Carbon180

Transition Book

Priorities for Administrative Action
on Carbon Removal in 2021+

ABOUT CARBON180

Carbon180 is a new breed of climate-focused NGO on a mission to fundamentally rethink carbon.

We partner with policymakers, scientists, and businesses around the globe to develop policy, promote research, and advance solutions that transform carbon from a pollutant to a resource and foster a prosperous, carbon-conscious economy that removes more from the atmosphere than we emit.

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Executive Summary

We are at the inflection point for stopping climate change. Growing public awareness and mobilization alongside increasingly devastating impacts from wildfires, hurricanes, and drought make clear that this moment is critically positioned for addressing the climate crisis. The next administration will need to take bold action in 2021 and beyond to drastically and swiftly reduce emissions across all sectors of the economy. And while there have been many decarbonization roadmaps that chart that track, there remains a critical piece missing from the climate fight: carbon removal.

The scientific consensus finds that cleaning up the carbon already in the atmosphere — in addition to reducing emissions — is essential to avoiding the worst impacts of climate change and protecting frontline communities across the globe. To hit our climate goals, estimates suggest that we'll need to deploy a portfolio of solutions on the scale of 10 billion tons of CO_2 per year by mid-century. While there has been significant promising innovation over the last decade, investments from the public and private sectors still do not match the scale needed.

Beyond their climate benefits, carbon removal solutions offer enormous economic and social advantages, including generating high-quality jobs, creating new sources of revenue for rural communities, developing new carbon-negative industries, improving biodiversity, and positioning the United States as the leader on carbon removal.

Though there has been growing interest in and action on carbon removal from Congress, there remains a foundational gap between our goals and the current efforts to make them a reality. The next administration should establish leadership on carbon removal in its first 100 days, taking early action to lay the groundwork for and begin actualizing the just carbon-removing economy of the future.

This report serves as a guide for transition teams as they explore pathways for administrative action on climate. We make recommendations for high-priority steps the White House should take within the first 30 days, as well as additional priorities for the first 100 days. For each agency, we outline key actions that can be executed within existing authority and funding. We also propose legislation and a draft first-year budget that the president should pursue in partnership with Congress. Together, these pieces form a comprehensive roadmap for ambitious administrative action on carbon removal.

Executive Summary *(Continued)*

	PRIORITY ACTIONS IN THE FIRST 100 DAYS	PRIORITIES FOR CONGRESSIONAL COLLABORATION

WHITE HOUSE	• *First 30 Days:* Release a series of executive orders that establish the administration's leadership on climate and carbon removal
	• *First 100 Days:*
	  • Establish the staffing and coordination frameworks required to scale carbon removal solutions
	  • Track progress on carbon removal research, development, demonstration, and deployment
	  • Direct agencies to explore procuring carbon removal products and services
		• Launch a "CarbonShot" innovation program to drive the cost of robustly verified carbon removal to less than \$100/ton CO_2 by 2025

DEPARTMENT OF AGRICULTURE	• Set ambitious goals for agricultural carbon removal and create mechanisms for tracking deployment • Improve coordination within the Department of Agriculture (USDA) and with other agencies on key research priorities related to land-based carbon removal • Improve coordination between the US Forest Service (USFS), Department of the Interior (DOI), and state/regional forestry agencies on fire management, forest management, and restoration • Relocate and restaff the USDA Economic Research Service (ERS) and the National Institute for Food and Agriculture (NIFA) • Increase carbon storage on farms and ranches through the USDA Commodity Credit Corporation • Adjust federal crop insurance to encourage the adoption of conservation practices	• Invest in the economic recovery and long-term resilience of agriculture and forestry communities • Fund research into key soil carbon topics and barriers to adoption of practices that store carbon in soils

Executive Summary *(Continued)*

	PRIORITY ACTIONS IN THE FIRST 100 DAYS	PRIORITIES FOR CONGRESSIONAL COLLABORATION
DEPARTMENT OF AGRICULTURE *(cont.)*	• Adjust existing conservation programs to prioritize carbon storage • Fund and revitalize the Biomass Crop Assistance Program (BCAP) and the Biomass Research and Development Initiative (BRDI)	—
DEPARTMENT OF ENERGY	• Overhaul the Department of Energy (DOE) to better prioritize carbon removal innovation • Expand the focus of existing programs within DOE and prioritize coordination across relevant offices • Launch a carbon removal initiative as part of the Clean Energy Ministerial (CEM) • Designate tech-to-market support for carbon removal technologies across DOE	• Expand funding across RD&D programs in alignment with CarbonShot innovation program recommendations • Create a loan guarantee program to enable low-risk financing for negative emissions technologies
DEPARTMENT OF THE INTERIOR	• Pre-permit Class VI wells on federal lands • Improve mapping of US mineral weathering capacity	• Provide additional funding for Department of the Interior (DOI) programs that address a breadth of restoration and wildfire risk reduction work on forests and rangelands
DEPARTMENT OF STATE	• Establish carbon dioxide removal as an item of consideration for the Ad Hoc Working Group on the Paris Agreement (APA) through the UNFCCC Conference of the Parties (COP) framework • Include carbon removal in the US Nationally Determined Contribution (NDC) • Initiate a Carbon Dioxide Removal Leadership Forum	—

Executive Summary *(Continued)*

	PRIORITY ACTIONS IN THE FIRST 100 DAYS	PRIORITIES FOR CONGRESSIONAL COLLABORATION
ENVIRONMENTAL PROTECTION AGENCY	• Establish lifecycle accounting guidance for biomass energy processes • Improve Class VI permitting on private lands • Prioritize the National Environmental Policy Act (NEPA) approval process for prescribed fire • Reform the Renewable Fuel Standard (RFS) to incentivize negative emissions biofuels and direct air capture (DAC)	—
NATIONAL SCIENCE FOUNDATION	• Modify the National Science Foundation's (NSF) Seed Fund to support carbon removal projects • Prioritize and emphasize interdisciplinary carbon removal projects	• Increase funding for ecosystem science toward the goal of carbon removal and climate change resilience • Include carbon removal as a priority in proposed NSF expansion bill

Section One

Introduction

We are at the inflection point for stopping climate change.

Growing public awareness and mobilization alongside increasingly devastating impacts from wildfires, hurricanes, and drought make clear that this moment is critically positioned for addressing the climate crisis. The next administration will need to take bold action in 2021 and beyond to drastically and swiftly reduce emissions across all sectors of the economy. And while there have been many decarbonization roadmaps that chart that track, there remains a critical piece missing from the climate fight: carbon removal.

The scientific consensus finds that cleaning up the carbon already in the atmosphere — in addition to reducing emissions — is essential to avoiding the worst impacts of climate change and protecting frontline communities across the globe. Key climate experts including the UN Intergovernmental Panel on Climate Change (IPCC), the US National Academies of Sciences (NAS), the US Global Change Research Program, and the White House Council on Environmental Quality (CEQ) have solidified the need for carbon removal. Estimates suggest that we'll need to deploy a portfolio of solutions on the scale of 10 billion tons of CO_2 per year by mid-century, and while there has been significant promising innovation over the last decade, investments from the public and private sectors still do not match the scale needed.

At the same time, the US faces interrelated challenges around the global pandemic, ongoing recovery efforts, and social justice. Over the next four years, the administration will need to focus on policy opportunities that can address these areas. Good climate policy does not only address the drivers of climate change, but centers economic development, social and environmental justice, and public health. The next administration should invest in carbon removal solutions to help drive an equitable economic future for communities across the country.

Beyond their climate benefits, carbon removal solutions, including both the land- and tech-based pathways discussed below, offer enormous opportunities to:

- Generate high-quality jobs across America's rural and industrial communities,
- Create new sources of revenue and build resilience for farmers, ranchers, and foresters,
- Develop new carbon-negative industries in traditionally carbon-intensive sectors, such as manufacturing and transportation,
- Improve biodiversity and increase the ecosystem benefits of natural lands, and
- Position the United States as the leader on climate action.

The next administration is uniquely positioned to establish leadership on carbon removal, realize these benefits, and set the trajectory toward a thriving and equitable society from day one.

Bridging the gap for carbon removal

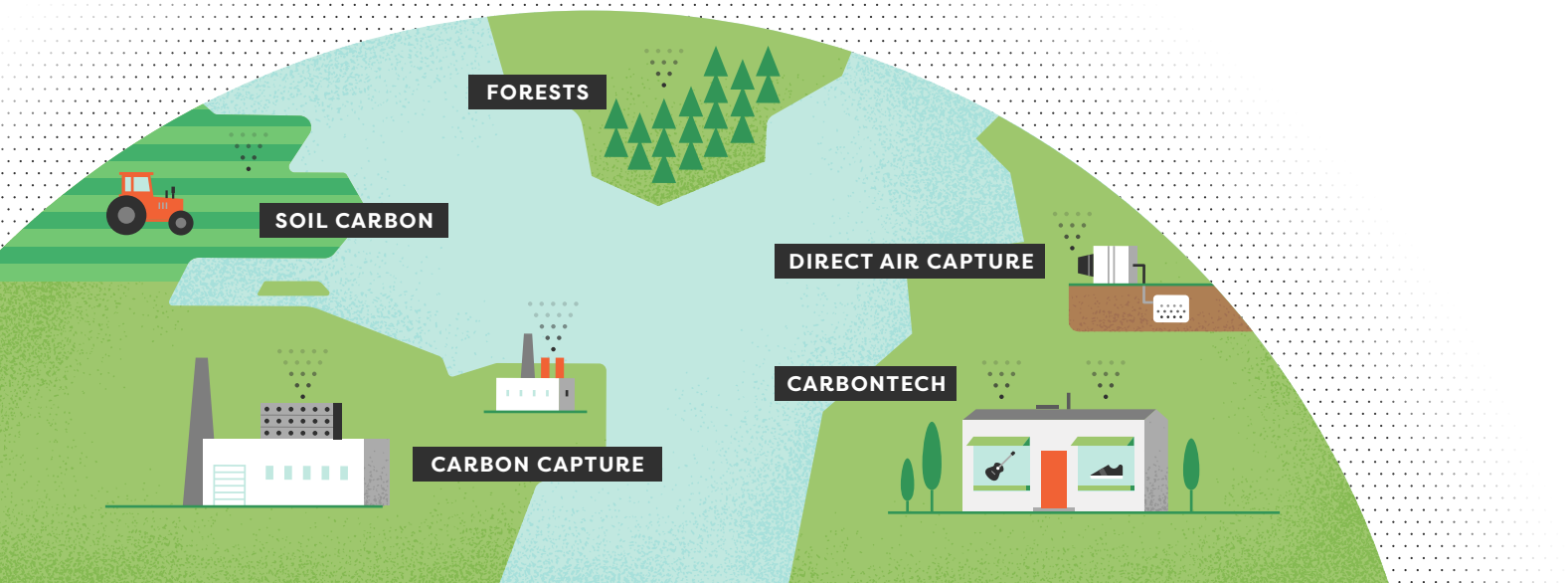
Pathways to meeting our climate goals and staying below 1.5°C of warming require that the world remove approximately 10 gigatons of CO_2 per year by mid-century, an amount roughly equal to a quarter of current annual global emissions. While this scale is significant, there is a whole portfolio of carbon removal solutions spanning sectors of the economy that can help us achieve this level of deployment.

Leading carbon removal approaches fall under two broad categories: land-based and technological. Land-based approaches draw carbon from the atmosphere through photosynthesis and store a portion of that carbon in the plants and soils of forests, wetlands, and agricultural ecosystems. Technological approaches use engineered systems and chemical processes to store carbon dioxide in rocks, geologic reservoirs, and materials.

Each approach has a number of advantages accompanied by associated challenges. For example, land-based carbon removal solutions such as forestry are relatively low cost but highly decentralized, and carbon stored in natural systems is more vulnerable to reversal through changes in management or extreme weather events. Tech-based solutions such as direct air capture are nascent and expensive but provide more durable carbon storage.

For more information on direct air capture, please see Carbon180's fact sheet.

A sample of leading carbon capture and carbon removal approaches. For more information on specific carbon removal approaches, explore our fact sheets.



Together, the portfolio of carbon removal solutions today faces several challenges:

- High costs for nascent carbon removal technologies, compounded by insufficient RD&D funding,
- Low demand for removal and associated products/co-benefits, keeping private sector capital sidelined,
- Inadequate regulations that could help ensure the safe, sustainable, and equitable deployment of carbon removal projects and give project developers the clarity to access existing incentives,
- Insufficient infrastructure to transport and store CO_2 (engineered solutions) and for carbon monitoring networks (natural solutions),
- Unclear guidelines on carbon monitoring, reporting, and verification for land-based approaches, and
- Lack of international coordination on RD&D and finance.

Additional Resources on Carbon Removal

National Academies of Sciences, *Negative Emissions Technologies and Reliable Sequestration: A Research Agenda*

Rhodium Group, *Capturing Leadership: Policies for the US to Advance Direct Air Capture Technology*

Carbon180, *Leading with Soil: Scaling Soil Carbon Storage in Agriculture*

World Resources Institute, *CarbonShot: Federal Policy Options for Carbon Removal in the United States*

Energy Futures Initiative, *Clearing the Air: A Federal RD&D Initiative and Management Plan for Carbon Dioxide Removal Technologies*

Setting a course for impact

In just the last few years there has been a groundswell of interest and action on carbon removal. Despite a stalemate on climate action more generally, Congress has continued to invest in carbon removal solutions in a bipartisan way.

Before fiscal year 2020 (FY20), Congress had appropriated only about $11.5 million to direct air capture (DAC) — ever. In FY20, Congress exponentially increased this funding, appropriating $68 million for negative emissions technologies, a portion of which was carved out for DAC.[1] The FY21 House appropriations bills built on this further, giving the US Department of Energy (DOE) $95 million for RD&D of negative emissions technologies, alongside $239.5 million within additional relief provisions

1. Burns, E. & Suarez, V. (2020, August 31). *Everything you need to know about federal funding for carbon removal.* Medium. https://carbon180.medium.com/everything-you-need-to-know-about-federal-funding-for-carbon-removal-bb2548595b41

for demonstrations of negative emissions technologies and interagency coordination.[2] Beyond research funding, Congress has also turned to incentivizing early deployment through expanding the 45Q tax credit to include DAC.

Recently, land-based carbon removal has been embedded into existing conservation programs. The 2018 Farm Bill secured several wins for soil health and soil carbon, including 1) changing conservation program descriptions to include soil health and carbon sequestration as targeted outcomes, 2) adding soil carbon as a consideration in the allocations of core conservation programs, and 3) providing $10 million for on-farm conservation innovation trials.[3] The FY21 House agriculture appropriations bill included funding for six programs whose work includes soil carbon. We've also seen an influx of bills on forest and soil carbon, including the bipartisan and bicameral Growing Climate Solutions Act. In parallel, the 2018 Farm Bill also made progress in utilizing the power of forests by establishing carbon sequestration as an explicit criterion under the Healthy Forests Restoration Act of 2003 Amendment.

This growing momentum is promising, but there remains a foundational gap between our goals and the current efforts to make them a reality. There are striking similarities between where solar and wind technologies were 20 years ago and where carbon removal is today. The rapid growth of those clean energy technologies has made a real impact — we can do it again *and faster*. To do so, we need the strong direction and leadership of the next administration.

The administration should establish this leadership on carbon removal in its first 100 days. These early actions can lay the groundwork for and begin actualizing the carbon-removing economy of the future. The policies the administration pursues should aim to:

- Increase innovation funding for a portfolio of carbon removal solutions, in line with National Academies of Sciences[4] and Energy Futures Initiative[5] recommendations,
- Lower the cost of all carbon removal solutions to less than $100/ton CO_2,
- Deploy a portfolio of carbon removal solutions at the scale of at least 1 million tons of CO_2 in 2021 and increasing thereafter,
- Launch bilateral and multilateral coordination on innovation and finance to support the global scale-up of carbon removal.

All carbon removal policies to accomplish these goals should 1) ensure that carbon removal is a complement — not a distraction — from economy-wide emissions reductions, 2) center high-quality job creation and labor protections accessible to all, and 3) improve the health, safety, agency, and prosperity of vulnerable and frontline communities. Doing so will require strong leadership committed to implementing ambitious policies developed through a collaborative and

2. Ibid.

3. Harrigan, K. & Charney, A. (2019). *Impact of 2018 Farm Bill Provisions on Soil Health*. The Soil Health Institute and the National Sustainable Agriculture Coalition. https://sustainableagriculture.net/wp-content/uploads/2019/09/FINAL-DIGITAL-Impact-of-2018-Farm-Bill-Provisions-on-Soil-Health.pdf

4. National Academies of Sciences, Engineering, and Medicine. (2019). *Negative Emissions Technologies and Reliable Sequestration: A Research Agenda*. National Academies Press. https://doi.org/10.17226/25259

5. Energy Futures Initiative. (2019). *Clearing the Air: A Federal RD&D Initiative and Management Plan for Carbon Dioxide Removal Technologies.*

transparent process.

This report outlines the key actions an administration should take to accomplish these goals and realize the full potential of carbon removal as a critical climate solution that elevates environmental, economic, and social co-benefits. We make recommendations for steps that can be taken in the first 30 and 100 days by the White House, and then outline recommended federal agency priorities for the first 100 days, focusing on the US Department of Agriculture (USDA), Department of Energy (DOE), Department of the Interior (DOI), Department of State, Environmental Protection Agency (EPA), and National Science Foundation (NSF). We also identify core staffing considerations and legislative opportunities for administrative collaboration with Congress. We conclude the report with recommendations for the President's Budget.

The next administration has a massive opportunity to leverage existing infrastructure and recent climate innovation to unlock economic opportunities, advance equitable policies, and take critical measures to stop climate change. This transition book outlines steps that would not just create a better future but ensure there is a future worth bettering.

Section Two

Establishing White House Leadership on Carbon Removal

The White House and the associated Executive Office of the President are uniquely positioned to take a leadership role on carbon removal, establishing the core vision and heading interagency coordination.

During the Obama Administration, the White House CEQ released its "Mid-Century Strategy for Deep Decarbonization."[6] This report laid out a roadmap for how the US government can drive carbon emissions to net-zero by 2050, with carbon removal being a key pillar. This pathway tracks with the ambition of other climate roadmaps, including the Green New Deal and the Biden-Sanders Unity Task Force recommendations. Alongside the recommendations in this report, the administration should take the lead on realizing the pathways laid out in the "Mid-Century Strategy."

As the administration establishes leadership on climate and carbon removal, it is critical to ensure that these actions are anchored by environmental and climate justice principles. Climate shocks will continue to hit the most vulnerable the hardest and fastest, further deepening inequities locally and globally. The nascency of the carbon removal field creates an opportunity for carbon removal to address inequities instead of contributing to them by ensuring that deployment strategies are developed through a collective, participatory process. To support a justice-oriented carbon removal and climate approach, the administration should follow the guidelines below:

- **EXECUTIVE ORDERS** must address environmental, economic, and social impacts of solutions and provide safeguards to ensure 1) adverse impacts are not borne by frontline communities, 2) all resources and benefits are equitably distributed, and 3) all impacted communities have the opportunity to meaningfully participate in decision-making processes.
- **PROGRAM FUNDING** appropriated by Congress should prioritize investments for underserved communities and provide America's most impoverished communities with higher levels of support in accessing and participating in all federal programs.
- **REGULATORY ACTIONS** must include strong safeguards that reduce cumulative impacts for frontline communities that are more likely to suffer from the effects of multiple pollution sources and legacy environmental and economic impacts.

6. The White House. (2016). *United States Mid-Century Strategy for Deep Decarbonization.* https://unfccc.int/files/focus/long-term_strategies/application/pdf/mid_century_strategy_report-final_red.pdf

Priority Actions in the First 30 Days

REC. 1

Release a series of executive orders that establish the administration's leadership on climate and carbon removal

Despite the climate imperative, carbon removal continues to fly under the radar. To scale these solutions, it will be important to incorporate carbon removal into major climate efforts within the administration and set specific targets for carbon removal. Strong US leadership is essential to signal the importance of carbon removal while also ensuring that it isn't used as an excuse for slowing or delaying aggressive emissions reductions. Executive orders can also create accountability around climate, social, and environmental outcomes. Finally, these early bold actions from the administration can signal to the private sector to ramp up investment.

A. Set a climate target of net-zero greenhouse gas (GHG) emissions by 2050, with net-negative emissions thereafter.

B. Set a 30x30 goal to conserve 30% of America's lands by 2030, while emphasizing carbon storage.

C. Set a goal to achieve net-zero GHG emissions on public lands and waters by 2030.

D. Make a commitment to establish leadership on carbon removal innovation and set a goal to drive the cost of technological carbon removal to less than $100/ton CO_2 by 2025.

E. Make a commitment to redress the historic injustice that Black and minority land managers and tribal communities have faced in accessing federal incentives and programs.

Recommendations continue on next page

F. Expand Executive Order 12898 on environmental justice to mandate annual agency reviews of climate and environmental justice impacts and enhance the Federal Interagency Working Group on Environmental Justice. This includes asking the working group to coordinate on 1) principles around how to best embed equity and justice into all research and development activities led by the administration, 2) principles of meaningful community engagement for all agencies to follow, and 3) providing technical assistance to communities.

Priority Actions in the First 100 Days

REC. 2

Establish the staffing and coordination frameworks required to scale carbon removal solutions

Existing work on carbon removal within past administrations has been decentralized and limited. Scaling carbon removal solutions will require coordination and dedicated staff within key White House executive offices.

A. Establish a new interagency task force on carbon removal led by the White House that includes multi-agency participation and representation from environmental justice, labor, and environmental NGOs as well as academia and industry.

B. Appoint a White House lead on carbon removal to spearhead efforts and lead the above interagency taskforce. This person will need to have detailed subject matter expertise and be able to coordinate activities across multiple agencies and White House offices working on climate efforts. This role can be structured as a **Deputy Assistant to the President at the Domestic Policy Council** or a similar role within the White House office that leads core climate work.

Recommendations continue on next page

C. Create new positions focused on carbon removal at core executive offices, including at CEQ and the Office of Science and Technology Policy (OSTP). These positions should be placed within a re-established Energy and Environment (E&E) branch of OSTP and the National Science and Technology Council. This position should be structured as an **Assistant Director for Carbon Removal at the E&E branch of OSTP**. This person will need to identify opportunities for coordination between tech- and land-based approaches with a focus on cross-cutting R&D, assess and improve cross-agency coordination on carbon removal, and emphasize collaborative long-term strategies across federal foundations, agencies, and offices. We also recommend the Director of OSTP be appointed as Assistant to the President for Science and Technology.[7]

D. Reestablish the White House Rural Council to improve the administration's ability to address rural challenges including agriculture resilience in the face of climate change, economic recovery, and environmental justice. The council should focus on embedding stakeholder and community engagement in the administration's policy design.

REC. 3

Track progress on carbon removal research, development, demonstration, and deployment

Due to the diversity of carbon removal approaches, action on carbon removal is currently spread across federal agencies. This creates a challenge in assessing federal action and investment in carbon removal, as well as tracking improvements in technology readiness and deployment. To make informed policy decisions, we will need to assess progress over time.

A. Direct the Office of Management and Budget to track carbon removal research funding on an annual basis, tracking funding levels to those recommended in the National Academies of Sciences report "Negative Emissions Technologies and Reliable Sequestration: A Research Agenda."[8]

Recommendations continue on next page

7. Congressional Research Service. (2020). *Office of Science and Technology Policy (OSTP): History and Overview.* https://fas.org/sgp/crs/misc/R43935.pdf

8. National Academies of Sciences, Engineering, and Medicine. (2019) *Negative Emissions Technologies and Reliable Sequestration: A Research Agenda. National Academies Press.* https://doi.org/10.17226/25259

B. Establish a "Quadrennial Carbon Review," akin to the "Quadrennial Energy Review,"[9] that would entail a cross-agency and stakeholder engagement effort to translate carbon removal goals into action across the federal government. This review could also extend to other climate and carbon-related activities, including work on the social cost of carbon, carbon footprints for products, and carbon pricing.

REC. 4

Direct agencies to explore procuring carbon removal products and services

The US government is responsible for approximately 75 millions tons of CO_2 emissions annually as part of its operations.[10] Addressing even a small percentage of these emissions with robustly accredited carbon removal could prove catalytic for carbon removal innovation.

A. Direct agencies to explore opportunities to procure carbon removal products and services via similar mechanisms that agencies have used to procure renewable energy certificates and carbon-intensity procurement mandates. Creating demand for removal would help drive down costs and open up the market for greater deployment-led innovation.

B. Lead the development of robust standards for additionality and permanence to help lower the barrier for other governments and organizations to procure carbon removal projects in the future. This should be done in partnership with core agencies — for example, USDA should establish standards for determining how to quantify carbon dioxide sequestration that can be considered additional beyond conventional management and develop monitoring standards to ensure carbon remains in biomass and soils.

9. The White House. (2014, January 9). *Presidential Memorandum — Establishing a Quadrennial Energy Review.* Office of the Press Secretary. https://obamawhitehouse.archives.gov/the-press-office/2014/01/09/presidential-memorandum-establishing-quadrennial-energy-review

10. US Department of Energy. (2020). *Annual Energy Management Data Report workbook.* https://www.energy.gov/eere/femp/downloads/annual-energy-management-data-report

Priorities for Congressional Collaboration

REC. 5

Launch a "CarbonShot" innovation program to drive the cost of robustly verified carbon removal to less than $100/ton CO_2 by 2025

Carbon removal will require significant RD&D to bring down costs, maximize co-benefits, and ensure the validity and scalability of solutions in real-world contexts. In addition to increased innovation, interagency coordination (as outlined in the bicameral and bipartisan CREATE Act) will be necessary to ensure that lessons are transferred across programs.

A. Announce a goal of $10 billion in new RD&D funding for the full portfolio of carbon removal solutions over the next decade as part of a larger effort to scale overall cleantech innovation.

B. Budget a coordinated interagency RD&D grand challenge as part of a broader climate innovation effort, allocating funding in line with recommendations from the National Academies 2018 "Negative Emissions" report. This effort will be an essential component of a strategy for driving down the cost of promising technologies and improving the credibility of management techniques.

C. Launch demonstration projects and pilots for a portfolio of carbon removal solutions.

Section Three

Key Actions for Federal Agencies

Beyond leadership, goal setting and tracking, and coordination led by the White House, the administration should embed efforts on carbon removal across federal agencies, using existing authority and budgets.

As Congress continues to increase the federal support for carbon removal, it will be important for the administration to set up the frameworks, build the staffing capacity and expertise, and close research gaps that will enable it to expand focus areas. Here, we touch upon recommendations for key actions in priority agencies (listed in alphabetical order).

Department of Agriculture

USDA plays an integral role in deploying land-based carbon removal solutions, including wetland, forestry, and agriculture approaches. These solutions not only help mitigate climate change, but also build resilience and generate new sources of revenue for rural communities. There is significant existing work within USDA that is complementary or reinforcing of carbon removal solutions. The bulk of research on agriculture approaches is housed within the Agricultural Research Service, Economic Research Service (ERS), and the National Institute for Food and Agriculture (NIFA). Early incentives and technical assistance to support practice adoption on crop and range lands are driven by the Natural Resources Conservation Service (NRCS). Forestry work is led by the US Forest Service (USFS), whose programs address a breadth of restoration, reforestation, conservation, and wildfire management work that can enhance long-term carbon storage in forest systems. Underpinning these programs is the USFS Research and Development branch. The next administration should expand these existing programs and improve coordination and research within and across USDA on soil carbon and forestry priorities, finding ways to deploy projects across natural and working lands.

Priority Actions in the First 100 Days

REC. 1

Set ambitious goals for agricultural carbon removal and create mechanisms for tracking deployment

Because of its overlap with conservation and soil health, USDA already has done a significant amount of work related to soil carbon. However, a dedicated roadmap for increasing soil carbon storage in agricultural lands can build on the existing research, incentives, and programs to more specifically measure and scale soil carbon storage.

A. Update the Building Blocks for Climate Smart Agriculture, clearly setting goals for carbon sequestration across US cropland and rangeland by 2024 (alongside other emissions reductions goals) and outlining the suite of federal actions needed to reach those goals. This strategy should focus on practices for working production systems and those that maximize economic, environmental, and resilience benefits.

Recommendations continue on next page

B. Encourage NIFA extension officers to collect data on conservation practices already implemented on farms across America to identify high-priority areas for targeted support and incentives. Many conservation practices have already been adopted across the United States, but data is scarce. To best assess climate research in the future, more data is needed on current practices. In addition to regular assessments by NIFA extension officers, the National Agricultural Statistics Service should include this information on practice adoption in their agricultural census taken every five years. As with all census data, this information should be made publicly available and accessible.[11]

REC. 2

Improve coordination within USDA and with other agencies on key research priorities related to land-based carbon removal

Leadership and coordination will be a critical component of the success of soil carbon and forestry research, especially to ensure that findings are rapidly shared within the agency, with other relevant federal programs, and transferred to the real world.

A. Explicitly include carbon removal research objectives in the USDA Departmental Strategic Plan and request that the Foundation for Food and Agriculture Research (FFAR) include carbon removal within its program scope.

B. Direct the Under Secretary for Research, Education, and Economics (REE) and Secretary of Natural Resources and Environment to serve as the lead coordinators for all of these research activities on soil carbon and forest carbon, respectively. This will help reduce redundancies, evaluate effectiveness, and support collaboration and data sharing across other agencies.[12] REE should review and advise on all USDA program office carbon removal research budget proposals and oversee the evaluation of said research projects.

Recommendations continue on next page

11. Jahn, M. (2020). *New solutions for a changing climate: The policy imperative for public investment in agriculture R&D.* The Chicago Council on Global Affairs. https://www.thechicagocouncil.org/sites/default/files/report_new-solutions-for-changing-climate_0.pdf

12. Energy Futures Initiative. (2019). *Clearing the Air: A Federal RD&D Initiative and Management Plan for Carbon Dioxide Removal Technologies.*

C. Mandate greater coordination between USDA and FFAR by easing the barriers for funding to flow between USDA agencies and FFAR. This will allow better coordination and collaboration with US agribusiness and could create more nimble responses to urgent issues. Increase funding to FFAR to better leverage the vast investments in agricultural research and development made by agribusiness.[13]

D. Update data curation and archiving standards and make existing data available for internal and interagency research efforts. The USDA chief data officer should oversee a team that focuses on data accessibility, integrity, availability of appropriate standards, stewardship, interoperability, curation, and full transparency. Research and incentive programs should be required to collect and make available all data according to current standards required by the granting agencies and curated long term.[14]

E. Mandate greater coordination between USDA, NSF, and EPA to bolster forestry research efforts that improve forest carbon monitoring.

F. Appoint a director of and fund the Agriculture Advanced Research and Development Authority (AGARDA), in order to accelerate the development of technologies and research tools pertinent to land-based carbon removal.

13. Jahn, M. (2020). *New solutions for a changing climate: The policy imperative for public investment in agriculture R&D.* The Chicago Council on Global Affairs. https://www.thechicagocouncil.org/sites/default/files/report_new-solutions-for-changing-climate_0.pdf

14. Ibid.

REC. 3

Improve coordination between USFS, DOI, and state/regional forestry agencies on fire management, forest management, and restoration

As the impacts of climate change increase in frequency and severity, policy for the management of US forests must meet the twin challenges of effectively mitigating wildfire impacts and protecting these valuable carbon sinks.

A. Enter a memorandum of understanding (MOU) to improve forest management plans through interagency coordination and collaboration. An interagency team can evaluate resources, develop recommendations, and identify additional tools that can enhance carbon removal potential in forests. This team can work to reassess forest management plans at the national, state, tribal, and regional levels.

B. Develop a federal version of California's Fire MOU Partnership.[15] The partnership unites experts, Cal Fire, NGOs, and federal land managers to collaboratively manage fire risk. A federal version could significantly help agencies coordinate efforts with scientists, policy makers, state-level land managers, and other relevant stakeholders.

C. Reduce limitations on resource sharing. No single entity has all of the people or equipment needed to do prescribed fire, which necessitates efficient resource-sharing among federal and state agencies, as well as other partners. The administration can encourage the Forest Service and DOI agencies to streamline charging to single funding codes at the national level (as with wildland fire events) — a recommendation of the US Government Accountability Office and field personnel.[16]

15. (2015). MOU: memorandum of understanding for the purpose of increasing the use of fire to meet ecological and other management objectives between USDA Forest Service, Pacific Southwest Region and Sierra Forest Legacy, California Department of Forestry of Forestry and Fire Protection, State of California Sierra Nevada Conservancy, The Nature Conservancy, USDI, National Park Service Pacific Region, The Wilderness Society, The Sierra Club, Center for Biological Diversity, Northern California Prescribed Fire Council, and the Southern Sierra Prescribed Fire Council. https://www.sierraforestlegacy.org/Resources/Community/PrescribedFire/FireMOUSigned.pdf

16. US Government Accountability Office. (2017). *Wildland Fires Risk Reduction: Multiple Factors Affect Federal-Nonfederal Collaboration, but Action Could Be Taken to Better Measure Progress.* https://www.gao.gov/assets/690/684545.pdf

17. Congressional Research Services. (2020, May 1). *Relocation of the USDA Research Agencies: NIFA and ERS* (CRS Report No. IF11527). https://crsreports.congress.gov/product/pdf/IF/IF11527

REC. 4

Relocate and restaff USDA ERS and NIFA

In 2019, USDA relocated most staff positions at two of its core research agencies — ERS and NIFA — from Washington, DC, to Kansas City, Mo. According to the Congressional Research Service, 75% of employees declined to relocate and left the agencies.[17] Due to continued staffing challenges, a number of agency activities have suffered and the USDA mission has not been fully delivered. For example, NIFA grantees have experienced delays in receiving funding awards and ERS has indefinitely delayed a number of reports.

A. Return relocated staff positions to their long-time location of Washington, DC, and work to return staff capacity to the levels required to deliver on their congressionally mandated mission and activities.

REC. 5

Increase carbon storage on farms and ranches through the USDA Commodity Credit Corporation

The USDA Commodity Credit Corporation (CCC) is a government-owned corporation used to implement specific programs established by Congress, as well as a broad set of activities defined in its original charter. The CCC has a $30 billion borrowing authority with the Department of the Treasury that has historically been used as a safety net for the agriculture industry. This authority was used under the Trump Administration to provide a $12 billion assistance package to farmers facing foreign retaliation against US tariffs.

A. Use the borrowing authority under the CCC to fund the deployment of practices that store carbon in soils and on farms. These payments would provide farmers with immediate financial relief in the face of COVID-19 impacts, while also building their long-term resilience to climate impacts. This could be funded under the existing scope of the CCC's charter.

REC. 6

Adjust federal crop insurance to encourage the adoption of conservation practices

The USDA Risk Management Agency (RMA) is responsible for managing the Federal Crop Insurance Corporation (FCIC), which provides loss coverage across approximately 300 million acres of farmland. The FCIC works with 18 approved private insurers to establish premiums for more than 100 crops in regions across the United States. The premiums are supported partially by farmers but mostly by the government.[18] Practices that sequester carbon in agricultural soils have also

18. Congressional Research Service. (2015). *Federal Crop Insurance: Background* (CRS Report No. R40532). https://fas.org/sgp/crs/misc/R40532.pdf

demonstrated the ability to increase resilience and reduce indemnification in the face of worsening climate change.[19]

A. Ask subprograms within USDA to share with RMA county-level data on conservation practices and their associated resilience benefits. RMA should then conduct a review of this research to determine which practices have the greatest ability to reduce indemnification and in which geographies. RMA should incorporate this data into their actuarial tables.

B. RMA should also be directed to disseminate these results to private FCIC insurers in order to facilitate the offering of reduced premiums for farms that adopt these practices. This adjustment would serve the dual benefit of reducing indemnification costs on agricultural yields and American taxpayers, while also sequestering carbon dioxide and mitigating climate change.

19. Woodard, J. D., & Verteramo-Chiu, L. J. (2017). Efficiency impacts of utilizing soil data in the pricing of the federal crop insurance program. American Journal of Agricultural Economics, 99(3), 757-772.

20. Kosar, U. & Amador, G. (2020). *Rooted in Resilience: Investing in America's Lands and Communities for a Green Recovery.* Carbon180. https://bit.ly/2Hbnlyc

REC. 7

Adjust existing conservation programs to prioritize carbon storage

Existing conservation programs — especially the Conservation Reserve Program, Conservation Stewardship Program (CSP), and Environmental Quality Incentives Program (EQIP) — are critical levers to help farmers and ranchers adopt and maintain practices that store carbon in soils. These programs continue to be underfunded, oversubscribed, and burdensome for land managers to access. In addition, these programs were not initially designed to maximize carbon storage. Small administrative tweaks to these programs could pay significant dividends for the climate.

A. Authorize an "automatic graduation" option that allows EQIP producers to automatically become eligible for CSP. This would increase continuity between programs, reduce administrative burdens for producers, and support the maintenance of carbon storage on working lands.[20]

Recommendations continue on next page

21. Ibid.

B. Give priority to program applications 1) with an explicit focus on carbon storage or the inclusion of practices with higher carbon storage potential (including agroforestry and forestry practices) and 2) from historically underrepresented groups in the agriculture and forestry industries, including first-time farmers and foresters, farmers and foresters of color, Indigenous land managers, tribes, and young farmers.[21]

C. NRCS should annually review and update conservation practice standards at the administrative level to integrate new and ongoing research outcomes, with geographic specificity.

REC. 8

Fund and revitalize the Biomass Crop Assistance Program (BCAP) and the Biomass Research and Development Initiative (BRDI)

BCAP was designed to support the collection, development, and sourcing of biomass feedstocks from farms and forests, but has not been funded in recent years. Similarly, BRDI operated as a collaborative extramural grant program between USDA and DOE, but has not been funded recently. Both of these programs could support the development of bioenergy with carbon capture and storage (BECCS) projects and yield low-carbon feedstocks with ecological and adaptation benefits.

A. Refund BCAP to encourage biomass power and conversion facilities to source low-carbon feedstocks from American farms and forests. Specifically, BCAP should emphasize the importance of matching payments for the removal of hazardous waste biomass from private forests to reduce wildfire risk.

B. Refund BRDI to support the development and deployment of improved biomass feedstocks. DOE should continue to serve as a collaborator in developing the scope and magnitude of funding offer announcements and reviewing proposals.

Priorities for Congressional Collaboration

REC. 9

Invest in the economic recovery and long-term resilience of agriculture and forestry communities[22]

A. Bolster EQIP and CSP. In addition to increasing funding, USDA should pair this expansion with investments in NRCS Conservation Technical Assistance and cooperative extension services at land-grant universities.

B. Provide additional funding for USDA programs that address a breadth of restoration and wildfire risk reduction work on forests and rangelands, including the Collaborative Forest Landscape Restoration Program, the Vegetation and Watershed Management Program, and the Burned Area Emergency Response program. USDA could also establish a grant program that supports local restoration projects on public lands. A collaborative model, similar to the Collaborative Forest Landscape Restoration Program, should be encouraged for projects that comply with the National Environmental Policy Act (NEPA) — are "NEPA-ready" — and involve stakeholders including federal, state, local, and tribal governments, communities, and NGOs.

C. Increase funding for research and development of innovative wood technologies, including cross-laminated timber, through the Forest Service Wood Innovation Grant.

D. Increase funding for reforestation efforts across public and private lands by providing grants, expanding existing conservation programs, and establishing a stewardship corps. Eliminate the cap on the Reforestation Trust Fund, as advocated for by American Forests and the bipartisan REPLANT Act.

22. Ibid.

For more information, please see *Rooted in Resilience.*

REC. 10

Fund research into key soil carbon topics and barriers to adoption of practices that store carbon in soils

Despite the significant opportunity in soil carbon storage, research is needed to explore the efficacy of soil carbon practices across geographies, verify carbon storage, and develop the next generation of agriculture solutions. USDA is uniquely positioned to lead an interdisciplinary, interagency collaboration to achieve these objectives that complement its existing mission.

A. Create and fund an interagency "moonshot" research program focused on soil carbon and led by USDA, in collaboration with DOE, DOI, National Aeronautics and Space Administration (NASA), and NSF. This research should focus on the following areas: 1) leadership and coordination, 2) foundational research, 3) data rescue and network integration, 4) monitoring, reporting, and verification, 5) economic and social science research, and 6) soil carbon demonstration trials.

Department of Energy

DOE is a key player in and integral to the development and deployment of technological carbon removal, carbon utilization, and geologic storage. Technological carbon removal, such as DAC, enhanced mineralization, or ocean capture, can convert carbon into products (e.g., building materials) or store it in geological reservoirs. Importantly, these methods can have economic benefits and create jobs — DAC at scale could add up to 300,000 jobs sector-wide.[23] However, while these approaches have incredible potential and must be integrated into cross-sectoral climate plans, they are still nascent and costly, and require considering energy and water needs, land use, and infrastructure for CO_2 transportation and storage.

DOE has numerous programs across offices that are applicable to different aspects of carbon removal. Though most carbon removal RD&D today is funded by the Office of Fossil Energy, important work is also ongoing in the Office of Science, Office of Energy Efficiency and Renewable Energy, Advanced Research Projects Agency-Energy (ARPA-E), and subprograms such as the Advanced Manufacturing Office. The following recommendations focus on restructuring relevant DOE offices to enable better prioritization and coordination, expanding existing programs to achieve more progress in critical areas, and working with Congress where new appropriations and authorizations will be necessary.

23. Rhodium Group. (2020). *Capturing New Jobs and New Business: Growth Opportunities from Direct Air Capture Scale-Up.* https://rhg.com/research/capturing-new-jobs-and-new-business/

Priority Actions in the First 100 Days

REC. 1

Overhaul DOE to better prioritize carbon removal innovation

Critical to our decarbonization goals is near-term large-scale investment and programming in technological carbon removal approaches across the RDD&D spectrum, alongside governance measures to ensure that sustainability and equity are top priorities. As the lead agency for many aspects of technological carbon removal, DOE must shift its focus to and prioritize this important work.

A. Rename the Office of Fossil Energy the Office of Carbon Management. The Office of Fossil Energy has traditionally focused on fossil fuel–fired power. However, as we shift focus to net-zero emissions goals, we must rethink how we organize federal work around decarbonization and move to prioritize carbon removal, carbon utilization, and industrial emissions.

B. Create an **Assistant Secretary of Industrial Decarbonization**, similar to recommendations from Washington Governor Jay Inslee's "Freedom from Fossil Fuels Plan."[24] Industrial emissions account for almost a quarter of national emissions, but consist of many hard-to-abate sectors. A dedicated secretary can better coordinate and oversee large-scale efforts and projects as part of a more ambitious agenda. This new role should oversee existing industrial-focused work in the Office of Fossil Energy and ongoing work in the Advanced Manufacturing Office and the Office of Science.

C. Encourage more synergistic approaches between hydrogen and carbon removal. DOE should be directed to collaborate with USDA to identify promising biomass feedstock opportunities for the development of green hydrogen. These efforts should operate across the Bioenergy Technologies Office, the Hydrogen and Fuel Cell Technologies Office, the Office of Fossil Energy Carbon Capture, Utilization and Storage R&D program, and USDA NIFA. These synergistic approaches should also leverage opportunities to test novel carbon-negative hydrogen technologies at the DOE National Carbon Capture Center.

24. Inslee, J. (2019). *Jay Inslee's Freedom from Fossil Fuels Plan.* https://www.jayinslee.com/issues/freedom-from-fossil-fuels/text/Inslee_FfFF_4.pdf

REC. 2

Expand the focus of existing programs within DOE and prioritize coordination across relevant offices

Programs that address different aspects of carbon removal, such as carbon storage, utilization, and early-stage research, exist across the Office of Fossil Energy, Office of Science, and Office of Energy Efficiency and Renewable Energy. The following recommendations focus on expanding these existing programs to achieve more progress in critical areas.

A. Expand the Carbon Utilization program. Using carbon in products, also known as carbontech, is a growing but nascent field with a $1 trillion domestic total available market, but requires coordinated federal attention.[25] Prioritizing research on carbontech will not only help lower the cost of carbon removal solutions, but also help decarbonize other sectors, including those with few low-carbon options today, including aviation and transportation. Expanded R&D on the full range of carbontech applications (e.g., building materials or fuels), technological advancements, and lifecycle analyses are needed for this potential to be realized. The program should increase private sector partnerships and work with other relevant agencies, including NSF, US Department of Transportation, and the National Institute of Standards and Technology.

B. Focus the efforts of the Carbon Storage Program on industrial sources of CO_2, DAC projects, carbon capture and storage (CCS) projects for commercial biofuel and biomass co-gasification plants, and biomass utilization. In addition, to ensure the safety and success in the deployment of large-scale CCS projects, funding for Phase IV (Class VI injection permitting and construction of the carbon storage complex) should be guaranteed for projects that complete Phase III successfully within the CarbonSAFE initiative.[26]

C. Ensure the Best Practice Manuals from the Regional Carbon Sequestration Partnership are applied. DOE should ensure these manuals and recommendations, especially for public outreach and education, are applied to large-scale storage projects moving forward.[27]

D. Expand basic science research in national labs for key DAC R&D needs to improve scalability, energy use, and cost.

Recommendations continue on next page

25. Jacobson, R. & Lucas, M. (2018, November 27). *Carbontech: A trillion dollar opportunity.* Medium. https://carbon180.medium.com/carbontech-a-trillion-dollar-opportunity-154a9c62cf1c

26. National Energy Technology Laboratory. (2020, April 13) *CarbonSAFE Advances Commercialization of Large-Scale Geologic Storage* [Press release]. https://netl.doe.gov/node/9667

27. Rodosta, T., Aljoe, W., Bromhal, G., & Damiani, D. (2017). US DOE Regional Carbon Sequestration Partnership Initiative: New Insights and Lessons Learned. *Energy Procedia*, 114, 5580-5592. https://doi.org/10.1016/j.egypro.2017.03.1698

E. Increase priority for carbon mineralization research, including fundamental science and demonstration. As this research spans agencies, a research directive spanning DOE, NSF, and the US Geological Survey (USGS) should be formed. USGS and NSF would focus on basic research into the technology, whereas DOE would support the transition of projects from the lab bench into demonstrations and pilots.

F. Expand the focus of the National Carbon Capture Center to include carbon capture from bioenergy and biofuel-producing technologies. The center can offer development and deployment insights by exploring BECCS integration using different feedstock sources and different biomass co-firing schemes such as waste-to-energy and cement plants.

G. Expand bioenergy R&D to include impacts of bioenergy crop production on soil carbon sequestration by explicitly including those parameters in funding announcements and by co-funding research across DOE offices and programs.

H. Use program funds from the Coal FIRST (Flexible, Innovative, Resilient, Small, Transformative) program, which currently supports carbon-free hydrogen production, to support R&D activities of net-negative hydrogen production from biomass, such as fast pyrolysis and supercritical and biological conversion of biomass to hydrogen. Funding these activities can help accelerate the technology readiness for deployment of combined hydrogen production and decarbonization.

REC. 3

Launch a carbon removal initiative as part of the Clean Energy Ministerial (CEM)

Currently, CEM leads international initiatives ranging from umbrella topics, such as policy and finance, to technology-specific approaches, including hydrogen, solar and wind, and nuclear.

A. Establish a carbon dioxide removal initiative as part of CEM. Given the structure and scope of current initiatives, a carbon dioxide removal initiative could span the portfolio of approaches, though it would likely most effectively be constrained to hybrid and engineered approaches. This initiative would facilitate both leadership on research and development as well as opportunities to export American innovation on carbon removal technologies. CEM could provide an avenue to highlight domestic research on carbon dioxide removal approaches and equip international decision-makers with the information required to invest in, implement, and scale technologies developed within the United States.

REC. 4

Designate tech-to-market support for carbon removal technologies across DOE

As new technologies are developed through federal RD&D, it will be important to provide assistance for the transfer from lab to market. Existing programs within DOE have been designed to alleviate common barriers that technologies face along this pathway and can expedite private-sector deployment. These programs, if applied to carbon removal solutions, could help accelerate the speed of deployment of carbon removal solutions.

A. Prioritize tech-to-market support across DOE for promising carbon removal technologies. This support should be embedded in existing programs, including the Small Business Innovation Research (SBIR) program, Small Business Technology Transfer (STTR) Program, ARPA-E's T2M Program, and I-Corps. In particular, DOE currently administers SBIR programs across different offices. Relevant programs, such as the Office of Clean Coal and Carbon Management, should focus their awards toward carbon removal-specific projects.

Priorities for Congressional Collaboration

REC. 5

Expand funding across RD&D programs in alignment with CarbonShot innovation program recommendations

Carbon removal approaches will require significant RD&D to lower solution costs, maximize co-benefits, and ensure the validity of solutions in real-world contexts.

A. Pass the appropriations necessary across DOE programs in geologic storage, carbon utilization, industrial emissions reductions, DAC, BECCS, and fundamental research in nascent technological carbon removal.

REC. 6

Create a loan guarantee program to enable low-risk financing for negative emissions technologies

Federal loan guarantees encourage private investment by sharing some of the financial risk of the deployment of new technologies that are not yet commercially viable.

A. Establish a new Loan Program Office initiative on carbon removal technology to support demonstration and deployment for projects in early stages of development and explore prioritizing these projects under the current Advanced Fossil Energy Projects initiative. This program should focus not just on DAC, but also enhanced mineralization, ocean capture, and carbontech. Such a program could potentially be housed in the Title 17 Innovative Energy Loan Guarantee Program and financed in a structure similar to the Advanced Fossil Energy Loan Guarantees and Renewable Energy & Efficient Energy Projects Loan Guarantees.

Department of the Interior

Together, US forests, wetlands, and agricultural lands sequester an amount roughly equal to 11% of annual US emissions[28] — a capacity that could be doubled if we take steps today to bolster and scale the land carbon sink.[29] In addition to the substantial opportunity for public lands to store carbon in natural ecosystems, these lands also possess significant geologic storage capacity, which is essentially unutilized today. The following recommendations outline steps toward harnessing the power of public lands to maintain the existing carbon sink and increase carbon removal. In the near term, we look toward recommendations that utilize and build upon DOI's control over subsurface storage rights on federal lands and existing expertise within USGS. For longer-term priorities, we recommend that the administration collaborate with Congress on restoration and wildfire risk reduction.

Priority Actions in the First 100 Days

REC. 1

Pre-permit Class VI wells on federal lands

EPA is currently under-resourced to facilitate the timely review of Class VI Underground Injection Control (UIC) permit applications on private lands. The Bureau of Land Management (BLM) is responsible for the review of geologic sequestration activities on federal lands and in the past has issued guidance for the exploration and site characterization of geologic storage resources on federal lands.[30]

A. Encourage BLM to identify optimal storage sites on federal lands and pre-permit these sites for geologic storage by eligible entities in coordination with EPA, which will reduce the Class VI UIC permitting burden on EPA and incentivize the geologic storage of carbon dioxide.

REC. 2

Improve mapping of US mineral weathering capacity

Mineral weathering, or carbon mineralization, is a form of geologic storage that reacts carbon dioxide with rocks and minerals to form a stable and solid carbonate

28. Environmental Protection Agency. (2019). 1990-2017 *National-Level U.S. Greenhouse Gas Inventory* [Fact sheet]. https://www.epa.gov/sites/production/files/2020-04/documents/fastfacts-1990-2018.pdf

29. Fargione, J. E., Bassett, S., Boucher, T., Bridgham, S. D., Conant, R. T., Cook-Patton, S. C., ... & Griscom, B. W. (2018). Natural climate solutions for the United States. *Science Advances*, 4(11), eaat1869. https://doi.org/10.1126/sciadv.aat1869

30. EPA Federal Requirements Under the Underground Injection Control (UIC) Program for Carbon Dioxide (CO_2) Geologic Sequestration (GS) Wells; Final Rule, 75 Fed. Reg. 77230 (Dec. 10, 2010) (to be codified at 40 CFR Parts 124, 144, 145, 146 and 147. . https://www.govinfo.gov/content/pkg/FR-2010-12-10/pdf/2010-29954.pdf

that sequesters carbon. In-situ and ex-situ methods have been proposed and tested, and both have the potential to be important carbon storage methods. USGS has done some historic work in this area, including mapping geologic resources and evaluating the economics of such approaches.[31]

A. Update USGS's "National Assessment of Geologic Carbon Dioxide Storage Resources"[32] with a focus on increasing the resolution of these surveys.

B. Perform a follow-up report on the 2019 USGS study, "Carbon Dioxide Mineralization Feasibility in the United States,"[33] and make specific suggestions for siting and additional research areas.

Priorities for Congressional Collaboration

REC. 3

Provide additional funding for DOI programs that address a breadth of restoration and wildfire risk reduction work on forests and rangelands

This is a necessary step in meeting both short- and long-term goals to create jobs, protect communities, and optimize carbon removal efforts.

A. Provide an additional $100 million per year over five years to the Hazardous Fuels Management Program, targeting highest-priority "NEPA-ready" projects.[34] This program funds proactive hazardous fuels treatment to address fuel overloads and helps restore and maintain fire-adapted landscapes.

Recommendations continue on next page

31. US Geological Survey. (2019, March 8). *Making Minerals-How Growing Rocks Can Help Reduce Carbon Emissions.* Department of the Interior. https://www.usgs.gov/news/making-minerals-how-growing-rocks-can-help-reduce-carbon-emissions

32. US Geological Survey Geologic Carbon Dioxide Storage Resources Assessment Team. (2013). *National Assessment of Geologic Carbon Dioxide Storage Resources—Results.* US Geological Survey. https://pubs.usgs.gov/circ/1386/

33. Blondes, M.S., Merrill, M.D., Anderson, S.T., and DeVera, C.A. (2019). Carbon dioxide mineralization feasibility in the United States: U.S. Geological Survey Scientific Investigations Report 2018–5079. US Department of the Interior and US Geological Survey. https://doi.org/10.3133/sir20185079

34. Kosar, U. & Amador, G. (2020). *Rooted in Resilience: Investing in America's Lands and Communities for a Green Recovery.* Carbon180. https://bit.ly/2Hbnlyc

35. Ibid.

B. Support and implement the National Prescribed Fire Act of 2020 or similar policy. The bill would establish a $300 million fund between DOI and USFS for prescribed burns on private lands and streamline permitting and regulatory hurdles without sacrificing public health or ecological integrity. Moreover, the bill would establish a workforce development program to train practitioners and an employment program for tribal communities, women, veterans, and the formerly incarcerated.

C. Provide an additional $15 million per year over five years to the Burned Area Rehabilitation Program, which supports the landscape recovery process following a fire event.[35]

D. Increase funding for and improve resource sharing and planning collaboration on wildfire risk reduction work on public lands managed by the Bureau of Indian Affairs, BLM, US Fish and Wildlife Service, and National Park Service.

Department of State

Within the State Department, the Bureau of Oceans and International Environmental and Scientific Affairs houses a number of offices that are well-positioned and resourced to provide the research and analysis required to allow the United States to serve as a leader in global carbon dioxide removal. The Office of Environmental Quality and Transboundary Issues (EQT) and the Office of Global Change all perform research, international negotiation activities, and policy implementation that could support the deployment of carbon dioxide removal approaches.

The Office of Global Change has been responsible for representing the United States in negotiations under the United Nations Framework Convention on Climate Change (UNFCCC). The Office of EQT has implemented foreign policy regarding a number of atmospheric pollutants, including ozone-depleting chemicals and long-range air pollutants. Additionally, the Office of EQT leads US involvement regarding a variety of environmental concerns across multilateral organizations, including the UN Environment Program, the OECD Environment Policy Committee, the North American Commission on Environmental Cooperation, and the World Bank. Both of these offices are well-suited to drive the development of carbon dioxide removal approaches through foreign policy such as trade agreements, multilateral environmental protocols, and sustainable development finance.

Priority Actions in the First 100 Days

REC. 1

Establish carbon dioxide removal as an item of consideration for the Ad Hoc Working Group on the Paris Agreement (APA) through the UNFCCC Conference of the Parties (COP) framework

Through a number of protocols, reports, and negotiations, the UNFCCC has indicated the importance of carbon dioxide removal. The UNFCCC has established criteria for carbon dioxide removal projects in the land use, land-use change, and forestry (LULUCF) sector, however, engineered and hybrid approaches have essentially been excluded from emissions accounting, removal, and reduction mechanisms. For domestic efforts to scale carbon dioxide removal approaches to the gigaton potential to succeed, it is likely that international cooperation and coordination will be needed. The UNFCCC offers an optimal venue to identify

international collaborations for the international research, development, and implementation of carbon dioxide removal approaches.

A. Establish carbon dioxide removal as an item of consideration for the APA. The APA's role is to prepare draft decisions to be recommended to the CMA (the signatories to the Paris Agreement). As an item of consideration, the APA could clarify the role of carbon removal within the global stocktake, Nationally Determined Contributions (NDCs), and adaptation measures.

REC. 2

Include carbon removal in the US NDC

Currently, approximately 66% of countries have referenced carbon dioxide removal through LULUCF within their NDCs under the Paris Agreement.[36] In many NDCs, carbon dioxide removal is already appropriately differentiated from conventional mitigation. However, it is less clear how carbon removal efforts should be quantified, accounted for, and implemented at the global scale, especially as some projects may span or require resources from a number of parties. Additionally, no nation has explicitly identified the use of engineered carbon removal approaches as a component of its NDCs. In addition to enhancing the feasibility of existing NDCs, the incorporation of clear methods for trading carbon removals for NDCs would also support and finance the implementation of the Sustainable Development Goals.[37]

A. Direct the Office of Global Change to lead the development of accounting standards and trading mechanisms for the emissions outcomes of natural, hybrid, and engineered carbon dioxide removal approaches in order to clarify how these solutions should be incorporated and traded within NDCs. Specifically, the Office of Global Change should provide leadership on how the current consensus on Article 6 of the Paris Agreement could facilitate the trading of internationally transferable mitigation outcomes (ITMOs) in the context of carbon dioxide removals to enhance the feasibility or ambition of NDCs. These trading mechanisms in combination with the domestic research and development programs discussed in this document are likely to position the United States as a global leader in and exporter of these technologies and land management approaches.

Recommendations continue on next page

36. Seddon, N., Daniels, E., Davis, R., Chausson, A., Harris, R., Hou-Jones, X., ... Wicander, S. (2020). Global recognition of the importance of nature-based solutions to the impacts of climate change. *Global Sustainability*, 3. https://doi.org/10.1017/sus.2020.8

37. Smith, P., Adams, J., Beerling, D. J., Beringer, T., Calvin, K. V., Fuss, S.,... Keesstra, S. (2019). Land-Management Options for Greenhouse Gas Removal and Their Impacts on Ecosystem Services and the Sustainable Development Goals. *Annual Review Of Environment and Resources, 44*, 255-286. https://doi.org/10.1146/annurev-environ-101718-033129

B. Coordinate with EPA, USDA, and DOE to issue a revised NDC under the Paris Agreement that explicitly incorporates natural, hybrid, and engineered carbon dioxide removal approaches. A revised NDC should detail the progress toward the current commitment and the role carbon dioxide removal approaches will serve in pursuing this target. This would 1) establish leadership and a precedent for incorporating carbon dioxide removal within NDCs,[38] 2) clarify the role carbon dioxide removal can serve in addition to conventional mitigation efforts, and 3) provide guidance for opportunities to exchange carbon removal units internationally through Article 6 of the Paris Agreement.

38. Torvanger, A. (2019). Governance of bioenergy with carbon capture and storage (BECCS): accounting, rewarding, and the Paris agreement. *Climate Policy*, 19(3), 329-341. https://doi.org/10.1080/14693062.2018.1509044

39. UN Environment Programme. (2020, September 2). Carbon Sequestration Leadership Forum (CSLF). Retrieved from http://climateinitiativesplatform.org/index.php/Carbon_Sequestration_Leadership_Forum_(CSLF)

REC. 3

Initiate a Carbon Dioxide Removal Leadership Forum

In 2003, the United States initiated the Carbon Sequestration Leadership Forum (CSLF), a ministerial-level international climate change initiative focused on development of cost-effective carbon capture and storage (CCS) technologies.[39]

A. Introduce a Carbon Dioxide Removal Leadership Forum in collaboration with DOE and USDA, continuing the United States' position as a global leader in energy and climate innovation. To increase global accessibility of carbon removal technologies and contribute to their scale-up and deployment, this forum should facilitate RD&D of these technologies across countries as well as collaborations to address key technical, economic, and environmental barriers to scaling solutions. The forum should also scope and assess potential areas of needed research and education, in particular surrounding social science and governance considerations for future carbon removal deployment.

Environmental Protection Agency

EPA's regulatory expertise and power will be critical to ensuring the safety and validity of carbon removal. Today, a lack of regulatory clarity and delays in approval processes hinder the development of carbon removal projects across land- and tech-based approaches. By engaging with and co-creating strong regulatory frameworks for carbon removal with frontline communities, the administration can ensure equity, justice, and environmental protection.

Priority Actions in the First 100 Days

REC. 1

Establish lifecycle accounting guidance for biomass energy processes

In 2018, EPA established that forest biomass feedstocks could be considered carbon neutral for the purpose of energy and power applications.[40] This standard neglects important carbon accounting considerations for harvesting, transportation, and processing emissions.

A. EPA should establish clear and rigorous guidance for quantifying the complete lifecycle emissions associated with forest biomass for energy applications.

B. Accounting for the complete lifecycle emissions of biomass energy feedstocks will be a necessary precursor for accurately quantifying the removals of BECCS projects.

REC. 2

Improve Class VI permitting on private lands

The development of any carbon removal project incorporating the geologic sequestration of carbon dioxide (without the production of oil or gas) in the United States requires the issuance of a Class VI UIC permit from EPA. The authority to regulate UIC wells on private lands is granted to EPA through the Safe Drinking

40. US Environmental Protection Agency. (2020). *EPA's Treatment of Biogenic Carbon Dioxide (CO_2) Emissions from Stationary Sources that Use Forest Biomass for Energy Production.* https://www.epa.gov/sites/production/files/2018-04/documents/biomass_policy_statement_2018_04_23.pdf

Water Act; however, the current review process for obtaining a permit is lengthy, cumbersome, and poorly understood by project developers. In many cases, obtaining a Class VI UIC permit has been and will continue to be a primary bottleneck and uncertainty for near-term DAC and BECCS projects. Currently, EPA has only issued two Class VI permits.[41]

Notably, the permitting process for Class II UIC wells, which cover the injection of fluids associated with oil and gas production, including carbon dioxide, has effectively issued nearly 200,000 wells and could serve as an excellent reference for improvements to the Class VI permitting process.

Due to the lengthy process of obtaining a Class VI permit at the federal level, several state governments have begun the process of applying for Class VI primacy in order to permit geologic storage wells within their jurisdictions through state review. This application and review process is also lengthy and complex, and only North Dakota and Wyoming have currently received approval from EPA to issue Class VI permits.

Presently, EPA is insufficiently staffed, funded, and resourced to meet the demand for Class VI UIC permits.[42]

A. Prioritize the review of Class VI UIC well applications to allow potential carbon storage projects to move forward. Because of the additional requirements associated with Class VI UIC permits (as opposed to Class II UIC permits), EPA should allocate additional staff and funding to support the accelerated review of Class VI UIC applications to avoid inhibiting the development of carbon removal projects. The administration should work with Congress to ensure that EPA funding is sufficient to meet these goals.

41. Congressional Research Service. (2020). *Injection and Geologic Sequestration of Carbon Dioxide: Federal Role and Issues for Congress* (CRS Report No. R46192). https://crsreports.congress.gov/product/pdf/R/R46192

42. Geraci, M., Ali, S. J., Romolt, C. & Rossman, R. (2017). *The Environmental Risks and Oversight of Enhanced Oil Recovery in the United States.* Clean Water Action and Clean Water Fund. https://www.cleanwater.org/sites/default/files/docs/publications/The%20Environmental%20Risks%20and%20Oversight%20of%20Enhanced%20Oil%20Recovery%20in%20the%20United%20States%2008.17.17a.pdf

REC. 3

Prioritize the NEPA approval process for prescribed fire

Prescribed burning is a critical tool to reduce wildfire risk and protect the capacity of forest carbon sinks. Currently the NEPA approval process for prescribed burns on federal lands can take years, which makes it difficult to schedule burns at reasonable intervals. As more communities face threats from increasing wildfires, it will be important to ensure that preventative measures can take place while also protecting the environmental and air quality of those same communities.

A. Expedite the NEPA approval process for prescribed burn permits, hiring additional staff as needed to process the increase in permit requests.

REC. 4

Reform the Renewable Fuel Standard (RFS) to incentivize negative emissions biofuels and DAC

The RFS was written with the best available technologies in mind, but recent technological developments have made the rulemaking unintentionally exclusionary. The RFS has the legal authority to incentivize negative-emissions bioenergy and DAC to a much greater extent than the current RFS is achieving.

A. Amend the RFS to include synthetic fuels derived from DAC carbon dioxide in addition to the biomass-derived fuels that are currently included. In particular, a reform of the RFS to incentivize fuels based on overall carbon intensity (CI), with explicit pathways to include DAC to fuels and/or storage, would both help to catalyze the development of carbon removal technologies and enable greater climate mitigation impact from the RFS program. California's Low Carbon Fuel Standard offers a good model for reforming the RFS in the future, and includes both a CI-based crediting mechanism and a protocol for DAC developers to generate credits for fuel production and/or DAC with geologic storage.

B. Prioritize working with Congress to implement these reforms to the RFS statutorily, or in the absence of Congressional action prioritize using existing authority to make these reforms.

National Science Foundation

NSF supports fundamental research and education across the sciences and therefore plays an important role in directing America's research and small business priorities toward inquiries that will help bring nascent carbon removal solutions to fruition. By designating carbon removal as a scientific priority, NSF can support related projects across disciplines. In addition to funding basic research and technical development, social science research will be critical to understanding the best ways to scale carbon removal solutions in a safe and equitable manner.

Priority Actions in the First 100 Days

REC. 1

Modify NSF's Seed Fund to support carbon removal projects

The SBIR and STTR programs have four statutory mandates: 1) stimulate technological innovation, 2) use small business to meet federal R&D needs, 3) foster and encourage participation by socially and economically disadvantaged small business concerns (SBCs) and women-owned SBCs in technological innovation, and 4) increase private-sector commercialization of innovations derived from federal R&D. Funding and solicitations for SBIR/STTR awards come from a variety of federal agencies, although around 97.5% of the funding comes from NSF, US Department of Defense, DOE, US Department of Health and Homeland Security, and NASA. While agencies have relative flexibility in administering the program, NSF has the most flexibility.[43] NSF's SBIR program, known as America's Seed Fund, awards $200 million annually[44] to various technology topic areas. STTR functions as a partner program to SBIR, and relevant STTR granting agencies include DOE and NSF.

43. Rozansky, R. (2019). *Becoming America's Seed Fund: Why NSF's SBIR Program Should Be a Model for the Rest of Government.* https://itif.org/publications/2019/09/26/becoming-americas-seed-fund-why-nsfs-sbir-program-should-be-model-rest

44. National Science Foundation Seed Fund. https://seedfund.nsf.gov/about/

A. Include carbon removal and utilization as a stand-alone topic area with specific subcategories. While carbon removal proposals could conceivably fit under some of the listed topic areas, including it as a stand-alone topic area gives emphasis, clarity, and focus. Modeling after the Environmental Technology option, an idea for a new category is:

Carbon Removal and Utilization
CR1. Technological Solutions
CR2. Terrestrial Solutions
CR3. Ocean Solutions
CR4. Carbontech
CR5. Other

B. Award at least $20 million annually for the next 10 years to carbon removal and utilization, with at least $10 million of these funds dedicated to increasing private sector commercialization of carbon removal innovations derived from federal R&D. Given the relative autonomy NSF has over the funding and administration of SBIR awards, it could potentially determine a minimum allotment for topic areas that are deemed urgent.

REC. 2

Prioritize and emphasize interdisciplinary carbon removal projects

While there are valuable external reports that reflect the interdisciplinary nature of carbon removal development and deployment, it is extremely important to encourage the creation of government products or government-sponsored projects that address carbon removal holistically, especially in the context of federal decision-making. NSF is uniquely positioned to tap into the academic community to support this research, and it could be a leader in facilitating an interdisciplinary approach to carbon removal development.

A. Offer at least one grant for a minimum of $500,000 for research to address governance of large-scale carbon removal from within existing budgets. In particular, NSF should solicit research grants specifically addressing the importance of public engagement and the analysis of various strategies to ensure when and how participatory processes can be integrated into the development of carbon removal regulatory frameworks and deployment decisions. When awarding grants for carbon removal projects, prioritize those that favor an interdisciplinary approach and include disciplines in the social sciences.

Priorities for Congressional Collaboration

REC. 3

Increase funding for ecosystem science toward the goal of carbon removal and climate change resilience

The effects of climate change over the coming decades will alter and destroy ecosystems around the country, and a deeper understanding of these systems may allow for the cultivation of resilience and the ability to protect and rebuild.

A. Make basic and applied ecosystem science a top priority area for NSF funding, and commit to increasing funding for this research over the next several decades.

REC. 4

Include carbon removal as a priority in proposed NSF expansion bill

In May, the proposed bicameral Endless Frontier Act advocated for the expansion of NSF into the National Science and Technology Foundation, with a huge increase in funding and scope over the next five years.[45] Applied technologies are the focus of much of the bill's expansion, including the construction of research hubs that

45. Mervis, J. (2020, May 26). U.S. lawmakers unveil bold $100 billion plan to remake NSF. *Science*. Retrieved from https://www.sciencemag.org/news/2020/05/us-lawmakers-unveil-bold-100-billion-plan-remake-nsf

focus specifically on tech development.

A. Include carbon removal as one of the 10 technology research hubs. These hubs are focused on bringing tech development from lab to market, which is key for carbon removal technology over the next decade. Creating a center focused on carbon removal will help create the infrastructure, develop the technology, and build the human capital required for this transition.

Section Four

Recommendations for the President's Budget

The administration should encourage Congress through the President's Budget to increase funding for the research, development, demonstration, and deployment of the full portfolio of carbon removal solutions.

Below, we recommend a few priority areas for the President's Budget for fiscal year 2022 (FY22). Over the following months, Carbon180 will continue to flesh out these recommendations and publish a complementary set for FY22 appropriations.

Across all agencies, the administration should work with Congress to launch a "CarbonShot" innovation program to drive the cost of robustly verified carbon removal to less than $100/ton CO_2 by 2025. The administration should announce a goal of $10 billion in new RD&D funding for the full portfolio of carbon removal solutions over the next decade — aiming to secure at least **$883 million in funding for FY22**.[46] In his budget, the president should aim to increase funding for innovation, as well as interagency coordination to ensure that lessons are transferred across programs. These requests should be in line with the recommendations from the National Academies, Energy Futures Initiative, and this report.

46. Energy Futures Initiative. (2019). *Clearing the Air: A Federal RD&D Initiative and Management Plan for Carbon Dioxide Removal Technologies.*

Department of Agriculture

USDA should work to coordinate and expand all land-based carbon removal efforts. They should focus on increasing their R&D capacity and invest in the economic recovery and long-term resilience of agriculture and forestry communities. Doing so will require increases in funding across core offices, including the NRCS, NIFA, USFS, and Agricultural Research Service (ARS). The president should also propose two new programs that:

- Provide federal grants to states, municipalities, tribes, and local governments to expand and establish tree nurseries. With their current capacity, tree nurseries will not be able to sustain a substantial increase in reforestation and tree planting efforts.
- Establish a stewardship corps, similar to the Civilian Conservation Corps, dedicated to restoring and reforesting public lands. The program can prioritize opportunities for people from low-income communities and those who are newly unemployed due to COVID-19.

OFFICE PROGRAM	FY20 FUNDING LEVEL	FY22 FUNDING REQUEST	PROGRAM DIRECTION
NRCS Conservation Technical Assistance	$735,760,000	$775,760,000	At least $40,000,000 for technical assistance related to healthy soils planning, soil carbon sequestration, and conservation activity planning.
NRCS Soil Survey Program	$74,987,000	$79,987,000	NRCS to carry out an on-farm soil carbon monitoring program through the National Resources Inventory with the $5,000,000 in additional funds allocated to the Soil Surveys Program.
ARS	$1,607,066,000	$1,707,066,000	$100,000,000 for fundamental research related to soil carbon sequestration, social science related to practice adoption, the development of advanced cultivars, research into cultivation system optimization and soil amendments, and the development of tools to predict and quantify soil carbon storage. These research priorities would fit under the following ARS subprograms: Crop Production; Plant Genetic Resources, Genomics, and Genetic Improvement; Sustainable Agricultural Systems Research; Grass, Forage, and Rangeland Agroecosystems; Soil and Air.

Department of Agriculture *(Continued)*

OFFICE PROGRAM	FY20 FUNDING LEVEL	FY22 FUNDING REQUEST	PROGRAM DIRECTION
ERS	$84,757,000	$89,757,000	$5,000,000 for research on the economics around landowner adoption of conservation practices, with a specific focus on practices that store carbon in soils.
NIFA Agriculture and Food Research Initiative	$425,000,000	$444,000,000	$4,000,000 for research on Soil Dynamics at Depth within the Foundational and Applied Science Program; $10,000,000 for High Carbon Input Phenotype Research within the Plant Breeding, Genetics & Genomics Program; and $5,000,000 for a data-model platform for predicting and quantifying agricultural soil carbon removal and storage within the Sustainable Agricultural Systems program.
Forest Service Collaborative Forest Landscape Restoration Program	$40,000,000	$90,000,000	—
Forest Service Hazardous Fuels Program	$445,310,000	$610,310,000	—
Forest Service Vegetation and Watershed Management	$182,000,000	$282,000,000	—
Forest Service Urban and Community Forestry	$32,000,000	$112,000,000	—

Department of Agriculture *(Continued)*

OFFICE PROGRAM	FY20 FUNDING LEVEL	FY22 FUNDING REQUEST	PROGRAM DIRECTION
Forest Service Land Management Planning, Inventory and Monitoring	$180,000,000	$216,000,000	—
Forest Service Forest and Rangeland Research	$305,000,000	$385,000,000	Additional $80,000,000 for the Forest Inventory Analysis National Program.

Department of Energy

DOE should launch a cross-cutting research program with the goal of driving the cost of technological carbon removal to less than $100/ton of CO_2. DOE should also focus on expanding RDD&D around geologic storage, carbon utilization, industrial emissions reductions, BECCS, and nascent technological carbon removal solutions. This will require increasing funding across offices, in particular the Carbon Capture program, Advanced Manufacturing Office (AMO), and the Office of Science. Funding for this new cross-cutting initiative should consist of no less than $160,000,000 for research and development of negative emissions technologies. In line with the recommendations on page 31, we suggest the newly created Assistant Secretary of Industrial Decarbonization oversees this crosscut. Finally, we recommend the Office of Fossil Energy be renamed the Office of Carbon Management to reflect its new mandate on industrial CCS and carbon removal.

OFFICE PROGRAM	FY20 FUNDING LEVEL	FY22 FUNDING REQUEST	PROGRAM DIRECTION
Office of Carbon Management (Currently the Office of Fossil Energy) Carbon Storage	$100,000,000	$200,000,000	To support research and development of technologies for the safe and secure storage of captured carbon dioxide.
Office of Carbon Management Carbon Utilization	$21,000,000	$50,000,000	For research and development activities to support valuable and innovative uses of captured carbon, including utilization by the conversion of carbon dioxide to higher-value products such as chemicals, plastics, building materials, and curing for cement.
Office of Carbon Management Carbon Capture	$117,800,000	$197,800,000	Additional $80,000,000 for research and development of DAC. The program is directed to collaborate with the Office of Science and the Office of Energy Efficiency and Renewable Energy to develop a coordinated program, as recommended by the National Academies, that supports research, development, and demonstration projects to advance the development and commercialization of DAC technologies on a significant scale. *(continues on next page)*

Department of Energy *(Continued)*

OFFICE PROGRAM	FY20 FUNDING LEVEL	FY22 FUNDING REQUEST	PROGRAM DIRECTION
Office of Carbon Management Carbon Capture	$117,800,000	$197,800,000	*(continued)* Within available funds, no less than $70,000,000 for research and optimization of carbon capture technologies at industrial facilities and not less than $10,000,000 for research and optimization of carbon capture technologies for natural gas power systems.
EERE BETO	$259,500,000	$309,500,000	Additional $50,000,000 for research and development on bioenergy with CCS, including algal biomass capture, biomass supply chain and logistics, biomass conversion to fuels.
EERE AMO	$395,000,000	$435,000,000	Additional $40,000,000 for research and development on DAC. The program is directed to collaborate with the Office of Science and the Office of Fossil Energy to develop a coordinated program, as recommended by the National Academies, that supports research, development, and demonstration projects to advance the development and commercialization of DAC technologies on a significant scale.
Office of Science Basic Energy Sciences	$7,000,000,000	$7,050,000,000	Additional $40,000,000 for research and development on DAC. The program is directed to collaborate with the Office of Science and the Office of Fossil Energy to develop a coordinated program, as recommended by the National Academies, that supports research, development, and demonstration projects to advance the development and commercialization of DAC technologies on a significant scale. Additional $10,000,000 for research and development on algal biomass capture.

Department of the Interior

DOI should expand its leadership on carbon removal in two core areas: mineral weathering and forestry. DOI should bolster funding for existing programs and establish new programs that address a breadth of restoration and wildfire risk reduction needs on forests and rangelands. This is a necessary step in meeting goals to create jobs, protect communities, and optimize carbon removal efforts. The president should also propose two new programs that:

- Establish a $300 million fund between DOI and USFS for prescribed burns on private lands and streamline permitting and regulatory hurdles without sacrificing public health or ecological integrity.
- Establish a workforce development program to train practitioners and an employment program for tribal communities, women, veterans, and the formerly incarcerated.

These programs are described in more detail in the National Prescribed Fire Act of 2020.

OFFICE PROGRAM	FY20 FUNDING LEVEL	FY22 FUNDING REQUEST	PROGRAM DIRECTION
Wildland Fire Burned Area Rehabilitation Program	$20,470,000	$35,470,000	—
USGS	$1,270,957,000	$1,275,957,000	Additional $5,000,000 for activities related to mineral weathering, including resource assessments, environmental impacts of mineralization products, and environmental and social impacts of expanded mining for mineralization.

Environmental Protection Agency

EPA's regulatory expertise and power will be critical to ensuring the safety and validity of carbon removal. Because of the additional requirements associated with Class VI UIC permits (as opposed to Class II UIC permits), EPA should allocate additional staff and funding to support the accelerated review of Class VI UIC applications to avoid inhibiting the development of carbon removal projects. The administration should work with Congress to ensure that EPA funding is sufficient to meet these goals. Additionally, the administration should increase funding for core environmental justice programs to ensure equity, justice, and environmental protection.

OFFICE PROGRAM	FY20 FUNDING LEVEL	FY22 FUNDING REQUEST	PROGRAM DIRECTION
EPA State and Tribal Assistance Programs Underground Injection Control	$10,164,000	$100,000,000	$100,000,000 for the Underground Injection Control program, with $50,000,000 for Class VI regulatory and permitting work.
Enforcement Environmental Justice	$9,554,000	$60,000,000	Additional funding should be split across the Environmental Justice Small Grants Program, Collaborative Problem-Solving Cooperative Agreement Program, the Community Action for a Renewed Environment Grant Program, and the Technical Assistance Services for Communities program.

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