth and impact of harmful algal blooms.

Financially, smaller communities have less ability to absorb large unexpected costs. Smaller budgets naturally have smaller margins to absorb unexpected costs and local governments have limited options to debt finance large-scale recovery costs.

Based on how financial costs are currently accounted for, the resources available to communities to prepare for and finance these impacts is largely dependent on that community's tax base and the revenue and bond financing available to that local government. These factors further environmental injustices that have affected the health and well-being of Americans across our country. A lack of access to resources for resilience and mitigation investments will make vulnerable communities even more vulnerable.

Based on the communities we engage with, the largest cities are most equipped with the staff technical capacity and necessary resources to do the immediate resilience planning required and to implement plans to reduce emissions. However, these communities also have the most infrastructure at risk due to climate impacts. Smaller communities need further support from State governments and the Federal Government in order to prepare for the climate impacts they will face in the coming years.

**RESPONSES TO WRITTEN QUESTIONS OF
SENATOR VAN HOLLEN FROM JOE FLARIDA**

Q.1. Do you think it's fair that taxpayers in Maryland—and all coastal States—are going to foot the bill to avoid the existential threat climate change, and rising sea levels, present?

Vulnerable Populations in Coastal Communities—According to the National Oceanic and Atmospheric Administration's Coastal County Snapshot, 50 percent of Maryland's Somerset County is located within the designated 100-year flood plain. Additionally, nearly 60 percent of the county's elderly population and 46 percent of low-income residents live within that same flood plain.

A.1. Our analysis focused on costs to Ohio local governments. Flood related costs which could include stormwater management, elevating roads, and road repair, could cost local government budgets in Ohio alone over \$1.1 billion per year by 2050. Additional impacts related to flooding and severe storms will vary State to State and the overall costs will also vary.

Based on how financial costs are currently accounted for, the resources available to communities to prepare for and finance these impacts is largely dependent on that community's tax base and the revenue and bond financing available to that local government. These factors further environmental injustices that have affected the health and well-being of Americans across our country. A lack of access to resources for resilience and mitigation investments will make vulnerable communities even more vulnerable.

According to a report by the Carbon Disclosure Project released in 2017, 100 companies account for 71 percent of all industrial greenhouse gas emissions since 1988. Moreover, some of the largest contributors of emissions knew the harm that the increased use of fossil fuels would have on the environment. Thanks to the work of journalists, independent researchers, and academics, we have seen internal company documents showing large oil and gas companies knew as early as the 1960s that their products would lead to climate change, and that it could have disastrous impacts worldwide.

The question of fairness and accountability is a critical one in determining how we address the mitigation and adaptation costs we face. Individual taxpayers should not be forced to foot the bill for a problem they did not cause.

Q.2. Can you provide any insight on the financial resources that these residents would need to adequately prepare for and recover from flood-events? How would you recommend we protect vulnerable populations from the dangerous and expensive impacts of more frequent flooding due to climate change?

A.2. Insurance costs for homeowners and renters that live in flood-risk communities are going up. We cannot rely on the insurance industry to adequately account for the severity of the problems these communities face, which are getting worse as a result of climate change. Residents need transparency and clarity on the risks they face when purchasing or renting a property. This requires adequate local, State, and Federal resources to support local planning and regulation, including the technical support to update maps and information on hazard areas. The actions to support vulnerable populations will vary by region and which resilience actions are prioritized as a result of the types of climate impacts the communities will face. In the long-term, zoning and building affordable housing in low-risk locations and using design practices and materials that will help mitigate the impact of severe weather events is one important step that local, State, and Federal agencies and relevant housing authorities can take to protect vulnerable populations.

**RESPONSES TO WRITTEN QUESTIONS OF SENATOR SINEMA
FROM JOE FLARIDA**

Q.1. Water supply challenges are one major consequence of a changing climate in Arizona and throughout the West. The ongoing drought is a constraint on economic growth in the medium and long term. From your perspective, could long-term water supply challenges pose a material risk to the financial health of a business? If so, do you believe existing disclosures are sufficient to inform investors, or do you believe additional information is needed for investors to make informed decisions?

A.1. Long-term water supply challenges will most certainly pose a material risk to the financial health of any business, especially those that rely heavily on access to water for their supply chain or manufacturing process. This particular climate impact alongside the array of other expected financial costs of climate change will absolutely hurt businesses and providing transparency for inves-

tors on climate risk will be necessary as we face greater climate impacts in every sector in the coming decades. While we would support further transparency, we are not in a position to comment directly on disclosures or perspectives of investors.

**RESPONSES TO WRITTEN QUESTIONS OF
SENATOR VAN HOLLEN FROM DAN K. EBERHART**

Q.1. Do you think it's fair that taxpayers in Maryland—and all coastal States—are going to foot the bill to avoid the existential threat climate change, and rising sea levels, present?

A.1. While all States bear the localized costs of climate change, East Coast States, Maryland included, have enjoyed the economic benefits of industrialization and the use of fossil fuels far longer than much of the country. Coal was the energy source of choice for East Coast industrialization in the 19th century, and what aided the migration of people from rural farming communities to the densely populated urban cities that continue to dominate the region today. Shipping has long been another economic anchor for Maryland and its coastal neighbors—an industry powered universally by petroleum. So, while every U.S. taxpayer pays for the Federal Government's response to climate change, not all taxpayers live in States that have had the same opportunity to benefit from fossil fuels as Maryland. Furthermore, while the oil and gas industry have continued to innovate and improve how it extracts and processes petroleum, the same embrace of innovation has not been seen in the shipping industry or in the embrace of offshore wind farms and other alternative energy sources. One of the greatest impediments to innovation and competition in renewable energy and in the free movement of energy in general is the protectionist Jones Act, which says only U.S.-built-and-operated ships can move goods between U.S. ports. The century old law adds unnecessary time and costs to the installation of offshore wind turbines and has also impeded the delivery of American energy to East Coast communities that continue to rely on gasoline for transportation and natural gas for electricity generation.

**RESPONSES TO WRITTEN QUESTIONS OF SENATOR SINEMA
FROM DAN K. EBERHART**

Q.1. Water supply challenges are one major consequence of a changing climate in Arizona and throughout the West. The ongoing drought is a constraint on economic growth in the medium and long term. From your perspective, could long-term water supply challenges pose a material risk to the financial health of a business? If so, do you believe existing disclosures are sufficient to inform investors, or do you believe additional information is needed for investors to make informed decisions?

A.1. Water supply has been a challenge in the West since before Arizona was admitted into the Union. It is not a new problem brought about by climate change nor do I agree with the idea of using it as a cudgel to punish certain businesses. In fact, the biggest challenge facing western States when it comes to water supply is population growth—the same challenge that existed a century

ago. Arizona Governor Doug Ducey has taken an innovative and bipartisan approach to managing a resource that is in high demand but has limited availability. Gov. Ducey has invested in acquiring water rights and empowered local communities to be flexible in how they manage water rights. That flexibility is crucial to maintain both conservation of a limited natural resource and promote continued economic growth and human flourishing in the arid West.

**RESPONSES TO WRITTEN QUESTIONS OF
SENATOR VAN HOLLEN FROM DAVID BUTTERWORTH**

Q.1. Do you think it's fair that taxpayers in Maryland—and all coastal States—are going to foot the bill to avoid the existential threat climate change, and rising sea levels, present?

A.1. This question is somewhat out of my wheelhouse because I do not know the current amount of taxes that Maryland and all coastal States are paying to avoid the existential threats of climate change and rising sea levels. I do know that Western Maryland has a large amount of natural gas pipelines and storage assets that I have personally worked on during my career. Pipeliners Local 798 is currently working on a project in Baltimore that will remove an aging mainline feed to Baltimore City and replace it with a new state-of-the-art pipeline built to maintain the public's safety while maintaining Baltimore's power grid and quality of life. For a State to divide itself and say its coastal region's taxes are unfair because it has little to no fossil fuel development as opposed to its inland regions is counterproductive to the essential goal of maintaining grid reliability as we develop strategies to use of all forms of energy in the power grid. It's time for compromise and a time to endorse policies focused on representing the good of the whole. Pipeliners Local 798 will be there waiting to work on projects that accomplish these goals and stand ready to embrace all of the above energy approaches that keep the membership working and achieve climate objectives at the same time.

**RESPONSES TO WRITTEN QUESTIONS OF SENATOR SINEMA
FROM DAVID BUTTERWORTH**

Q.1. Water supply challenges are one major consequence of a changing climate in Arizona and throughout the West. The ongoing drought is a constraint on economic growth in the medium and long term. From your perspective, could long-term water supply challenges pose a material risk to the financial health of a business? If so, do you believe existing disclosures are sufficient to inform investors, or do you believe additional information is needed for investors to make informed decisions?

A.1. In answer to the first part of the question I do believe that water supply challenges could pose a material risk to the financial health of a business, and I believe that pipelines could aid in thwarting these challenges. I'm not a scientist or an engineer and haven't studied how this could be done, but I don't see a reason why we can't transport water from regions with an abundance of water to drought starved regions via pipelines. For this to become

a reality the current permitting will have to change because most projects of this magnitude will be protested by the “Not In My Back Yard” groups that currently have pipeline projects in my area of expertise held up with legal challenges. I believe the upcoming Permitting Reform bill endorsed by Senator Manchin will help to get infrastructure projects freed up from their current gridlocked situation as the bill promises to, “Direct the President to designate and periodically update a list of at least 25 high-priority energy infrastructure projects and prioritize permitting for these projects.”

I also realize that water transport does not necessarily fall under the “energy permitting” scope, but I think the significance and similarities of the two go hand in hand with maintaining the current quality of life in the United States. I also recommend reading a September 5, 2022, *New York Times* article by Harry Fountain titled “Climate Change Is Ravaging the Colorado River. There’s a Model To Avert the Worst”. This article describes the triumphs water managers have had in the Yakima River basin located in Central Washington and describes how their successes can be applied to the current situation faced by the seven Colorado Basin States. The second part of your question asking whether existing disclosures are sufficient to inform investors is beyond my field of expertise and I cannot honestly answer that part of the question.

**RESPONSES TO WRITTEN QUESTIONS OF CHAIRMAN BROWN
FROM SHALINI VAJJHALA**

Q.1. In your work with communities, are you finding that they have the capacity and in-house expertise to evaluate physical and financial climate risk?

A.1. Communities vary widely in their capacity to assess the physical and financial risks associated with climate change. The greatest divides are between large and small cities, urban and rural areas, and well-resourced and impoverished communities. The regions that have been most successful in evaluating their physical and financial risks to date have been able to proactively grow their adaptive capacity and bring together public sector entities with local universities and companies to develop comprehensive risk assessments and start working collectively toward regional solutions. By contrast, the regions that need the most support have experienced recurring disasters, deep staffing shortages and/or major data gaps, and they often lack steady access to outside expertise and technical assistance.

Q.2. How can Congress help them with this task?

A.2. The Infrastructure Investment and Jobs Act (IIJA) and the Inflation Reduction Act (IRA) are major steps forward in supporting communities to better characterize and respond to the physical and financial risks of climate change. Congress can build on these efforts by continuing to prioritize Federal agency resources and staff capacity for baseline data collection and sharing, deep technical assistance for the communities in greatest need, and multibenefit infrastructure predevelopment. Where possible, Congress should consider how to streamline Federal funding applications and support partnerships among Government agencies and colleges and univer-

sities to build more durable local capacity for addressing long-term challenges. Some examples of relevant risk modeling initiatives, data partnerships, and local knowledge exchanges, include the Wharton Risk Center, the Georgetown Climate Center, and The Atlas, which is an online platform for local officials to engage with peer communities as they are learning-by-doing.

Q.3. How can investing in adaptation or resilience create new economic development opportunities for communities?

A.3. Two national examples of where investing in resilience has been an engine for economic growth and innovation are the Netherlands and Israel. Both countries have faced major resource constraints and challenges that have required drastic adaptation measures. The Netherlands has developed world-leading expertise in coastal protection engineering and water management. Israel has cultivated world-class water efficiency and agriculture technology start-ups to build a drought-tolerant agriculture sector. There are examples within the U.S. as well—Hampton Roads, Virginia, and Milwaukee, Wisconsin, have created test beds for technology innovation with promising potential to scale. These are just a few of many examples of where creatively responding to resource challenges can seed new climate smart industries and foster greater economic growth.

Q.4. In your written testimony you touch on property values being reduced as a result of climate change. When do you expect this to happen and what effect will this have on local revenues? What will this mean to communities?

A.4. There is a growing body of research on the property value losses and associated tax implications of climate change. The main takeaway is that the effects of climate change will not occur simultaneously or evenly in the market. Some communities have already been devastated, while others are facing certain future disruption. Individuals, communities, and local governments all face the same challenge of trying to understand when and how to take action to limit the worst consequences, what proactive physical and financial protection measures are available, and how to make effectively timed decisions.

Q.5. In your testimony, you spoke about climate impacts reducing infrastructure asset lifetimes, and in a December 2020 Brookings report, you emphasized the ways in which legacy infrastructure—including roads, pipes, telephone lines, power plants, and transmission lines—often entrenches historic inequities, saying that we, “must invest with purpose and undo the harms of our legacy infrastructure systems. Too often, households have struggled to afford water and energy bills, to physically reach jobs, or to plug into the internet.”

Are there actions related to addressing climate change that are so vital they should be taken by communities to respond, adapt, or to make themselves more resilient, to climate impacts even if such action might have the ancillary effect of continuing a legacy of inequity in the building and maintenance of infrastructure?

A.5. Just as a clean environment and a strong economy are not mutually exclusive, for infrastructure to be resilient and to build

community resilience it inherently needs to be equitable. Balancing these priorities is a design challenge. It is also an important question that every local government and community needs to confront directly. Responding effectively to climate change will involve trade-offs. Doing so successfully will require communities to be engaged in making those trade-offs, so that we don't default to an exclusionary and inequitable status quo. There are many promising approaches for engaging communities early in planning processes and creating shared economic value and greater community wealth, whether that is for powerlines, seawalls, or new lithium resources. Given the long-standing opposition to many large-scale infrastructure projects, even renewable energy, I believe it is not only possible, but essential to reconsider how infrastructure is designed and maintained so that new projects don't recreate past failures.

Q.6. Our payments system is also critical Government infrastructure that supports local economies. With digital payments on the rise, and the Federal Reserve exploring the prospect of a Central Bank Digital Currency, how can we promote resilience in the digital infrastructure that our communities increasingly depend on to participate in today's economy? Like with other forms of infrastructure, is it important that access is equitable?

A.6. Equitable access should be a cornerstone of all public infrastructure. Digital infrastructure is particularly complex, because system resilience depends directly on the resilience of other infrastructure, such as the power grid and cybersecurity systems. One key consideration is the much shorter asset lifetimes of technology systems versus the multidecade asset lifetimes in the transportation and energy sectors. Planning and budgeting for upgrades to maintain system resilience will require even more frequent attention than many other types of infrastructure.

Q.7. Relatedly, people are increasingly recognizing the importance of offline digital payments for resilience in the face of disruptive climate events. Is it important to build resilience by supporting logical financial technology innovations that work offline and serve the public in a cheap, reliable manner?

A.7. Redundancy, robustness, and flexibility are important elements of resilience and should absolutely be considerations in the design of digital payment systems.

**RESPONSES TO WRITTEN QUESTIONS OF
SENATOR VAN HOLLEN FROM SHALINI VAJJHALA**

Q.1. *Natural Buffers:* In order to reduce the negative impacts of climate change, we're working to sustain climate-resilient infrastructure—including our natural infrastructure. The Chesapeake Bay's wetlands act as natural drainage systems that absorb the damage from storms while also reducing storm surges and runoff. Can you quantify the associate costs of fortifying natural buffers as opposed to building new resilient infrastructure? What efforts have you all made to measure the importance of wetlands and other natural buffers to lessen flood damages?

A.1. There has been significant progress in recent years on characterizing both the costs and the benefits of nature-based solutions,

such as wetlands and mangroves for flood risk reduction. However, the ability to compare different types of “gray” and “green” infrastructure measures depends on the quality of the baseline data and models available for site-specific interventions. Ongoing research and programs, such as the U.S. Army Corps of Engineers (USACE) Engineering with Nature Program, show tremendous promise for developing more standardized methodologies for design and evaluation.

Q.2. *Sea Walls:* Despite having the Chesapeake Bay as our first line of defense against rising sea levels, analysts with the Center for Climate Integrity and Resilient Analytics estimate that it would cost \$27.4 billion to build nearly 3,000 miles of sea walls to protect Maryland from chronic flooding by 2040.

Would restoring the Chesapeake Bay’s wetlands lower this cost-estimate?

A.2. Ecosystem restoration can play a central role in improving coastal protection and adapting to rising sea levels. Research on how and how much different types of natural infrastructure can cut costs and improve performance continues become more robust. While these types of studies can help identify which types of projects are best suited to different contexts, evaluating whether any specific intervention will be more cost-effective than any other alternative requires site-specific analysis.

Q.3. To your knowledge, would Big Oil and Gas companies provide any financial support to States like Maryland that will be on the hook for billions of dollars of climate resilience and mitigation costs?

A.3. Coastal States play a vital role in global supply chains. While international corporations in any sector are unlikely to provide financial support for addressing broad climate impacts, Maryland and other coastal States have the opportunity to develop strategic public-private partnerships around public infrastructure and investments in resilience that can help protect supply chains and private sector operations in critical local and regional economic sectors.

Q.4. Do you think it’s fair that taxpayers in Maryland—and all coastal States—are going to foot the bill to avoid the existential threat climate change, and rising sea levels, present?

A.4. The impacts of climate change are unequally distributed across the U.S. and around the world. Successful adaptation to the worst climate impacts, including sea-level rise, will require coordination and a focus on the broader economic, social, and health benefits of taking action quickly over delay or inaction. In my experience, the best coastal protection and climate resilience projects do not use taxpayer dollars to preserve the status quo, instead they leverage both public and private sector resources to actively improve lives and create wider economic and environmental benefits.

**RESPONSES TO WRITTEN QUESTIONS OF SENATOR SINEMA
FROM SHALINI VAJJHALA**

Q.1. Water supply challenges are one major consequence of a changing climate in Arizona and throughout the West. The ongoing drought is a constraint on economic growth in the medium and long term. From your perspective, could long-term water supply challenges pose a material risk to the financial health of a business? If so, do you believe existing disclosures are sufficient to inform investors, or do you believe additional information is needed for investors to make informed decisions?

A.1. Water supply challenges can and do pose material risks to the financial health of businesses. A 2020 CDP Global Water Report notes that water dependent companies—including energy and power, agriculture, and food and beverage operations—are already experiencing the consequences of extreme drought conditions. Voluntary disclosures about water supply risks are also increasing. These types of disclosures highlight where upstream economic impacts of severe drought, for example to hydropower generation, can create cascading economic losses across other sectors from manufacturing to electronics supply chains.

I believe the Securities and Exchange Commission’s March 2022 proposed rule on “The Enhancement and Standardization of Climate-Related Disclosures for Investors” is an important step forward in ensuring that investors can make more informed decisions about both chronic and acute risks associated with climate change. This type of information can also help academic researchers and public sector entities recognize where issues in one sector can have compounding economic and health effects across other sectors and identify potential adaptation and resilience measures.