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Testimony on the Development and Deployment of Large-Scale Carbon Dioxide Management Technologies

United States Senate
Committee on Energy and Natural Resources

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Chairman Murkowski, Ranking Member Manchin, and members of the committee, thank you for convening this hearing on the development and deployment of large-scale carbon dioxide management technologies in the United States. BPC's Energy Project has a number of initiatives underway that relate directly to carbon dioxide management and I appreciate the opportunity to share our views on this important subject. My testimony today focuses specifically on options for removing carbon dioxide that is already in the atmosphere, but it is worth emphasizing at the outset that BPC subscribes to an "all of the above" approach to addressing climate change. Technologies that reduce or avoid further emissions, including low- and zero-carbon fuel and electric power alternatives, energy efficiency, and carbon capture, storage, and utilization systems for large point sources of emissions are obviously all part of the solution, together with the carbon dioxide removal options I'll be discussing here. In short, the scale of the challenge is so large, and the stakes are so high, that we simply must be able to draw on a large, diverse, and flexible toolset of policies and technologies to succeed.

For this hearing, I'd like to emphasize five key points:

- Carbon dioxide removal strategies, including both natural and technology-based strategies, will be needed along with emissions reduction strategies to meet national and international climate change goals. Because it won't be practically and economically feasible to eliminate all human-caused sources of greenhouse gases over the next few decades, we need ways to also pull carbon dioxide out of the atmosphere to achieve net-zero emissions.
- Effective carbon removal strategies are needed to diminish the economic disruption and dislocation that is inevitable as our nation makes the necessary transition to a net-zero emissions profile over the next three decades.
- Experience shows the constructive and often vital role that government support can play in spurring innovation and nurturing new industries. This support can take different forms, as appropriate, at different points in the innovation cycle, from funding research, development, and demonstration (RD&D) to providing a policy and market environment in which new technologies can gain a foothold and become commercially successfully.
- Congress and this committee can take a number of steps to meaningfully advance large-scale carbon dioxide management technologies and strategies. Doing so would deliver near-and long-term benefits in terms of economic competitiveness, flexibility to meet climate objectives, farm and forest productivity, and other environmental co-benefits (clean water, ecosystem protection, etc.).
- Different types of carbon dioxide removal strategies present different challenges. Direct air capture of carbon dioxide or "DAC" is a new technology that requires additional RD&D and financial support to achieve the cost reductions and performance improvements needed to enable large-scale deployment. By contrast, farm- and forest-based solutions are available and can be implemented now but are hampered by a lack of durable market and policy drivers to catalyze needed long-term investments in improved land management and carbon monitoring and accounting approaches.

1. Introduction

The Bipartisan Policy Center (BPC) is a Washington, D.C.-based think tank that actively fosters durable bipartisan solutions to critical public policy challenges by engaging with good ideas from across the political spectrum. BPC's Energy Project focuses on advancing policies and technologies that promote American prosperity, economic competitiveness, and energy security while also addressing the problem of climate change and accelerating the transition to low- and zero-carbon technologies. As detailed later in this testimony, three ongoing BPC Energy Project initiatives are especially relevant to this hearing: the American Energy Innovation Council, which was founded in 2010, consists of 11 corporate leaders and is dedicated to promoting clean energy innovation; our Direct Air Capture Advisory Council includes industry, business, and policy leaders and is working to advance DAC technology; and our recently launched Farm and Forest Carbon Solutions Initiative focuses on natural carbon removal through land-based strategies that also create new economic opportunities for rural and farm communities.

My testimony today begins by discussing the imperative to remove carbon dioxide from the atmosphere—in conjunction with concerted efforts to reduce and avoid new emissions—to achieve a net-zero-carbon economy. I'll then turn to the challenges and opportunities associated with two different approaches to carbon dioxide removal: direct air capture or DAC, in which mechanical and chemical processes are used to extract carbon dioxide from the air (once captured, the carbon dioxide can be used in other industrial processes or products or permanently stored in geological reservoirs), and farm- or forest-based strategies that increase the uptake and storage of carbon dioxide from the atmosphere in soils and biomass. The last part of my testimony suggests specific actions Congress and this committee can take to support the development and deployment of these "negative emissions" strategies and summarizes BPC's near-term plans for work in this area.

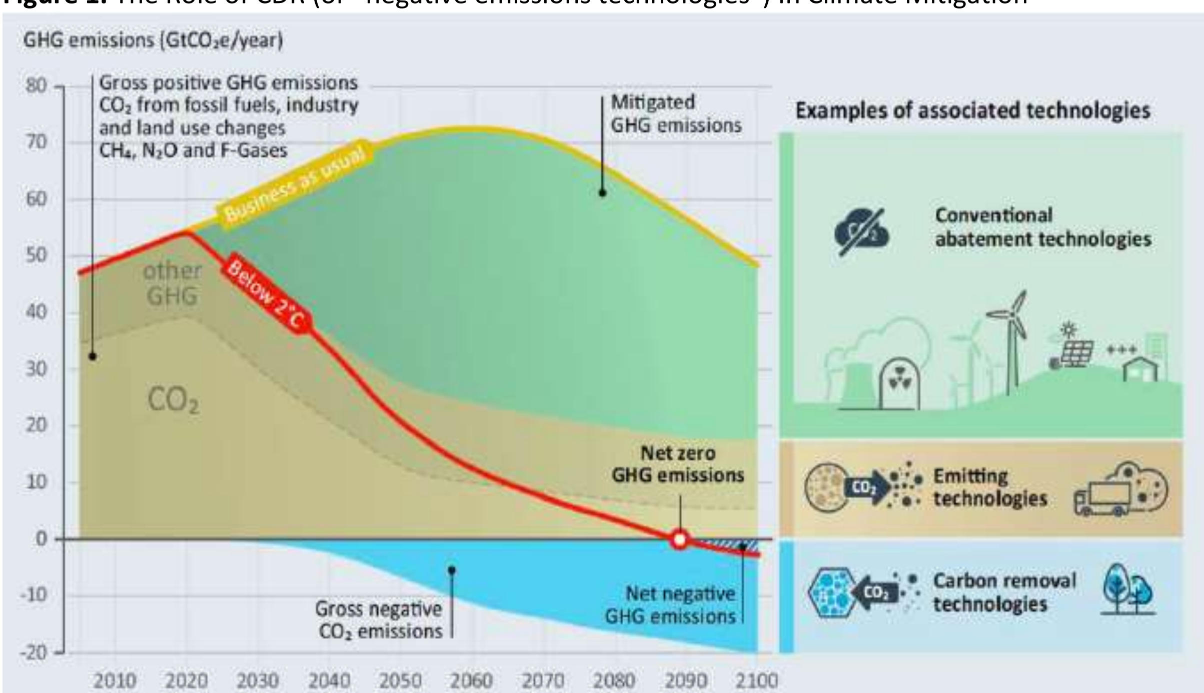
2. Carbon Dioxide Removal is Needed to Achieve "Net Zero" Greenhouse Gas Emissions

Recent years have brought the risks of climate change into clearer focus and strengthened the scientific case for urgent action to limit rising levels of greenhouse gases in the atmosphere. To meet internationally accepted climate goals, experts agree, net emissions globally will have to be reduced to nearly zero by roughly 2050—meaning that within a mid-century timeframe, remaining human-caused releases of carbon dioxide and other greenhouse gases into the atmosphere will have to be balanced by an equal quantity of carbon dioxide removed. The dimensions of this challenge are difficult to overstate given the scale of the energy systems involved and the variety of sources, from agriculture and industrial processes, to power plants and cars, that contribute to the problem.

While attention has long focused on technologies for reducing or avoiding new emissions, recent years have also seen increased interest in strategies for actively removing carbon dioxide from the atmosphere. This interest reflects a growing recognition that while commercially viable options for rapid decarbonization already exist in some sectors—the electric power industry, for example, has recently seen strong growth in the use of wind and solar technologies—low and zero-carbon options have yet to emerge or remain prohibitively expensive for other energy-use applications such as long-haul air travel and marine shipping. Adding to the overall challenge of getting to zero carbon are the various nonenergy sources that also produce greenhouse gases: some industrial processes, for example, generate carbon dioxide as a direct by-product of chemical reactions. According to a recent report released by the International Energy Agency, "key technologies the energy sector needs to reach net-zero emissions are known today, but not all of them are ready."[1]

Given that some level of dependence on fossil fuels is likely to continue well into the second half of this century, several expert organizations have concluded that active carbon dioxide removal (CDR) strategies—sometimes also called "negative emissions technologies" (NETs)—will be essential. For example, a synthesis report issued by the United Nations in 2019 highlighted the need for "immediate and all-inclusive action encompassing deep decarbonization complemented by ambitious policy measures, protection and enhancement of carbon sinks and biodiversity, and *effort to remove CO_2 from the atmosphere*" (emphasis added).[2] In 2018, a special report by the Intergovernmental Panel on Climate Change (IPCC) similarly noted that *all* modeled pathways for limiting warming this century to 1.5°C project the use of CDR.[3] And the National Academy of Sciences has concluded that negative emissions technologies will need to play "a significant role," for the simple reason that deploying such technologies "may be less expensive and less disruptive than reducing some emissions."[4]

Figure 1. The Role of CDR (or "negative emissions technologies") In Climate Mitigation[5]



Fortunately, several options exist for removing carbon dioxide from the atmosphere, some of which rely on natural processes (such as photosynthesis) while others make use of chemical and mechanical processes. Direct air capture is a technology-based approach for extracting carbon dioxide from the ambient air; once captured, the carbon dioxide can be used in other applications or permanently stored so it can't re-enter the atmosphere. Other strategies aim to increase carbon uptake by forests or soils, for example through afforestation (planting new forests) and reforestation (replanting previously forested lands), or by restoring degraded lands and changing agricultural practices. Bioenergy with carbon capture and storage (BECCS) is another negative emissions option: In this approach, biomass energy plants are paired with systems for capturing the resulting carbon dioxide emissions at the point of discharge and permanently storing the carbon dioxide away from the biosphere. Other options that have been identified under the broad heading of CDR strategies include enhanced weathering to promote carbon mineralization (essentially, exposing reactive minerals in rock to bind with carbon dioxide in the atmosphere) and ocean alkalization.[6]

Known strategies for carbon dioxide removal, as the IPCC has pointed out, "differ widely in terms of maturity, potentials, costs, risks, co-benefits and trade-offs."[7] BPC's current work, and my testimony today, focus on two specific approaches to carbon dioxide removal—direct air capture (DAC) and land-based strategies—that we believe hold promise for widespread deployment in the timeframe needed to achieve current climate goals. Of these two options, DAC is less advanced but offers important potential advantages in terms of siting flexibility and scalability that justify near-term federal investment to accelerate the process of technology development, demonstration, and commercialization. Land-based CDR strategies, by contrast, have been studied for some time and could be deployed at scale almost immediately if the funding and interest were there. For these strategies, the salient challenges are not so much technological—rather a lack of market or policy drivers constitutes the chief obstacle to investment despite the substantial economic and environmental co-benefits such strategies often deliver.

The next sections of this testimony discuss the opportunities and challenges for DAC and farm- and forest-based carbon sequestration in more detail and suggest some areas where we would urge the committee and Congress to consider a more active federal role.

3. Direct Air Capture

The concept of capturing carbon dioxide in the ambient air has been around for some time, but DAC technology as a potentially important tool for addressing climate change has only recently come to the attention of policymakers, investors, and industry. The appeal of DAC is that it offers nearly unlimited carbon dioxide removal capability, provided costs can be sufficiently reduced and systems for transporting and storing captured carbon dioxide can be developed. Longer term, the United States has ample capacity to sequester large quantities of captured carbon dioxide in saline aquifers and other geological reservoirs. In the near-term, however, the economics may favor pairing DAC with existing markets for carbon dioxide in applications such as cement production and enhanced oil recovery.

A variety of DAC systems have been proposed and a few small operating DAC facilities have been constructed in the United States, Canada, and Europe.[8] All of these systems use fans to move large quantities of air through a filter or a liquid, which contains chemicals that bind to the carbon dioxide in the air. In some designs, the carbon dioxide is first turned into a solid that will release pure carbon dioxide gas when heated; in other designs the filter or sorbent is directly heated to produce a concentrated stream of carbon dioxide. Because of these steps, DAC systems require energy to operate; depending on the specific design, they typically also require inputs of chemicals and water.

Costs estimates for DAC vary widely. Costs for early systems were reported to be as high as $600 per ton of carbon dioxide captured; more recent reports from DAC developers claim costs as low as $100 to $200 per ton or less. The European company Climeworks, for example, aims to drive costs down to around $100 per ton within 10 years.[9] In the United States, several projects are at the pilot stage or under development. Carbon Engineering, a Canadian company, has one plant in British Columbia and aims to build another plant in partnership with Occidental Petroleum in the next couple of years in west Texas. An American company, Global Thermostat, has pilot plants in California and Alabama, a demonstration project under construction in Oklahoma, and plans to build a technology center in Colorado.

As a candidate to provide additional, large-scale CDR capability, DAC offers important advantages—particularly with respect to scalability and siting flexibility. DAC plants can be large or small, and because they rely on industrial processes, they can be controlled and adjusted as needed. DAC capacity can also be added in increments, using modular systems, which allows for flexible expansion as the need or opportunity arises. Siting flexibility makes it possible to locate DAC systems where low-cost and preferably low- or zero-carbon energy sources are available (e.g., waste heat or renewable energy) and where competition with other land uses is not a concern. And unlike systems that capture carbon dioxide from more concentrated exhaust gas streams, DAC plants need not be co-located with major emissions sources such as power plants.[10] Finally, siting flexibility means that DAC plants can be located in settings that are favorable for the permanent geological storage of captured carbon dioxide (e.g., atop saline aquifers) or where commercial opportunities exist to use the carbon dioxide.

Overall, a recent modeling assessment[11] put the global potential for carbon dioxide removal and storage using DAC at 16–30 billion metric tons per year in the 2070–2100 timeframe under different deep decarbonization scenarios and economic and technical assumptions. The study authors found that deploying DAC "significantly reduces mitigation costs" and "complements rather than substitutes other NETs." The authors also concluded that the key factor limiting DAC deployment is the rate at which the technology can be scaled up.

In light of this potential, extending America's record of leadership in innovation to DAC technology could have substantial benefits, not only in terms of achieving domestic climate mitigation goals but in tapping a large and growing global market for net-zero-carbon technologies. Other positive economic impacts would be more immediate: The Rhodium Group, for example, has estimated that the build out and operation of a single DAC plant with a carbon dioxide capture capacity of 1 million tons per year would create more than 3,400 jobs, including nearly 300 ongoing jobs to operate and maintain the completed facility.[12] A thriving DAC industry would also increase demand for high-quality jobs in steel, cement, chemicals, industrial equipment manufacturing, construction, engineering, and electric power, among others.

To realize these benefits, however, important cost, technology, and scale-up challenges still have to be overcome. Experience with a wide range of technologies, in energy and other sectors, suggests that rapid cost reductions and successful commercial deployment are possible if promising innovations can be nurtured through the early stages of technology development. (The striking cost reductions achieved by wind and solar energy technologies over the last two decades provide a dramatic illustration of this point). Moreover, the U.S. government has often played a vital role in the innovation cycle, by funding basic research and development, sponsoring or supporting demonstration projects, and enacting policy changes that help create markets for new technologies. We therefore applaud recent efforts by Congress to provide funding and other support for DAC development, as discussed in Section 5 of this testimony.

4. Farm and Forest Natural Carbon Solutions

Farm- and forest-based strategies represent another important category of CDR options. Among their key advantages, these natural carbon solutions (1) employ technologies and land management practices that are ready for implementation today, (2) are comparatively low-cost options per ton of carbon removed from the atmosphere, and (3) provide important co-benefits to the local environment (e.g., improved water quality and wildlife habitat) and to local economies in predominately rural areas (e.g., sawmills, wood products manufacturing, farming). Farm- and forest-based strategies encompass a variety of land management practices that remove carbon dioxide from the atmosphere by plant photosynthesis and store it in soils and forest biomass. Many individual farmers, ranchers, and forest managers use carbon-storage-enhancing land management practices today, but primarily for other reasons such as soil erosion control, crop and forest productivity, and wildlife habitat. Stronger policy and program support is needed to scale up practices and to streamline and improve measurement and accounting of carbon removal benefits.

The National Academy of Sciences estimate that the U.S. can store an additional 500 million metric tons of carbon dioxide per year—or about 9 percent of the nation's annual greenhouse gas emissions—through a mix of carbon-enhancing practices on croplands, grasslands, and forests.[13] This is a central estimate with current practices that do not involve using protected forest areas or compromising food supply or biodiversity. Achieving this level of additional carbon storage will require the widespread participation of private land managers, but public land managers and the federal research enterprise will also be critical to scaling up natural carbon removal. BPC's recently launched Farm and Forest Carbon Solutions Initiative has identified an initial set of wide-ranging policy options that we urge Congress to consider. We believe these options have substantial potential to garner broad bipartisan support.

Specific policy priorities that fall within the purview of the Energy and Natural Resources Committee include:

- Scaling up carbon removal in federally managed forests. Reforestation, restoration, and improved forest management are key practices to sequester more carbon in trees. Reforestation is the re-planting of trees on land that was once forested. Restoration involves actions designed to recover lost or degraded forest structure, ecological functioning, and biodiversity. Restoration improves overall forest health and resilience to pests, diseases, and wildfire that can kill trees and cause carbon loss. Improved forest management involves a wide variety of practices that can increase the rate of carbon removal by forests, including thinning to promote growth, expanding harvest rotations to grow larger trees and maintain carbon removal rates, and treating areas affected by pests and diseases.
- Scaling up carbon removal in federally managed grasslands. Restoration of native grasslands can significantly improve soil health, increase soil carbon sequestration, and improve the resilience of the landscape to wildfire. Grassland buffers can also be used along streams to sequester

carbon in the soil. Support for sustainable grazing practices on federal lands can have significant carbon removal benefits. For example, rotational grazing (when animals are moved around to different pastures) encourages plants to send out more and deeper roots, which increases soil biomass and sequesters carbon from the atmosphere.

- Investing in improved soil monitoring and research. Soils represent a significant pool of stored carbon, but further research is required to understand the dynamics of soil carbon fluxes and to develop better carbon monitoring methods and land management practices for effectively increasing stored soil carbon. Further research, including field and lab trials, is also needed to investigate how working lands benefit from increased soil carbon and to estimate the economic value of implementing soil management practices that increase carbon sequestration. Genomic development of the root systems of biofuel crops is a key area for research into improving the economic value and carbon sequestration potential of specific types of crops.

Cost estimates for agricultural and grassland soil carbon storage practices are in the range of $30–$100 per metric ton of carbon dioxide removed, while forests fall in the range of $10–$100 per metric ton, depending on the specific practice and region of implementation.[14] These costs are comparatively low relative to other identified CDR options available today, and many measures to enhance carbon sequestration also align well with the goal of making U.S. farm and forestry operations more resilient to changing economic and climate conditions. Common co-benefits include increased productivity and yields, cleaner water, greater drought resilience, improved wildlife habitat, open space conservation, and increased rural economic opportunities.

Job creation in forestry and agriculture is an economic benefit of increased investment in enhanced carbon sequestration practices—one that may have particular appeal in the aftermath of the current COVID crisis. According to the Economic Policy Institute, a total of 13.4 direct, indirect and induced (DII) jobs are created for every million dollars of final demand in the forestry industry.[15] Direct jobs are jobs specifically related to an industry, indirect jobs support the industry, and induced jobs result from the increased spending of those employed in direct and indirect jobs. In agriculture, the estimate is 16.0 DII jobs and 14.4 DII jobs created per million dollars of final demand in crop agriculture and animal production, respectively. Further, support activities for agricultural production and forestry contribute 11.8 jobs for every $1 million in final demand. Agriculture and forestry are traditionally rural industries that create jobs and generate positive local economic impacts, including for many rural Native American, Alaska Native, and indigenous communities.

Despite their advantages, natural CDR strategies are not being widely implemented today due to a lack of consistent national demand for the climate benefits of forest and soil carbon sequestration. These climate benefits are typically valued based on their ability to compensate for, or offset, greenhouse gas emissions that occur elsewhere. A carbon offset is a unit representing the reduction or removal of one metric ton of carbon dioxide (or its equivalent). Governments and the private sector have created two systems to monetize and stimulate demand for carbon offsets: (1) regulatory programs that create compliance carbon markets, and (2) voluntary carbon markets that satisfy individual and corporate climate commitments. These markets have been instrumental in mobilizing private capital for natural CDR deployment, but they have had mixed success in creating steady demand for carbon offsets. The growth of compliance markets in the United States and internationally has been hindered by lengthy and expensive project approval procedures and changing eligibility rules. Trading volumes in the voluntary market have been limited given that demand is created only by voluntary buyers (corporations, institutions, and individuals).

Beyond carbon markets for offsets, various government incentive programs at the state and federal levels provide financial compensation and technical assistance to private landowners and managers to improve forest, soil, and rangeland health. These programs have been successful in expanding implementation of forest and soil carbon-enhancing practices among participants, but they have enrolled only a small percentage of private farms and forests.

Natural CDR strategies also present methodological challenges related to data measurement, verification, and carbon accounting issues that have long been debated within the climate policy community. At the heart of the debate is the tension between two primary goals: (1) providing clear incentives and simple accounting approaches to support straightforward implementation and encourage widespread landowner participation, and (2) establishing the measurement, monitoring, and verification protocols needed to ensure that claimed sequestration benefits have actually occurred. Related to this second point are issues of permanence and how to address the risk that carbon sequestered by a project may be reversed (i.e., released back to the atmosphere). Forests and agricultural lands are vulnerable to carbon reversals from natural and human-caused disturbances including harvest, wildfire, and conversion to other land uses. Most carbon accounting protocols address the permanence issue by including mechanisms to account for potential carbon losses—for example, by requiring a buffer pool, which holds a portion of carbon credits from a project in reserve to draw from in the event of an unexpected disturbance.

5. Considerations for Federal Policy

A first priority for members of this Committee should be passing the American Energy Innovation Act, which contains a number of critical provisions addressing carbon capture and CDR strategies. We particularly commend Chairman Murkowski and Ranking Member Manchin for their work on this bill, which, among other provisions, expands research into carbon capture technologies and establishes a program for developing CDR technologies at scale. Strategies such as creating a DAC prize competition, test center, and pilot and demonstration program can all be effective in generating the breakthroughs needed to push this technology forward.

In fact, one of the reasons the European company Climeworks has been successful in developing DAC facilities despite the absence of a larger market driver is because it received considerable funding from the European Union (i.e., EU Horizon 2020 and incubators). By contrast, the United States still has no operating commercial DAC facility. In the coming months, BPC's own DAC advisory council, which includes former political leaders such as Mississippi Governor Haley Barbour and former Senator Byron Dorgan, will be exploring additional opportunities to close this gap by focusing on business models that can help jumpstart investment in DAC projects. projects

In addition, BPC recommends that Congress extend by five years the 45Q tax credit for geologic storage of carbon dioxide to account for delays by the IRS in issuing final guidance related to use of the credits. We also recommend the passage of direct pay tax provisions that apply to the 45Q tax credit to support the deployment of commercial-scale carbon capture in the United States. Further, consideration should be given to 45Q expansion to incentivize direct air capture.

BPC applauds recent congressional efforts to fund nascent DAC research, development, and deployment programs at the Department of Energy (DOE) as part of FY 2020 appropriations. The provision of $35 million for DAC research and development across multiple DOE offices, specifically the Office of Fossil Energy, the Advanced Manufacturing Office and Bioenergy Technologies Office, and the Office of Science, is a welcome step and gives DOE flexibility to determine appropriate research priorities and collaboration strategies. In addition, provisions from the SEA FUEL Act that were included in the FY 2020 National Defense Authorization Act provide $8 million to the Department of Defense for R&D on direct air capture and ocean carbon capture. Together, these early investments can provide a foundation for expanded federal efforts to advance DAC technology in future years.

A more active federal role could also be decisive in expanding on-the-ground implementation of forest and soil carbon practices—particularly in public forests, grasslands, and rangelands managed by the U.S. Forest Service, Bureau of Land Management, National Park Service, and other agencies of the Department of Interior. Practices can be focused on areas that are in need of ecological restoration and that are near the wildland–urban interface, where certain forest and soil carbon practices have the added benefit of reducing the threat of wildfire to people and property. Expanding wildfire and hazardous fuels programs at federal land management agencies is also critical to reduce wildfire-induced carbon losses in forests and grasslands.

In addition, we urge Congress to continue supporting research programs related to forest and soil carbon at the U.S. Geological Survey, the DOE National Laboratories, and the Advanced Research Projects Agency–Energy. Priorities for further study and policy development include improving and simplifying measurement and verification protocols for natural carbon sequestration, particularly in soils, in order to streamline implementation, reduce transaction costs, and boost project participation.

Finally, BPC has developed a broad set of recommendations for leveraging U.S. agriculture and forest carbon opportunities in recovering from the economic fallout of the COVID crisis.[16] We specifically call the committee's attention to the below subset of BPC recommendations that particularly benefit rural industries and create jobs, many of which are outdoors and conducive to social distancing:

- Congress should provide an additional $35 to $50 million per year in funding over four years for the U.S. Forest Service's Collaborative Forest Landscape Restoration Program (CFLRP). The program provides grants that cover up to 50% of the cost of carrying out and monitoring restoration treatments on national forests. Many projects under the CFLRP have gone through National Environmental Policy Act review and could be initiated quickly with additional funding.
- Congress should provide additional funding for Interior Department hazardous fuels reduction programs on public lands managed by the National Park Service, U.S. Fish and Wildlife Service, Bureau of Land Management, and Bureau of Indian Affairs.
- BPC recommends lifting the cap on the Reforestation Trust Fund (RTF) to $60 million per year and funding the U.S. Forest Service at that full amount to implement reforestation projects in National Forests. This is similar to the Reforestation Act introduced this Congress. The RTF, which was established in 1980 to reforest public lands impacted by wildfire, pests, disease, or timber harvests, is funded by existing tariffs imposed on imported timber and wood products. Lifting the cap would not raise tariffs.

- Additional funding for the U.S. Forest Service Wood Innovation Grant Program and the Rural Revitalization Technologies Program would help diversify rural economies by fostering opportunities for innovative wood products, such as cross-laminated timber. These grants promote the use of wood in commercial building construction and broaden wood products markets. BPC recommends federal funding of $40 million over four years for the Community Wood Energy and Wood Innovation Program and $20 million over four years for the Rural Revitalization Technologies Program.
- BPC recommends additional funding for the U.S. Forest Service Jobs Corps Civilian Center Wildland Fire Program and the AmeriCorps National Civilian Community Corps to (1) increase the number of certified wildland firefighters and (2) increase the number of trained workers available for completing necessary conservation and resource management projects on public lands and in communities across the country. AmeriCorps members are shared among various agencies including the U.S. Forest Service and the U.S. Fish and Wildlife Service.

We believe a significant opportunity now exists to advance policies that drive greater development and deployment of natural carbon storage practices. This is why the BPC Energy Project recently launched a new Farm & Forest Carbon Solutions Initiative that will focus on developing bipartisan consensus around a more specific set of policy options. As part of that process, we aim to fill key information gaps by:

- Analyzing the efficacy of existing USDA and Interior Department programs and authorities with respect to promoting natural carbon solutions;
- Identifying best practices for tailoring farm- and forest-based carbon policies to public, private, and tribal lands;
- Examining the need for changes to existing statutory authorities;
- Evaluating policy options—including for nutrient and manure management and for methane capture and use—that maximize economic and environmental benefits; and
- Assessing potential funding and implementation mechanisms such as public-private partnerships, voluntary carbon and/or ecosystem services markets, and federal grant programs or incentive payments to landowners.

6. Conclusion

Today's hearing is a welcome indicator of growing bipartisan interest in pragmatic, cost-effective solutions that can make a meaningful difference on climate change and help safeguard American prosperity and energy security as our nation makes the necessary transition to net-zero emissions. The fact is that we do not yet possess the technological capacity to fully decarbonize our energy systems consistent with the demands of a modern economy. Globally, the situation is even more daunting given many countries' current resource constraints and development needs.

Against this backdrop, BPC's American Energy Innovation Council has consistently called for a tripling of federal energy innovation budgets and for increased efforts to deploy "first of a kind," breakthrough technologies here in the United States. Achieving net-zero carbon emissions in a mid-century timeframe clearly requires some combination of greatly expanded deployment of already available and cost-competitive low- and zero-carbon options, together with the accelerated development and implementation of new technologies such as advanced nuclear, zero-carbon fuels, long-duration electricity storage, carbon capture and storage, and direct air capture. For many new technologies, targeted federal support can make the difference in the crucial leap from early-stage research and demonstration to commercial success.

Getting to net-zero carbon, however, also requires fresh thinking about how to unite diverse stakeholders around the multiple benefits that can flow from effective climate action. Among farm owners and forest managers, for example, there is growing interest in natural carbon removal opportunities. As in other industries, however, policies that are viewed as increasing cost or uncertainty are likely to continue to lack support. Finding new ways to encourage and reward practices that also deliver economic benefits to farmers and forest owners—and that position farmers, ranchers, and forest managers as valued contributors to climate solutions—will be instrumental. Similarly, positioning DAC as a mitigation option for industries that might have difficulty fully decarbonizing, and as a way to supply carbon dioxide for use in other applications while also delivering climate benefits, could help increase investor interest in this technology. In both cases, a diverse coalition in support of CDR solutions can be a powerful voice in the conversations that are occurring now around economic stimulus and recovery in the near term, and viable climate solutions in the longer run.

For too long, the debate over policy responses to climate change has been held hostage by extreme views: that there’s either no problem, or in any case nothing to be done, on the one hand, or that solutions are easy and costless on the other. Now time is running short. The Committee’s willingness to engage these issues with the seriousness and purpose they deserve is grounds for hope that a new consensus, and a new basis for real progress, is beginning to emerge.

Endnotes

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[8] The three companies currently active in DAC are U.S.-based Global Thermostat, with pilot plants in California and Alabama and plans to build a commercial demonstration plant in Oklahoma and a technology center in Colorado; Canada-based Carbon Engineering, with a pilot plant in British Columbia; and Switzerland-based Climeworks, with plants in Iceland, Switzerland, and Italy. (See BPC Fact Sheets. Available at: https://bipartisanpolicy.org/report/explaining-direct-air-capture)

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