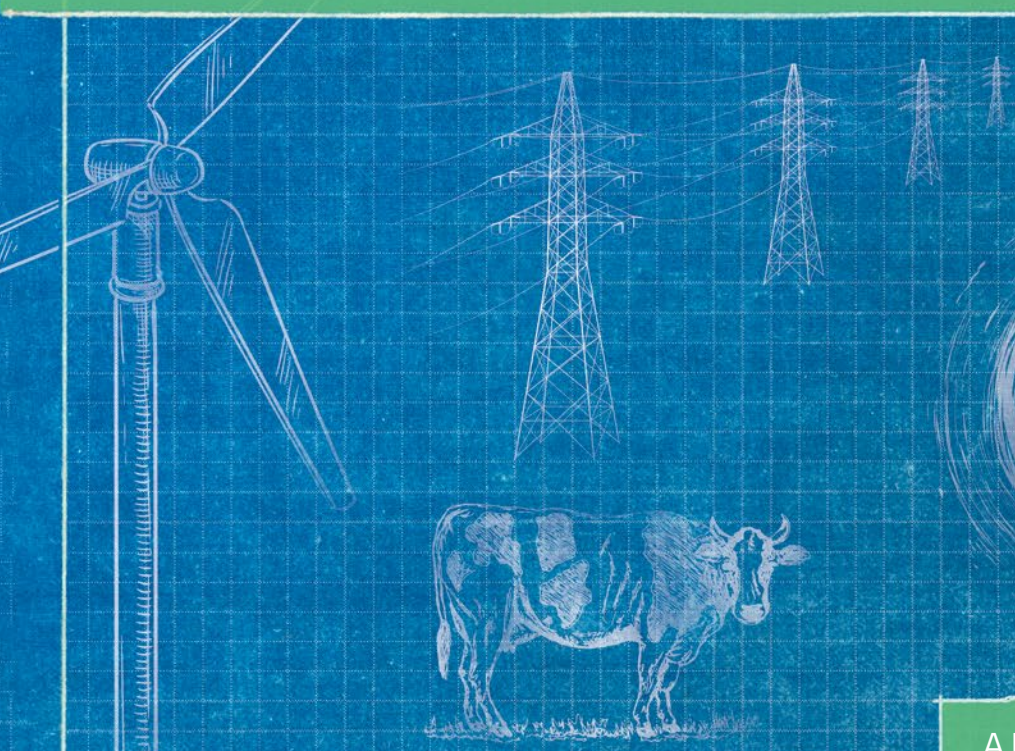
AMERICAN ACADEMY
OF ARTS & SCIENCES

FORGING CLIMATE SOLUTIONS

How to Accelerate Action Across America



A Report from the

COMMISSION ON ACCELERATING CLIMATE ACTION

Xavier Cortada, Underwater HOA Elevation Drive, 2018 (Acrylic paint on asphalt)
This public art piece by Miami-based eco-artist Xavier Cortada depicts the vulnerability of Miami neighborhoods to climate change. The number 9 corresponds to how many feet the sea needs to rise before this intersection will be permanently underwater. In January 2023, the Commission on Accelerating Climate Action met in Miami with the CLEO Institute and Miami-Dade County Office of Resilience and viewed several neighborhoods vulnerable to the most severe effects of climate change.

COMMISSION ON
ACCELERATING
CLIMATE ACTION

FORGING CLIMATE SOLUTIONS

How to Accelerate Action Across America

AMERICAN ACADEMY OF ARTS & SCIENCES
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A Letter from the President of the American Academy

In 2021, the Board of the American Academy of Arts and Sciences issued a public statement affirming that "All of us—scientists, engineers, humanists, lawyers, social scientists, educators, artists, and individuals from the private sector and government—must work together to limit and respond to climate change. In these efforts, we need to collaborate with national and international companies, organizations, and institutions." The Board's statement not only served as a rallying cry, but also set in motion a significant endeavor within the Academy, one that would span several years and encompass diverse disciplines. This initiative, the Commission on Accelerating Climate Action, epitomizes nonpartisanship and multisector collaboration. It embodies the Academy's commitment to identify obstacles impeding climate action while charting a course to expedite climate mitigation and adaptation.

Our country is experiencing irreparable changes that reflect our failure to act on climate change—from food supply shortages to more frequent and intense storms, droughts, and wildfires. But it is also a time of increasing legislative action, private-sector engagement, and public concern. The prospect of profound transformation lies before us, if only we dare embrace the potential. The interdisciplinary nature of the Academy allowed us to convene a commission that rises to this challenge, addressing the existential threat of climate change from a whole-of-society approach. The recommendations here do not seek to elucidate the nuances of any single sector or area for climate action. Instead, they construct a comprehensive vision that encompasses the entirety of American society, delineating a pathway for collective action on a broader scale. This report also embeds the paramount concern of environmental justice in its recommendations, promoting a vision of the future in which climate impacts do not disproportionately burden marginalized populations, and the benefits of resiliency can be enjoyed by all.

The Commission would not have been possible without the leadership of our cochairs. The Academy expresses deep gratitude to Mustafa Santiago Ali, Vice President of Environmental Justice, Climate, and Community Revitalization for the National Wildlife Federation; Christopher Field, the Perry L. McCarty Director of the Stanford Woods Institute for the Environment and the Melvin and Joan Lane Professor for Interdisciplinary Environmental Studies at Stanford University; David G. Victor, Professor of Innovation and Public Policy and Co-Director of the Deep Decarbonization Initiative at the University of California, San Diego, and Nonresident Senior Fellow at the Brookings Institution; and Patricia Vincent-Collawn, Chairman and CEO of PNM Resources. The Academy is also grateful for the wise guidance and hard work of their fellow Commission members, who generously dedicated their time and expertise and, most importantly, set aside personal interests and disagreements to fully endorse this report,

which aims to improve the well-being of all Americans (see pages vii–viii for a complete list of Commission members).

Forging Climate Solutions builds on the work of three Commission working groups: the Communications Working Group (chaired by Bob Inglis, Kathleen Hall Jamieson, and J. Marshall Shepherd), the Private Sector Working Group (chaired by Leanne Kealoha Fox and Chad Holliday), and the Human and National Security Working Group (chaired by Gary Roughead and Hilary Tompkins). In preparation for this report, each working group published an executive summary of their findings, and the Communications and Human and National Security Working Groups published white papers. All Commission publications, detailed information about the recommendations, additional case studies, and project updates are available at www.amacad.org/climate.

In addition to the diverse expertise of the Commission, we are indebted to the insight provided in interviews with more than seventy leaders in the arts, the private sector, the military, agriculture, government, and more. Furthermore, we extend our heartfelt appreciation for the invaluable insights provided by participants in several roundtable discussions of environmental justice, whose feedback greatly contributed to enhancing those aspects of our report. Their wisdom and perspectives have significantly enriched our understanding and reinforced our commitment to addressing these crucial issues (see Acknowledgments on page 47 for a list of sounding session and roundtable participants).

We are grateful to the funders who have made the work of the Commission possible: Roger Sant and Doris Matsui, Hansjörg Wyss, Bob Higgins, the Grantham Foundation for the Protection of the Environment, William and Helen Pounds, the David and Ellen Lee Family Foundation, the Alfred P. Sloan Foundation, and an endowment provided by John E. Bryson and Louise Henry Bryson.

We express our profound gratitude to the numerous Academy members who have been instrumental in supporting this project from its inception. A special acknowledgment goes to the dedicated members of the Board of Directors, Council, and Trust for their commitment to this Commission and their continued support of the Academy's science, engineering, and technology initiatives. Thanks, as well, to members of the Academy staff who helped realize the vision of this Commission and guide the report to publication: Carson Bullock, Kate Carter, Leo Curran, Tania Munz, Kelsey Schuch, Jen Smith, Alison Franklin, Alex Parker-Guerrero, Peter Robinson, Sophia Charan, Islam Qasem, Phyllis Bendell, Key Bird, Scott Raymond, and Peter Walton.

Since 1780, the American Academy of Arts and Sciences has been dedicated to addressing some of the most important challenges facing our nation. It is clear that climate change is the challenge of our time. I hope that you will join me in supporting and sharing the vital work of this Commission, so that our country may embark on this bold plan for a more sustainable future.

Sincerely,
David W. Oxtoby
President, American Academy of Arts and Sciences

About the Commission on **Accelerating Climate Action**

The Commission on Accelerating Climate Action was formed in 2021 by the American Academy of Arts and Sciences. The Commission's work answers two core questions: 1) What policies would most effectively and equitably remove barriers to climate action? 2) How can the United States accelerate climate mitigation and adaptation strategies for all Americans? While the science of climate change is well-established, the Commission leverages its diverse composition to identify strategies for building a durable and inclusive political coalition for climate action. In the first phase of the project, the Commission interviewed seventy experts across three domains—communication, the private sector, and human and national security—which enabled the Commission to assess the national landscape on climate action.

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Executive Summary

Momentum is growing for action on climate change. But actual shifts in U.S. investment and policy have been erratic, failing to address the needs of communities that will be hardest hit by climate change. American climate policy lacks a broad, durable commitment to maintain and accelerate progress. Despite significant advances, including recent federal legislation, there remains much more to be done—in Washington and across the nation.

The nonpartisan Commission on Accelerating Climate Action of the American Academy of Arts and Sciences has articulated how we can forge a whole-of-society commitment to addressing climate change. Its thirty-one members come from across the country, with expertise in industry, government, academia, and the arts to craft an approach for the whole of America.

The Commission articulates a "fair bargain" on climate change. Anchored in the principles of justice, pragmatism, and accountability, our approach is not to highlight any one policy but to outline the totality of the required effort.

As efforts become more visible and create new industries and opportunities, the political support needed to accelerate that action will grow. Challenges that are complex and daunting today will become more manageable with experience. Ultimately, these recommendations create a strategy for building and maintaining a broad, durable coalition for accelerated action that reduces emissions, promotes adaptation, and advances the interests of frontline communities.

Forging Climate Solutions is organized into five strategies for accelerating climate action.

STRATEGY 1: Prioritize Equity, Fairness, and Justice in Climate Action to ensure that strategies lessen, not exacerbate, harm by focusing on those who will suffer from the consequences of climate change, energy transition, and adaptation efforts.

STRATEGY 2: Engage and Educate Diverse Communities to shift climate change communication from an elite, science-focused endeavor to one led by credible voices from diverse communities.

STRATEGY 3: Mobilize Investment to unleash the immense capital of the public and private sectors needed to cut emissions and make society more resilient to the impacts of climate change.

STRATEGY 4: Deploy Diverse Options for Controlling Emissions to send clear market signals to investors to accelerate mitigation across all sectors.

STRATEGY 5: Ensure Adaptation at All Levels of Society to protect vulnerable communities, respond to disasters, and enhance national security, which will require vast resources, coordination, and planning at the federal, state, and local levels.

Summary of **Recommendations**

STRATEGY 1:

Prioritize Equity, Fairness, and Justice in Climate Action

RECOMMENDATION 1.1
Prioritize investment in communities that are on the front lines and are the hardest hit by the consequences of climate change, energy transition, and adaptation efforts.

RECOMMENDATION 1.2
Build capacity for climate action by engaging diverse voices, removing barriers, and disseminating promising practices.

RECOMMENDATION 1.3
Weave frontline communities and Indigenous Knowledge into research on controlling pollution and managing the impacts of climate change.

STRATEGY 2:

Engage and Educate Diverse Communities

RECOMMENDATION 2.1
Empower diverse and trusted messengers to communicate climate change issues that resonate with specific communities.

RECOMMENDATION 2.2
Support and celebrate concrete commitments to climate action by government, businesses, community groups, and NGOs.

RECOMMENDATION 2.3
Combat climate misinformation in the news and across social media.

RECOMMENDATION 2.4
Expand access to climate education across K–16 subjects and into formal and informal education venues. Advocate for climate education in all state curricula and develop tools for knowledge assessment.

STRATEGY 3:

Mobilize Investment

RECOMMENDATION 3.1
Design, implement, and iteratively evaluate policies to push the technological frontier.

RECOMMENDATION 3.2
Leverage investments in infrastructure modernization to correct historical underinvestment in marginalized communities.

RECOMMENDATION 3.3
Create more robust, credible, and comprehensive incentives to retire and replace high-emission facilities and vulnerable infrastructure.

RECOMMENDATION 3.4
Redesign permitting processes to be less burdensome and more trustworthy.

RECOMMENDATION 3.5
Strengthen the mandate for companies to measure and disclose climate-related physical and transitional risks that are auditable, replicable, and material.

STRATEGY 4:

Deploy Diverse Options for Controlling Emissions

RECOMMENDATION 4.1
Implement a fair carbon price in conjunction with other policies to create strong demand for low-emission technologies.

RECOMMENDATION 4.2
Cooperate with international allies to realign trade rules in favor of emissions reductions and make supply chains more resilient.

RECOMMENDATION 4.3
Advance efforts to control non-CO_2 greenhouse gases and climate-warming aerosols, especially pollutants that have large impacts on human health and the environment.

RECOMMENDATION 4.4
Incentivize farmers and other landowners to decrease greenhouse gas emissions and increase carbon sequestration.

RECOMMENDATION 4.5
Support effective nature-based climate solutions.

STRATEGY 5:

Ensure Adaptation at All Levels of Society

RECOMMENDATION 5.1

Spur increased investment in comprehensive adaptation plans through codevelopment with the federal government, states, tribes, cities, companies, and NGOs, including justice-centered voices from civil society.

RECOMMENDATION 5.2

Improve coordination and accessibility of existing climate resources and investments across federal agencies.

RECOMMENDATION 5.3

Invest in a diverse portfolio of adaptation options, including both responses to specific threats and broad commitments to building resilience.

RECOMMENDATION 5.4

Identify and eliminate perverse incentives, such as subsidies for hazard insurance, that have impeded efforts to understand and respond to climate-related risks.

Introduction

Over the last two decades, the United States has begun to make progress on addressing climate change. Emissions are coming down—slowly at first, but now accelerating rapidly. The federal government has adopted new legislation, such as the Inflation Reduction Act and Infrastructure Investment and Jobs Act, that directs unprecedented funding toward technological innovation and clean energy. Many communities—from Miami to Bozeman, Denver, Fairbanks, and Houston—are now starting to address the impacts of a warming world experiencing more extreme hurricanes, wildfires, floods, and droughts. Public concerns about climate change are at an all-time high, and a growing number of state and local governments are acting, as are many community groups and corporations. The will to work toward a safer, healthier future is finally spreading beyond activists and scientists.

However, the American response to climate change remains timid and ineffective. Across the country, vulnerable communities already face the consequences of inconsistent government engagement and decades of inaction. Massive changes in industrial and agricultural processes will be necessary to combat the effects of climate change, which will be expensive and disruptive to many parts of American society. Though mitigating and managing climate change will ultimately require global cooperation, here we focus on the United States because our large economy, significant emissions, and strong engine of innovation give us unique opportunities and capabilities to enact change.

What is missing in American climate policy is a durable strategy that aligns many disparate and often halting efforts and a vision for a "fair bargain" that guides how the nation responds. To achieve this long-term change, such a strategy must unite efforts across sectors, ideological divides, and the many other forms of diversity that characterize our nation.

This Commission reflects that American diversity. To these issues we bring a varied and powerful toolkit that spans business, the arts, faith communities, environmental justice, youth activism, the natural and social sciences, Indigenous people and Indigenous Knowledge, public health, and urban design. But we are also everyday Americans who live across the country, hold different political views, and have our own beliefs and values. Over the past three years, we have learned to communicate with each other across our varied interests. We have realized that the identities that may divide us are weaker than the shared goal of sustained and meaningful climate action.

A JUST, PRAGMATIC, AND ACCOUNTABLE APPROACH TO AMERICAN CLIMATE POLICY

Ambitious and durable action on climate change must be woven into the political and social fabric of the country. Many previous reports have detailed the intricacies of climate science and the nuances of policy-making. Our purpose here is not to repeat their excellent scholarship. Instead, our report integrates this previous work to build a whole-of-society climate strategy that can weather shifting political environments.

We aim to build a roadmap for a climate response that is just, pragmatic, and accountable. By *just*, we mean a strategy that acknowledges the existing inequities in this country and chooses climate action that reduces, not exacerbates, them. Justice is not one-dimensional and must recognize social, economic, environmental, racial, and intergenerational outcomes. By *pragmatic*, we mean to include practical considerations such as collective engagement, time, effort, cost, and political feasibility. By *accountable*, we mean actions that are well-defined, measurable, credible, and transparent.

Justice and pragmatism in climate action have long been perceived as opposing priorities. We firmly reject this assumption. In preparing *Forging Climate Solutions*, we have learned of many examples that demonstrate how incorporating justice into policy actions enhances cost-effectiveness and accountability. When justice and pragmatism are not aligned, we hold that considering justice first creates opportunities for practical and responsible action.

In this report, we adopt a comprehensive interpretation of environmental justice. Environmental justice encompasses not only individuals residing in heavily polluted areas or those anticipated to face the most severe consequences of climate change, but also communities reliant on declining legacy industries for their economic livelihoods. While the immediate interests of these communities may not always align, all of them stand to gain from a climate strategy that prevents the exacerbation of existing inequities and promotes health and economic well-being. The central goal of our work is to shift away from the differences in language and approach that have created division and prevented decisive climate action, to create a future of broad and durable progress—rooted in authentic engagement, recognition of shared values, the uniqueness of different communities, and compromise. In this future, low-wage earners will benefit from clean, nonpolluting energy in their homes and cars; communities threatened by climate change will have the means to adapt safely; and children will enjoy the right to clean air, safe water, and a healthy, thriving future, complete with family-sustaining jobs from new economic opportunities.

HOW TO ACCELERATE CLIMATE ACTION

We propose a strategy that balances changes that are clearly affordable and widely supported, such as building new green infrastructure, with more complex changes, such as coordinating cooperation across the whole of government. Action will beget action. Investments in experimentation and learning will build efficiency and increase support across communities. In time, emissions from the United States will decline more rapidly, and the politics of climate change will become easier to manage because more of society will see tangible benefits from action. The nation's resilience against climate impacts will grow.

Commission cochairs meet in Miami, Florida, January 2023. From left to right: Christopher Field, David G. Victor, Mustafa Santiago Ali, and Patricia Vincent-Collawn, with Academy President David W. Oxtoby.

At the center of this report is the idea of a fair bargain. Whole-of-society action on climate change requires compromise and the recognition of shared interests. Ultimately, changes in one sector, community, or federal agency will not be sufficient to meet the climate emergency. Therefore, any innovation offered by this report is not in individual recommendations but in strategies to join diverse communities and causes around a shared vision. To not exacerbate historical inequities, the exact nature of the bargain must be decided by all involved, including traditionally excluded and frontline communities. The fair bargain advocated in this report will yield climate action that is both more equitable and more durable politically.

Our recommendations are organized around five strategies. Each contributes critical opportunities to mitigate and adapt to the climate crisis through an environmental justice lens. In creating these recommendations, we draw not only on the wide range of experiences and perspectives represented on the Commission, but also on seventy-one sounding sessions we conducted with leaders in climate communication, the private sector, environmental justice, and human and national security.

STRATEGY 1:
Prioritize Equity, Fairness, and Justice in Climate Action

The climate crisis cannot be overcome without simultaneously addressing environmental injustices suffered by historically marginalized groups that have already disproportionately carried the burden of climate change effects. Achieving this goal requires frontline communities to have the funding, tools, and political organization to advocate for themselves, help develop research that will advance their community needs, and fund resilience-building. People affected by energy transition must have the resources to build new communities and pursue new livelihoods. And communities harmed by adaptation actions must have the resources to sustain healthy and safe communities. Without actively including these groups in decision-making, they will continue to experience underinvestment.

Integrating environmental justice in research and decision-making about public and private projects is not only morally and politically essential but provides the additional benefits of creating jobs, protecting local economies, strengthening communities, reducing health disparities, and ensuring cleaner air and water.[1] This inclusion will make projects more sustainable and politically durable and help address areas of disagreement before they become entrenched.

The problems targeted by the environmental justice movement are expansive and affect all communities, regardless of political affiliation and race. These range from communities of color disproportionately exposed to pollutants to coal miners who have lost jobs to rural farmers who must change agricultural practices to respond to a changing climate.[2]

People use different terms to describe protecting the most vulnerable groups in our country and ensuring that the necessary changes will serve all Americans. The Commission has found that these terms, including *fairness*, *justice*, and *equity*, reflect core values that span ideologies. Our shared commitment to accelerating action on climate change is stronger than any divisions resulting from the language we use to discuss it.

1.1 Prioritize investment in communities that are on the front lines and are the hardest hit by the consequences of climate change, energy transition, and adaptation efforts.

Addressing climate change requires profound changes to American society. America must prioritize investment in both communities on the front lines, who will bear the brunt of climate change impacts, and communities that will be most severely affected by the transition to alternative energy sources and climate adaptation efforts. Without specific and targeted measures, historically marginalized communities will continue to experience disinvestment, neglect, and injustice.

Increasing investments to help these communities is an immediate priority. While some communities may find it easier to transition to wind, solar, geothermal, or nuclear energy compared with others, investing in all communities is crucial to foster diverse and resilient economies that are not solely reliant on the energy sector.[3] These investments should encompass increased research funding as well as support for local businesses and community resources, including essential services like health care and housing.

Workforce development and job retraining programs can help realize a more just transition by creating opportunities for workers, their families, and all those displaced by climate impacts and the energy transition. In New Mexico, the government, the utilities, the Navajo Nation, and environmental organizations collaborated to develop the Energy Transition Act, which has allocated $40 million to community and workforce development. Also, the Public Service Company of New Mexico partnered with the Navajo Nation to provide scholarships to Navajo students for job training in advance of coal plant closures.[4]

In addition to economic development, communities will require infrastructure investment to respond to climate change. This requires significant financial resources, which are not equally available to all communities. Investments from agencies such as the Appalachian Regional Commission can provide improvements in infrastructure and educational institutions.[5] Whenever possible, communities should have ownership in these projects, such as the 235-megawatt wind farm majority-owned by the Standing Rock Sioux Tribe in North Dakota. Investment in local adaptation is essential to communities already at the greatest risk of climate hazard or those located near existing sources of pollution. Retrofitting homes in low-income areas, such as through the Weatherization Assistance Program, creates green solutions that lower energy bills and decrease health risks from extreme heat.[6]

Planning new projects should include a comprehensive analysis of benefits and liabilities that incorporate the full range of potential impacts, including on the local environment, the economy, health, and social cohesion. Evaluating these benefits should include engaging in discussions with communities to understand local concerns, ideas, and interests while being mindful of potential power imbalances. Not all benefits or impacts are easily quantified; in these cases, additional measures must ensure that benefits are weighed appropriately. There are several examples of this approach to draw from, including a 2021 Army Corps of Engineers' assessment that weighs social, environmental, and economic benefits and a 2023 research study of climate interventions that incorporates health.[7]

EPA Administrator Michael S. Regan embarks on a "Journey to Justice" tour, visiting communities impacted by environmental injustice in Houston, Texas, on November 19, 2021.

Promote funding for project codevelopment through public–private partnerships and federal incentives.

Frontline communities benefit when projects emerge through codevelopment, wherein community members and researchers or project developers participate as equals. Establishing more federal funding incentives for codeveloping projects with frontline communities encourages businesses to create projects that actively seek input from communities throughout the project lifespan, decrease concerns over costs, and make funding applications more competitive to public and private funders.

Private-sector and philanthropic contributions can make codevelopment more feasible by providing technical expertise, job retraining, and resources for community resilience. These partnerships remain crucial for equitable support of communities disrupted by climate impacts, green energy transformations, or adaptation.

One such example is the Partnership for Resilience and Preparedness (PREP), which is a public-private partnership between the World Resources Institute, the National Oceanic and Atmospheric Administration, and the insurance company Swiss Re.[8] Through its funding and technical support, PREP has helped build capacity for climate adaptation planning in several communities, including the Biloxi-Chitimacha-Choctaw tribe in Louisiana, which is one of the first communities in the United States to be affected by climate-induced migration.[9] The tribe is located on Isle de Jean Charles, a small island in the Gulf

ReGenesis Institute:
Fostering Relationships between Communities and Industry

The Arkwright and Forest Park communities in Spartanburg, South Carolina, are close to several significant sources of pollution, including two Superfund sites and the still-operational Solvay chemical plant. In addition to hazardous waste sites, these communities were left behind by revitalization attempts in other areas of Spartanburg in the 1970s. Disinvestment and disenfranchisement resulted in a lack of resources, including access to healthy food and health care. These problems were further exacerbated by poor infrastructure: the only road leading to the communities was often inaccessible and blocked by trains, isolating residents.

In 1998, local resident and later state representative Harold Mitchell Jr. founded the ReGenesis Institute to clean up and revitalize these communities after he experienced severe health issues from exposure to toxic chemicals, a common occurrence in Arkwright and Forest Park.[10] The ReGenesis Institute partnered with state and local government and Solvay. Tensions between the communities and Solvay were initially high, but sustained and intentional trust-building made it possible for these groups to work collaboratively toward community development. This success is partially attributed to a mediator, Timothy Fields, and the focus on consensus-building rather than litigation.

Through the efforts of the ReGenesis Institute—with funding from the Environmental Protection Agency, Solvay, the City of Spartanburg, and many other public and private sources—the Arkwright and Forest Park communities have opened a community health center, a grocery store, and a community center. Cleanup efforts have repurposed previously contaminated sites as community infrastructure and green space. Further revitalization efforts in the Arkwright and Forest Park communities continue.

Pedestrians walk along West Main Street in Spartanburg, South Carolina, in June 2021. Through the efforts of the ReGenesis Institute, the town has opened a health center, a grocery store, and a community center, while cleanup efforts have converted previously contaminated hazard waste sites as community infrastructure and green space.

of Mexico that has lost over 98 percent of its land due to rising sea levels, coastal erosion, and subsidence.[11] PREP helped the tribe develop an adaptation plan, build sustainable and elevated housing for residents, create job opportunities for those displaced, and preserve the tribe's cultural heritage and identity.

Government incentives also encourage co-development. The Inflation Reduction Act (IRA) of 2022 provides tax credits for projects in areas experiencing recent unemployment from a fossil fuel industry closure or transition. Other government incentives, such as the Department of Housing and Urban Development's Community Development Block Grant (CDBG) program, incentivize investments in infrastructure improvements that make business operations possible, such as incubators for green technology. In Baltimore, CDBG funds supported the creation of an incubator focused on sustainable manufacturing in collaboration with local communities. Housed at the University of Baltimore, this incubator has supported the development of several successful businesses that produce energy-efficient LEDs and manufacture lightweight materials for green infrastructure while also promoting economic growth in traditionally underserved neighborhoods.[12]

1.2 Build capacity for climate action by engaging diverse voices, removing barriers, and disseminating promising practices.

Frontline communities are often excluded from public and private project development decision-making, leading to conflict and adverse outcomes for communities and projects alike.[13] These include industrial projects that produce harmful pollutants and land use projects that reduce the overall impacts of climate change yet often harm marginalized communities by increasing local risk, such as sea walls that increase the likelihood and severity of flooding locally.

Environmental justice is not just an outcome but a process that requires meaningful participation across all points of decision-making. Community members frequently possess knowledge or skills that increase the project's speed and effectiveness or remove issues with implementation, making their input not only ethically important but often crucial to a project's success. Building capacity means assessing challenges to community member engagement and identifying resources and opportunities to address those barriers. Ultimately, impacted communities should have authority and ownership in project selection, but iterative engagement to strengthen community involvement and build trust are also important initial steps.

Establish positions focused on meaningful community engagement.

Companies and government bodies must create, fund, and maintain positions, such as director of community relations, focused on community engagement and inclusion. Establishing these positions before conceptualizing projects allows for early and ongoing community relationship-building and engagement.

Authentic engagement is built on trust, long-term relationships, and efforts to place everyone on an equal footing. Although engaging with communities can sometimes slow project development, many experts emphasize that this outreach accelerates projects in the long term by avoiding costly missteps and delays. Communities' experience and local insight can provide a comprehensive view on project

cost-benefit analysis.[14] Companies should create processes that are proactive and participatory, that understand competing priorities, and that provide compensation for the time community members spend offering their perspective. For example, companies such as Southern California Edison have already implemented processes for involving communities throughout the lifespan of their projects, including consulting with communities during the planning process and incorporating their feedback.[15]

Remove barriers to meaningful participation.

Often the biggest barrier to community participation in selecting and codeveloping projects is not interest or insight but navigating the technical issues related to identifying and taking advantage of available funding opportunities. These difficulties can range from internet access to English translation to managing and reporting climate funding, and were among the most frequent barriers mentioned by the community engagement experts the Commission interviewed. Communities are often left on their own to make decisions about redevelopment plans, despite the availability of significant federal funding and resources.[16]

While the solutions that remove these barriers can be straightforward, they require ground-level implementation and demand significant resources. Partnerships between fed-

San Onofre Community Engagement Panel: Creating Opportunities for Community Dialogue

In June 2013, Southern California Edison, San Diego Gas and Electric, the City of Anaheim, and the City of Riverside announced their decision to decommission the San Onofre Nuclear Generating Station. As several aspects of the decommissioning process affect the surrounding communities, including environmental impacts of decommissioning and the removal of spent fuel, the decommissioning team formed a Community Engagement Panel of volunteer representatives from affected communities.[17]

This Community Engagement Panel meets quarterly and gives the affected communities the opportunity to engage in open dialogue with Southern California Edison. Members of this panel represent diverse groups, including elected officials, environmental NGOs, administrators from school districts, local Indigenous groups, and nuclear professionals.[18] These meetings, all of which are open to the public, serve the dual purpose of informing the public about the decommissioning process and allowing for feedback, concerns, and questions from the public.

Issues of local concern addressed by the Community Engagement Panel include storage of nuclear waste and radiation levels. Southern California Edison has responded to these concerns by making storage canisters more resistant to corrosion and providing real-time radiation level monitoring in their storage facilities. High levels of engagement from both the panel and Southern California Edison have been vital for building trust and giving community members a forum to frequently offer input on the decommissioning process.

eral agencies, community organizations and other nonprofits, and local universities are crucial. In California, Climate Resolve's Ready for Tomorrow program has secured more than $9 million in climate-related grant funding for local community action, including by providing translation services to Spanish and Chinese communities.[19] In Alaska, the Denali Commission along with the Alaska Federation of Natives and Alaska Pacific University have helped distribute funds and provide project management to rural Alaskan communities.[20]

Amplify existing guidebooks on promising practices for authentic community engagement and encourage periodic revisions that incorporate input from communities.

Guidelines and successful examples help organizations to learn from prior experiences and integrate diverse voices into decision-making. These examples are necessary for demonstrating that engaging with communities about proposed actions and prioritizing environmental justice will strengthen proposals and improve outcomes—that this is not simply some burdensome and inefficient process. Increasing the visibility of these cases, such as through chamber of commerce gatherings, will encourage businesses and governments to integrate environmental justice into their practices.[21] Philanthropy should support this work by funding periodic assessments to ensure that the guidebooks and promising practices are effective.

Many of these tools already exist. The Environmental Protection Agency (EPA) provides several resources on how businesses can engage with communities, including legal tools that provide information on environmental justice laws.[22] The Department of Energy (DOE), the Organisation for Economic Co-operation and Development, and independent organizations such as the Electric Power Research Institute have also created and shared similar guidebooks.[23] These resources provide concrete steps and considerations for those interested in beginning to engage and codevelop climate-related projects with communities. The EPA also provides the EJScreen tool to help identify where frontline communities are located. As guidebooks are revised and new ones created, agencies should seek community input to help make these resources accessible to broad audiences.

1.3 Weave frontline communities and Indigenous Knowledge into research on controlling pollution and managing the impacts of climate change.

Many of the research projects necessary to advance climate solutions are occurring in frontline communities, creating both risks and opportunities for these communities. Without diverse community voices, climate research can unintentionally reinforce existing power imbalances or lead to policies that increase local vulnerability. To avoid these outcomes, research projects should incorporate frontline communities' knowledge and interests to ensure that benefits resulting from the research extend to those most affected by climate actions, and to strengthen communities' adaptation efforts. A study in 2017, for example, evaluated recent evidence of the interactions between climate change, air pollution, and health, highlighting how low-income and minority communities have higher exposure to air pollution, a finding that strengthened policy and funding efforts to assist these communities.[24]

Follow and expand existing promising practices for codeveloped research.

Climate researchers have been leaders in establishing appropriate practices for equitable research involving local communities.[25] Still, many researchers in mitigation and adaptation fail to adequately involve local input. Strategies for effective codevelopment of research include establishing relationships with communities before planning projects, using culturally sensitive research collection techniques, maintaining transparency and accountability with local researchers, and sharing data after project completion. Climate researchers should share not only the outcomes of their projects, but also promising practices for broadening community codevelopment. Researchers should not avoid projects on more challenging mitigation and adaptation issues but should seek to address distributional impacts and consider trade-offs within their studies.

Prioritize funding to research projects that are codeveloped with local communities.

To minimize community harm and build trust, research funding from government agencies and philanthropy should prioritize projects that promote codevelopment with community members. Projects that give local community members authority in project design or oversight should be funded over those that only hold listening sessions or other late-stage engagements.[26] One example that used this codevelopment framework is the Ikaagvik Sikukun (Land Bridge) Project, in which Indigenous communities in Alaska participated in developing the research questions, as well as in data collection and implementation.[27]

Microgrants are another model for effective community engagement: small community grants given by corporations or larger research grant recipients to invest in meaningful climate action within target communities. Microgrants not only offer direct benefits for the research project but also build trust between community members and corporations and help communities identify and learn to navigate other funding opportunities.[28] The Solutions Project provides microgrants to community climate organizations predominantly led by women of color, hastening adoption of green energy technology and strengthening resilience.[29]

Recognize additional ways of knowing, such as Indigenous Knowledge.

We urgently need climate action, and increasing research speed at the necessary rate will ultimately require incorporating additional ways of examining and assessing the problems. Indigenous peoples have relationships with the land spanning millennia, giving them a deep understanding of how a changing climate has altered ecosystems.[30] Indigenous Knowledge rooted in cultural practices, traditions, oral history, and language all document these changes. Despite a vast amount of valuable knowledge, Western scientists have often disregarded Indigenous science and observations. However, there is a growing recognition of the value of weaving Western and Indigenous Knowledge systems together.

Permafrost Pathways, a research initiative in Alaska, is a partnership between Western scientists and policy-makers, and Indigenous leaders and residents.[31] The project aims to use Indigenous Knowledge in combination with Western science to monitor permafrost thaw, an issue that poses significant risks to both the regional landscape and the global climate. Permafrost Pathways is also working to cocreate adaptation strategies with participating communities.

STRATEGY 2:
Engage and Educate Across Diverse Communities

Over the past decade, American society has made progress in public understanding of and engagement with climate change. It is no longer just discussed by scientists, but across whole communities—in churches, through civic organizations, and at the family dinner table. K–12 educators are increasingly teaching climate science, supported by climate-friendly curricula such as the Next Generation Science Standards.[32] The media has largely abandoned debating whether humans cause climate change and embraced coverage of climate issues in news and weather.[33] As a result of these efforts, a record number of Americans both accept the scientific evidence for climate change and feel empowered to act.[34]

Yet debate around climate change continues. Some aspects of these debates are genuinely contentious, such as how to share the burden of action equitably, but other controversies result from ineffective communication strategies or misinformation campaigns. While education can be an effective intervention, there remain inconsistencies in climate curricula across the country.

Decades of community outreach and education, as well as communication research, have created a roadmap for strengthening climate engagement, but barriers to implementation remain.[35] The recommendations here focus on expanding the number of credible climate voices, celebrating concrete commitments to climate action, and combatting misinformation. An improved strategy for communication must also offer educators broader curricula that focus not just on climate science, but on how society manages climate-related challenges and opportunities.

2.1 Empower diverse and trusted messengers to communicate climate change issues that resonate with specific communities.

The United States comprises a host of diverse communities based on location, political affiliation, race, socioeconomic status, faith, and other identities—and these communities tend to view climate issues in dramatically different ways. For example, communities that live close to coastlines may associate climate change with observable coastal erosion, while

Battelle/Pacific Northwest National Laboratory researchers participate in the second annual Celebration of Science at John Dam Plaza in Richland, Washington, in 2018.

inland communities may worry about climate-related flooding.[36] There is now an emerging body of research, including the *Proven Principles of Effective Climate Change Communication* paper put out by this Commission, that seeks to improve climate messaging strategies.[37] Communities engage most effectively with climate issues that reflect their values, such as the protection of public health, conservation, or being a good steward for creation. Communicating well not only helps reach broader audiences but strengthens social cohesion, which improves mental health and better prepares communities to adapt and build resilience.

Communicating climate change has historically been done by scientists and experts who some communities perceive as elite and respond poorly to. For this reason, empowering messengers and trusted leaders from various communities can be more persuasive, especially for reaching skeptical populations. For example, advertising campaigns from New Climate Voices, a group of conservatives focused on effecting climate action by appealing to economic growth, national security, and other issues typically prioritized by conservatives, have successfully increased Republican understanding of climate change.[38]

Encouraging scientists to emphasize other parts of their identities also facilitates effective communication. For example, the group Science Moms puts a spotlight on climate scientists who are also mothers.[39] Communicating about climate issues by emphasizing concern for children's well-being frames the issue in a way that engages and motivates mothers.

Research has also shown that the most effective communication does not come from sharing scientific knowledge, but through messages targeting emotion, morality, and the human

spirit.[40] Art, music, and poetry help people understand climate change, connect with the issue emotionally, and take action. For example, the Miami-based CLEO Institute (Climate Leadership Engagement Opportunities) created sculptures of iconic Florida symbols that melted in temperatures above 90 degrees Fahrenheit, raising awareness of the impact extreme heat will have on quality of life in the state.

Framing climate issues in personally relevant and less abstract ways also makes it easier to engage diverse communities. Finding the messengers that resonate with audiences is key to successful messaging. For example, the Hip Hop Caucus uses the visibility of popular musical artists to spread climate information, while the organization Good Energy consults on engaging ways to integrate climate issues in TV and film.[41] Medical professionals such as nurses and physicians, who remain two of the most trusted professionals, can emphasize the extent of harmful health effects from climate change and the health benefits of many climate solutions.[42]

Cultural context varies enormously and has a significant impact on communication. For example, the Indochinese Cultural and Service Center considered intergenerational knowledge transfer while communicating with their community about climate issues. Because elders in many Asian/Pacific Islander communities are more likely to listen to their grandchildren than their adult children, they focused on educating the youth on climate issues to spread climate information most effectively throughout the entire community.[43]

Many of these examples have been funded by philanthropy. For philanthropists seeking to make an impact on climate change, supporting these authentic messengers is a highly effective way to spend resources.

In 2020, Miami's CLEO Institute developed a wax sculpture of a Florida panther, which melted in the heat to reveal the hidden message at its core: "More heat, less wildlife."

Evangelical Environmental Network:
Mobilizing Religious Groups for Climate Action

Communicating climate through values that resonate with different populations is key to building a diverse coalition. Churches and other religious institutions have the power to gather a wide range of people and are often cornerstones in local cultures and communities. Spreading climate information and encouraging engagement in these settings are powerful tools for accelerating climate action.

Traditional climate messaging is rarely successful with more conservative audiences and, as a result, evangelical Americans are less likely to express concern over climate change than the overall American population.[44] The Evangelical Environmental Network (EEN), led by Reverend Mitchell Hescox, is a nonprofit organization whose mission is to rewrite this relationship by educating and mobilizing evangelical Christians to advocate for climate action.[45] The EEN emphasizes Christian responsibility for "creation care," or the act of caring for all of God's creations by preventing harmful activities, including those that contribute to climate change.

The EEN provides a variety of resources to help churches and individuals take climate action, including webinars, workbooks, and written materials. Additionally, they have led a campaign focused on how air and water pollution harm unborn children, a key concern for many members. The EEN also runs education initiatives about other key issues, including methane pollution and the protection of public lands. The EEN's efforts have successfully mobilized conservatives to support federal policies, including Mercury and Air Toxics Standards and the Inflation Reduction Act, as well as other actions to ensure clean energy, pristine air, and pure water.

2.2 Support and celebrate concrete commitments to climate action by government, businesses, community groups, and NGOs.

As organizations and governments reduce emissions, public communication about their specific actions can build accountability and inspire others to follow their example. This public communication often takes the form of climate action plans, which detail current emissions and strategies for emissions reduction and improving climate resiliency. Existing initiatives such as the Global Covenant of Mayors for Climate and Energy have inspired the formation of new climate action plans.[46]

While celebrating climate action can pressure other corporations to act themselves, these actions must include timelines, monitoring, and accountability. Tools, training, and procedures, such as those provided by the Greenhouse Gas Protocol, currently exist to help corporations and governments quantify and manage their emissions and allow for more accurate carbon footprint disclosure.[47] Organizations such as Stand.earth and 350.org also track and make publicly available records of these commitments in the Global Fossil Fuel Divestment Commitments Database to increase accountability.[48]

2.3 Combat climate misinformation in the news and across social media.

The media has a responsibility to convey information about climate change accurately. Despite this, some outlets have intentionally or unintentionally spread misconceptions (such as conflating weather and climate) or misinformation that complicates understanding.[49] The lack of clear, consistent messaging around climate change has created an information environment in which people require basic clarification about the need for action and the appropriate actions to take.[50] Though the solutions proposed below focus on climate change, these are also effective remedies to combat the ongoing problems of misinformation in media more broadly.[51]

Fund, implement, and evaluate a national communication campaign to increase support for climate action.

Though the public is becoming more accepting of the reality of climate change, many people still report confusion over which individual, local, and national and international actions will meaningfully contribute to solving the climate emergency. Misinformation promoting hopelessness about individual action or suggesting that additional consumption is a solution to the climate crisis feeds this confusion.[52] To counteract such misinformation, this Commission urges the federal government and philanthropy to design and launch a nationwide climate campaign to credibly reach and inform all Americans and build the social and political will for urgent climate action. The design of such a campaign should take inspiration from the anti-smoking campaigns of the 1990s and early 2000s that increased public awareness of the dangers of smoking and built broad support for new regulations and penalties on the tobacco industry.

Enforce false advertising laws and amend Federal Trade Commission (FTC) guidance on statements about climate change and the environment.

Modern climate misinformation has shifted from climate denial to misleading consumers and activists about the environmental impacts of products or services.[53] In other countries, false claims have led to ads being banned and companies being fined, such as the sanctions incurred by the 2019 Ryanair ads falsely claiming that the company was the lowest-emission airline.[54] Though similar provisions for false advertising exist within U.S. law, there are few cases in which these have been successfully used.

For the first time since 2012, the FTC is currently amending its Green Guides and is expected to add additional guidance about misleading environmental statements and better definitions for terms such as *organic* and *recyclable*.[55] The updates will also include guidance on clear and accurate representation in claims about carbon offsets and renewable energy usage. The Commission strongly supports the FTC amending their guidelines to help motivated consumers make climate-informed choices about the products they purchase. Furthermore, the FTC rarely takes enforcement action using the Green Guides standards, having done so only thirty-six times since 2013.[56] To increase accountability, the FTC must take more action to address false green marketing claims.

Encourage responsible journalistic coverage of climate change.

News outlets can help make climate change information digestible, factual, and locally relevant. Improving journalistic coverage of climate change has been a growing goal of

mainstream news media and specialty journalism. With more than five hundred news partners around the world, from the largest media groups to some of the smallest, Covering Climate Now regularly collaborates with newsrooms and journalists to incorporate climate in news coverage and to create stories that encourage public conversation.[57] The organization shares best practices and provides reporting resources.

Journalism organizations and news outlets are also broadening their climate coverage to be more relevant and appealing to their audiences. Climate Matters provides resources for meteorologists to incorporate climate content accurately in their coverage, integrating climate to discuss increases in the populations of mosquitos, the spread of poison ivy, and the likelihood of extreme weather.[58] These broadcasts improve public understanding of climate science and drive viewers to act.

Encourage social media platforms and news media to fact check climate misinformation and to incorporate content promoting media literacy.

Many Americans have shifted to social media as their primary source of news. These platforms are significant transmitters of misinformation about climate, health, and other issues because anyone can provide content, and many platforms' business models rely on algorithms that attract readers into increasingly polarized bubbles.[59] Social media platforms should expand their use of fact-checking and other evidence-based ways of controlling misinformation, such as highlighting climate consensus or stating accurate information first.[60] Recently, the idea of responding to misinformation has been scrutinized, as even well-executed strategies do not change many minds.[61] However, misinformation that is not combatted will gain circulation and drive further public confusion and harmful actions. Recent "soft moderation" by X (formerly Twitter) and other social media platforms has led to a slight reduction in user's tendency to share false information, but such tactics are not enough.[62]

2.4 Expand access to climate education across K–16 subjects and into formal and informal education venues. Advocate for climate education in all state curricula and develop tools for knowledge assessment.

The country's increased engagement on climate change will be easier to sustain over the long term if more Americans have access to climate change education. To that end, sustained climate engagement requires education at the K–12 through university levels, and informally through community outreach, adult education, broadcast science series, museums, and science fairs. Climate science should be incorporated into state curricula and assessments and rooted in known techniques for instruction.[63]

Advocate for adopting climate standards during state education standards reviews to create lesson plans that incorporate climate learning across subjects.

In the United States, the quality of K–12 climate change education varies from state to state.[64] Some states, such as Wyoming, clearly teach anthropogenic climate change across all grades, while others, such as Pennsylvania, do not mention climate change in their standards. However, even in comprehensive frameworks,

most climate discussion centers on traditional frames, such as conservation or fossil fuel reduction, instead of adaptation, Indigenous Knowledge, and environmental justice. Further, less than 50 percent of social studies and 5 percent of language arts standards discuss climate change.[65] Adequately preparing students for the challenges ahead requires an integrative approach that links climate change with civic engagement, media literacy, and justice. States revise their standards every five to twenty years, typically seeking comments from the public and education experts. Parents, who overwhelmingly support teaching climate change in schools, should continue to advocate for revisions that increase climate content in state standards.[66]

Create and validate a national assessment instrument to measure climate change knowledge in K–12 and university students.

Improving climate education requires assessing and targeting current gaps in student knowledge. However, while there are instruments to assess student attitudes and beliefs about climate change, there are no standard instruments to measure knowledge, as exist for many other complex and controversial science topics (such as evolution, genetics, and vaccines).[67] Developing and validating this instrument would improve national monitoring of climate knowledge growth and refine educational approaches to address remaining gaps. Education researchers should make the development of this tool a priority. Educators should use these results to develop curricula that address knowledge gaps and help integrate climate concepts outside the science classroom. Key topics include balancing risks and benefits, political decision-making, and the consequences of inequality.

Fund experiments to design and test new methods for integrating climate across curricula.

Participatory experiences like place-based learning and activities that focus on collective causes and action are effective strategies for climate education. Role-playing games, such as the World Climate Simulation, are particularly effective for strengthening applied climate knowledge.[68] School-based projects, such as environmental advocacy or climate action plans, further help students get involved in climate action. While many curricula use these strategies, they often require significant funding and climate knowledge to teach, which amplify existing inequities in education.[69] Therefore, an investment must come from the district or state rather than individually motivated teachers.

This experimental approach requires testing new curricula and evaluating which approaches are effective.[70] Philanthropy, school boards, and state educational institutions should provide funding for education researchers to test curricular efficacy.

A Role for Informal Science Education

Informal science education outside the traditional school system can be a powerful tool to integrate climate education into different venues, educate people who may not thrive in a structured classroom environment, and extend the reach and audience for climate knowledge. Science fairs, climate weeks, museums, libraries, nature centers, civic organizations such as the Boy Scouts and Girl Scouts of America, and faith groups, including adult study groups, Sunday schools, Hebrew schools, and youth groups, all can be effective platforms for climate education. These opportunities allow climate information to reach audiences of all ages and geographic regions, including those where climate change is not adequately taught in the school curriculum.

The Science Festival Alliance highlights science festivals in locales nationwide, from Alabama to Virginia, Colorado, Massachusetts, and California.[71] These festivals allow the public to engage with climate science and scientists. They also provide resources for those interested in setting up new community festivals. Collaboration with local museum exhibits and discussions provides additional opportunities for increased exposure to climate change science outside the classroom.

Informal science education opportunities are beneficial because they are often free or available at low cost and are accessible to all ages and a wide range of demographics. However, local views of climate science and policies can sometimes dissuade event and program organizers from implementing informal science education opportunities and programs where access to this information would be most impactful. Framing climate issues in a local context, increasing accessibility of scientific information, ensuring available funding, and forging partnerships and collaborations with experts help overcome these barriers.

"Washed Ashore: Art to Save the Sea" is displayed at the Smithsonian's National Zoo in 2016. The sculpture pictured is made of plastic found on beaches and helps to educate visitors about the consequences of climate change.

STRATEGY 3: **Mobilize Investment**

By most estimates, the United States will need to invest trillions of dollars in direct climate actions, research, infrastructure, workforce development, and economic incentives to cut emissions and manage the impacts of climate change.[72] Investments in clean industry in the United States are rising sharply, though are still far too low. Also rising are investments in the infrastructure and technologies required to make the country more resilient to the effects of climate change, such as wildfire-resistant power lines, high-capacity stormwater management systems, and crops that can withstand drought.

Mobilizing private capital to cut emissions, develop new technologies, and build resilience in frontline communities will require powerful incentives. For this deployment to be financially and politically sustainable, the incentives for private investment must be more credible and consistent, and must be supported by the removal of barriers to implementation, such as reforms to permitting processes.

3.1 Design, implement, and iteratively evaluate policies to push the technological frontier.

Studies project that most of the emissions reductions needed can be generated by technologies that are already mature or in early adoption. However, other technologies needed do not yet exist or are still too costly to be widely deployed.[73] Clean energy technologies, such as advanced nuclear reactors, offshore wind systems in deep water, and carbon capture and storage, have been imagined but not yet demonstrated at scale in the United States. What is missing is a clear mapping of the plausible impacts of these technologies, along with stronger incentives to expand the array of potential climate-resilient innovations and develop the workforce necessary to realize rapid expansion. Together, this will lower the cost of climate action, enabling pragmatic, just, and accountable investments in climate action.

Increase investment in early-stage research, development, and demonstration of new technologies.

Significant funding has been made available through the Infrastructure Investment and Jobs Act (IIJA) and Inflation Reduction Act. The CHIPS and Science Act may also lead to substantial funding for climate-related technologies. The private sector and philanthropy must also sustain and expand funding for frontier technologies and research.

New technologies are intrinsically uncertain, making them less appealing for private-sector investment in the absence of public

Onlookers gather to watch the demolition of the Navajo Generating Station, which was the largest coal-fired plant in the Western United States before it was demolished in 2019.

policy incentives. Therefore, an important priority must be reducing the financial risk to investors that want to deploy novel technologies but are unwilling or unable to absorb all the risks themselves.

The Commission does not take a position on the exact level of funding that government or philanthropy should invest. Experts' assessments of the appropriate expansion of public-sector support for new technologies range from doubling to tripling current investments, or increasing by even larger ratios.[74] A greater combination of resources and funding would deliver value to American society through cutting emissions and providing jobs. The U.S. government has long performed this role through the national laboratories, the DOE loan programs office, the Advanced Research Projects Agency for Energy, and others.[75]

Later-stage prototypes will need support from blended finance models that combine government and private investment. Recent legislation provides support for clean energy technologies, although the longest-lasting provisions tend to be subsidies for mature technologies while the provisions for the most innovative technologies will expire too quickly. Boosting innovation and testing new technologies for the long term requires the extension of funding beyond these programs' projected expirations in five to seven years. And while there has been substantial support

for innovation related to emissions reduction and control, much less is dedicated to novel technologies that could improve the nation's resilience to the impacts of climate change.

Reassess and eliminate barriers to expanding international scientific collaborations.

It is imperative that the U.S. national system of innovation remains strong and effective. That system relies on international students at American universities, collaborators around the world, and innovators from abroad who start companies in the United States.[76] Burdensome visa processes, overclassification, and mistrust between nations impede the flow of scientists across borders and harm the pace and quality of scientific achievement. While the American public is often reluctant to commit to overseas relationships, the United States must nevertheless maintain international connections for the benefit of the laboratories, universities, and companies that are the engines of American innovation.[77]

Regularly evaluate the effectiveness of the U.S. investment in clean industry and climate resilience innovation.

Innovation is intrinsically steeped in uncertainty: about the sources of new technologies, how market demand affects that supply, and the effectiveness of various policy instruments. Thus, the United States must regularly evaluate the efficacy of its national policy strategies for technological development and deployment. That evaluation must focus on innovation around emission controls and efforts to improve resilience. With input from the Office of Management and Budget and other arms of the government that address these issues, such as the Congressional Budget Office and Office of Science and Technology Policy, evaluations can ensure that funds are spent efficiently, effectively, and ethically. These reviews should be done by independent, specialist organizations and funded by the government or private philanthropy.

3.2 Leverage investments in infrastructure modernization to correct historical underinvestment in marginalized communities.

Much of new climate-related spending, such as through the recent Infrastructure Investment and Jobs Act, will go toward infrastructure projects related to energy, clean industry, and resilient buildings. These new investments are an opportunity to bring resources to communities that have experienced historical underinvestment. Polluting industries with disproportionately high greenhouse gas emissions are frequently located among marginalized communities, so these investments have simultaneous benefits for climate, human health, environmental and social justice, and local economies.[78]

The electricity grid is one promising area for infrastructure modernization that increases equity. Local conditions of the grid determine the ability of the grid to take on renewable resources, thus perpetuating historical underinvestment by keeping older, more polluting energy sources near the poorest communities with underinvested grids. Prioritizing investment in frontline communities through identifying local infrastructure gaps builds a more equitable, less polluting, and more resilient grid.

Support for modernizing infrastructure can come from government incentive programs to redevelop communities unduly impacted by pollution. Many business owners the

Students address a group gathered for a tour of the EPA's Clean School Bus Program in Virginia on May 20, 2022. This program is replacing 2,600 school buses with electric alternatives in frontline communities.

Commission spoke to identified tax credits and state-administered rebates as key to enabling infrastructure improvements in frontline communities.[79] Recent executive actions have also created new opportunities to connect these communities with funding. The Justice40 Initiative mandated that at least 40 percent of federal climate investments go directly to frontline communities. Justice40 recommends the creation of screening tools that identify underresourced communities and set funding guidelines to improve economic conditions and protect against climate impacts.[80] One such tool, the Climate and Economic Justice Screening Tool, features an interactive map identifying communities experiencing different categories of environmental and economic burdens. Publicly available and continuously updated with new data, this tool can direct private-sector spending to communities at the greatest risk and with the most to gain. For example, the screening tool helped fund the EPA's Clean School Bus Program, which is replacing 2,600 school buses with electric alternatives in frontline communities.[81] Many other large federal agencies have already drafted and are beginning work on Justice40-covered programs.

In addition to the large federal projects covered by Justice40, community-led organizations should be funded directly to identify and support local projects. Public funders such as the EPA's Environmental Justice Thriving Communities Grantmaking Program and private grantmakers such as the Climate and Clean Energy Equity Fund or the Building Equity and Alignment Fund provide millions of dollars annually to nonprofit grassroots organizers. These grantmakers also support local

Dominion Energy:
Supporting Local Economies through Investments in Renewable Energy

Dominion Energy's Coastal Virginia Offshore Wind (CVOW) project plans to build 176 wind turbines and three substations off the coast of the Hampton Roads region of Virginia, along with accompanying onshore transmission lines.[82] Once completed, this will be the largest offshore wind project in the United States and is expected to support economic development in the region as well as provide new clean energy jobs. Economic analysis performed by the firm Magnum Economics predicts that the project will result in nine hundred new jobs and millions of dollars in economic output and local and state tax revenues.[83] To fill new jobs, Dominion Energy has agreed to hire and train local workers, with a focus on employing veterans and people from historically marginalized communities.

Throughout the planning process, Dominion Energy has engaged with the local community in a variety of ways, holding public meetings and producing materials in multiple languages.[84] In addition, they created the online tool GeoVoice to allow community members to view and provide feedback on transmission line route options.[85] Community feedback, along with an analysis of existing infrastructure, historical sites, and community and natural resources, was essential to determining the final route.

Construction for CVOW is expected to begin in 2024 and to be completed in 2026.

capacity-building by providing technical assistance and sharing strategies for economic development with grantees. Similarly, the DOE provides funding and technical assistance for municipalities and community organizations to implement energy efficiency and weatherization programs in all fifty states and U.S. territories.[86]

3.3 Create more robust, credible, and comprehensive incentives to retire and replace high-emission facilities and vulnerable infrastructure.

Over the last decade, the nation has begun to retire high-emitting industrial facilities, notably coal-fired power plants. Coal has shrunk from generating about 52 percent of power in 2005 to about 22 percent today.[87] These plant closures have reduced local air and water pollution, lowered carbon dioxide (CO_2) emissions, and opened the way for a new generation of investments in energy generation.

The process of retiring existing high-emission assets should be extended and even accelerated, clearing away high-polution infrastructure to make more room for newer, cleaner systems. The United States has simultaneously begun to identify infrastructure and places that are particularly vulnerable to climate impacts. In some cases, retiring those assets to make room for newer and more resilient

approaches would help improve the nation's ability to adapt to climate impacts while also benefiting the most vulnerable communities. Owners of aging infrastructure often expect compensation for stranded assets, but regulators and other policy-makers have been haphazard in their responses. In some states, legislators and utility regulators have compensated asset owners for the early retirement and stranded costs of coal plants.[88]

Augment state, local, private, and philanthropic funding mechanisms with a national fund to compensate early retirement of high-emission facilities and of infrastructure particularly vulnerable to climate impacts.

In other pollution-control areas, government programs have used a combination of subsidies and fees to incentivize the removal of high polluters. These programs leverage market forces to ensure funds are spent effectively while evaluating proposals for their cobenefits to community health and redevelopment. Evaluation criteria should ensure that funds go to diverse projects.

Articulate a national strategy for the retirement or retrofitting of high-carbon industrial facilities within the next five years.

The nation can accelerate deep cuts in emissions by helping high-pollution facilities retire, allowing cleaner alternatives to spread more widely and into service more quickly. An effective funding program in this area would offer the building blocks for a comprehensive strategy, including a toolkit of effective practices, identification of key successes, and outline of the vision for growth. This toolkit should be funded and organized by philanthropic organizations that emphasize community redevelopment, for they have the relationships and knowledge to integrate climate change into local development.

To implement this strategy successfully, organizations involved in implementation such as the National Association of Regulatory Utility Commissioners and the National Governor's Association should develop and share their own strategic toolkits that offer promising practices and successful, transferable examples.

3.4 Redesign permitting processes to be less burdensome and more trustworthy.

Cutting emissions and making society more resilient to the effects of climate change will require new infrastructure, such as transmission lines and improved water handling and treatment systems. Yet due to the current regulatory environment, the actual building of this infrastructure lags far behind what is needed. For example, the U.S. electric transmission system currently expands by 1 percent per year but must move closer to 2.3 percent annually to achieve deep decarbonization.[89]

Expanding this key infrastructure more rapidly will require reforms to permitting processes, which at present can slow projects by years and deter investors from pursuing some projects altogether. But permitting is one of the nation's tools for ensuring that projects do not cause undue harm to the environment or the health of surrounding communities. Infrastructure with such harmful effects exacerbates existing inequities when near low-wealth communities or communities of color. Applying a justice lens to reforms to permitting processes makes it easier for low-income communities to gain clean energy.

Streamline the permitting process by adopting promising practices at federal, state, and local levels.

It is possible to improve and accelerate the permitting process for siting new clean energy infrastructure using existing legislative authority. Many of the most promising opportunities lie with broadening participation early in project planning so developers can better anticipate resistance and adjust designs, especially for multijurisdictional projects. Such transparent engagement increases trust between communities, government agencies, and project developers. It may also reduce the odds of lawsuits when the project approaches completion.

Achieving deeper and earlier engagement requires that government agencies continue to identify and share promising practices for broadening early participation, especially for making the permitting process accessible to nonexperts. It also requires adequate funding to train personnel in federal agencies on how to engage on environmental justice issues. In addition, Congress should amend the Federal Advisory Committee Act to allow convenings of agencies, project proponents, industry, tribes, and state and local governments without cumbersome notification and other constraints.[90]

Permitting regulations at the state and local levels can pose additional complications. Most localities have zoning laws that restrict a wide variety of new developments. The National Renewable Energy Laboratory has identified nearly two thousand siting ordinances on wind power and one thousand on solar power.[91] Infrastructure projects that cross state and municipal boundaries often must engage with a patchwork of regulations, complicating approval processes for projects as a whole. To ease the permitting of clean energy, electricity transmission, and resilience projects, federal funding should be contingent on state and municipal adherence to a unified set of guidelines.[92] These guidelines should be similar to those in the federal government's FAST-41 program, created in 2015 to accelerate infrastructure in certain sectors.

Continue to reform permitting without meaningfully compromising the quality or inclusivity of environmental review, while giving siting authority to federal agencies for high-value energy projects.

Historically, the permitting process has been slow and has favored developers with the capital and lawyers to navigate the process.[93] But to achieve just outcomes, projects of all types must advance, especially those that advantage frontline communities. The Fiscal Responsibility Act, passed in June 2023, contains reforms to the National Environmental Policy Act (NEPA) designed to speed up the permitting process by limiting times for review and exempting some projects from major reviews.[94] The reforms also narrow the scope of environmental effects and options for alternatives under reasonableness standards, while providing the opportunity for greater state, local, and tribal engagement through lead and cooperating agency roles. Further reforms to the NEPA and other permitting processes should maintain the quality of environmental review while removing existing barriers to build green infrastructure.

A promising development is the new backstop authority given to the Federal Energy Regulatory Commission (FERC) by the Infrastructure Investment and Jobs Act to site particularly valuable electric power lines. The FERC is proposing that developers submit an

environmental justice public engagement plan and an environmental justice resource report. So environmental justice communities can have a well-articulated, influential voice in this process, developers and government should fund environmental-justice and Indigenous liaisons. The establishment of a mandatory funded account could be a meaningful reform to provide funding for this purpose.

Projects that are predesignated by federal agencies to be both low-risk and clean-energy, as well as projects that are outside of federal land, are candidates for exemption from lengthy federal review processes. Already many federal agencies, including DOE, are advancing efforts to identify these high-priority, low-risk infrastructure projects. Additionally, the North American Electric Reliability Corporation will be carrying out a study to identify where key transmission projects may be needed.[95] Having the government engage in programmatic reviews for solar, wind, and transmission projects could help proponents make more informed siting decisions that have comprehensive benefits.

To preempt disputes and facilitate resolution outside of the courts, litigants could be required to submit feedback during the public comment period. Alternatively, the statute of limitations could be shortened, decreasing the period when projects could become enmeshed in litigation. As an alternative to the court system, the Federal Permitting Improvement Steering Council (FPISC) should be empowered to resolve interagency disputes, and the director of the FPISC should be a Senate-confirmed position that reports to the President. Remaining lawsuits could also be directed to a specialized court with expertise on NEPA and conservation that many courts lack. Despite many reforms included in the Fiscal Responsibility Act that could speed up agency reviews, the fundamental problems created by looming litigation on the content of those reviews remain largely unchanged.

Use promising practices to determine and consider cumulative impacts to reduce the potential pollution burden on frontline communities.

Cumulative impacts refers to the combined effects of multiple environmental stressors on communities, especially those that are already facing multiple burdens, such as pollution, poverty, and lack of political agency. Permitting decisions that fail to consider cumulative impacts can result in the concentration of environmental hazards in certain areas, which can further exacerbate existing inequalities and decrease broad public will for climate action. For example, a community may be burdened with multiple sources of pollution, such as a power plant, a refinery, and a waste facility, leading to higher levels of air and water pollution and associated health risks.

To ensure these impacts are considered and distributed more fairly, the federal government should develop standards on how to measure them. Many federal, state, and local mitigation and adaptation projects already include assessments and mitigation of cumulative impacts in their planning. For example, the Light Rail Transit Project in Phoenix created a model that considered air and water quality, noise pollution, and impact on existing traffic that they shared with local community members in outreach sessions. Based on this model and community feedback, the builders changed the plans to better protect water quality and not disturb sensitive habitats. To expand cumulative impacts analysis and demonstrate how to improve current practices, philanthropy

should identify high-value projects that could benefit from more systematic assessments and invest in a sample of them.

3.5 Strengthen the mandate for companies to measure and disclose climate-related physical and transitional risks that are auditable, replicable, and material.

The changing climate and society's responses to it pose immense risks to the economy, especially in the sectors with the highest emissions and locations most exposed to the impacts of climate change. Some companies and government agencies have begun to assess their exposures. The insurance industry has produced reports analyzing the physical risks of climate change to their industry, and some segments of the oil and gas industry have calculated the risk of transition to low-emission futures. However, awareness and data on these risks are highly uneven, and many organizations do not measure or report their vulnerabilities.[96] For example, the municipal bond industry, one of the nation's most important mechanisms for raising money for public works projects, has made little progress in recognizing physical climate risks.[97] Without better data, shareholders and debtholders cannot make informed decisions about risk or participate effectively in proxy votes, which weakens oversight and accountability.

Inconsistency and imprecision in reported metrics undermine the usefulness of current risk assessments. Several organizations have undertaken efforts to standardize disclosures, including the Sustainability Accounting Standards Board, the Task Force of Climate-Related Disclosures, and the International Sustainability Standards Board.[98] The Securities and Exchange Commission (SEC), the primary government agency responsible for market oversight, must determine which disclosure standards should be implemented in the United States.

In 2022, the SEC published a proposal for enhancing climate-related disclosures.[99] If confirmed, the rule would require disclosures of, among other items, climate-related risks and their actual or likely material impacts on business, strategy, and outlook. While there is demand for reform to climate-related disclosures, including from some of the world's largest asset managers and many of our private-sector interviewees, the specifics of the proposal were often unpopular.[100] Many of our interviewees felt the disclosures required by the proposed SEC rule were insufficiently relevant to their investing and voting decisions and too costly to adhere to. Because of widespread opposition during the public comment period, the process stalled before taking effect, leaving no clear timeline for when a modified rule would be proposed. Even if the current draft rule were sustained, it would face severe legal challenges.

In this context, this Commission recommends a renewed proposal by the SEC that would align with independent experts' recommendations, and whose disclosures are comparable across companies within a given sector, verifiable, and updated regularly. And as SEC rules only cover public companies, this Commission recommends incentives for private companies to comply voluntarily. Municipal bond rating agencies also should develop a similar proposal to help investors in those instruments invest wisely.

STRATEGY 4: Deploy Diverse Options for Controlling Emissions

Decarbonization is essential but disruptive. There are many options, but no silver bullets. Strategic mitigation must therefore balance diversification and experimentation with the power of market forces to direct investments toward the most promising options.

This report is agnostic about the appropriate technologies for emissions reduction. Some options for decarbonization raise questions about safety (nuclear power), others around resource use (land use for mass deployment of solar and wind). Some options remain cost-prohibitive without subsidies (clean hydrogen or carbon capture and storage), while others remain untested or undeveloped (many of the technologies needed for controlling methane and nitrous oxide). All options involve real concerns and tradeoffs, and viable solutions will vary by region and time. In practice, the best option will likely be a combination of well-developed strategies, such as improved building efficiency standards, and more long-range technologies, such as advanced nuclear, clean hydrogen, or electricity from natural gas with carbon capture and storage.[101] It is clear, however, that the costs of delay, measured in avoidable climate impacts, greatly exceed the costs of accelerated action to reduce emissions.[102]

Emphasis on emissions-reduction strategies that are equitable, affordable, reliable, and tuned to local conditions can ensure rapid progress. Engagement and compromise can be the foundation for building mitigation strategies that are both just and pragmatic. Keeping all reasonable options available will lower the cost of action and enhance feasibility. The best overall strategies for cutting emissions will likely involve a blend of approaches. Those include economy-wide signals that incentives for cutting emissions will strengthen over time. These strategies must incorporate mitigation technologies that are popular and politically feasible as well as those that are more challenging. They also include investment in innovation to expand the range of viable technologies and business practices, reducing the overall cost of action.

Midwest Alliance for Clean Hydrogen:
Public–Private Partnerships to Establish Regional Clean Hydrogen Hubs

The Department of Energy's Office of Clean Energy Demonstrations announced the H2Hubs Program in 2022, which aims to direct funding from the Bipartisan Infrastructure Law toward building regional hydrogen hubs to promote the production of clean hydrogen and work toward net-zero carbon emissions goals. The Midwest Alliance for Clean Hydrogen, composed of partners across the public and private sectors, is one group that hopes to take advantage of this funding, to initiate hydrogen projects across Illinois, Indiana, Kentucky, Missouri, and Wisconsin.[103]

The alliance comprises seventy members from these states, including universities, nonprofits, national laboratories, energy transmission and distribution companies, and independent research institutes. Legislators and governors have voiced bipartisan support of the alliance.

Implementation of the proposed projects will benefit communities, with an emphasis on supporting historically disadvantaged communities. Clean hydrogen projects will bolster local economies by increasing energy independence and creating job opportunities. Alliance members, including academic institutions, plan to provide workforce training opportunities for community members.

4.1 Implement a fair carbon price in conjunction with other policies to create strong demand for low-emission technologies.

Every ton of CO_2 emitted into the atmosphere causes damage for which no one is currently held responsible. Because of shifting political environments, the Commission has not developed a consensus view on the right price for emissions, but offers $100 per ton of CO_2 emitted as a price that may be politically feasible and sends a clear signal about the need to act.[104]

The country should aspire to align the price set on carbon emissions with the full costs that carbon pollution puts on the economy and society. Those costs, known as the social cost of carbon, include the vast health care costs, estimated at $820 billion annually, from pollutants created when fossil fuels are burned.[105] Estimates of the social cost of carbon vary widely due to different approaches to weighing current costs against future harms and benefits. However, the trend in the research is clear: estimates of the social cost of carbon are rising sharply.

Achieving a carbon price in the United States has been politically challenging, as demonstrated by the failure of the 2009 Waxman-Markey Bill to initiate a cap-and-trade system. Many of the concerns surrounding the Waxman-Markey Bill are still highly relevant to current pricing efforts, including those related to fairness, international relationships, target-setting, and revenue spending. But despite this historical context, there

are several reasons to encourage continued efforts. Thirteen U.S. states have already implemented emissions trading schemes. Both taxes and trading schemes are also used internationally, especially in Europe, where an emission pricing system covers between one-third and one-half of all EU emissions.[106]

Carbon pricing is a powerful tool to motivate decarbonization, but it will not be sufficient on its own. Particular attention is needed to address the potential disproportionate economic impact on lower-income American neighborhoods, such as through the many proposals that have focused on refunding some or all of the revenues directly to the public.[107] This "fee and dividend" approach could be used to offset other taxes in ways that could improve the nation's public finances and shift the taxation burden. This model has broad support, though no concrete proposal exists.[108] Through interviews, the Commission found that these ideas also commanded significant support from businesses.[109] Such an approach has the advantage of making the level of effort to cut emissions highly transparent, which could assist with the imposition of corrective tariffs on goods traded in international markets.

4.2 Cooperate with international allies to realign trade rules in favor of emissions reductions and make supply chains more resilient.

Many emission-intensive products such as steel, automobiles, and agricultural products are traded globally. Approximately one-quarter of global emissions of CO_2 and one-half of global emissions of methane result from the production of internationally traded goods.[110] Decarbonization will require developing low- or no-emission alternatives to producing these goods, but it will also depend on creating low-emission global supply chains.

With the proper rules, U.S. exporters can use clean technologies to gain strategic advantages in the global market. However, if the United States adopts strong emissions-control policies, exporters in countries with more relaxed regulations gain a competitive advantage, hurting U.S. industry and employment. Such investment losses occurred in Europe as its Emissions Trading Scheme grew stricter.[111] Disengaging from the global economy is not a viable answer because low-emission industrial economies depend on global supply chains to access low-carbon technologies. These supply chains reflect both potential employment opportunities and economic vulnerability to monopolies.

Develop standard and accurate metrics for assessing the carbon footprints of industrial activities and phase in a carbon-border-adjustment system.

One of the most significant barriers to strengthened cross-border cooperation is inconsistency in the carbon pricing of traded goods and services. Accurate estimates of a product's carbon footprint are complex, particularly as the environmental cost may vary significantly based on the production technique.[112] Currently, many U.S. industries have unique and opaque systems to determine carbon footprints that do not necessarily incorporate the environmental cost of raw materials, making comparisons difficult. However, developing goods that meet multiple standards can also be prohibitive for small producers.

Combatting carbon leakage, whereby the unilateral imposition of a carbon price in one area

Agricultural Technology to Reduce Methane Emissions

Livestock farming is integral to many communities, providing food security and playing an important role in many cultures. However, livestock-produced methane emissions account for about 27 percent of anthropogenic methane emissions.[113] Ruminants, including cattle and sheep, are responsible for most of these emissions due to the structure of their digestive systems and the scale at which they are raised.

Employing strategies such as increasing feed intake, grazing on less mature grass, and adding methane inhibitors to feed have all been proposed to mitigate methane emissions. Increased quantitative research on these methods is needed to evaluate negative environmental or livestock health effects, but the data so far suggest that these strategies could significantly reduce livestock-produced emissions levels.[114] While employing combinations of these strategies will likely result in greater emissions reductions, it is possible that the use of certain strategies in tandem will decrease their efficacy. Further investigation into how these strategies interact with each other is needed to determine the compatibility of strategies. Additionally, the cost-effectiveness of these strategies needs to be evaluated to ensure that all farmers, regardless of income level, have access to more climate-friendly livestock practices and technology. Where financial barriers exist, additional support or incentives may be necessary.

Hereford and Angus cattle eat at a trough. Livestock-produced methane emissions, mainly from cattle and sheep, account for about 27 percent of anthropogenic methane emissions.

encourages production in less regulated areas, also requires international cooperation. Instead of a global carbon price, carbon border adjustment mechanisms (CBAMs) can reinforce individual carbon prices while decreasing overall emissions. Congress has drafted but not yet implemented legislation on this subject.[115] Along with strong national emission control policies, the nation should adopt a border tariff mechanism. Congress should design that system to align with the World Trade Organization (WTO) standards, which allow for border adjustments applied for legitimate environmental purposes.

Strengthen U.S.–EU trade relations by identifying equivalent national policy mechanisms that foster open trading.

As the United States debates adopting a border measure, Europe has already enacted most of the elements of such a measure. In December 2022, the European Union passed regulations to introduce CBAMs in several sectors starting in October 2023.[116] Whether and how EU measures will recognize U.S. efforts to control emissions remains unclear because the European CBAM regime is designed around the European emission control strategy (which hinges on an EU-wide cap-and-trade system). At the same time, the U.S. policy is a more eclectic mix of subsidies and regulations and a few market-based mechanisms. Domestic subsidies created by the Inflation Reduction Act, including incentives for onshore production, have created tensions with Europe. The U.S. government should take the lead in outlining a productive trade relationship. Solutions should balance promoting open trading with key allies without hurting domestic production of green technology.

4.3 Advance efforts to control non–CO_2 greenhouse gases and climate warming aerosols, especially pollutants that have large impacts on human health and the environment.

Non-CO_2 greenhouse gases, including methane, nitrous oxide, and fluorinated gases (such as hydrofluorocarbons), account for almost 20 percent of all greenhouse emissions in the United States.[117] The primary sources include livestock, oil and gas drilling, coal mining, soil management, and refrigeration. Most non-CO_2 greenhouse gases trap more heat per molecule than CO_2 in the atmosphere, although they have shorter atmospheric lifetimes. In addition to non-CO_2 gases, particulate pollution (soot) causes significant amounts of climate warming while also causing severe health impacts—particulate pollution is the leading environmental cause of premature death.[118] Particulate pollution from fossil fuels is predominantly located in impoverished areas with high proportions of racial and ethnic minorities in the United States, exacerbating environmental inequality.[119]

Strengthen and enforce existing regulations and incentives for non–CO_2 gases.

Regulation of these non-CO_2 gas emissions offers a tremendous opportunity to provide tangible benefits to the climate while also advancing other goals such as protecting public health. The EPA has written some regulations on emissions of non-CO_2 gases, such as methane via the New Source Performance Standards, which regulate the oil and gas industry, and nitrogen oxide emissions from heavy-duty diesel vehicles.[120] Recent legislation also includes a new tax on methane emissions, although implementation of that tax has yet to be worked out. Some states, including

California, have independently implemented additional regulations, such as controlling refrigerants and including methane and fluorinated gases in their cap-and-trade program.[121] Since 2019, Wyoming has enacted policies that require oil and gas companies to capture or reduce methane emissions and regularly inspect equipment with the goal of reducing methane emissions by 45 percent by 2025.[122]

Focus funding to communities suffering from high pollution by particulates.

Particulate pollution, such as from large agricultural operations, power plants, and diesel trucks, is often concentrated in frontline communities. Many of the health risks can be reduced with investments in closing coal electricity plants and getting diesel trucks off the road, and targeted investments from federal agencies and states in frontline communities will be necessary to both control these pollutants and minimize the health risks.[123] Additional investments should also target improved monitoring and data sharing, which will allow more strategic pollution control.

4.4 Incentivize farmers and other landowners to decrease greenhouse gas emissions and increase carbon sequestration.

Agriculture is responsible for approximately 25 percent of climate-warming pollution through livestock emissions, forest clearing and land degradation, overfertilization, and fossil fuel use in agricultural production.[124] Achieving mitigation targets will require changes throughout the agricultural sector. The best options for solutions will vary by location, climate, crop or commodity, site history, and available management technologies. Those that can increase resilience and can support continued progress on yields are likely to have bipartisan support and show the greatest political feasibility.[125]

Support federal programs that offer training and education in technologies for emissions reduction and carbon sequestration.

Governments and the private sector should provide the technical and financial assistance required to ensure widespread access to emissions-reduction and carbon-sequestration knowledge and tools by all agricultural producers, regardless of income or geography. For example, the omnibus Farm Bill could include expansions of programs such as the Conservation Innovation Grants, which provide funding to develop and demonstrate cutting-edge conservation and emissions-reduction technologies.[126] Similarly, the Environmental Quality Incentives Program provides technical assistance to farmers and ranchers to implement conservation practices on their lands.[127] The focus on market-based solutions and the support for rural communities make both of these programs popular across the political spectrum.

Increase funding for programs focused on researching and implementing emissions reductions and carbon sequestration.

Climate change is also directly impacting farmers, reducing agricultural productivity and worsening droughts. Given the substantial financial risk for farmers in adopting innovative technology, farmers need the expansion of programs such as the Conservation Stewardship Program that incentivize emissions reductions, soil carbon sequestration, or improved conservation on their land.[128] These expansions should emphasize support

for small farms and farms located in communities on the front line of climate change, which have historically been less able to access stewardship funding. As more research is needed to measure soil health and quantify carbon sequestration, the U.S. Department of Agriculture (USDA) should partner with land-grant universities to develop reliable measuring tools.

4.5 Support effective nature-based climate solutions.

Nature-based climate solutions, those using natural processes, systems, and biodiversity to address environmental and societal challenges, can be important tools for reducing emissions and increasing sequestration while protecting biodiversity and improving overall community resilience.[129] Examples of nature-based climate solutions include the protection and restoration of wetlands, grasslands, and forests, as well as the expansion of carbon-sequestering ecosystems, where appropriate. Nature-based climate solutions have the potential to contribute to emissions reduction and also build resilience in local communities. However, many nature-based climate solutions created for carbon offset calculation are of low quality.[130] To combat this, the government should take enforcement action against offset systems that make false or misleading claims about their effectiveness.

Nature-based climate solutions are most attractive when they combine affordable costs with cobenefits such as conservation of biodiversity, water quality improvements, disaster risk reduction, and job creation in local economies. Nature-based climate solutions have been effectively applied in some of the most vulnerable areas in the United States, particularly along the Gulf Coast. The Louisiana Coastal Master Plan includes $1.7 billion for investments in coastal restoration and wetland revitalization.[131] The Alabama Coastal Foundation has worked to restore oyster reefs, which protect against storm surge and erosion, while also improving water quality and growing the local economy.[132]

In addition to providing investments in local communities, these efforts have increased well-being in some of the most vulnerable areas through green sector jobs, greater access to green space, and the preservation of cultural heritage. These cobenefits make nature-based climate solutions popular across the political spectrum: they can appear market-friendly and can appeal to a wide set of values and priorities, such as increasing rural land management and development, conserving nature for fishing and hunting, and promoting environmental justice.[133]

Expand the integration of nature-based climate solutions in climate policy.

Climate policy at the federal, state, and local levels should recognize nature-based climate solutions as key parts of the response portfolio for mitigating climate change. This can include setting targets for carbon sequestration and promoting the use of nature-based climate solutions in emissions-reduction plans. For example, the federal government's Climate Action Plan includes a goal to conserve at least 30 percent of U.S. lands and waters by 2030, an investment in reforestation and restoration of wetlands and other ecosystems, and funding for coastal resilience projects.[134]

Amending existing regulations to better incorporate nature-based climate solutions will increase available funding streams. Many

existing laws and regulations may not explicitly allow for or support the use of nature-based climate solutions, creating legal and regulatory barriers to implementation. Updating laws to better support nature-based climate solutions could help reduce these barriers and facilitate their adoption. For example, amending the Coastal Zone Management Act to require consideration of nature-based solutions, such as living shorelines, as part of coastal zone management planning and decision-making processes would allow frontline communities access to more resilient solutions.

Promote Traditional and Indigenous Knowledge and leadership.

Traditional and Indigenous Knowledge provides valuable insights into climate mitigation options through nature-based climate solutions. For example, many Indigenous communities in the United States have used prescribed fire for thousands of years. Prescribed fire can contribute to climate mitigation by reducing available fuel and promoting the growth of fire-resistant vegetation, which sequesters carbon. The Karuk Tribe in California helps incorporate their traditional ecological knowledge into contemporary fire management practices to promote ecosystem health and resilience while also mitigating climate change.[135] Indigenous-led conservation projects in the United States also protect important biodiversity and carbon storage areas while supporting Indigenous livelihoods and cultural values. For example, the Yurok Tribe in California has established the Yurok Carbon Project, which aims to reduce greenhouse gas emissions and sequester carbon by sustainably managing their forests.[136]

Suncoast Youth Conservation Center (SYCC) kayakers pass through a mangrove forest at Newman's Creek Paddling Trail in Apollo Beach, Florida, in March 2015. This trail and others are a cobenefit of mangrove restoration done by a local nonprofit conservation group supported by federal fundings.

STRATEGY 5: **Ensure Adaptation at All Levels of Society**

Even with improved national strategies for controlling emissions, the country will experience profound effects of global climate change.[137] These burdens will fall disproportionately on marginalized communities and will have consequences beyond our borders.[138] Human migrations, rearranged supply chains, altered transboundary flows of major rivers, and conflicts exacerbated by climate change will all require renewed dialogue and cooperation across communities and countries. Climate solutions will also cause worker displacements and economic shocks as industries transform. Recognizing this alignment of shared vulnerability can be a powerful incentive for building broad coalitions and overall resilience.

Effective adaptation requires engagement at every level of society. Governments, businesses, communities, and individuals all have key roles to play. And every entity or community will benefit from understanding its vulnerability and investing in adaptation.[139] Proactive planning that anticipates future adaptation requirements reduces costs and exposure. Early efforts will empower learning from experience, growing expertise and making it easier to build resilience.

However, adaptation is not as well funded as mitigation, receiving only 7 percent of funds invested in climate action overall.[140] In addition, because of the regional nature of many adaptation solutions, the lack of adequate funding poses significant risk of further perpetuating geographic inequities. Denser, low-income communities may lack the infrastructure, capacity, or capital required for many adaptation solutions and may need additional funding and political support. The burdens and costs of climate change solutions also weigh more heavily on those populations that have already suffered disproportionally from the effects of climate change.

Communities should consider a broad range of options for adaptation, recognizing that the viable solutions will vary by region and time. Local voices must participate in every discussion and decision about adaptation. While this report remains agnostic about the ideal adaptation strategies for any region, the Commission recognizes the advantage of choosing options that deliver cobenefits and minimize adaptation costs for any population.[141]

U.S. Army Corps of Engineers Sacramento District make repairs to the San Joaquin River Levee in California in February 2017.

5.1 Spur increased investment in comprehensive adaptation plans through codevelopment with the federal government, states, tribes, cities, companies, and NGOs, including justice-centered voices from civil society.

Climate adaptation planning is critical for national security and efficient resource use. Without adequate planning, climate impacts will be more disruptive to critical infrastructure such as power grids, transportation systems, and communication networks.[142] Climate will also have greater impacts on food and water security, which are critical for the country's health and well-being.[143]

Despite the importance of these systems, few resources are devoted to city, county, state, and regional adaptation planning. Given the intricacies of preparing society for climate impacts, funding community-based plans is critical for tuning to local needs and opportunities.[144] Normalizing a culture of adaptation planning will also encourage virtuous cycles of continuous improvement.

Federal funding, such as the Department of Housing and Urban Development's National Disaster Resilience Competition grants, has effectively provided communities like those on the Ohio Creek Watershed in Norfolk, Virginia, with the resources to implement adaptation strategies to reduce flooding, improve the local economy, and strengthen neighborhood

connections.[145] This adaptation plan engages several players, including the city, the local community, nonprofit organizations, and architectural firms.

The federal government must mobilize the private sector to develop tools for community adaptation and resilience through public-private partnerships. Investments in green technology, such as sustainable transportation and resilient buildings, benefit both local communities and investing companies. One example is the Rockefeller Foundation's 100 Resilient Cities Initiative, launched in 2013, which provides funding and technical assistance to cities worldwide to develop and implement resilience strategies. The initiative has also received support from private-sector partners such as Swiss Re, Microsoft, and Veolia.

5.2 Improve coordination and accessibility of existing climate resources and investments across federal agencies.

Despite several attempts, the United States remains one of the few countries that lacks a highly coordinated national adaptation strategy. Although local climate adaptation planning is crucial, coordination at the federal level is also necessary for projects that require significant capital or regional cooperation. Every federal department has responsibility for important aspects of climate change adaptation. However, the effectiveness of the policies and investments depends critically on actions by other departments, as well as states, communities, tribes, and companies.

Centralize the federal climate response and develop a comprehensive climate adaptation plan with a clear chain of command.

The White House National Climate Advisor should advance a cohesive climate adaptation plan by forming interagency working groups that will facilitate improved coordination and communication. Key to these groups will be establishing a clear chain of command for climate policy within the federal government that outlines the specific role of every agency. These working groups can also facilitate efficient and equitable distribution of funding resources and spur the creation of additional public-private partnerships.

Improve the federal strategy for prioritizing and coordinating climate investments and data.

A national strategy should include mechanisms for learning from experience, sharing promising practices, and integrating a commitment to justice. It should provide a durable but flexible road map that considers local interests and the needs of vulnerable communities. Adaptation is never one-size-fits-all, but increasing national planning, data, and project coordination is a critical starting point for efficiently allocating scarce resources. Because adaptation technologies will change and the needs of individual communities will vary over time, this strategy should include provisions for periodic assessment of the effectiveness and efficiency of climate spending.

Much of the data needed to help both the nation and local communities develop adaptation strategies already exist.[146] But because of the current difficulty of navigating many sources of federal data, a central element of a national climate adaptation strategy must be the organization and provision of data. The federal government can make the data much more useful by collaborating with states and universities to establish a principal place to access climate data and promising practices. In

Crew members guide a buoy marker in Seward, Alaska, aboard U.S. Coast Guard Cutter HEALY, an icebreaker ship, in 2016. During this trip, Cutter HEALY helped researchers to gather data on the effects of climate change on the Arctic Ocean.

addition, agencies need more clearly defined responsibilities for producing and validating climate data and data on adaptation science and funding opportunities.

5.3 Invest in a diverse portfolio of adaptation options, including both responses to specific threats and broad commitments to building resilience.

Adaptation to climate change will involve large social and economic disruptions. It will be hard to predict exactly which adaptation option will work best in different circumstances. Narrowing the range of options will increase costs, decrease success, and magnify the negative impacts of chosen adaptation technology for frontline communities. Some climate impacts can be prevented using approaches that have long been available, such as early-warning systems and upgraded disaster preparation and response. Other adaptation approaches are broadly acceptable but require substantial capital, including those custom designed to address local risks (such as sea walls or cooling centers) and those that support vibrant economies and ecosystems while also building future resilience. Long-term

Indigenous Knowledge

Indigenous Knowledge refers to the body of knowledge systems and practices that were developed by peoples who have been stewards of the lands and waters of the world, including those of the United States, for millennia. Partnering with Indigenous peoples on adaptation planning helps create responses to climate change that minimize harm to the surrounding environment.[147] Indigenous Knowledge fills gaps in the analysis of changing weather patterns, predicts the occurrence of droughts, helps protect communities from flooding by providing local resources, and leads to the construction of more climate-resilient buildings.

Many reports, including the most recent publications by the Intergovernmental Panel on Climate Change, have explicitly recognized the many benefits and importance of using Indigenous Knowledge in climate research and responses.[148] Because of the success of partnering with Indigenous people on both community acceptance and the results of adaptation projects, multiple federal agencies are intentionally seeking out partnerships with local peoples. The U.S. Geological Survey has started the Strategic Needs of Water on the Yukon (SNOWY) project, which weaves Indigenous Knowledge with hydrology to create regional adaptation plans.[149] Reframing ideas through Indigenous perspectives, such as considering climate continuity, have led to changes in climate responses from researchers and local communities.[150] Indigenous Knowledge also informs and improves existing policy, especially when preparing for large-scale disasters in which poor planning can exacerbate existing inequities.[151] But this crucial resource is still underutilized in adaptation response, especially in the United States. Strategically increasing funding opportunities to support partnerships and learning from Indigenous practices will be necessary for protecting vulnerable peoples and ecosystems while responding to climate change.

options must be more transformative to cope with climate impacts' magnitude and disruptive nature. These will include strategies for relocation, reconstructing ecosystems, and rethinking the relationship between people and the environment.

Invest in learning and sharing promising practices for balanced adaptation strategies across communities.

While specific hazard responses and broad resilience investments can be effective, the United States will benefit most from balancing both approaches, and adjusting the balance according to community needs and circumstances. For example, a community that invests in both gray infrastructure (such as levies and sewer systems) and green infrastructure (such as restoring wetlands) may be better able to withstand floods than a community that only invests in traditional approaches.[152] Similarly, investing in fire-resistant building codes and early-warning systems may offer better wildfire protection than focusing solely on thinning forests.[153] Considering climate adaptation in existing infrastructure development can make resilience more cost-effective and efficient: for example, after Hurricane Katrina, builders used more resilient designs

and incorporated green infrastructure in the construction of new industrial plants.[154] Balancing responses also reduces the negative impacts of specific hazard responses and helps prevent the most vulnerable communities from being unduly impacted.

As the correct balance of adaptation strategies is unknowable at the outset, government and philanthropy must support coordinated efforts to fund adaptation experiments and share promising practices across communities. The Kresge Foundation's Climate Resilience and Urban Opportunity Initiative funded both direct adaptation efforts as well as learning networks for intercommunity dialogue.[155] Through these networks, communities were able to share not only what combination of adaptation efforts worked well, but also strategies for implementation and evaluation.

Increase incentives and requirements for considering cobenefits in adaptation planning.

The federal and state governments, community development organizations, and philanthropies

Living Breakwaters:
Using Green Infrastructure to Build Resilience

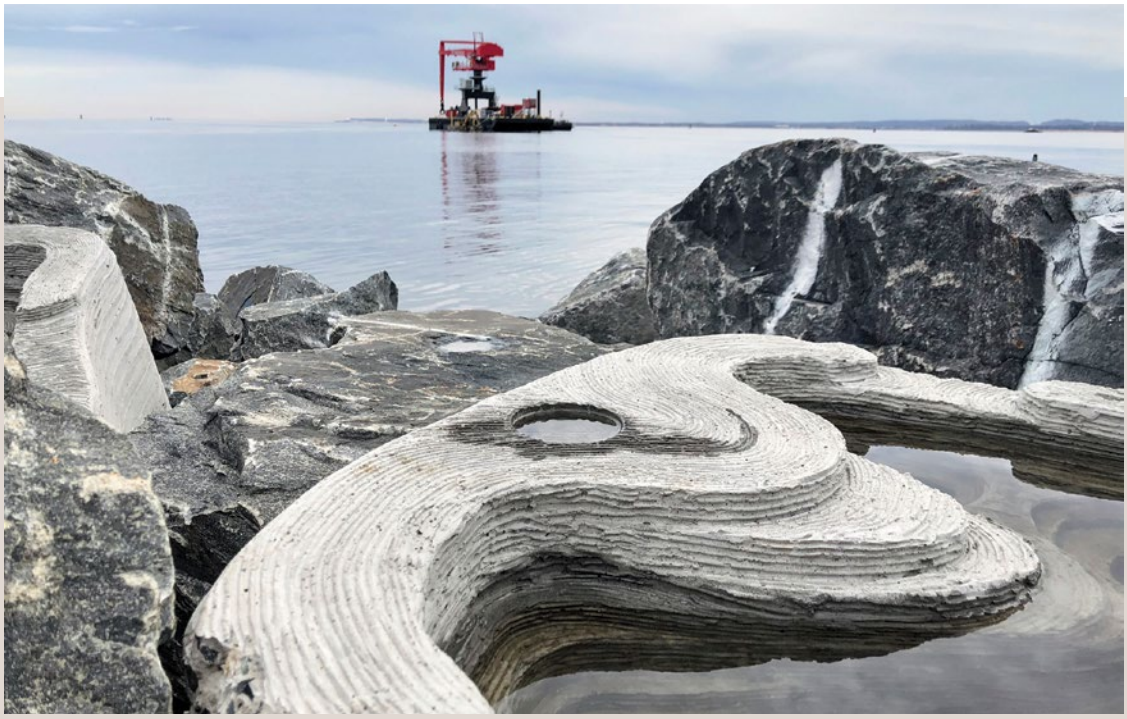
In October 2012, Hurricane Sandy devastated many coastal communities across the Northeast, including throughout Staten Island, New York. The storm and resulting flooding caused injuries and fatalities and destroyed many homes. These tragedies emphasized the extent to which decades of pollution, oyster overharvesting, and dredging had destroyed natural barriers that previously buffered much of the greater New York–New Jersey Harbor from storm surge and erosion. In collaboration with New York State and other organizations, the landscape architecture firm SCAPE developed a plan for a 1.5-mile necklace of "living breakwaters" off the South Shore of Staten Island to help reduce flood risk in the neighborhood of Tottenville, which was hit particularly hard by Sandy.[156]

Now under construction, the breakwaters are built of stone and biologically enhanced concrete units configured into rocky crests that reduce damaging waves and help reverse coastal erosion. Some breakwaters also feature structural modifications called "reef ridges" and "reef streets," which introduce a mosaic of intertidal habitat space for fish, oysters, and other marine species. After construction is complete in 2024, the Billion Oyster Project, a New York–based nonprofit, will assist with oyster restoration through methods including seeding young oysters on the breakwaters and installing oyster, clam, and scallop shells recycled from New York restaurants to encourage reef growth. As the reef grows over time, it will boost the breakwaters' ability to reduce waves, enhance water quality, and foster marine biodiversity.

The Living Breakwaters project also aims to build social cohesion onshore by engaging with and educating the local community. SCAPE and the Billion Oyster Project collaborated to develop an open-access Living Breakwaters Curriculum, which has been taught in local schools and is available online. This curriculum provides teachers with lesson plans that engage students on topics

should invest in strategies that consider comprehensive adaptation efforts with known cobenefits for the environment and human health and well-being. In addition to being lower cost and having high degrees of public support, investing in adaptation options with cobenefits to health and well-being advances environmental justice by addressing the underlying social determinants of health, reducing existing disparities through green infrastructure, and building social cohesion.[157]

Implementing these changes will require a combination of government incentives and increased regulatory requirements. Several states, such as Massachusetts and Minnesota, have adopted the Health in All Policies framework, which incentivizes funding for projects that consider the impacts of climate policies and projects on the determinants of health.[158] This framework also creates accountability metrics to measure and evaluate project performance.



Living Breakwaters is a climate adaptation project in Staten Island, New York. Prompted by funding after Hurricane Sandy, the breakwaters reduce the risks and damages of extreme weather.

such as resilience, risk reduction, and local ecosystems, using the project as a case study for these themes. The curriculum also acknowledges that although the breakwaters reduce risk, climate change still presents continued threats to the community.

This public-private partnership demonstrates the potential for large-scale ecosystem restoration in severely degraded environments and can serve as a model for similar projects at a national and global scale. When complete, Living Breakwaters will have created and strengthened marine ecosystems, reduced risk to the island's vulnerable shoreline, and reached thousands of New Yorkers through outreach and education.

5.4 Identify and eliminate perverse incentives that have impeded efforts to understand and respond to climate-related risks.

Federal policy and funding influence behavior. Though the federal government has increased financial support for overall climate policy through the Bipartisan Infrastructure Law, the Inflation Reduction Act, and other recent climate initiatives, existing policies still incentivize risky behavior or undercut efforts to enact effective climate responses.

These perverse incentives are best represented in the federal response to natural disasters.[159] The federal government shoulders the majority of recovery costs through the Federal Emergency Management Agency (FEMA), USDA, and other agencies, investing an average of seven times more into recovery efforts than resilience. In addition, FEMA and the National Flood Insurance Program fund extensive rebuilding after disasters, even in areas vulnerable to repeated disasters that have already caused financial losses to insurers.[160] This practice blunts the incentive for individuals, firms, and governments to find ways to reduce future risks.

Climate change will devastate much of the nation's critical infrastructure, particularly coastal installations such as military bases and ports. Though several ports have undergone resilience planning, other port administrations believe they are too big to fail and opt for the costlier route of taking government funding to restore damaged infrastructure.[161] Policies that disincentivize climate action are not limited to disaster response. The Colorado River Basin has a complicated history of water rights, involving "use it or lose it" access to water. This policy incentivizes farmers to use all the water allocated to them, even if it is much more than needed, and discourages shifts to more climate-resilient, less water-intensive crops. In May 2023, after years of deadlock, the states that access the river's water reached an agreement that allows the federal government to pay irrigators, cities, and tribes to reduce their water usage. However, even after this compensation, the reductions in usage are still significantly less than the drop in water supply due to climate change.[162] As many rivers across the country continue a historic period of drought, further alternatives that allow climate-friendly uses of water must be enacted.

Create a federal initiative to identify and rectify perverse policies across all agencies.

Establishing policies that will reform perverse incentives without creating unintended consequences requires significant investment in research and analysis that includes input from policy-makers, industry representatives, and affected communities. A federal interagency task force that identifies perverse incentives in existing regulation and develops a plan of action will be necessary to avoid inadvertent outcomes.[163] This taskforce should also develop standards for impact assessment to minimize perverse incentives in future regulations.

In the long-run, proactive resilience planning for climate disasters is more cost-effective, timely, scalable, and just than reactive disaster response. Despite this being well known for decades, shifting toward an adaptation planning mindset has been held up by political and more-immediate economic considerations. For example, it is not politically popular to withhold relief after disasters to send a message about the necessity of early adaptation, or to enact policies that encourage community relocation. Therefore, much of the struggle is building political will for necessary but unpopular policies.

Conclusion

When we began this Commission in 2020, the thirty-one of us held different ideas about climate action and used different terms to articulate these visions. Three years later, diversity and disagreement across our Commission remain. What has transformed instead is our understanding of how important each Commission member's sectors and communities are to advancing action on the climate crisis. Through our dialogue, we have found shared values underneath our different terms and approaches. Other times, we remain in disagreement, but recognize the necessity of varied approaches to accelerating progress.

For our world to have both the capacity and the will to engage with the problems ahead, society must experience this same transformation of perspective.

Forging Climate Solutions offers a vision for this future, a future when disparate groups recognize the urgency of climate change and work to speed up decarbonization and resilience-building despite ideological differences. If these actions center justice, are rooted in effective communication, unleash investments, and take a balanced approach to mitigation and adaptation, we open a path to dramatically accelerating climate solutions.

The country and the world must act now. Some of the actions detailed in this report can—and must—be accomplished in the next five years. Other endeavors will require time to achieve fruition, but it is imperative that the underlying research and planning begin now. And while we must act with speed and efficiency, we cannot ignore the needs of frontline communities. The work we do to solve the climate crisis must increase equity, not perpetuate or intensify existing harm.

Climate action must not exist in a bubble. To anchor larger societal change, it must be integrated into the myriad other priorities of the nation, such as reducing energy costs, improving health outcomes, and ensuring national security. Only by collectively advancing these interrelated goals can climate shift from an isolated issue promoted by environmental policy-makers to a core priority built into the fabric of American society.

Thankfully, the United States is primed for climate action. This report is published at a time of intense legislative and executive action, demonstrated involvement by corporations, and genuine interest from the broader public. *Forging Climate Solutions* also appears in the context of increasingly visible and harmful effects of climate change, further underscoring the need for sustained and unified action. We must seize this opportunity, as waiting will only make the challenges and changes required greater.

With concerted effort, there is hope for our future. We see motivation for accelerated climate action, creating decisive reductions in

emissions and improved preparations across the country to deal with the physical effects of climate change. The necessary actions are highly dispersed across society and the political system. Each must do its part, guided by a common vision for how these efforts are pragmatic, just, and accountable. Only together can we hope to effectively confront the challenges posed by climate change and foster a future that safeguards the well-being of future generations in the United States and beyond.

Members of the Commission on Accelerating Climate Action meet at the Knight Foundation in Miami, Florida, in 2023.

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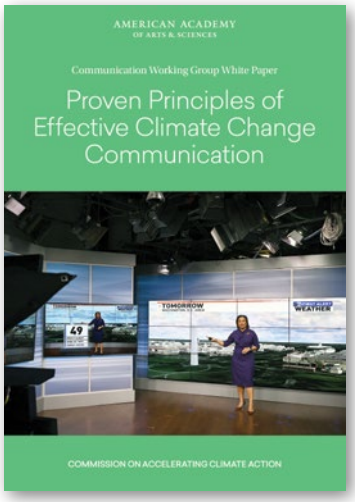
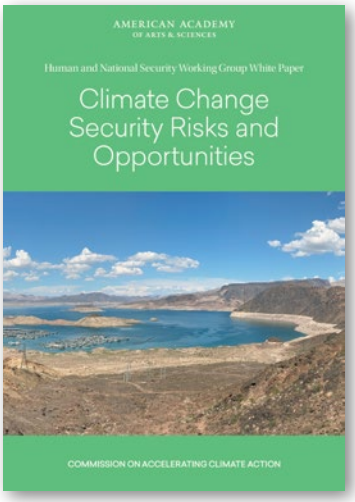
Also from the **Commission on Accelerating Climate Action**

THE COMMISSION ON ACCELERATING CLIMATE ACTION was launched in 2021 to identify solutions to climate change. The first phase of the work explored the landscape through interviews with seventy issue-area experts across three working groups in Communication, the Private Sector, and Human and National Security.



The Communication Working Group developed twelve principles for effective climate change communication, ranging from communicating consensus on climate change to framing climate change through impacts that audiences will relate to. Using examples from across the media landscape, the two publications of this working group highlight needed changes to the ways that climate is discussed broadly.

The Private Sector Working Group compiled barriers to action in the private sector, identifying key challenges business leaders face and how such challenges may be overcome with changes to staffing, strategic partnerships, and long-term planning.



The Human and National Security Working Group considered how climate action is impeded by ineffective communication, unmanaged risks, and lack of integration with frontline communities. Using the Colorado River Basin and the Gulf Coast as case studies, the two publications of this working group feature analysis of key problems preventing effective action and suggest paths forward for managing the security risks caused by a changing climate.

www.amacad.org/climate

Whispers of Change: America's Climate Call

In the rhythm of Earth's hushed plea,
From wildfire's dance to storm-tossed sea,
America, awake, our journey's not done,
Unified action, together we run.

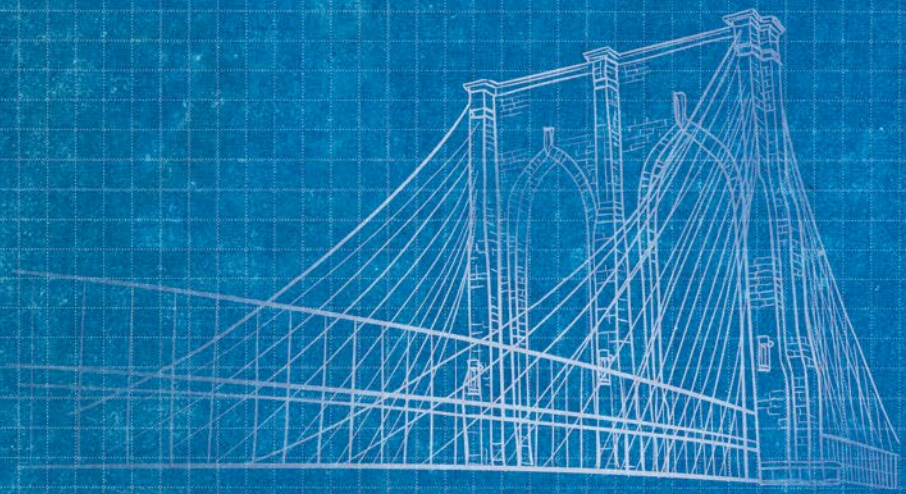
For a fair bargain, we stride and stand,
A nation diverse, across this vast land,
Equity whispers, justice must sing,
For in every heart, change must ring.

Oceans whisper tales, islands ablaze,
Floods wash dreams, in a haunting haze.
Heat wraps us close, an unwelcome embrace,
Yet in this challenge, a coalition takes place.

No silver bullet, no magic cure,
But in every action, our commitment sure.
Learning and growing, the signals we send,
A pact for the future, on which we depend.

Justice's call, for all to hear,
Marginalized voices, we bring them near.
Disruption awaits, transformation anew,
Companies, communities, the old and the new.

For in the dance of sun and rain,
Together we heal, together we gain.
America, listen, in unity we trust,
For in this climate crisis, together is a must.



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