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To Examine Opportunities and Challenges in Deploying CCUS and DAC Technologies on Federal and Non-Federal Lands

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Thank you, Chairman Manchin, Ranking Member Barrasso, and Members of the Committee. I appreciate the opportunity to discuss with you the work being done at the Department of Energy (DOE) to advance carbon management across the whole value chain, including carbon capture from industrial facilities and power plants, removing carbon dioxide (CO2) directly from the atmosphere, the conversion of captured carbon emissions into useful products, and the regional transport and geologic storage of CO2.

I also appreciate the Committee's longstanding bipartisan interest, support, and commitment to providing DOE and the Office of Fossil Energy and Carbon Management (FECM) with the tools necessary to advance critical carbon management technologies and infrastructure.

Thanks to unprecedented federal funding, financing, and tax credit provisions enacted by Congress in the Energy Act of 2020, Bipartisan Infrastructure Law (BIL), and Inflation Reduction Act (IRA), we now have a once-in-generation opportunity to accelerate the deployment of carbon management needed to meet midcentury climate goals, support domestic energy security and industrial production, protect and create high-wage jobs, and provide tangible economic and environmental benefits to communities.

DOE, primarily through FECM, has been investing in carbon management technologies for more than 25 years and across five presidential administrations. The sustained support from both sides of the aisle for DOE's carbon management work over that time has enabled carbon management to emerge into a promising, scalable, and commercially viable decarbonization option in which the U.S. can continue to lead the world in the coming decades.

Through this bipartisan congressional investment, DOE's research, development, demonstration, and deployment funding (RDD&D), analysis, and stakeholder engagement activities have helped deliver a range of critical outcomes, including:

- The demonstration of safe and permanent geologic storage of CO2 at scale in dedicated saline aquifers, such as the more than 4 million tons of CO2 injection and storage accomplished through the two DOE-funded Archer Daniels Midland projects;
- Successful demonstration of integrated and large-scale commercial capture and storage of CO2 emissions in multiple industries, including ethanol production, clean hydrogen production from natural gas, and coal-fired power generation;
- The measurement, monitoring, reporting, and verification of CO2 throughout the carbon management value chain to validate secure geologic storage, build public confidence in emissions reductions achieved, and provide certainty for carbon markets;
- Pilot project activities at the National Carbon Capture Center and across the country, which have shown that CO2 capture technology can cost-effectively reduce emissions by over 95% from a wide range of industrial and power sources;
- Technical assistance from DOE and its National Laboratories to other federal agencies to help ensure more protective, transparent, and efficient permitting of geologic storage projects and safe CO2 pipelines; and
- Leading-edge technoeconomic and lifecycle carbon accounting analyses to inform effective and economical decarbonization of industry and electric power generation.

As a result of these and other efforts undertaken with industry and other partners, we now have a strong foundation of successful large-scale domestic deployment that includes over 5,000 miles of CO2 pipeline infrastructure and 13 operating commercial-scale carbon capture projects across multiple industries that collectively capture, transport, and store over 20 million metric tons of CO2 annually. This represents more than one third of the world's 30 commercial-scale carbon capture projects operating globally at the end of 2022, which captured and stored 46 million tons of CO2 emissions from industries as diverse as ethanol, hydrogen, fertilizer, natural gas processing, steel, chemicals and fuels, and power generation, contributing to well over a quarter billion tons of cumulative geologic storage worldwide.

Recent legislative achievements have enabled us to continue building on this foundation of success and have prompted a significant shift in the commercial outlook for deployment of carbon management projects in the U.S. and abroad. Nearly 200 new projects have been publicly announced in response to the IRA's reform and expansion of the federal 45Q tax credit—a massive increase over today's 13 operating projects.

As noted in the recent DOE Pathways to Commercial Liftoff report, the enhanced 45Q tax credit provides an important financial driver for private investment in a wide range of projects. The tax credit by itself offers a sufficient incentive for many industries with higher concentration CO2 emissions, and therefore lower costs of capture—such as ethanol, fertilizer, gas processing, and hydrogen production—to move forward with investments in carbon capture, transport, and storage.

While challenges remain for heavy industry, electric power generation, and direct air capture, which have lower concentration CO2 emissions and higher capture costs, the pilot and demonstration project funding and loan guarantees in the BIL and IRA have the potential to close the cost gap remaining after 45Q, thus increasing the economic viability of such projects.

Given the powerful leveraging effect of BIL investments in conjunction with the 45Q tax credit, FECM, the Office of Clean Energy Demonstrations, and the Loan Programs Office have been working aggressively to ensure that federal funding flows to the highest impact projects as quickly and effectively as possible. DOE's carbon management RDD&D activities are also evolving alongside this shift in commercial outlook. Our funding opportunities have begun to focus on later-stage innovation, including implementation of the BIL funding for pilots, demonstrations, and hubs.

Since the enactment of the BIL, DOE has made funding available, or selected projects for negotiations, for all of BIL's carbon management provisions. This includes $1.2 billion for two direct air capture hub demonstration projects and nearly $100 million for 19 direct air capture feasibility and front-end engineering and design (FEED) studies; $7 billion for seven clean hydrogen hubs, with an expected $40 billion in matching funds from private investment; $1.7 billion for commercial carbon capture demonstration projects; $820 million for carbon capture large-scale pilots; eight carbon capture FEED studies; and $115 million for pre-commercial and commercial direct air capture technology prize competitions.

FECM's base appropriations funding is also shifting to support the expansion of carbon management beyond the foundation laid by IRA and BIL funding. Our investments in engineering studies now focus on enabling carbon capture at a wider range of industrial facilities, often in collaboration with other offices at DOE that are pioneering complementary industrial decarbonization strategies.

FECM is also exploring the application of carbon management to the power grid by enabling power plants fitted with carbon capture to operate more flexibly and contribute to energy storage and demand management.

Our CO2 transport and storage funding now prioritizes the creation of regional scale "carbon hubs" that connect clusters of CO2 emissions sources across industries with multimodal (e.g. pipeline, rail, truck, barge, ship, etc.) CO2 transport infrastructure to optimal sites for large-scale CO2 storage.

More generally, our RDD&D work is aimed at not only bringing down the costs for technology and infrastructure, but also understanding how to monitor, manage, and stress-test CO2 capture, transport, and storage at large scale, so communities, regulators and others can make evidence-based decisions regarding carbon management projects.

DOE is also pioneering new directions for the carbon management field. Our Carbon Negative Energy Earthshot sets a goal of driving down the cost of carbon removal technology over the next decade to less than $100 per metric ton of carbon dioxide removed from the atmosphere. We also have an expanded CO2 conversion program that draws on both BIL funding and base appropriations, which explores ways to convert waste carbon emissions, both carbon monoxide and CO2, into value-add industrial products that can help decarbonize our built environment and petrochemical and fuel supply chains.

DOE also recognizes that an expanded effort to meaningfully engage communities and local stakeholders is essential if we are to unlock the promise of carbon management as a decarbonization and energy security solution. We simply cannot realize the full deployment

potential of the funding, financing, and incentives in recent legislation without broad-based understanding of and support for carbon management and other clean energy projects and infrastructure from local communities and stakeholders, in particular communities with environmental justice concerns

DOE's Regional Initiatives program builds on over a decade of support for place-based analysis and engagement in regions across the U.S. with the greatest opportunity for CO2 storage. DOE has expanded our efforts on this front by including Community Benefits Plan requirements in our funding opportunities to ensure that recipients of DOE funding are creating high-quality jobs, protecting the environment by addressing existing and unintended pollution, and ensuring that projects are sited and operated with significant input from and serve to benefit local communities. Through implementation of the Community Benefits Plans, project developers commit to prioritizing ongoing engagement throughout the life of the DOE-funded project. Additionally, DOE is taking the information from these Community Benefits Plans to create additional communications materials.

Additionally, FECM and federal partners held five interactive community workshops on carbon management in 2022. The purpose of the workshops was for (1) DOE and other government agencies to learn about community priorities, concerns, and ideas related to carbon management projects, including how community members would like to be involved in projects moving forward and (2) for community members to learn about the potential carbon management projects that might be a fit for their area, the rationale for these projects, and opportunities for public participation along the lifespan of a project. FECM is currently planning additional community engagement meetings in the coming year.

Finally, we are exploring a voluntary Responsible Carbon Management Initiative designed to identify and elevate industry best practices and encourage project developers to pursue the highest levels of safety, environmental stewardship, transparency, and community engagement and benefits for projects.

DOE also recognizes that the United States is a global leader regarding policies and regulations that support the development of carbon management technologies and infrastructure. Therefore, DOE leads the United States' participation in a number of emerging international efforts, including:

- Carbon Management Challenge;
- Clean Energy Ministerial's Carbon Capture, Utilization and Storage Working Group;
- Mission Innovation's Carbon Dioxide Removal Launchpad;
- International Energy Agency's Greenhouse Gas R&D Programme; and
- Several cooperative bilateral efforts with countries such as Canada, Norway, and the United Kingdom.

Despite the progress of recent years, there remains an enormous gap between the current levels of carbon management deployment and levels required to achieve net zero emissions by 2050. The United Nations' Intergovernmental Panel on Climate Change has noted that we cannot reach global emissions reduction goals without economywide carbon management at scale, including both carbon capture and carbon dioxide removal.

Additionally, a recent International Energy Agency analysis estimated that we must achieve 1 Gigaton (Gt) of annual CO2 capture and storage globally by 2030, if we are to remain on track to reach net-zero emissions by 2050.

The Carbon Management Challenge, launched by President Biden during the Major Economies Forum on Energy and Climate in April, aims to help achieve these goals. It builds on Mission Innovation's Carbon Dioxide Removal Mission and the Clean Energy Ministerial's Carbon Capture, Utilization and Storage Initiative to accelerate the use of carbon management technologies together with an aggressive suite of other necessary mitigation options, such as expanded renewable energy deployment and deep reductions in methane emissions.

Convening countries from every major region of the world, the Carbon Management Challenge represents a joint effort and call to action on the need to accelerate deployment of carbon capture, removal, use, and storage technologies.

Reaching our energy security and climate goals will also require DOE to collaborate with Congress, other federal agencies, the private sector, communities, and other key stakeholders to further remove barriers to commercial deployment of carbon management technologies at home and abroad. Only through continued collaboration will we be able to deliver on the full potential of carbon management technologies and infrastructure that Congress has consistently supported to date.

Mr. Chairman, and members of the Committee, this completes my prepared statement. I would be happy to answer any questions you may have at this time.