S. HRG. 118–313

OPPORTUNITIES AND CHALLENGES IN DEPLOYING CARBON CAPTURE UTILIZATION AND SEQUESTRATION AND DIRECT AIR CAPTURE TECHNOLOGIES ON FEDERAL AND NON-FEDERAL LANDS

HEARING

BEFORE THE

COMMITTEE ON ENERGY AND NATURAL RESOURCES UNITED STATES SENATE

ONE HUNDRED EIGHTEENTH CONGRESS

FIRST SESSION

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OPPORTUNITIES AND CHALLENGES IN DEPLOYING CARBON CAPTURE UTILIZATION AND SEQUESTRATION AND DIRECT AIR CAPTURE TECHNOLOGIES ON FEDERAL AND NON-FEDERAL LANDS

THURSDAY, NOVEMBER 2, 2023

U.S. SENATE,
COMMITTEE ON ENERGY AND NATURAL RESOURCES,
Washington, DC.

The Committee met, pursuant to notice, at 10:01 a.m., in Room SD–366, Dirksen Senate Office Building, Hon. Joe Manchin III, Chairman of the Committee, presiding.

OPENING STATEMENT OF HON. JOE MANCHIN III, U.S. SENATOR FROM WEST VIRGINIA

The CHAIRMAN. The Committee will come to order.

Before we begin today's hearing, I want to take a minute to say that we are thinking and praying for the families and loved ones of the man that was killed at the Martin Coal Mine Prep Plant demolition site in Martin County, Kentucky this week, and the worker still trapped beneath the rubble that still has not been located. It is a tragic reminder of the dangers our coal communities face and the sacrifices they make to power our nation. In this case, the sacrifices continue, even after this facility has been closed.

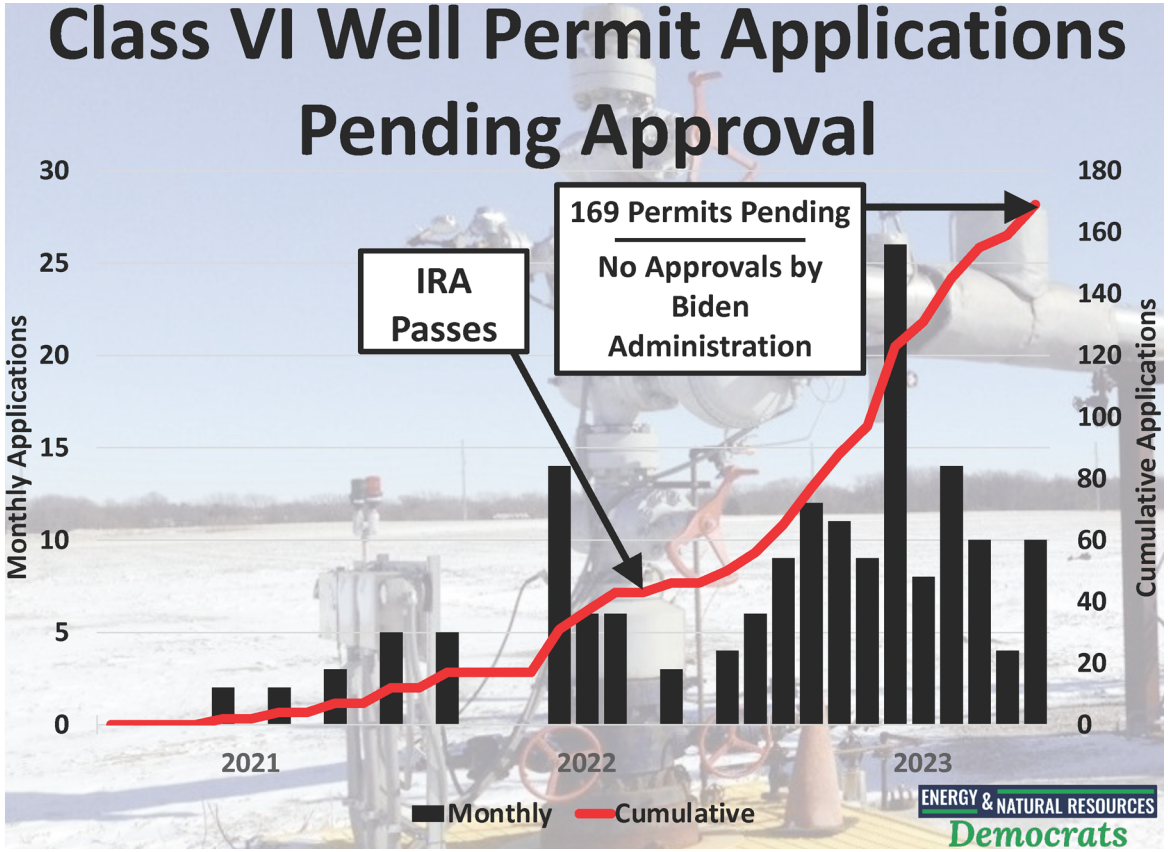
I also want to express my frustration that just this morning, the Bureau of Ocean Energy Management announced that it will again delay the Gulf of Mexico Lease Sale 261, despite the Director testifying before this Committee one week ago that "all systems are go" to hold the lease sale on November 8. BOEM is once again blaming the courts for delaying the sale, but the delays are entirely the Administration's fault. The Department of the Interior was so eager to meet the demands of environmental groups to restrict the sale that it bypassed important legal requirements, leading to this litigation.

Moving to today's topic, we are going to be hearing about the examined opportunities and challenges our country has with deploying carbon capture utilization and sequestration, or CCUS, and direct air capture, or DAC. Both of these critical technologies have received significant bipartisan support from Congress in recent years, and that should come as no surprise, as they will play a vital role in protecting American energy security, keeping electricity reliable, and creating jobs here at home, while reducing our emissions for decades to come. Between the improvements we made

to the 45Q tax credit in the Inflation Reduction Act and the funding that we included for deployment and demonstration in the Bipartisan Infrastructure Law, CCUS and DAC are now on the rise. In the IRA, we increased the value of the 45Q tax credit from $50 per ton to $85 for carbon captured and sequestered, from $35 to $60 per ton for carbon captured and utilized, and more than doubled the credit for direct air capture because that technology is currently more expensive. These IRA provisions built off of earlier improvements to 45Q that our colleague Senator Barrasso spearheaded and I supported. In the IRA, we made important changes to the 45Q proposal in the BBB bill, which would have excluded many of our dispatchable coal and natural gas power plants from continuing to use the credit. Furthermore, our Committee's portion of the Bipartisan Infrastructure Law included over $10 billion in DOE programs to commercialize large CCUS and DAC projects.

We spent decades researching and proving CCUS technologies work. The program in the IRA and Infrastructure Law were intended to accelerate the full-scale deployment of them, and this legislation is attracting unprecedented private-sector investment. CCUS and DAC developers have submitted more than 120 applications to EPA for Class VI well permits to sequester carbon since the IRA passed, and there are 169 total pending applications. You can see where we are, and not one approval has been made by the Biden Administration. The current Administration claims to be supportive of carbon capture, just as Congress has been.

[Chart depicting Class VI well permit applications pending approval follows:]


Class VI Well Permit Applications Pending Approval
Monthly Applications
Cumulative Applications
30
25
20
15
10
5
0
180
160
140
120
100
80
60
40
20
0
IRA Passes
169 Permits Pending
No Approvals by Biden Administration
2021
2022
2023
Monthly
Cumulative
ENERGY & NATURAL RESOURCES
Democrats

The CHAIRMAN. They issued a report in June of 2021 which stated: "The Administration is committed to accelerating the responsible development and deployment of CCUS to make it a widely available, increasingly cost-effective, and rapidly scalable climate solution." The same report also argues that: "if the United States is to achieve its climate goals, research suggests that CCUS deployment should increase tenfold over the next decade." But it's hard for me to square this Administration's own report with its actions. Nearly two and a half years after that report came out, not a single Class VI well has been approved. The chart behind me shows the backlog. Many of these applications have been pending for years. At the same time, the Administration is more than happy to mandate widespread deployment of carbon capture on gas and coal-fired power plants.

All we want is a level playing field, just a fair, level playing field. So let me be clear: issuing a mandate to use carbon capture on power plants while withholding Class VI well approvals is nothing more than a mandate to shut down all of our dispatchable coal and gas-powered plants prematurely, and the Supreme Court has been clear that Congress has not given EPA the authority to mandate a transition of our generation fleet. I am disappointed that the talk from the Administration seems to be completely out of step with their inaction. However, I am optimistic that as more states, including West Virginia, Louisiana, and Texas, are granted primacy from EPA to approve Class VI wells themselves, the backlog will decline, and we will really scale up carbon capture sequestration. I am also concerned that while the Bipartisan Infrastructure Law passed more than two years ago, much of the CCUS funding has yet to go out the door. As we wait for awards on the carbon capture large-scale pilot programs, financial assistance for CO_2 pipelines, and other programs, the clock is ticking to deploy this technology and build out infrastructure necessary to do so.

I am glad we have witnesses joining us from the EPA and DOE to discuss how to get these important permitting and financial assistance programs back on track. Earlier this week, the EFI Foundation, which is led by former Secretary of Energy Moniz, released a report highlighting the potential infrastructure needed to meet the EPA's proposed power plant regulations. In fact, it was released on Halloween, which is fitting, because it really presents a scary picture. As they explain, "permitting CCS is a highly uncertain process that can take years in ideal conditions" because "the CCS value chain covers multiple sectors" and there is "little federal coordination." As one example, the report predicts that we may need to increase the total miles of CO_2 pipelines from 5,000 to over 50,000, which is a 1,000 percent increase in just over a decade. The report specifically notes that the current Class VI well and NEPA permitting processes call into serious question the feasibility of EPA's power plant proposal.

I have already expressed my grave concern with the EPA's power plant proposal, highlighting its threat to electric reliability and energy security, and EFI's analysis just adds to my concerns. If we are going to recognize the economic, energy security, and environmental benefits from CCUS and DAC, it will require much more coordination from the Federal Government. CCUS is also essential

for applications much broader than coal or gas power plants. Hydrogen projects may rely on CCUS to realize the incentives for clean hydrogen production that we included in the Infrastructure Law and the IRA. Steel and cement companies will look to CCUS to decarbonize their manufacturing to compete in global markets. DOE's own analysis found that widespread deployment of carbon capture and removal technologies could add nearly $1.5 trillion to the economy by 2050.

We are at an inflection point. We are really at an inflection point. Historic investment from Congress is meeting scientific innovation to deploy cutting-edge technologies and infrastructure. However, regulatory and permitting uncertainty could cause this tremendous opportunity to slip right through our fingers. This is an opportunity, not just for American companies here at home, but for us to lead the world in the energy economy of the future, and it's also an opportunity to learn from our partners abroad. For example, our allies in Norway are ahead of us sequestering carbon in subsea formations. They are already sequestering carbon at depths of more than 3,000 feet beneath the sea floor and are pursuing new projects beyond 8,000 feet. Yet here in the U.S., we are a year behind schedule even issuing the requirements to apply for carbon sequestration permits on our Outer Continental Shelf, a permitting program that was required by the Infrastructure Law.

The U.S. has led the world in developing both CCUS and DAC, and forgoing that leadership because of government inaction is unconscionable. Its success is crucial to our energy security, our economy, and our environment. I hope today's hearing will shed some light on what else is needed to ensure deployment of these critical technologies, and I look forward to continuing to work with the Ranking Member and all members of this Committee to that end.

With that, I look forward to an engaging discussion today with our panel of distinguished witnesses, and I will turn it over to my Ranking Member and friend, Senator Barrasso, to give his opening remarks.

OPENING STATEMENT OF HON. JOHN BARRASSO, U.S. SENATOR FROM WYOMING

Senator BARRASSO. Well, thanks so much, Mr. Chairman.

And before giving any opening statements, I want to address, like you did, the news from this morning, where just last week the Director of the Bureau of Ocean Energy Management, Elizabeth Klein, sat at this table, at that seat, and she told the Committee "all systems are go" for Lease Sale 261. She went on to say "we don't see anything in the way of holding that sale." Well, she lied to the Committee, because today, this very morning, she postponed the sale indefinitely. This Administration is becoming even more brazen in its disregard for the law of the land and for the members of this Committee, and it is shameful.

So Mr. Chairman, I want to thank you for holding today's very important hearing. President Biden has made it clear that he wants to eliminate the production and the use of coal in the United States. Just last year, the President said "we are going to be shutting these coal plants down all across America and having wind and solar." Well, the Biden Administration has followed through on

this reckless promise. The Biden Administration has blocked coal leasing on federal lands. It has slow-walked mining permits. It has proposed emissions regulations aimed at shuttering coal-fired power plants. It is attempting to kill coal by a thousand cuts. This is a recipe for disaster for our country and for our citizens.

According to the Department of Energy's Energy Information Administration, coal will be an important part of our energy mix for decades to come. It makes no sense to block American coal production and then import coal from other countries. There is a good reason that coal will be needed well into the future. In contrast to wind and solar, coal-fired plants can provide dispatchable power, that is, they can provide electricity 24 hours a day, seven days a week. In the last six months, this Committee has received testimony from representatives of FERC, the Federal Energy Regulatory Commission and NERC, the North American Electric Reliability Corporation. So we are talking about regulations as well as reliability. They all told us that the premature retirement of dispatchable generation, which includes coal—they all say it jeopardizes our nation's electric reliability. Eliminating this generation risks putting Americans in the dark and keeping the electric vehicles that they want to force on the American public parked and on empty.

Instead of elimination, we should encourage innovation. Wyoming is doing just that. The Integrated Test Center in Gillette, Wyoming is a shining example of an innovative public-private partnership. It develops carbon capture utilization and storage technologies in real-world conditions. The University of Wyoming has also been at the cutting edge of research and development of carbon capture utilization and sequestration. It sponsored one of the original proposals picked to participate in the Department of Energy's CarbonSafe program. The program aims to develop geologic storage sites to store 50 million metric tons of carbon dioxide. The University was recently awarded additional funding under the program. This funding will be used to advance a carbon capture and storage hub in the Greater Green River Basin. It will do this with carbon dioxide derived from trona mining and direct air capture.

Despite advances in carbon capture technology, challenges remain. For example, new carbon dioxide pipelines are needed to transport the carbon dioxide. And there is uncertainty around the rules that govern how to store carbon dioxide on federal land. Now, I believe we can overcome these challenges. More difficult are the ideological obstacles. Some environmental extremists don't want to see carbon capture move forward. To them, carbon emissions are not simply the problem. To them, coal, oil, and natural gas are the problem. The Environmental Protection Agency is under immense pressure from extremists to deny states the authority to permit carbon dioxide injection wells. Opponents of carbon capture fear that states would actually permit these projects in a timely manner. Well, the EPA appears to have buckled under that pressure from the extremist groups because only two states have the authority at this point to permit these wells—my home State of Wyoming and Senator Hoeven's home State of North Dakota. Projects in other states must get a permit from the EPA.

Currently, 163 wells are seeking approval from the EPA in a process that can take up to six years. Meanwhile, the EPA is pushing extreme air regulations that require the widespread use of carbon capture technology long before it can be implemented. It appears the EPA's goal is not to help carbon capture technology, but to kill it. If we intend to maintain electric reliability in this country and reduce emissions at the same time, it is critical that we get this right. That means advancing policies that give carbon capture technologies a chance to reach their full potential. So I am hoping today's hearing, Mr. Chairman, will move us in that direction.

Thank you, Mr. Chairman.

The CHAIRMAN. Thank you, Senator.

As I mentioned, we have a distinguished panel of witnesses with us today, including The Honorable Brad Crabtree, Assistant Secretary for Fossil Energy and Carbon Management at the Department of Energy.

We have Mr. Bruno Pigott, Deputy Assistant Administrator for Water at the Environmental Protection Agency.

We have Ms. Erin Burns, Executive Director of Carbon180, and a proud West Virginian. I would like to note that Ms. Burns previously served her home state in my office from 2011 to 2015. She earned her bachelor of arts from Carnegie Mellon University. It's always nice to have a fellow West Virginian and former colleague of mine working side by side. Erin, congratulations on two young children—one and three, I understand. That's wonderful.

And I am going to turn to my colleague, Senator Barrasso, to introduce our final witness.

Senator BARRASSO. Well, thanks, Mr. Chairman. I would like to welcome Ms. Lily Barkau, who is one of our witnesses today. She has traveled from Cheyenne, Wyoming to be here with us, and she is an expert on siting underground injection wells for carbon capture and sequestration projects. She has a bachelor's degree in geology from Wichita State University. She then earned a master's degree in environmental sciences and engineering from the Colorado School of Mines. She has served at the Wyoming Department of Environmental Quality since 2006, which were the dates when I was back in the Wyoming State Senate. Lily, thanks so much for being here today, for sharing your expertise with the Committee, and I look forward to hearing your testimony.

Thank you, Mr. Chairman.

The CHAIRMAN. Thank you, Senator.

And now we are going to hear from our witnesses with their opening remarks, and Mr. Crabtree, we will start with you.

STATEMENT OF HON. BRAD J. CRABTREE, ASSISTANT SECRETARY FOR FOSSIL ENERGY AND CARBON MANAGEMENT, U.S. DEPARTMENT OF ENERGY

Mr. CRABTREE. 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 to advance carbon management technologies and infrastructure to meet our energy security and climate goals. It is also an honor to join my colleagues, Bruno Pigott of EPA, Erin Burns of Carbon180, and Lily Barkau of the Wyoming Department of En-

vironmental Quality. I appreciate the Committee's longstanding, bipartisan interests supporting commitment to providing the Department of Energy and the Office of Fossil Energy and Carbon Management with the funding and tools necessary to advance critical carbon management technologies and infrastructure. Thank you for that support.

As you know, Mr. Chairman, we have been investing in carbon management technologies for more than 25 years and across five presidential administrations, and this longstanding support from both sides of the aisle for this important work 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. Thanks to bipartisan legislation from annual appropriations to the 2020 Energy Act, Bipartisan Infrastructure Law, bipartisan efforts, as the Chairman mentioned, to enhance the 45Q tax credit, and most recently the CHIPS and Science Act, the Department of Energy has been able to deliver a range of critical successes for carbon management. These include over 5,000 miles of CO_2 pipeline infrastructure and 13 operating commercial-scale carbon capture projects across multiple industries that collectively capture, safely transport, and permanently store over 20 million metric tons of CO_2 annually. This represents more than one-third of the 30 commercial-scale projects operating globally at the end of 2022.

The past several years of legislative progress have enabled us to build on this foundation of success, and have prompted a significant shift in the commercial outlook for deployment of carbon management projects. Nearly 200 projects have been publicly announced in response to improvements to the 45Q tax credit, a massive increase over today's 13 operating commercial projects. Given the powerful leveraging effect of the Infrastructure Law investments in the 45Q tax credit, our Office of Fossil Energy and Carbon Management, the Office of Clean Energy Demonstrations, and the Loan Programs Office, have been working aggressively on implementation to ensure that federal funding can flow to the highest-impact projects as quickly and effectively as possible. DOE's carbon management research development, demonstration, and deployment activities are also evolving alongside this shift in commercial outlook, and our funding opportunities have begun to focus on later-stage innovation, including implementation of the Infrastructure Law funding for pilots, demonstrations, and hubs. We are also expanding our focus to enable carbon capture at a wider range of industrial facilities, often in collaboration with other offices at DOE that are pioneering complementary industrial decarbonization strategies.

Additionally, our Carbon Negative Energy Earthshot is aimed at advancing carbon removal by driving down the cost of that technology over the next decade to less than $100 per metric ton of carbon dioxide removed from the atmosphere, and we have expanded our CO_2 conversion program to explore ways to convert waste carbon emissions, both carbon monoxide and CO_2, into value-added industrial products that can help decarbonize our built environment and petrochemical and fuel supply chains. All of these advances are important for our domestic priorities, but they are also good news

for international carbon management efforts, and for America's longstanding global leadership and initiatives to stand up and deploy these technologies around the world.

Meanwhile, here at home, DOE recognizes that we simply cannot realize the full deployment potential of the funding, financing, and incentives in recent legislation without broad-based understanding and support from local communities and other stakeholders. To that end, we are including community benefit plan requirements in our funding opportunities to ensure that the recipients of DOE funding create high-quality jobs, protect the environment from unintended pollution, and ensure that projects are sited and operated with significant input from and benefit to local communities. And 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.

Mr. Chairman, thank you again for the Committee's interest, support, and commitment to providing DOE with the funding and tools necessary to increase the speed and scale of carbon management deployment. I look forward to your questions. Thank you.

[The prepared statement of Mr. Crabtree follows:]

Testimony of Brad Crabtree

Assistant Secretary

Office of Fossil Energy and Carbon Management

U.S. Department of Energy

Before the

U.S. Senate Committee on Energy and Natural Resources

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

November 2, 2023

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.

The CHAIRMAN. Thank you, sir.
Mr. Pigott.

STATEMENT OF BRUNO PIGOTT, PRINCIPAL DEPUTY ASSISTANT ADMINISTRATOR, OFFICE OF WATER, U.S. ENVIRONMENTAL PROTECTION AGENCY

Mr. PIGOTT. Good morning, Chairman Manchin, Ranking Member Barrasso, and members of the Committee. My name is Bruno Pigott. I serve as the Principal Deputy Assistant Administrator for Water at EPA. Thank you for the opportunity to testify before this Committee today on the critical topic of carbon capture and storage. Prior to my serving in my current position over the past year and a half, I served in bipartisan administrations for 20 years in a coal state—Indiana—in a variety of roles at the Department of Environmental Management in Indiana, including as its Commissioner. That state experience taught me the importance of issuing timely, defensible permits, and I am committed to doing the same here.

The Biden-Harris Administration set a goal of reducing greenhouse gas emissions 50 percent by 2030, and net-zero emissions economy-wide by 2050. Carbon capture utilization and storage, widely known as CCUS, will be central to achieving those goals. The growth of CCUS is expected to produce between 390,000 and 1.8 million good-paying jobs, especially in those communities that have been most affected by the transition to a net-zero economy. CCUS, then, holds enormous environmental and economic potential, and recognizing that potential, Congress provided historic funding through the Bipartisan Infrastructure Law and Inflation Reduction Act. Thank you for that.

CCUS is a proven technology. It has been used for decades. It traps carbon emissions from industrial sources and stores them permanently. EPA's role, under the Safe Drinking Water Act, is to ensure that these activities do not contaminate our waters, and that is why we issue permits for injecting CO_2 in underground wells. These permit requirements protect America's drinking water from contamination, and as a result, protect public health.

I would like to talk for a minute about primacy. EPA strongly supports efforts by states to obtain primacy for the Class VI program. My time in Indiana taught me that states play a key role in regulatory programs, and we are working hard to grant primacy to states for Class VI, as we have in most of our other permitting programs. We are grateful to Congress for the appropriations we received to grow our state primacy team, and for the more than $50 million Congress provided in the Bipartisan Infrastructure Law to support primacy activities. EPA is announcing this morning the opening of the application process for those dollars for states. Currently, as indicated, North Dakota and Wyoming have primacy for Class VI, and Louisiana is in the final stages of the application process. Texas, West Virginia, and Arizona are all in the pre-application phase, and 21 other states and two tribal nations have expressed interest in primacy. We believe this grant program will provide the resources states need to set up these programs. Thank you so much for that funding.

Where states have not obtained Class VI primacy, EPA issues permits. EPA is committed to reviewing the Class VI applications efficiently. Permit applications are technical documents. They contain information about the geology to ensure the area is free of faults and fractures, the injected CO_2 plume, to know where that CO_2 goes, and specifics about well construction to make sure it is operated in a way that works. We evaluate this information to ensure our source water is protected. Interest in Class VI wells has grown exponentially over this last year. To meet the increased demand, EPA is using the resources from both Congress and the Federal Permitting Improvement Steering Council to increase our staff of experts to review these permits. Additionally, through interagency agreement with the Department of Energy, many of the applications are being reviewed by the National Laboratories that DOE operates to ensure that we review the models appropriately.

EPA's goal is to make permit determinations within 24 months after receipt of a complete application. Our job is to ensure all people are fully protected from the adverse environmental and health hazards and have equitable access to a healthy environment. EPA has taken several actions over the last year to fulfill this commitment. Most recently, in August, the agency finalized guidance to provide clear expectations for transparency in community engagement. And these common-sense practices will help set clear expectations. EPA and our growing Class VI team are committed to clear, consistent, speedy issuance of these permits.

Thank you for the opportunity to testify.

[The prepared statement of Mr. Pigott follows:]

TESTIMONY OF
MR. BRUNO PIGOTT
PRINCIPAL DEPUTY ASSISTANT ADMINISTRATOR FOR WATER
U.S. ENVIRONMENTAL PROTECTION AGENCY

HEARING ON CARBON CAPTURE AND STORAGE

BEFORE THE
COMMITTEE ON ENERGY AND NATURAL RESOURCES
U.S. SENATE

November 2, 2023

Good morning, Chairman Manchin, Ranking Member Barrasso, and Members of the Committee. I am Bruno Pigott, Principal Deputy Assistant Administrator for Water at the U.S. Environmental Protection Agency. Thank you for the opportunity to testify before this Committee today on the critical topic of carbon capture and storage, and to do so alongside Brad Crabtree, my colleague at the Department of Energy along with other distinguished experts in this field.

The Biden-Harris Administration has set a goal of reducing greenhouse gas emissions 50 percent by 2030, and net-zero emissions economy-wide by 2050. Carbon capture utilization and storage will be central to achieving those goals.

Moreover, the growth of the carbon capture, utilization, and storage market, widely known as CCUS, is expected to produce between 390,000 and 1.8 million good-paying jobs, especially in those communities most affected by the transition to a net-zero economy. CCUS, then, holds enormous environmental and economic potential.

Congress provided historic funding for CCUS through the Bipartisan Infrastructure Law and the Inflation Reduction Act, and the Biden-Harris Administration is hard at work to expeditiously implement this funding to accelerate carbon reduction efforts to help achieve our climate goals, ensure energy reliability, create good jobs, and improve the lives of people and communities.

Background

CCUS is a proven technology and process that has been used for decades to trap carbon dioxide emissions from industrial sources (or more recently, to pull carbon dioxide directly from the atmosphere) and permanently store it to prevent its release into the atmosphere. The Federal Government has an existing regulatory framework that is rigorous and capable of managing permitting and review actions while protecting the environment, public health, and safety as CCUS projects move forward. Key guidance documents and best practices have been developed by the Federal Government and non-governmental organizations to assist CCUS project developers in moving CCUS efforts forward responsibly and efficiently. As with any industrial activity, the applicable permits and reviews will depend on the characteristics of the particular project. EPA has a responsibility in this process under the Safe Drinking Water Act (SDWA) to ensure that these activities do not contaminate underground sources of drinking water. EPA administers the Underground Injection Control, or "UIC," program, to issue permits for wells that serve a variety of underground injection needs, including sequestration of carbon.

EPA's UIC program developed appropriate and stringent federal requirements for injecting CO_2 in underground wells – called Class VI wells. These requirements protect underground sources of drinking water from contamination, and as a result, protect public health. The Class VI requirements are described in the regulations which were promulgated in 2010 and are supported by guidance and training.

Like many of EPA's programs, states may apply for and EPA may grant primary enforcement responsibility, often called "primacy," to a state, territory, or Tribe. If a state, territory, or Tribe does not obtain primacy, EPA implements the program directly through its regional offices. Activities performed by the primacy agency include, but are not limited to, reviewing and issuing permits, ensuring compliance, and conducting enforcement where appropriate. EPA retains oversight of UIC programs implemented by states, territories, and Tribes. Currently, North Dakota and Wyoming have primacy for

Class VI, and EPA implements the Class VI UIC program everywhere else in the country.

Primacy

EPA supports efforts by states, Tribes, and territories to seek primacy for Class VI UIC programs. The primacy application process has four phases: Phase I: pre-application activities, Phase II: completeness review and determination, Phase III: application evaluation, and Phase IV: rulemaking and codification. EPA carefully reviews each primacy application pursuant to the SDWA to ensure the application is complete; the applicant has the capacity, funding, staffing, and expertise to run the program; and the applicant's UIC Class VI permitting regulations are as stringent as the federal regulations. These activities require specialized legal and technical staff at our headquarters and regional offices, and we are grateful for increased appropriations over the last five years to support these essential activities. As a result, the agency has a team of more than 8 FTEs dedicated to the state primacy development process.

Louisiana, Texas, West Virginia, and Arizona are all actively pursuing primacy. EPA expects to make a decision regarding Louisiana's application after reviewing all public comments on EPA's proposed rule. Texas, West Virginia, and Arizona are all in Phase I, the pre-application phase, and EPA is working with these states to get them to the next phase. EPA is also aware that 21 other states and two Tribes have expressed an interest in Class VI primacy. States, Tribes, and territories obtaining Class VI primacy in accordance with the SDWA will help with the processing of the expected increase in Class VI permit applications.

Permitting

Where states have not obtained Class VI primacy, EPA is the Class VI permitting authority. EPA is committed to reviewing UIC Class VI permits as expeditiously as possible when the agency is the

permitting authority. Reviewing a Class VI permit application entails a multidisciplinary evaluation to determine whether the application includes the required information, is technically accurate, and supports a risk-based determination that underground sources of drinking water will not be endangered by the proposed injection activity. A wide variety of technical experts – from geologists to engineers to physical scientists – review permit applications submitted to EPA. We are continuously working to develop staff expertise and increase capacity, and we have effectively deployed appropriated resources over the last five years to scale our expert team from just a few people to more than 25 FTEs across our headquarters and regional offices. Additionally, through an interagency agreement with the Department of Energy, several National Laboratories with deep expertise in carbon storage contribute to capacity building activities and conduct technical reviews of the subsurface modeling portions of permit applications.

These additional resources and staff capacity have been invaluable as the number of applications submitted to EPA for review continues to grow quickly. Most of the permits submitted to the agency have been in the last 8 months. EPA's goal is to make a permit determination 24 months after receipt of a complete application. This number of permit applications underscores the importance of this program, the growing interest from industry, and the importance of funding that Congress has appropriated to EPA to build the staff capacity in our headquarters and regional offices to implement this essential program.

Environmental Justice, and Grants to Assist States, Tribes, and Territories

In implementing all aspects of EPA's UIC program, our goal is to ensure all people are fully protected from disproportionate and adverse environmental and human health effects and hazards and have equitable access to a healthy, sustainable, and resilient environment in which to live, learn, and play. This is consistent with the Biden-Harris Administration's goal of advancing environmental justice, which means the just treatment and meaningful involvement of all people—regardless of income, race,

color, national origin, Tribal affiliation, or disability—in agency decision-making and other Federal activities that affect human health and the environment. With respect to the UIC program, EPA has taken several actions in the last year to fulfill this commitment.

In December 2022, EPA sent a letter to state governors recommending that states which are seeking Class VI primacy incorporate environmental justice (EJ) into their proposed UIC Class VI programs, including in permitting. On August 18, 2023, the agency finalized its Environmental Justice Guidance, which serves as EPA's operating framework for identifying, analyzing, and addressing EJ concerns when reviewing, implementing, and overseeing UIC Class VI permitting and primacy actions.

EPA is committed to working with states to set a strong foundation of practices that will protect affected communities, including communities with environmental justice concerns, from bearing a disproportionate health and environmental burden while encouraging the development of Class VI UIC state primacy programs.

Most recently, on October 31, 2023, EPA announced over $48 million in grant funding from the Bipartisan Infrastructure Law to help states, Tribes, and territories develop and implement UIC Class VI programs. EPA requires applicants to the new Class VI UIC grant program to demonstrate how environmental justice and equity considerations will be incorporated into their Class VI UIC primacy programs; for example, grant recipient commitments could include enhancing public involvement, enhancing transparency throughout the permitting process, and minimizing adverse effects to public health and the environment.

Next Steps

EPA, and our growing Class VI team at our headquarters and regional offices are committed to supporting both our program and state programs to ensure that we all achieve our dual goals of protecting drinking water and the health of all communities, while building carbon management solutions necessary to achieve America's greenhouse gas reduction goals. EPA appreciates the funding

Congress has provided in both EPA's annual appropriation and the Bipartisan Infrastructure Law for Class VI work. We are hard at work implementing this program, working hand in hand with states, communities, and permittees to drive this process forward while ensuring all stakeholder needs are appropriately considered. Thank you for the opportunity to testify before you today, and I look forward to our discussion.

The CHAIRMAN. Thank you.
Now we have Ms. Burns.

STATEMENT OF ERIN BURNS,
EXECUTIVE DIRECTOR, CARBON180

Ms. BURNS. Thank you.

Thank you for the opportunity to testify today on the deployment of direct air capture in the United States. I am Erin Burns, the Executive Director of Carbon180, an independent non-profit organization focused on reversing two centuries of emissions. I also want to take a moment to say I am particularly honored to be here today. As Chairman Manchin mentioned, I previously staffed him, my home-state senator, when he was a member of this Committee.

Direct Air Capture can play an essential role in meeting climate goals through addressing legacy emissions. It can also bring enormous benefits beyond climate, including bolstering American technological leadership and driving economic growth. And those benefits can be realized across the country. Today, the U.S. is the global leader in direct air capture. The majority of DAC companies are headquartered here in the U.S. And while some of the largest companies are not U.S.-based, they still have their first full-scale deployments planned here. That is because of legislation like the Energy Act, the Infrastructure Investment and Jobs Act, and the Inflation Reduction Act.

Today, global DAC capacity is in the tens of thousands of tons. Recently enacted policies, however, are estimated to result in one to eight million tons of DAC deployment by 2030, and by 2035, that figure could be as high as 84 million tons. This deployment can create new jobs and businesses, it can promote market and economic growth, and it can provide long-term wealth-building opportunities. According to an analysis released just this past month, a 500,000-ton direct air capture plant could generate more than 1,200 jobs in construction, engineering, materials, and equipment, and more than 300 jobs in operation and maintenance over the facility's lifetime. Eight million tons of deployment by 2030 would mean up to 24,000 jobs. Eighty-four million tons of deployment by 2035 could mean more than 260,000 direct air capture jobs. To fully realize this economic opportunity, however, we must also invest in domestic supply chains. Around a third of the jobs identified are in supply chains, and direct air capture plants should be built using steel and other materials produced in the U.S.

There is also enormous private-sector demand for direct air capture that can be unlocked by policy support. Voluntary carbon removal markets are estimated at $10 to $40 billion by 2030. But in that same year, demand for direct air capture is expected to exceed productive supply. Importantly, direct air capture projects can be sited in many regions, including those that are navigating an economy impacted by a reduction in the production and use of fossil fuels where workforces have many overlapping skill sets with those required in the construction, operation, and maintenance of a direct air capture facility. Personally, this opportunity on economic growth and wealth creation is one I am particularly excited about. I am from southern West Virginia, an area whose history is deeply interconnected with coal, and I want to see a DAC industry where

the wealth created goes into the pockets of those folks who are doing the work, supporting high-paying union jobs and the benefits that come with those jobs. The opportunity for a place like West Virginia to build a new industry that leverages our existing skill sets, that has a long future in a world where markets have a preference already for low- and zero-carbon industries, is one that I am personally deeply invested in.

To make those potential benefits a reality in places across the U.S., however, we are going to need additional policy. My written testimony includes several specific recommendations, but I would like to highlight three, in particular. First, one of the most significant barriers to direct air capture deployment today is infrastructure. We need to capture billions of tons of CO_2. Those are going to need to be safely and securely stored. The Department of Energy should coordinate with the Environmental Protection Agency to ensure timely and thorough Class VI review for things like the Direct Air Capture Hubs projects, and also provide technical assistance to those projects. We are also really excited about more ambitious ideas like the DOE and EPA looking at pre-permitting carbon storage hubs, including in places where communities might opt-in to hosting those hubs.

Second, we need continued, robust R&D support. Over the past few years, Congress has passed really groundbreaking legislation, and it has helped secure American leadership on direct air capture. Continued funding can and should include a diverse portfolio of direct air capture pathways supporting emerging technologies alongside those being deployed today. This can increase learnings, drive innovation, and prevent technology lock-in. DAC will also require additional clean energy coordination across DOE's applied offices and can support research on key questions at the intersection of carbon removal and renewable energy.

Finally, with a $35 million Carbon Dioxide Removal Procurement Prize, the Federal Government can play a unique role in establishing high standards for direct air capture and other long-duration carbon removal pathways in ways that unlock additional private capital and increase public acceptance. Robust performance-based standards across a portfolio of durable carbon removal technologies and solutions will help drive the market toward quality and consistency, de-risking investment, crowding in private funding, and setting the stage for more robust policy support.

Thank you again for the opportunity to testify, and I look forward to your questions.

[The prepared statement of Ms. Burns follows:]

Testimony of Erin Burns, Executive Director, Carbon180
U.S. Senate Committee on Energy and Natural Resources
November 2, 2023
Full Committee Hearing to Examine Opportunities and Challenges in Deploying CCUS and DAC Technologies on Federal and Non-Federal Lands

Introduction

Thank you for the opportunity to testify today on deploying direct air capture (DAC) in the US. I'm Erin Burns, the Executive Director of Carbon180, an independent non-profit organization focused on reversing two centuries of carbon emissions. Specifically, we design and champion equitable, science-based policies that bring carbon removal pathways to gigaton scale to eliminate legacy carbon emissions and create a livable climate in which current and future generations can thrive. We were founded in 2015 as the first and only NGO in the United States dedicated to carbon removal. Our funding comes primarily from philanthropy and individual donors.[1]

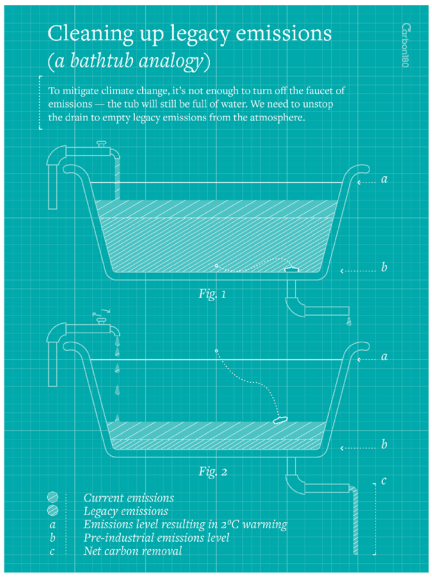
In nearly a decade of working in this field, Carbon180 has seen first-hand the enormous potential of carbon removal and direct air capture. Carbon removal is our only tool to reverse the more than two trillion tons of carbon that's already been emitted into our atmosphere. If deployed responsibly alongside deep cuts to new emissions, carbon removal can be a wellspring of new economic and environmental prosperity for communities. Poised to become a trillion-dollar industry, carbon removal could be a rising tide that lifts all boats — creating high-quality jobs, establishing carbon-negative industries, and activating new sources of revenue for US businesses and communities.

Why Carbon Removal is Necessary

Direct air capture is a form of carbon removal, a set of technologies and practices that remove carbon dioxide (CO_2) from the atmosphere. According to the United Nations Intergovernmental Panel on Climate Change, carbon removal is an essential tool in meeting climate goals and we are expected to need gigaton-scale carbon removal by mid-century.[2]

In our view, the primary goal of all carbon removal, including and especially direct air capture, is to address legacy emissions and not to enable the continued use of fossil fuels. In addition to stopping emissions as quickly as possible, we must also remove billions of tons of CO_2 that has already emitted into the atmosphere.

[1] https://carbon180.org/annual-report
[2] https://www.ipcc.ch/sr15/



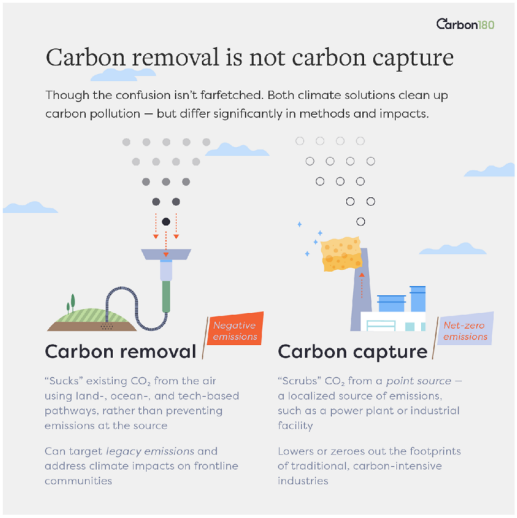
What is Direct Air Capture and Where Are We Today?
Direct air capture (DAC) is a suite of technologies that use chemistry to capture CO_2 directly from the atmosphere. The captured CO_2 can be injected deep underground for dedicated geologic storage, or converted into value-added products. Products like concrete provide long-term storage, whereas some applications like beverages or synthetic fuels have short-lived storage.[3][4][5]

Today's DAC technologies rely on large air contactors and chemical sorbents or solvents that selectively react with CO_2, removing it directly from the atmosphere. Because CO_2 only makes up .04% of the atmosphere, DAC plants rely on active air contactors—usually giant fans—to funnel massive amounts of air into their system. From there, CO_2 will come into contact and then bind with sorbents or solvents until they become saturated. At that point, heat is often applied to release a stream of CO_2.[6]

[3] https://www.wri.org/insights/direct-air-capture-resource-considerations-and-costs-carbon-removal
[4] https://static1.squarespace.com/static/5b9362d89d5abb8c51d474f8/t/64e7ca54fd8b1d2622f15daa/1692912213556/Carbon180+Deep+dive+DAC+ENG.pdf
[5] https://static1.squarespace.com/static/5b9362d89d5abb8c51d474f8/t/64e7c87dabd1b503e8a1116e/1692911741602/Carbon180+Fact+sheet+DAC+ENG.pdf
[6] https://cdrprimer.org/read/chapter-2#sec-2-8

Current DAC costs range from $152 to $398 per ton of CO_2, based on technology type, scale, energy source, end-use, and other project-specific components.[7] The passage of the Energy Act of 2020 established the first-ever dedicated carbon removal research and development (R&D) program at the Department of Energy. Federally supported R&D has a proven track record of dramatically decreasing the cost of emerging technologies, in addition to decreases that are expected to come from private sector investments, learning-by-doing, and additional supportive policies. Core developments in DAC technologies include moving towards passive air contacting, modular designs, and alternative capture materials, all of which have significant cost-saving potential.[8]

While DAC and carbon capture utilization and storage (CCUS) have some shared technology and infrastructure, there are also many ways in which they are unique; as a result, they will require some shared and some different policy mechanisms to reach scale. Shared needs include dedicated geologic storage, CO_2 transportation networks, and some similar R&D needs. The chief difference between the two: DAC pulls down CO_2 that's already in the atmosphere, while CCUS scrubs new emissions at their source, which can help decarbonize power and industrial plants. Carbon removal, including DAC, will largely function as a public good.



[7] These costs are adjusted for inflation; original costs from the report are are $124 to $325 per ton in 2018 dollars https://rhg.com/wp-content/uploads/2019/05/Rhodium_CapturingLeadership_May2019-1.pdf
[8] https://carbon180.medium.com/the-future-of-dac-is-knocking-168326270d33

Today, there are 18 currently operational DAC plants located in Canada, Europe, and the United States.[9] Orca, located in Iceland, is the largest-scale operation, removing 4,000 tons of carbon dioxide annually.[10] There are also many planned DAC plants across the US. 1PointFive, a development company owned by Oxy Low Carbon Ventures, is currently constructing a DAC facility in Ector County, Texas, and once complete, will remove 500,000 tons of carbon dioxide annually.[11] Awards for the Department of Energy's Regional DAC Hubs program are expected to be dispersed in early 2024 and will include the deployment of two additional million-ton scale DAC hubs.[12]

There has also been significant private sector investment in DAC. Frontier is an advance market commitment to purchase more than a $1 billion of permanent carbon removal between 2022 and 2030; this strong demand signal has already accelerated the deployment of durable carbon removal pathways. It was founded by Stripe, Alphabet, Shopify, Meta, McKinsey, and tens of thousands of businesses using Stripe Climate.[13] In April 2022, the Swiss direct air capture company Climeworks signed an equity round amounting to about $650 million.[14] [15] Similarly, Heirloom, a US-based DAC start-up received a $53 million investment in a Series A round of funding.[16] [17]

Opportunities in Direct Air Capture Deployment

DAC can play an essential role in meeting climate goals through addressing legacy emissions. It can also bring enormous benefits beyond climate. US federal policies such as The Energy Act of 2020, the Infrastructure Investment and Jobs Act, the Inflation Reduction Act, and annual Energy and Water Development Appropriations Acts have bolstered support for DAC technologies in the US. The Rhodium Group estimates that these policies will result in between one and eight million tons of DAC capacity deployment in 2030.[18] Those tons can help drive continued American leadership, propel economic growth, and realize benefits across the country.

- **Continued US leadership on carbon removal.** The majority of DAC companies are headquartered in the US and while some of the largest companies are not US-based, they have planned their first full-scale deployments here. Federal policy support — a 45Q tax credit that provides $180 per ton, the Direct Air Capture Hubs program, robust R&D

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[9] https://iea.blob.core.windows.net/assets/78633715-15c0-44e1-81df-41123c556d57/DirectAirCapture_Akeytechnologyfornetzero.pdf

[10] https://climeworks.com/plant-orca

[11] https://www.1pointfive.com/ector-county-tx

[12] https://www.energy.gov/oced/regional-direct-air-capture-hubs-selections-award-negotiations

[13] https://frontierclimate.com/

[14] https://www.bloomberg.com/news/articles/2022-04-05/climeworks-raises-650-million-in-largest-round-for-carbon-removal-startup?embedded-checkout=true

[15] https://climeworks.com/uploads/documents/climeworks-press-release-finalized_05.04.22_.pdf

[16] https://www.prnewswire.com/news-releases/direct-air-capture-startup-heirloom-raises-53mm-series-a-among-the-largest-investments-in-new-carbon-removal-technologies-301505399.html

[17] https://carbonherald.com/new-53-million-in-funding-for-heirloom-ensures-further-growth/

[18] https://rhg.com/research/direct-air-capture-workforce-development/

support — has meant that the US is far and away leading the world in planned DAC projects.

The US can also play a central role in derisking new technologies, including DAC, enabling further global deployment and supporting climate justice.[19]

- **Economic Growth**. DAC has strong potential to create new jobs and businesses, promote market and economic growth, and provide long-term wealth-building opportunities. According to an analysis released this month from the Rhodium Group, a 500,000 ton DAC plan could generate 1,215 jobs in construction, engineering, materials, and equipment and 340 jobs in operations and maintenance over the facility's lifetime. Importantly, 37% of the jobs identified by the Rhodium report are in supply chains. To fully realize the economic opportunity in building a robust DAC sector in the US, we must invest in domestic supply chains. The Rhodium Group's estimate of one to eight million tons of capacity deployment by 2030 could mean up to 19,000 jobs in the next several years.[20] These benefits are even more promising for historically fossil fuel-dependent communities, whose workforces have many overlapping skill sets with those required in the construction, operation, and maintenance of a DAC facility.

  There is also enormous private sector demand for DAC that can be unlocked by policy support. Voluntary carbon removal markets are estimated at a $10 to $40 billion market by 2030, but in that same year, demand is expected to exceed projected supply.[21] Policy support can help realize the full economic benefits of DAC.

- **Regional distribution of benefits.** Importantly, DAC projects can be sited in many regions, including those that are navigating an economy impacted by a reduction in the production and use of fossil fuels. Support for workforce development and close alignment with unions, including those who have regional representation in fossil fuel areas like the United Mine Workers of America, can help these communities realize the full economic benefits of high-paying DAC jobs.

  Flexibility in siting can also provide opportunities for communities to opt in to hosting DAC projects, helping to build public support and social license for deployment. DAC can also unlock opportunities including long term local wealth and ownership.

Current Barriers to Direct Air Capture Deployment
While recently enacted legislation has made major strides in addressing the immediate needs of DAC, barriers to deployment at scale remain. These include demand signals, access to geological storage, performance standards, insufficient research and transparency, and the need for additional clean energy.

- **Reliable demand signals.** Reliable demand signals, including offtake agreements, are necessary to finance large-scale projects. These signals from the private sector, most

[19] https://www2.itif.org/2014-federally-supported-innovations.pdf
[20] https://rhg.com/research/direct-air-capture-workforce-development/
[21] https://www.bcg.com/publications/2023/the-need-and-market-demand-for-carbon-dioxide-removal

notably the Frontier advance market commitment, have helped drive the current wave of deployment. Reaching million- and then billion-ton scale will require robust demand signals from the US federal government.

- **Secure geologic storage.** We need to capture billions of tons of CO_2, which will then need to be safely and securely stored. A key part of that process is the Environmental Protection Agency's Underground Injection Control program, which oversees the permitting, siting, operation, and monitoring of Class VI wells. While the US has enormous geologic storage potential (around 2,400 gigatons), an historically under-resourced Class VI program has resulted in functionally no new permits for saline storage.[22] [23]

- **Monitoring, reporting, and verification (MRV)**. To operate at scale, the carbon removal industry, including DAC companies, need rigorous, science-based standards for the quantification of net carbon removed from the atmosphere. Standards bring clarity, consistency, and transparency across the market, de-risking investment and enabling the development of legally enforceable offtake agreements that protect both the buyer and the supplier of carbon removal services. Standards also enable independent validation of DAC project or facility performance. Independent validation allows for unbiased comparisons between technologies and investment in those solutions that work best. [24]

- **Transparent, accessible, and relevant information.** As DAC deployment rapidly scales, community engagement and social license are essential to the sector's success. One of the immediate barriers to strong community engagement is a lack of transparent, easy-to-access, and unbiased educational materials. Additionally, there are significant research gaps on issues important to environmental justice organizations.

- **Additional clean energy**. Meeting climate goals requires rapid decarbonization. DAC requires clean energy to operate. To ensure that scaling DAC doesn't in any way slow decarbonization, the US will need additional clean energy build out.[25]

Policy Recommendations for Direct Air Capture Deployment
Over the past 6 years, the US has passed the world's most ambitious carbon removal and DAC policies and we are poised to move to megaton scale plants in the coming years. Additional policy support is necessary to maintain our leadership and trajectory on scaling DAC. These policies can also help unlock additional private sector capital, ensure the full benefits of the technology are realized, and help the US meet climate goals.

- **Research, development, and demonstration (RD&D).** Continued and increased funding of the Department of Energy's RD&D work will be necessary for continued innovation and improvement of DAC. Considerations for the future of this R&D work can include:

[22] https://www.usgs.gov/faqs/how-much-carbon-dioxide-can-united-states-store-geologic-sequestration
[23] https://www.epa.gov/uic/table-epas-draft-and-final-class-vi-well-permits
[24] https://carbon180.medium.com/a-buyers-guide-to-high-accountability-mrv-2435fd8e5681
[25] https://cdrprimer.org/read/chapter-2#sec-2-8

- Ensuring R&D includes a diverse portfolio of DAC pathways, supporting emerging technologies alongside those being deployed today. This can increase learnings, drive innovation, and prevent technology lock-in. Carbon180 has endorsed S. 2812, the Carbon Dioxide Removal Research and Development Act, which would "direct federal agencies to support research on technology-based, land-based, and ocean-based approaches to remove carbon dioxide from the atmosphere. The bill takes a whole-of-government approach and includes specific research provisions across solutions such as DAC, carbon mineralization, agroforestry and perennial agriculture, forestry, and more."[26]
- DAC requires additional clean electricity. Coordination across DOE's applied offices can support research on key questions at the intersection of carbon removal and renewable energy.
- The Department of Energy's work on carbon storage should receive increased attention and support. This could include R&D on offshore storage and more research on subsurface mineralization as a storage mechanism.
- Additional support for R&D on monitoring, report, and verification will be essential for ensuring accountability in DAC projects and building public trust.
- There are key research gaps on questions raised by environmental justice experts and organizations around DAC and CCUS. The Department of Energy should ensure that R&D efforts include addressing these gaps. [27]
- The Direct Air Capture Hubs program has included requirements for community benefit plans (CBPs). The Department of Energy could explore utilizing CBPs for other agency funding opportunities and mechanisms to better center community engagement and buy-in.

- **Infrastructure and Domestic Supply Chains.** DAC at the megaton and gigaton scale will require a build out of CO_2 infrastructure and related supply chains. It is our view that infrastructure barriers are one of the most significant barriers to deploying DAC and should be a priority for policymakers. In addition to permitting challenges that the DAC sector has increasingly highlighted, the first questions we get on DAC from environmental justice and community organizations are often on the safety of CO_2 transport and storage.[28][29] There is an enormous opportunity to build public trust and realize the full potential of DAC jobs, but this will require getting it right on infrastructure on multiple dimensions. Our recommendations include:
  - To the greatest extent possible, the Department of Energy should leverage the capacities of the Office of Fossil Energy and Carbon Management's Carbon

[26] https://carbon180.org/policy-tracker

[27] https://www.federalregister.gov/documents/2023/09/12/2023-19608/white-house-environmental-justice-advisory-council-notification-of-virtual-public-meeting

[28] https://carbon180.medium.com/regranting-for-just-carbon-removal-one-year-later-dd06a7955a3b

[29] https://static1.squarespace.com/static/5b9362d89d5abb8c51d474f8/t/6115485ae47e7f00829083e1/1628784739915/Carbon180+RemovingForward.pdf

Storage Program to pair DAC hubs with Carbon Storage Assurance Facility Enterprise Initiative projects, to facilitate permitting and technical assistance.[30]
- The Department of Energy should coordinate with the Environmental Protection Agency to ensure a timely and thorough Class VI review for DAC Hubs projects in order to appropriately schedule project milestones and support application development, including providing technical assistance to projects.[31]
- Congress should explore opportunities for investment in the domestic supply chains for DAC deployment at scale to ensure there can be US production of materials and components, including steel and chemicals. This should include coordination with the Made in America Office to ensure compliance of all federally funded projects.[32]
- The Department of Energy and Environmental Protection Agency could explore more ambitious cross-agency work, such as pre-permitting carbon storage hubs where communities opt in to hosting geologic storage.

- **Building the Carbon Management Workforce.** As the Department of Energy plays a central role in deploying DAC, we believe that publicly funded carbon management projects should prioritize jobs for local residents. The Department of Energy's Office of Economic Impact and Diversity and the Department of Labor should ensure that project developers are connected with "recognized apprenticeship programs to encourage local economic development and skilled training opportunities." [33]

- **More transparency.** Communities need clear, accessible, and trustworthy information on DAC projects, especially those receiving federal funding. There should be transparency in decision making and accessibility to data, including comprehensive maps listing all proposed, planned, in-process, and completed projects. The Department of Energy should use specific terminology for projects, rather than the umbrella term carbon management.[34]

- **Markets and Procurement.** Corporate purchases have helped drive the current market for durable carbon removal, including DAC. At the same time, the market for carbon removal faces a near-term supply crunch, with even large and dedicated corporate purchasers struggling to find high-quality and durable tons to purchase and nascent carbon removal companies seeking early investment to move along the innovation curve. Given the unique purchasing power of the government, there is agreement across industry, climate advocates, and policymakers on both sides of the aisle that establishing direct public purchasing of carbon removal services could be catalytic. The carbon removal industry and voluntary corporate procurement initiatives like Frontier see federal

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[30] https://static1.squarespace.com/static/5b9362d89d5abb8c51d474f8/t/6261d1890b76863f1047a2dd/1650577901659/Carbon180-SettingDAConTrack.pdf

[31] Ibid.

[32] Ibid.

[33] Ibid.

[34] https://www.federalregister.gov/documents/2023/09/12/2023-19608/white-house-environmental-justice-advisory-council-notification-of-virtual-public-meeting

procurement as critical to supporting innovation, expanding the portfolio of available solutions, unlocking additional private capital, and driving down costs.

With the $35 million Carbon Dioxide Removal Procurement Pilot Prize, announced as part of the Department of Energy's Carbon Negative Shot, the federal government can play a unique role in establishing high standards for DAC and other long-duration carbon removal pathways. Specifically:

- Federal procurement policy should set a high bar for MRV while also creating a glide path for future inclusion of new approaches. Near-term emphasis on adopting robust, performance-based standards across a portfolio of durable carbon removal technologies and solutions will help drive the market towards quality and consistency, de-risking investment, crowding in private funding, and setting the stage for more robust policy support.
- Procurement policy should also establish high standards on labor and community engagement, as well as social and environmental safeguards, including but not limited to requiring applicants to adopt the agency's Responsible Carbon Management Principles. Procurement policies can and must be designed to ensure that local, social, and non-CO_2 pollution impacts, including but not limited to air quality, water quality, traffic, seismic impacts, and adverse land use impacts, are controlled, and that just and equitable community engagement is a prerequisite for understanding those priorities.

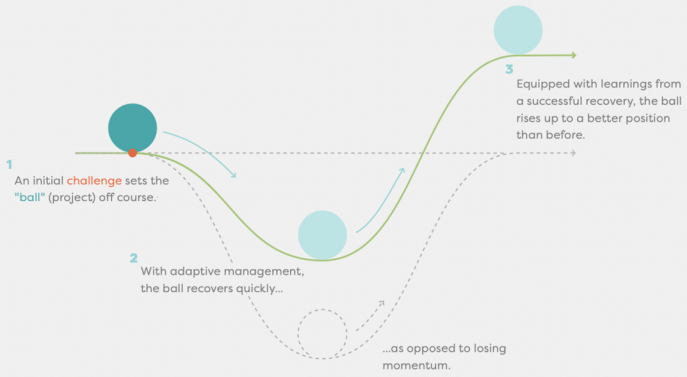
With these standards established, Congress should build on the current Carbon Dioxide Removal Procurement Pilot Prize.

- **DAC Hubs.** The $3.5 billion Direct Air Capture Hubs program is the single most significant DAC policy in the world. It can set the foundation for an equitable, just, and thriving DAC industry in the US and success of the program is critical. In our report from earlier this year, *How Direct Air Capture Succeeds: A Framework for Effective DAC Hubs*, we make the case that "success is dynamic across time and perspectives [...and that] as civil society and policymakers evaluate the DAC Hubs program, it will be important to consider not just *what* to evaluate but also *when* to evaluate it, *who* is evaluating it, and *how* a project responds to and evolves from challenges."[35]

[35] https://static1.squarespace.com/static/5b9362d89d5abb8c51d474f8/t/63c6b2a3ad67251500e487a4/1673966245209/Carbon180-HowDirectAirCaptureSucceeds.pdf

The Resilience Function for DAC Hubs

A resilient DAC Hubs program will successfully adapt to and recover from challenges, sustaining climate and non-climate benefits through changing political environments. Targeted investments, flexibility, and responsiveness to internal and external demands can put the ball back on track and potentially lead to growth from the baseline. The program may be more or less resilient depending on stakeholders' capacity, preparation, and reactions to a given challenge.



SOURCE:
Adapted from Ratcliff, N. J., Nair, D. T., Goldstein, J.R. (September 2019). The Area of Resilience to Stress Event (ARSE): A New Method for Quantifying the Process of Resilience. *The Quantitative Methods for Psychology, 15*(2), 148-173. 10.20982/tqmp.15.2.p148

The CHAIRMAN. Thank you.
Now we have Ms. Barkau.

STATEMENT OF LILY R. BARKAU, GROUNDWATER SECTION MANAGER, WATER QUALITY DIVISION, WYOMING DEPARTMENT OF ENVIRONMENTAL QUALITY

Ms. BARKAU. Good morning, Chairman Manchin, Ranking Member Barrasso, and honorable members of the Committee. I appreciate the opportunity to be with you here today.

My name is Lily Barkau, and I am the Groundwater Section Manager at the Water Quality Division at the Wyoming Department of Environmental Quality. The Groundwater Section oversees the implementation of the underground injection control program. Wyoming received primacy of the Underground Injection Control (UIC) program in 1983 for five classes of wells, and in September 2020, the Department received primacy of Class VI wells for permanent storage of carbon dioxide. Our long history in implementing the UIC program demonstrates expertise and experience that is easily transferrable to the Class VI program. Wyoming began enacting legislation in 2008 to allow and promote CO_2 storage.

Within Wyoming's regulatory framework, prospective CO_2 storage operators can pursue CCS in an environment with well-defined risks and liabilities. Wyoming is also well-suited geologically for CO_2 storage due to the number of high-storage potential sedimentary basins in the state. Because of these factors, Wyoming is poised for successful deployment of CCS, and interest in CCS projects is high. Currently, 12 proposed Class VI wells in Wyoming are in various stages of the permitting process, ranging from the pre-application stage to the permit issuance stage. The Department anticipates issuing its first three Class VI permits for well construction by the end of the calendar year. In order to help applicants meet the Department's rules and expedite permitting of these Class VI wells, the Department has developed and is implementing a streamlined permitting process that encourages operators to meet with regulatory agencies early in that process. The Department anticipates it will be able to issue a Class VI permit authorizing injection within one-and-a-half to two years from the date it received the application. However, the permitting timeline ultimately depends on the condition of the submitted permit application and the responsiveness of that applicant.

Permitting for CO_2 storage is only one facet of the CCS process. Other factors may pose obstacles for Class VI permitting. CO_2 storage on federal lands needs further consideration. Given the high concentration of federal lands located in Wyoming, large-scale CCS projects are almost certain to implicate federal holdings, generating questions about how federal land agencies, such as the Bureau of Land Management, will approach CCS and access to pore space, in particular. Current federal law does not provide a legal definition of pore space, much less clarify the ownership of pore space in situations of split estates where the surface rights are privately owned but the mineral rights are federally owned. Therefore, clarification on federal pore space and unitization of that pore space is needed to support timely permitting of CCS projects.

Furthermore, improved coordination between the Department and Wyoming BLM is needed to ensure that Class VI permit issuance and BLM right-of-way authorizations are issued at the appropriate times and such that each agency has the information it needs to make its decisions within its regulatory authorities. The Class VI permit authorizes injection of CO_2 such that underground sources of drinking water (USDWs) are protected. Whereas, under the BLM right-of-way, BLM is charged with ensuring access to federal pore space and the federal mineral estates are not damaged. It is important to keep these two roles and authorities distinct. Further, clarification on financial assurance through bonds for Class VI permits on federal lands is needed to identify what portions of the CO_2 storage site require bonding through the Department and BLM. Avoiding duplication of bonding will be important to CCS projects financially.

In addition to federal pore space just discussed, interstate pore space may pose an obstacle as well. Wyoming's sedimentary storage basins traverse or are situated near state borders. The CO_2 storage site is defined as a CO_2 plume, pressure front, and any displaced fluids, and is referred to as the Area of Review. The federal Class VI program regulations do not consider pore space in the issuance of the permit, and only require public notification to local, tribal, or neighboring states in the Area of Review. However, the process for acquisition and storage in a neighboring state's pore space has not been identified, especially if that neighboring state does not have current regulations regarding pore space.

Another topic of consideration is that Class VI regulations require that CO_2 injection occur below the lowest-most USDW, and do not allow for new aquifer exemptions to be approved. Wyoming has deep formations that may be considered a USDW, but under other UIC well classes, would be afforded an aquifer exemption in accordance with federal regulations. Not allowing aquifer exemptions for Class VI may eliminate additional storage reservoirs. And finally, there is currently no federal funding being provided to states to implement Class VI primacy programs. While under the Infrastructure Investment and Jobs Act, EPA is offering one-time grant funding to support states either with or seeking Class VI primacy, long-term funding opportunities and grant requirements are not available.

Thank you again for the opportunity to be here, and I will gladly answer any questions.

[The prepared statement of Ms. Barkau follows:]

Testimony of Lily R. Barkau, P.G., Groundwater Section Manager
Water Quality Division
Wyoming Department of Environmental Quality

Before

U.S. Senate Committee on Energy and Natural Resources

Hearing to receive testimony on

"Full Committee Hearing to Examine Opportunities and Challenges in Deploying CCUS and DAC Technologies on Federal and Non-Federal Lands"

November 2, 2023 at 10:00 AM
Room 366 Dirksen Senate Office Building

Contents

Regulatory Background

Since 2008, the State of Wyoming has passed comprehensive legislation to allow and promote carbon dioxide (CO_2) sequestration, also referred to as CO_2 storage. Within Wyoming's regulatory framework, prospective CO_2 storage operators can pursue carbon capture and storage (CCS) in an environment with well-defined risks and liabilities. Wyoming statutes and regulations (1) localize and streamline the storage process by authorizing the Wyoming Department of Environmental Quality (WDEQ) to oversee CCS injection permitting in Wyoming; (2) provide clarity for the ownership and leasing of pore space by establishing a regime for the ownership and conveyance of pore space rights; (3) create efficiencies by authorizing multiple pore space interests to be combined for development as a single unit (unitization); and (4) allocate responsibility for long-term stewardship of and liability for geologic storage facilities.

Section 1421 of the Safe Drinking Water Act (SDWA) requires the US Environmental Protection Agency (USEPA) to develop Underground Injection Control (UIC) program requirements that protect underground sources of drinking water (USDW). Primary enforcement authority, often called primacy, refers to a state, territory, or tribal responsibility that has been authorized to implement USEPA-approved UIC programs. Primacy programs are established under Sections 1422 and 1425 of the SDWA. Wyoming received primacy over Class I through V UIC wells in 1983. The WDEQ received primacy over Class VI wells for the geologic sequestration of CO_2 on September 3, 2020. Wyoming is one of two states to have received primacy for implementing the UIC Class VI program; the other is North Dakota.

The WDEQ implements the UIC Class I, III, V, and VI well programs. The Wyoming Oil and Gas Conservation Commission (WOGCC) implements the UIC Class II program (disposal of hydrocarbons, brines, or other fluids produced in conjunction with oil and gas production). Class IV wells (injection of hazardous waste into or above a usable aquifer) are prohibited in Wyoming. The WDEQ's Class I program currently has 93 permitted wells that inject hazardous and non-hazardous fluids (industrial and municipal wastes) into deep, isolated rock formations below the lowest USDW. The WDEQ has issued over 3,000 permits (rule authorized, general, or individual permits) for Class V wells that inject non-hazardous fluids into or above a USDW. The WDEQ's long history of permitting and enforcing the Class I and V UIC Programs has supported WDEQ's primacy of the UIC Class VI program and represents four decades of expertise and experience that are easily transferable to the UIC Class VI program.

Wyoming's Underground Injection Control Class VI Program

Carbon Capture, Utilization, and Storage (CCUS) refers to the utilization of the captured CO_2 either directly or indirectly in various products or for enhanced oil recovery projects, whereas CCS focuses on permanent storage (i.e., sequestration) (Figure 1). The UIC Class VI program permits storage and will be the focus of this testimony (Item Number 4 of Figure 1).

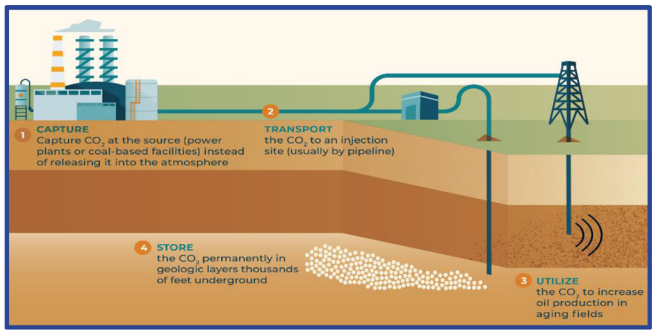


Figure 1. CCUS, Energy & Environmental Research Center, 2021

Wyoming is well suited for CCS due to its number of high-storage potential sedimentary basins (Figure 2).

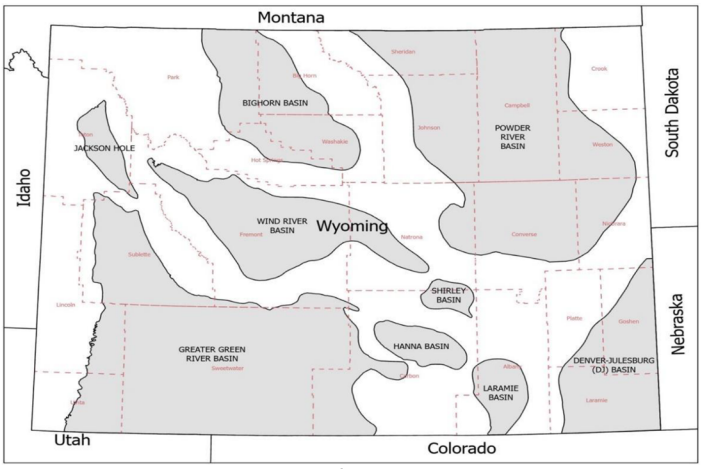


Figure 2. Sedimentary basins in Wyoming[1] 2023

At this time, the WDEQ is aware of four geologic sequestration projects consisting of 12 proposed UIC Class VI wells in Wyoming. Permitting of these UIC Class VI wells are in various stages, ranging from the pre-application stage to the permit issuance stage. Currently the WDEQ is reviewing submitted applications for a total of five UIC Class VI wells. WDEQ anticipates issuing the first three UIC Class VI permits (permits to construct the wells) by the end of the calendar year for a project in the southwest corner of the State. Each UIC Class VI permit represents one Class VI well; multiple wells cannot be authorized under the same permit.

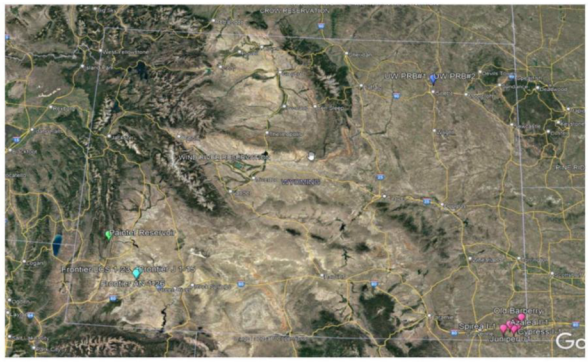


Figure 3. Wyoming CCS Project Locations, 2023 (See Attachment A)

[1] Data Sources: Esri, BLM, BoR, DoD, NPS, USFWS, USFS, USGS, Wyoming State Geological Survey.

Program Successes

As noted above, WDEQ received primacy of the UIC Class VI program in September 2020. WDEQ estimates that obtaining primacy, from primacy application submittal to receipt of primacy, took 33 months. In 2008, the Wyoming Legislature drafted bills specifying ownership of subsurface pore space and creating a regulatory scheme for geologic storage by directing WDEQ to develop standards for regulating long-term, geologic storage of CO_2 in Wyoming under the existing UIC Program. In addition, a workgroup consisting of state agencies, industry, and academia was convened to assess the risks of geologic storage and recommend financial assurance requirements and duration of post-closure care. Wyoming's long-term efforts to build a regulatory framework for CCS provided a foundation for Wyoming to obtain UIC Class VI primacy, and Wyoming was discussing and establishing CCS regulations before EPA promulgated Class VI federal regulations in 2011. WDEQ's experience with permitting UIC Class I wells, which are also technically complex, is easily transferable to the Class VI program.

As part of obtaining primacy, WDEQ established rules to regulate Class VI wells in Wyoming such that USDWs are protected. These rules are established in Water Quality Rules Chapter 24, and Wyoming's rules are as stringent as federal regulations.

Wyoming's Class VI rules are robust and cover the siting, permitting, operation, testing and monitoring, financial assurance, post-injection site care, and closure of Class VI wells. Below are a few of the key requirements an applicant must meet:

- Operators seeking a UIC Class VI permit for injection operations as part of CCS must demonstrate the ability of the subsurface formations to safely contain the CO_2 and adhere to a stringent well construction standard.
- The operator must conduct a monitoring program and carry financial assurance throughout the life of the project.
- All UIC Class VI wells must:
    - Be sited in areas with a suitable geologic system comprised of an injection zone of sufficient areal extent, thickness, porosity, and permeability to receive the total anticipated volume of the CO_2 stream, and
    - Have confining zones that are free of transmissive faults or fractures and of sufficient areal extent and integrity to contain the injected carbon dioxide stream and displaced formation fluids and allow injection at proposed maximum pressures and volumes without initiating or propagating fractures in the confining zones or causing non-transmissive faults to become transmissive.

In order to help applicants meet WDEQ's rules and to expedite the permitting of UIC Class VI wells in Wyoming, the WDEQ has developed and is implementing a streamlined permitting process (Figure 4) that encourages operators to meet with regulatory agencies early in the process. A detailed breakdown of the permitting process is available in Attachment B.

Figure 4. Wyoming UIC Class VI Permitting Process, 2023

Key steps in the permitting process include the following:

- The process begins with an **Informational Meeting:** Operators are encouraged to meet with WDEQ early, as soon as they work through screening and feasibility evaluations of the sequestration site. Discussions regarding site characterization activities to date, the scope of the project, the location of the project including property ownership and mineral estates, and the anticipated timeframe to submit a UIC Class VI permit will assist WDEQ in expediting permit application reviews. In addition, the WDEQ provides information to help and encourage the operator to meet with other state and federal regulatory agencies, such as:
    - Wyoming Oil and Gas Conservation Commission
    - Wyoming Office of State Lands and Investments
    - Wyoming Department of Environmental Quality – Industrial Siting, Air Quality, and Land Quality Divisions
    - Wyoming Game and Fish Department
    - County Commissioners
    - Bureau of Land Management

- An operator who determines that they do not have the information to demonstrate appropriate site characterization for the sequestration site may choose to drill a **stratigraphic test well** to collect additional site information prior to completing a UIC Class VI permit application.

- A **pre-application meeting** is held with the operator 45 days prior to the application being submitted, at which time the applicant and WDEQ will continue discussing Class VI application requirements, and the applicant will meet with other WDEQ divisions to discuss potential permitting requirements in those divisions (e.g., Air Quality Division permits).

- The operator submits the application, and WDEQ then conducts the UIC Class VI permit **application review**. The WDEQ must review the application for completeness within 60 days of receipt of the application. If the WDEQ determines an application to be incomplete, it will prepare comments for the operator to provide the additional information needed. The application is reviewed for:
    - The protection of USDWs to include the presence/absence of faults or fractures, and cap and bottom rock seal integrity
    - Geologic exhibits for site characterization
    - Geologic model construction and numerical simulation of carbon dioxide injection
    - Area of review
    - Testing and monitoring plan
    - Post-injection site care and facility closure plan

- Emergency and remedial response plan
- Well casing and cementing program
- Plugging plan
- Injection operations
- Financial Assurance

If the WDEQ finds technical deficiencies, it will work with the operator to address them through the comment/response process.

- Once the WDEQ determines an application to be complete and all regulations are met, the WDEQ drafts a **Permit to Construct** and holds a 60-day public comment period. The WDEQ then issues the Permit to Construct, provided no new information was received during the public comment period that indicates additional information is needed for the well to meet regulations.

- The operator **drills the injection well and associated monitoring wells** and completes **pre-injection testing**. The operator submits data acquired from these construction and testing activities to the WDEQ in a permit modification application to finalize site characterization information and other items as identified above.

- The WDEQ reviews the permit modification application to ensure regulations are met. If regulations are met and once unitization of pore space has been demonstrated through an Order issued by the Wyoming Oil and Gas Conservation Commission (WOGCC), the WDEQ drafts a permit modification to **authorize injection**. The permit modification is available for another 60-day public comment period. Following the public comment period and provided no new information has been submitted indicating that regulations aren't met, the WDEQ will issue the modified permit to authorize injection.

- WDEQ provides oversight for the life of the project during the injection phase, including compliance and inspection activities. Under Water Quality Rules Chapter 29, the operator is charged a 7 cents/ton fee during the injection period. Funds are placed into a special revenue account to support the monitoring and management of the site during the long-term stewardship phase.

- Once injections are complete, the operator is required to conduct **post-injection site care and closure** requirements. In order to achieve closure, Wyoming statutes require the operator to provide a minimum of three years' data indicating the CO2 plume is stable without the use of control equipment.[2]

- After closure requirements have been met, the permit is terminated and the project moves into the **long-term stewardship phase**. Wyoming passed legislation in 2022 that transfers the title and liability for the CO_2 to the state after site closure. The transfer of title and liability cannot occur until: all UIC Class VI permit conditions and regulations have been met; financial assurance is returned; and the permit is terminated. The transfer cannot occur until at least 20 years after injections cease.

Given WDEQ's efforts to streamline the permitting process and encourage early and often communication with applicants, the WDEQ anticipates it will be able to issue a Class VI permit authorizing injection within 1 ½ to 2 years from the date it receives the application (this includes the entire permitting process from when an application is received, issuance of a Permit to Construct,

[2] WY Stat § 35-11-313(f)(vi)(F)

injection well construction, submission of additional information, and issuance of the modified permit authorizing injection). However, the permitting timeline ultimately depends on the condition of the submitted permit application and the responsiveness of the applicant.

A robust outreach program for the UIC Class VI wells has also been implemented. Wyoming Statute requires applicants to publish a notice of the application being submitted in a newspaper of general circulation, in each county the proposed operation will occur, weekly for four consecutive weeks.[3] In addition, notice is sent to surface owners, mineral claimants, mineral owners, lessees and other owners of record of subsurface interest located within one mile of the proposed boundary of the geologic sequestration site. Water Quality Rules Chapter 24, Section 27 outlines the public notice requirements of WDEQ's intent to issue or deny a permit, which includes a 60-day public comment period. For recent draft permits, WDEQ held stakeholder meetings with county commissioners and citizen organizations once the application was received and conducted a hearing at the conclusion of the public comment period to ensure all comments were received.

Federal Lands for CCS Projects

Given the high concentration of federal lands located in Wyoming (Figure 5), large-scale CCS projects are almost certain to implicate federal holdings, generating questions about how federal land agencies, such as the BLM, will approach CCS. In particular, how BLM or other federal agencies will approach access to pore space needs further clarification.

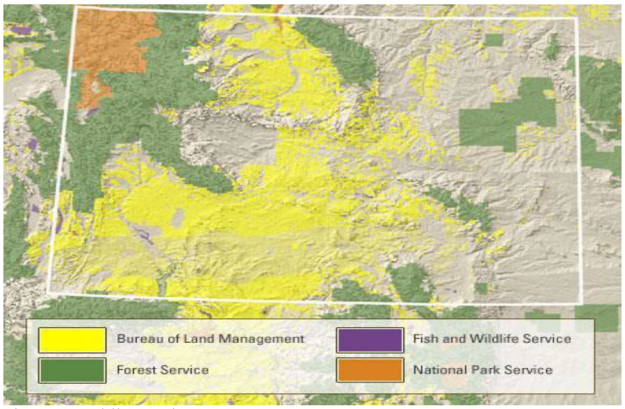


Figure 5. Public Lands, 2023

Wyoming Statute, Title 34, Article 1, Section 34-1-152 identifies that the ownership of all pore space in all strata below the surface lands and waters of the state is declared to be vested in the several owners of the surface above the strata. [4] In other words, the surface owner also owns the pore space. Furthermore, the statutes define pore space to mean subsurface space which can be used as storage space for carbon dioxide or other substances. Prior to WDEQ authorizing injection under the UIC Class VI permit, WOGCC must have issued an Order for the unitization of the pore space within the geologic storage site.

[3] WY Stat § 35-11-313(f)(ii)(N)
[4] WY Stat § 34-1-152 (2022)

Current federal law does not provide a legal definition of pore space, much less clarify the ownership of pore space in estates owned in less than fee simple (aka, in split estates, where the surface rights are privately owned, but the mineral rights are federally owned). Due to the private/federal split estate, there is particular uncertainty surrounding the ownership of pore space under approximately 70 million acres of land in the United States patented under the Stock Raising & Homestead Act of 1916, which granted land to settlers for the grazing and farming of livestock.[5]

Obstacles in Implementing CCS Projects
The WDEQ, based on its experience with CCS projects to date, has identified the following obstacles to issuing UIC Class VI permits in a timely and effective manner:

1. Clarification on federal pore space and unitization of that pore space is needed to support timely permitting of CCS projects. The federal UIC Class VI Program is silent on pore space and injection activities as the purpose of the program and a Class VI permit is to protect USDWs. However, as noted previously, the WDEQ cannot authorize injection under a Class VI permit until a pore space unitization order has been issued. Given the extent of federal lands and mineral estates in Wyoming, clarity on where federal pore space exists, particularly on split-estate lands, and how federal pore space will be unitized will help ensure that CCS operators can plan projects, communicate with landowners, and obtain unitization orders such that WDEQ can issue Class VI permits in a timely manner.

2. Improve coordination between WDEQ and Wyoming BLM to ensure that
    a. WDEQ Class VI permits issuance and BLM Right-of-Way (ROW) authorizations are issued at the appropriate times: A CCS operator is not required to have the Class VI permit before applying for the BLM ROW, but the operator must have the BLM ROW before WDEQ can issue the Class VI permit. However, an operator with a potential CCS project that obtains a BLM ROW may never apply for a Class VI permit. The first operator obtaining a BLM ROW should not exclude a second operator from also obtaining the BLM ROW so that the second operator can submit a Class VI application. The WDEQ and Wyoming BLM Office have discussed this timing issue and have agreed that a CCS operator should obtain the BLM ROW first but that the issuance of the BLM ROW is not exclusive. Other operators can also obtain a ROW in the same area, and the ability of an operator to inject in that area is dependent on obtaining the Class VI permit.

    b. WDEQ Class VI permit issuance and BLM Right-of-Way (ROW) authorizations are issued such that each agency (WDEQ and BLM) has the information it needs to make decisions and such that each agency is staying within its regulatory authority: Under the Class VI permit, the WDEQ authorizes injection of the CO2 such that USDWs are protected. Under the BLM ROW, the BLM is charged with ensuring access to federal pore space and that federal mineral estates are not damaged. It is important to keep these two roles and authorities distinct.

    The WDEQ and Wyoming BLM continue to discuss the information-sharing necessary to achieve this coordination and the best ways for one agency to communicate questions and concerns to the other agency. Some of the information WDEQ needs for a Class VI permit may be the same information that BLM needs for a ROW authorization. As each agency reviews this information, it is important that WDEQ's review relates to the

[5] Kevin Doran and Angela M. Cifor, *Does the Federal Government Own the Pore Space Under Private Lands in the West? Implications of the Stock-Raising Homestead Act of 1916 for Geologic Storage of Carbon Dioxide*, 42 LEWIS & CLARK ENV'T L. REV. 527, 531 (2012); Righetti, et al., *supra* note 27, at 194.

issuance of the Class VI permit, that BLM's review relates to the issuance of the ROW authorization, and that the concurrent reviews are conducted in such a way to avoid creating delays.

Additionally, the scope of BLM's ROW review for different pore space/mineral estate scenarios could be clarified. For example, is the scope of BLM's ROW review the same if it is solely ensuring protection of a federal mineral estate (e.g., if surface ownership is private and thus pore space ownership is private but a federal mineral estate exists above the injection zone) vs. if BLM is providing access to federal pore space (e.g., federal surface ownership and federal pore space)?

c. WDEQ and BLM are not requiring duplicative financial assurance through bonds. Clarification is needed to identify what portions of the geologic sequestration site require bonding through WDEQ vs. what portions require bonding through BLM. Currently, the WDEQ and Wyoming BLM are in discussions to establish procedures to coordinate financial assurance for CCS projects and ensure that duplicative bonding does not occur, particularly for CCS projects with minimal use of federal pore space.

3. Interstate pore space: As shown on Figure 2, Wyoming's sedimentary storage basins traverse or are situated near state borders, including the Greater Green River Basin extending into Colorado and Utah, the Bighorn and Powder River Basins extending into Montana, and the Denver Basin (variously referred to as the Denver-Julesburg Basin) extending into Nebraska and Colorado. The Area of Review (AoR) for a geologic storage site is defined as the CO_2 plume, pressure front, and any displaced fluids. The federal UIC Class VI Program regulations do not consider pore space in the issuance of the permit and only require public notification to local, tribal, or neighboring state jurisdictions in the AoR. Therefore, in Wyoming, the WDEQ as the primacy agency would be required to notify local, tribal, or neighboring state jurisdictions where the AoR occurs. For example, if the AoR crosses into Colorado, the WDEQ would need to notify Colorado. However, a process for acquisition and storage in a neighboring state's pore space has not been identified, especially if a neighboring state does not have current regulations regarding pore space. Because the WDEQ cannot issue the Class VI permit until the pore space unitization order has been issued, the use of interstate pore space calls into question how unitization will occur, thus impacting the WDEQ's ability to issue the Class VI permit. Further discussions need to be held to identify processes for interstate pore space.

4. Aquifer Exemptions: As identified in Figure 2, Wyoming has significant storage potential within its saline sedimentary basins. UIC Class VI regulations require that CO_2 injection occur below the lowest-most USDW. Wyoming has deep freshwater aquifers that under UIC Class I federal regulations, would be allowed to obtain an aquifer exemption. However, UIC Class VI federal regulations do not allow for new aquifer exemptions for CCS projects other than aquifer exemption expansions associated with already issued UIC Class II aquifer exemptions.

5. Federal funding for state primacy programs. At this time, no federal funding is being provided to states to implement UIC Class VI primacy programs. Thus, Wyoming is using state general funds and permit fees to support the program. While under the Infrastructure Investments and Jobs Act (IIJA), EPA is offering one-time grant funding to support states either with or seeking UIC Class VI primacy, it is unclear when that funding will be available and what requirements EPA will apply to that funding. That funding will also only support state programs for a limited time.

WDEQ CONTACTS

Todd Parfitt, Director
307-777-7937
todd.parfitt@wyo.gov

Jennifer Zygmunt, Water Quality Division Administrator
307-777-5985
Jennifer.zygmunt@wyo.gov

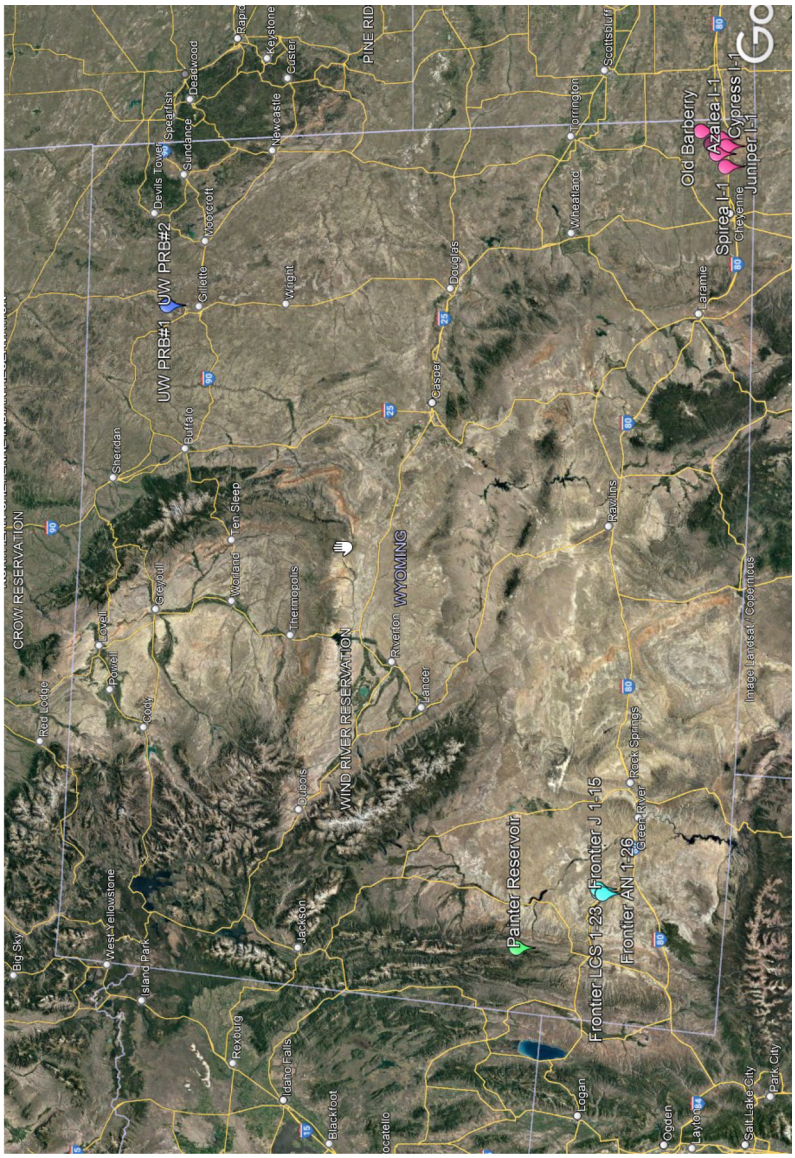
Lily R. Barkau, P.G., Groundwater Section Manager
307-777-7072
Lily.barkau@wyo.gov

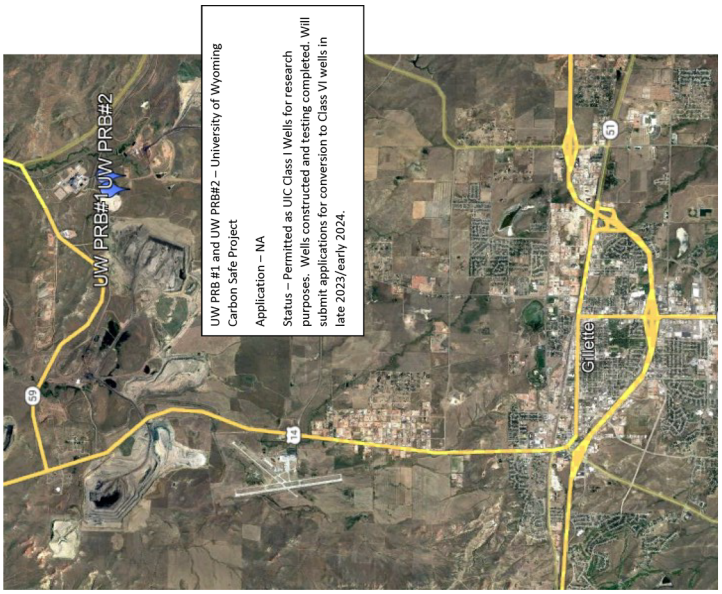
Wyoming Department of Environmental Quality, Water Quality Division Class VI Website
https://deq.wyoming.gov/water-quality/groundwater/uic/class-vi/

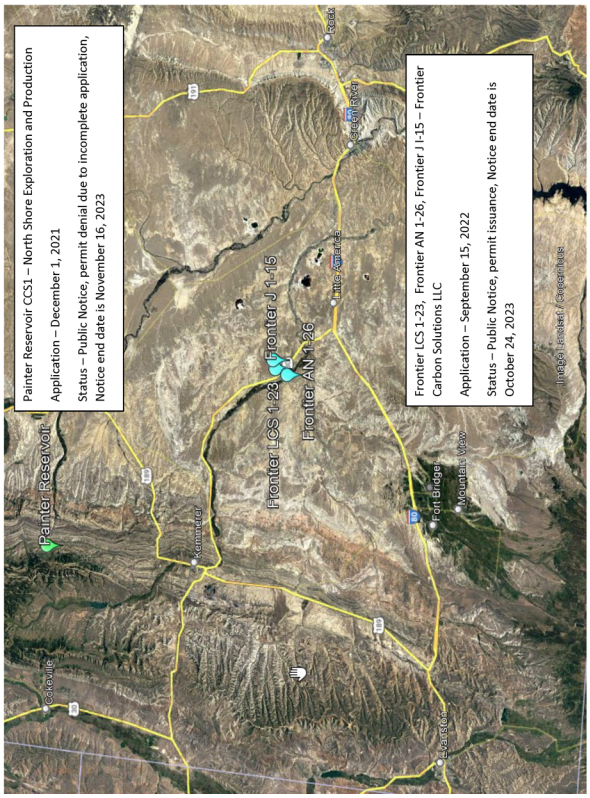
ATTACHMENTS

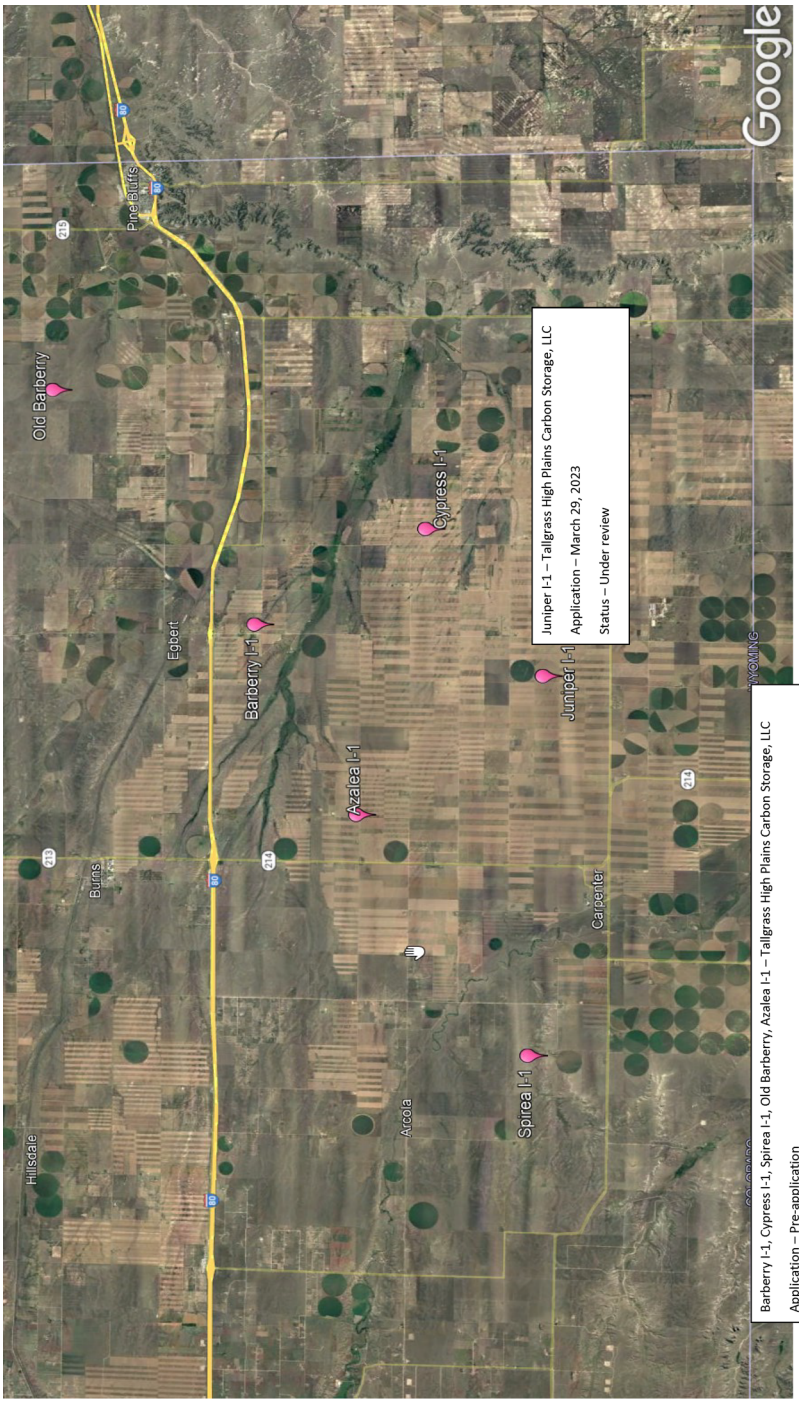
Attachment A: UIC Class VI Well Locations
Attachment B: UIC Class VI Permitting Process

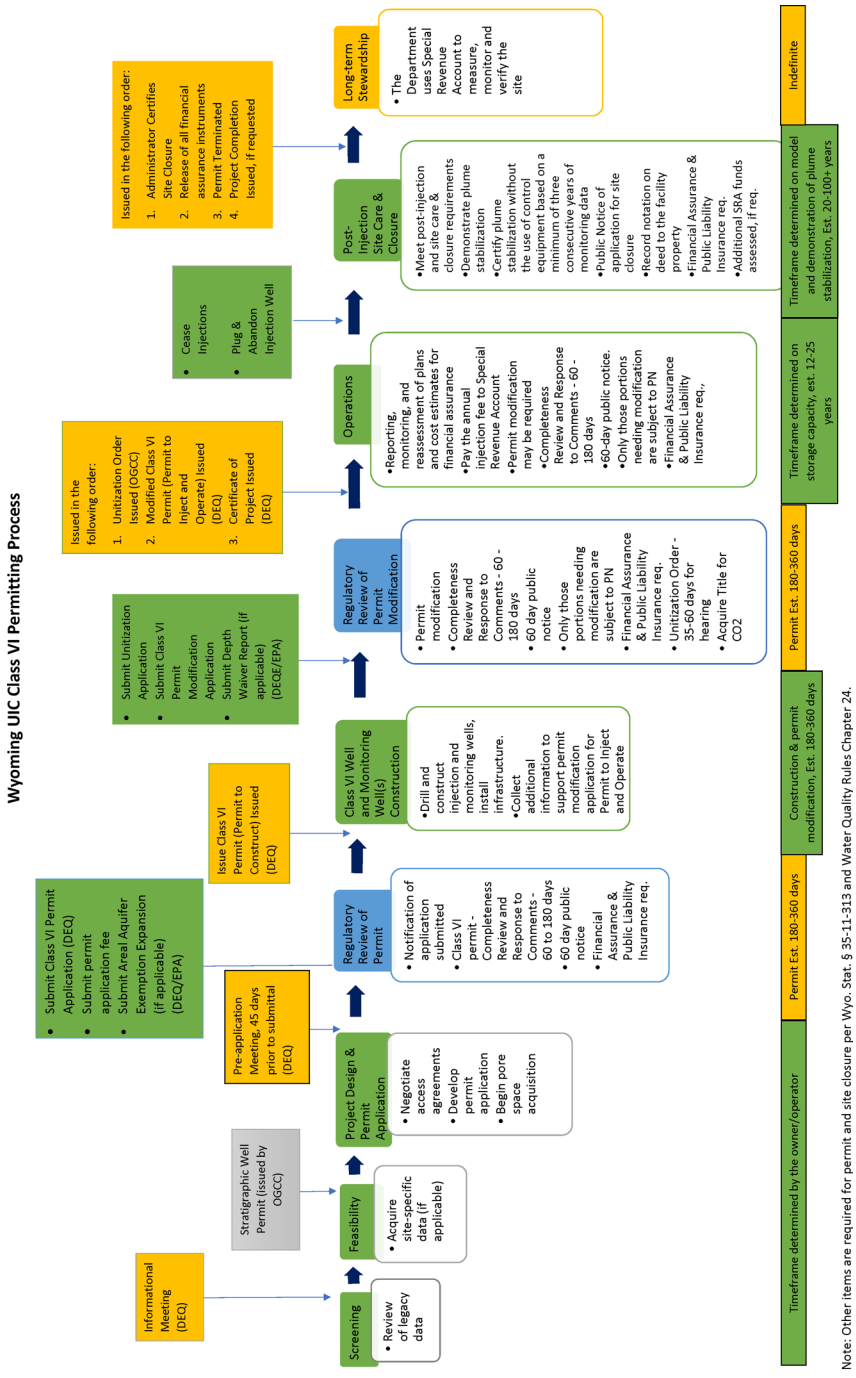
Attachment A - Wyoming UIC Class VI Well Locations




UW PRB#1
UW PRB#2
Gillette
59
14
51
UW PRB #1 and UW PRB#2 – University of Wyoming Carbon Safe Project
Application – NA
Status – Permitted as UIC Class I Wells for research purposes. Wells constructed and testing completed. Will submit applications for conversion to Class VI wells in late 2023/early 2024.


Painter Reservoir
Frontier LCS 1-23
Frontier AN 1-26
Frontier J 1-15
Painter Reservoir CCS1 – North Shore Exploration and Production
Application – December 1, 2021
Status – Public Notice, permit denial due to incomplete application, Notice end date is November 16, 2023
Frontier LCS 1-23, Frontier AN 1-26, Frontier J I-15 – Frontier Carbon Solutions LLC
Application – September 15, 2022
Status – Public Notice, permit issuance, Notice end date is October 24, 2023


Old Barberry
Pine Bluffs
Egbert
Barberry I-1
Cypress I-1
Juniper I-1
Azalea I-1
Spirea I-1
Burns
Hillsdale
Arcola
Carpenter
Juniper I-1 – Tallgrass High Plains Carbon Storage, LLC
Application – March 29, 2023
Status – Under review
Barberry I-1, Cypress I-1, Spirea I-1, Old Barberry, Azalea I-1 – Tallgrass High Plains Carbon Storage, LLC
Application – Pre-application
Status – Applications to be submitted late 2023
Google



Note: Other items are required for permit and site closure per Wyo. Stat. § 35-11-313 and Water Quality Rules Chapter 24.

The CHAIRMAN. Thank you. I want to thank you all for your introductory statements, and now we are going to start with our questioning. I will begin with Mr. Pigott.

This May, EPA proposed a new rule under the Clean Air Act to restrict carbon emissions from both new and existing coal and natural gas plants, largely using carbon capture. A typical Class VI well can sequester around one megaton per year, depending on the geology. According to EPA's own greenhouse gas inventory, the U.S. power sector emits around 1,500 megatons of CO_2 annually. Even if we want to capture one-third of that, that would be 500 Class VI wells. So, as you know, the EPA has the permitting responsibility. Do you think they will be able to permit enough wells to meet the demand created by these rules that have been proposed by you all?

Mr. PIGOTT. Thank you, Senator Manchin. It is an important question, and it recognizes that importance of the Class VI program to all of these projects. The Class VI well application process is a linchpin to the success of these things. And we have been—thank you to you all—the Bipartisan Infrastructure Law and the Inflation Reduction Act granted the funding to increase our staffing to ensure that we meet that demand. But also, I recognize, as we have heard from Lily, the importance of states in ensuring that we allow them to have primacy that has been granted for all of our permit programs because states can operate efficiently and effectively to issue permits.

The CHAIRMAN. Let me add to that as you go into your final statement here. Do you believe that carbon capture is cost effective?

Mr. PIGOTT. I believe that carbon capture is the linchpin to ensuring that we use all the tools necessary to meet our climate goals, sir.

The CHAIRMAN. Do you believe it can be done?

Mr. PIGOTT. I believe we can accomplish this together, and through the funding provided by Congress, we have increased our staffing from 7 people to 34, and because of the Federal Permitting Improvement Steering Council, we have more funds to direct for increased staffing at the same time that we award primacy because the good work that we have seen——

The CHAIRMAN. We have seen the surge of demand. There are 169 wells that are still in the permit process waiting for actions. And that depends an awful lot on whether we are able to meet the demand that's going to be brought on by market conditions. That's what we are concerned about. So I would say with the additional funding that you have, and DOE's role in this too, hopefully, you all are able to get up to speed.

Let me segue into that. Ms. Barkau, a proven way to bring more resources to speed up Class VI wells is allowing primacy. Primacy means that the states would have the responsibility. In Wyoming, you are one of the two states that successfully applied for Class VI primacy. I can ask you two things—how has it affected, and how long did it take you to get that? We have been trying since 2022 in West Virginia because we have a lot of formations that'll work also. How long was your process in getting your permit, and how has it affected uptake since receiving primacy in your state?

Ms. BARKAU. Yes, so we have received—it took approximately 33 months to get through the entire primacy application process from submitting that application in January 2018 through receipt of that in September 2020. Since receiving primacy, we have held numerous informational meetings to work with operators on getting those permits issued and setting up the program to outline the exact needs so that we can streamline that permitting process. So it's very important for——

The CHAIRMAN. It took you about two years to get approval?

Ms. BARKAU. Yes, sir.

The CHAIRMAN. Do you have any wells in activity right now? Any wells permitted in Wyoming?

Ms. BARKAU. We are about to issue three permits for construction. We don't have any to date that have been permitted.

The CHAIRMAN. How long will it take to put that in production? How long would it take for those to get in production once you permit them?

Ms. BARKAU. They will have to construct those wells. They are looking to possibly construct them starting in May and then that will take several months. We will have to do any kind of permit modifications to get through the authorization to inject and then it should be within a year or two.

The CHAIRMAN. Ms. Burns, how important are timely Class VI well permits? Your organization is kind of watching what we are doing with all this CO_2. We have a way to do it, we want to do it, and we have the technology to do it. We just have to have the will to do it in a timely fashion. So what is your——

Ms. BURNS. Extremely important. I appreciate why a lot of the focus, historically, on things like direct air capture has been in bringing down the cost of the technology, which we need to continue to do. I think we also have a really strong track record at the Department of Energy being really good at bringing down the cost of new technologies, and I am pretty bullish on the opportunities to bring down the cost of things like direct air capture. What worries me more is the infrastructure. We are going to need to store billions of tons of carbon dioxide and we need a robust and well-functioning Class VI permitting process.

The CHAIRMAN. And have you weighed in on that with the EPA and with the DOE and all of them on how important it is to get this done?

Ms. BURNS. Yes, sir.

The CHAIRMAN. Yes. Okay.

With that, Senator Barrasso.

Senator BARRASSO. Thanks, Mr. Chairman.

Let me start with Mr. Crabtree. Welcome back to the Committee. This is a Committee with diverse opinions, and you were confirmed unanimously by the Committee and unanimously by the U.S. Senate, which shows there is a lot of faith in your ability to handle this problem. And you know, earlier this week, two offshore wind projects were officially scrapped. A story in the New York Times today, and Mr. Chairman, I ask that we unanimously consent to put this in the record.

The CHAIRMAN. Without objection.

[The article referred to follows:]

The New York Times | https://www.nytimes.com/2023/11/01/business/energy-environment/offshore-wind-farm-new-jersey.html

Offshore Wind Firm Cancels N.J. Projects, as Industry's Prospects Dim

Denmark's Orsted said it would be forced to write off as much as $5.6 billion as wind developers in the U.S. faced wrenching financing costs.

By Stanley Reed and Tracey Tully
Nov. 1, 2023

Plans to build two wind farms off the coast of New Jersey were scrapped, the company behind them said on Wednesday, a blow to the state's efforts to cut greenhouse gas emissions and the latest shakeout in the U.S. wind industry.

The move, which will force Orsted, a Danish company, to write off as much as $5.6 billion, will crimp the Biden administration's plans to make the wind industry a critical component of plans to reduce greenhouse gas emissions. High inflation and soaring interest rates are making planned projects that looked like winners several years ago no longer profitable.

"The world has in many ways, from a macroeconomic and industry point of view, turned upside down," Mads Nipper, Orsted's chief executive, said on a call with reporters on Wednesday.

The two projects, known as Ocean Wind 1 and 2, were destined to provide green energy to New Jersey. They were strongly backed by the state's governor, Phil Murphy, a Democrat with national ambitions who stresses his environmental credentials but who has lately drawn scorn for falling short in combating climate change. On Wednesday he suggested that Orsted was a dishonest broker and insisted that the "future of offshore wind" along the state's 130-mile coastline remained strong.

Mr. Nipper said Orsted thought that losses on the New Jersey projects would rise over time, so "the only sensible thing is to draw a line in the sand."

Overall, the Biden administration wants to install 30 gigawatts of wind power in the United States by 2030, and officials in New Jersey had been aiming to produce 11 gigawatts by 2040.

Offshore wind and other parts of the renewable industry have hit some snags in Europe, especially in Britain. But Mr. Nipper said the problems were more acute in the United States because early contracts lacked protection from inflation and developers incurred high costs because of delays in approvals during the Trump administration.

The company's stock price fell nearly 26 percent on Wednesday after it reported a loss of about $3.2 billion for the third quarter and warned that the write-downs — essentially a reduction in the value of the company's investments — would affect Orsted's finances.

Orsted is writing off 28.4 billion krone, or about $4 billion, now. The company estimates that it may take another charge of up to 11 billion krone later in the year.

Orsted is not alone in encountering hazards in the fledgling offshore market in the United States.

On Tuesday, BP, the London-based energy giant, said it would write down $540 million on three planned wind projects off New York, after the state authorities declined to renegotiate their terms. BP says it is assessing future plans for the projects in light of the decision.

In its announcement, Orsted said it would move forward with a $4 billion project called Revolution Wind intended to supply power to consumers in Rhode Island. And other developers have projects under construction, like Vineyard Wind, which will eventually have 62 turbines in the waters off Martha's Vineyard, Mass.

Offshore wind is not dead, but the industry and its backers are certainly learning some harsh lessons. The ambitions of the Biden administration and states along the East Coast like New York, New Jersey and Massachusetts to install large amounts of clean electric power generation through offshore wind in the coming decades are likely to be set back.

The industry is dealing with equipment shortages as result of pandemic-era supply chain issues, and trying manage a growing number of orders for wind turbines as governments seek to meet green energy goals. And escalating interest rates, as central banks around the world try to curb inflation, have caused financing costs to soar.

Consumers will also probably pay more in their electric bills for power generated from offshore wind, as developers demand higher prices and protection from inflation.

Mads Nipper, the chief executive of Orsted, in Copenhagen in March. Charlotte de la Fuente for The New York Times

Mr. Nipper said rekindling interest in developing offshore wind off the East Coast depended on “a reset of what offshore power needs to cost.”

New York State declined in October to renegotiate existing offshore wind power contracts, but a subsequent auction awarded deals to supply power at significantly higher prices and with various provisions to protect the developers from inflation.

Still, there is little question that the confluence of challenges that Mr. Nipper characterized as a “perfect storm” is weighing down an industry that governments are counting on to produce large volumes of clean and relatively cheap electricity to tackle climate change.

Orsted has been both a pioneer and a leading developer of offshore wind. After building the first offshore wind farm off Denmark in the early 1990s, the company has built up a global portfolio with projects in Britain, Poland and Taiwan as well as the United States.

Mr. Nipper said the company would be looking at various cost-saving measures including reshaping its portfolio. The company is likely to be more cautious in its investment plans, at least in the near term.

Orsted’s problems are not occurring in a vacuum. Siemens Energy, a large German maker of electric power equipment, recently said it was seeking government help to finance guarantees for orders and forecast large losses because of problems in its wind turbine unit, Siemens Gamesa.

In the case of Orsted, the write-downs are largely a result of the company’s decision to cancel the large project off New Jersey that was well underway, Ocean Wind 1, and a sister project, Ocean Wind 2.

The write-offs will include investments the company has already made in building the project, payments to suppliers for goods already ordered or delivered and penalties for walking away from contracts.

The projects had become politically charged in New Jersey, opposed by many residents of the Jersey Shore concerned about tourism revenue and marred ocean vistas, and fishermen worried about the impact on their livelihoods. When Orsted broke ground in September in Ocean City, N.J., workers were greeted by roughly 60 protesters, including six who were arrested after refusing police orders to move back.

Jeff Tittel, a longtime New Jersey environmental advocate and former director of the Sierra Club's state chapter, said Orsted's pullout was a considerable setback for the state's efforts to generate more green energy.

"There's really not a Plan B right now," he said. "It's a political disaster."

Stanley Reed reports on energy, the environment and the Middle East from London. He has been a journalist for more than four decades. More about Stanley Reed

Tracey Tully covers New Jersey. She joined The Times in 2018 as a senior editor. She previously covered city and state government at The Daily News, the Albany Times Union and the Jersey Journal. More about Tracey Tully

A version of this article appears in print on , Section B, Page 1 of the New York edition with the headline: Coastal N.J. Wind Farms Are Halted

Senator BARRASSO. "Offshore wind firm cancels New Jersey projects, as industry's prospects dim." It says a combination of "high inflation and soaring interest rates are making planned projects that looked like winners several years ago no longer profitable," and that this move "will crimp the Biden Administration's plans to make the wind industry a critical component of plans to reduce greenhouse gas emissions," which says to me it's even more critical to achieve the goals of the Administration for carbon capture and sequestration to work. So if we are serious about reducing CO_2, projects advancing this technology need to continue to move forward, and at a brisk pace.

In May of this year, the Department announced it is going to award the University of Wyoming's School of Energy Resources a grant under the CarbonSafe program. The project is going to play a critical role in expanding carbon dioxide transportation and storage infrastructure in the region. My understanding is that the Department has not yet started negotiations with the University on this grant. It has been about five months. When do you expect the Department to begin negotiations with the University on this grant?

Mr. CRABTREE. Senator, just to clarify, is that the Sweetwater project?

Senator BARRASSO. Yes.

Mr. CRABTREE. Yes. I actually had a conversation this week, coincidentally. My understanding—so let me take one step back to answer your question. There is about $2.5 billion in the infrastructure bill for the geologic storage program. We are implementing that through an expanded CarbonSafe, of which Sweetwater is one of many projects that have been approved. Our goal is to enable, with private sector investment and federal investment, 20 to 40 regional geologic storage sites over the five-year life span of the funding from the infrastructure legislation. We need to make sure that we engage consistently with all the different projects and that we co-fund in a consistent way.

I heard from one of your constituents concern that this was taking too long. I have followed up. And the reason for the delay is the team is trying to make sure that, in response to Wyoming's situation, we are treating Wyoming in the same way—in terms of the number of wells, types of wells—that we are in Pennsylvania or any other state. I was assured that they would be getting feedback shortly.

Senator BARRASSO. Great, because we do have a cowboy culture. We kind of get things done quickly, and that's an ability to do that, and in Wyoming we don't think we ought to be held back because of delays in other states. So thank you. Thanks for your attention.

Mr. CRABTREE. Well, sir, I am from North Dakota. I appreciate that.

Senator BARRASSO. Great.

Ms. Barkau, if I could go to you, the Environmental Protection Agency granted the state the authority to permit the Class VI wells in 2020, the second state to receive the authority. How many applications is your agency currently working on? I know you said you had three that you are doing the permits for now.

Ms. BARKAU. We have five that are in house that are under review, the three that are about to be issued, one that has been somewhat stagnant and deficient and we asked the applicant to reattempt the application, and one that is currently in discussions. We received five additional ones for a pre-application phase. And then there are the CarbonSafe projects up in the Dry Fork Station that will be converted from Class I to Class VI in the near future, and a number of other permits submitted by them.

Senator BARRASSO. So do you believe that this authority that we have in Wyoming helps Wyoming stay on the cutting edge of carbon capture?

Ms. BARKAU. Absolutely. Basically, Wyoming knows Wyoming. So with us getting out there to issue these permits and do the reviews, we are protecting the underground sources of drinking water. We are able to streamline the process and work collaboratively with operators to move this forward. And so, having the primacy of the program really helps us to work best with the operators for the state itself.

Senator BARRASSO. Okay.

So Mr. Crabtree, a rule that recently came out of the EPA requires coal plants to capture 90 percent of their carbon dioxide emissions. Under the Clean Air Act, the EPA can only rely on emissions reduction technologies that are "adequately demonstrated." So could you name the commercial power plants that are currently and consistently achieving this 90 percent capture rate? Because I don't think there is one at all.

Mr. CRABTREE. Well, actually, Petra Nova—the project at the power plant in Houston—contrary, Senator, to all the criticism of the project that you see in the media, it has met all of its technical milestones. It was on time, it was on budget, and its capture rates were exactly what the Department of Energy was expecting. Now, as I think you know, the business model for that power plant was to store its CO_2 through enhanced oil recovery. They did not claim the 45Q tax credit. They were an early adopter. So they were in a much more challenging commercial environment to do a second-of-a-kind project in the world. And so they, when COVID happened and everything collapsed in terms of the oil market, they took that project offline, but it is now back up and operating. And so it's very much a success story in terms of the application of retrofit technology to a thermal power plant.

Senator BARRASSO. Yes, and it's not 90 percent. I mean, that's the concern, that the technology isn't there for broad distribution to really be at 90 percent, which is what the EPA—I think it's an unrealistic effort by——

Mr. CRABTREE. I feel a need to defend the technology because we have environmental critics asserting that is not the case. What is important to bear in mind is that that project was designed to optimize its economic performance given that it was a demonstration project.

Senator BARRASSO. Sure.

Mr. CRABTREE. So it's not designed to capture all the CO_2 from all the flue gas stream. It's a portion of that flue gas stream. But what is important is that it is achieving 90 percent or better from

that flue gas stream that it was designed to capture. So it's actually a technical success in that regard and important to recognize.

Senator BARRASSO. Thank you, Mr. Chairman.

The CHAIRMAN. Thank you.

Senator Heinrich.

Senator HEINRICH. Thank you, Chairman.

Ms. Burns, how important are the 45Q tax subsidies in the Inflation Reduction Act to both carbon capture and direct air capture projects?

Ms. BURNS. Thank you, Senator Heinrich.

So the 45Q tax incentive for direct air capture to saline storage is $180 per ton, up from $50 per ton. That is really significant. It is based on an analysis out of 2019 from the Rhodium Group, looking at, really, what value is needed. And the fact that Congress was able to take quick action in response to that was really helpful in the direct air capture sector, and in particular, paired with other pieces of the Inflation Reduction Act, the infrastructure bill, all of those pieces combined—robust R&D support. Congress has been extremely responsive to needs identified through those analyses, through things like the National Academies Report, and it has really spurred, again, you know, even though some of the early direct air capture companies, like Climeworks and Carbon Engineering came out of countries not the U.S., we are still the global leader in direct air capture because of that policy support.

Senator HEINRICH. What would be the—as you know, there are a number of Members of Congress who have called for the repeal of the Inflation Reduction Act. What would be the impact on direct air capture, and for that matter, CCS projects in the pipeline right now, were the Inflation Reduction Act to be repealed in its totality?

Ms. BURNS. Yes, I think it would be, without any sort of formal analysis, pretty catastrophic. Again, it's because of the federal policy support that the U.S. is seeing far more deployment in technologies like direct air capture and other durable carbon removal pathways. There is excitement about what other durable carbon removal pathways could be supported through things like tax incentives that are modeled after the success of the 45Q tax incentive. And so, I think that would represent sort of waving the white flag on American leadership on things like direct air capture.

Senator HEINRICH. The word you used was catastrophic, right?

Ms. BURNS. Yes, sir.

Senator HEINRICH. Yes.

Mr. Pigott, you were asked by the Chair about the economic viability of CCS and direct air capture projects. Setting aside enhanced oil recovery—and we have seen that that has a business case here—without 45Q, would any of these projects be economically viable at this stage in technology development?

Mr. PIGOTT. Well, in the Class VI program, our evaluation is not of the economics of the viability, but how quickly do we process and ensure that the projects that are put in place protect our sources of drinking water. And therefore, our economic analysis is not in regard to the viability. I am sure that the incentives that have been provided through the Bipartisan Infrastructure Law, the Inflation Reduction Act, and other funding sources, such as the 45Q tax credit, have provided an incentive, and therefore, we have seen

a dramatic increase in the interest in these Class VI applications and——

Senator HEINRICH. Mr. Crabtree, why don't you answer that question then? Without the 45Q incentives, what percentage of the projects in the pipeline for both direct air capture and CCS would be economically viable today, do you believe?

Mr. CRABTREE. Very few would be economically viable without a tax credit, as is the case with most clean energy technologies. That is the role that tax credits have historically played to accelerate innovation, and ultimately, deployment. I think—if I might?

Senator HEINRICH. Sure.

Mr. CRABTREE. It's really important to distinguish—if you think about the full suite of technologies we need to meet our climate challenge and net-zero emissions by 2050—carbon capture and storage, as a family of technologies, including carbon removal, has historically received very little federal policy support compared to other clean energy technologies. That started to change in 2018 with the reform and expansion of 45Q. It has dramatically changed with the 2020 Energy Act, followed by the infrastructure legislation and the Inflation Reduction Act. Now, you know, parity can be defined in many different ways, but we have, broadly, parity across a family of technologies that we need. And what is really misunderstood about costs for carbon management is that it's the only set of technologies that are expected to justify themselves on a per-ton basis.

But you can look at all the technologies we need from a climate standpoint, in terms of what they cost on a per ton basis, and what you will find across that cost spectrum is, whether it's carbon management, or renewables, or fuels, or a whole range of technologies, they go from very, very inexpensive to very, very costly. So we have carbon capture projects that will move forward now under the 45Q tax credit, ethanol production, gas processing, hydrogen production, fertilizer production, with just the tax credit, and dozens of projects will be likely moving forward. But when you get to things like heavy industry, power generation, then we will need the investments from the infrastructure bill to help de-risk.

Senator HEINRICH. If we repeal the IRA in its totality, what would happen to all those projects, Mr. Crabtree?

Mr. CRABTREE. Well, "all" is many, but historically, I think if you look at 13 operating commercial-scale projects, the reason there are only 13 is that until very recently, those projects could only be financed because a wide range of optimal things came together—location, infrastructure, opportunity to store CO_2 through enhanced oil recovery. That is a very limited universe that nearly 200 projects that have been publicly announced would shrink dramatically to probably near nothing.

Senator HEINRICH. Thank you, Mr. Chair.

The CHAIRMAN. Thank you, Senator.

I just want to add that. The whole purpose of these pieces of legislation is to mature proven technologies. And if we can mature them, the quicker we mature them, we all benefit by them. So that is really what we see happening. Sometimes we get in our own way, and everyone has their ideological beliefs that slow things down or they would like to see things fail. We never put the money

toward carbon capture that we should have. We talked about it. We never did it. And now that we are doing it, it's going to basically, rapidly change the face of how we provide energy, the type of energy we can provide to have dependability and reliability.

With that, Senator Murkowski.

Senator MURKOWSKI. Thank you, Mr. Chairman. We don't want to see things fail. In fact, we feel we have great, extraordinary opportunities up north, and as we think about carbon capture utilization and sequestration and direct air capture, I don't think there is a single climate model that exists that states that these technologies are not going to be needed in the future, and then, of course, dramatically scaled up.

So I am curious this morning to hear how Department of Energy is implementing these provisions, how we are getting funding out the door, and I will start by expressing, Mr. Crabtree, my appreciation for the announcement that ASRC, in consortia with Repsol and Santos, was selected to receive funds for the feasibility of the direct air capture hubs up on the North Slope. We are excited about that. I also want to express my hope that the Department will take a real hard look at the existing Alaska applications for the carbon capture large-scale pilot project up there as well. It is really exciting. And when you think about it, it can be so transformative. What this application would do is, test the technology of these seven Frame-5 gas turbine generation equipment units there at Prudhoe. But when you think about the potential to make a difference, this alone has the potential to address 35 percent of the state's emissions—not just of the emissions up there—35 percent. And then again, once it's successful in demonstrating the replication of this technology, to then move that to 20 Frame-5 turbines, all located within a five-mile perimeter there on the Slope.

So my question for you this morning is, when the Department is looking to make determinations on these pilots, and I know that you are somewhat restricted in giving too much information, but just more holistically, when you are looking at these applications, how important is the ability of replication for these projects to then be able to expand to address emission sources in nearby areas? Do you take that into account?

Mr. CRABTREE. We do, Senator. And by the way, I just have to say, I was as excited as you were to see the award on the North Slope.

Senator MURKOWSKI. Yes.

Mr. CRABTREE. If you would have asked me a few years ago, would we have Native Alaskan and industry cooperation around a direct air capture project on the North Slope of Alaska, I would not have imagined that.

Senator MURKOWSKI. Super-exciting.

Mr. CRABTREE. It is very exciting.

Obviously, you already acknowledged this. I can't speak to projects under consideration, but yes, replicability, it's actually inherent in the whole approach to demonstration. The idea is, with the demonstration funding, as with the success of these projects, it will de-risk these projects and facilitate investment in future similar projects in the marketplace. And that's why it's so important that Congress provided—and you, Senator, played a role with the

2020 Energy Act in expanding the role, not just to R&D that DOE can play, but supporting commercial-scale demonstration of these technologies.

Senator MURKOWSKI. And that's why I think we are so excited about the potential out there, because we are in this unique ecosystem, if you will, given the topography and the geography of the Slope compared to other areas in the Lower 48. You know, you have an opportunity here where you can utilize both CCUS and direct air capture in a heavily concentrated and primarily industrialized area there between Prudhoe and Kuparuk. And so, you have an amazing opportunity up there to demonstrate in a way that is unique, driven by, again, the topography and how things are concentrated. So we are very, very excited about it.

You mentioned the recognition that we are working with Alaska Natives—ANCs and Arctic Slope Regional Corporation. I think you have been up to Alaska enough to know and understand the complexity of the institutions that are serving Alaska Native people. It's not just tribes—it's tribal consortia, it's the corporations. And I have heard from some applicants that there is a worry or a concern that there is this disconnect, or perhaps a lack of appreciation or understanding for how ANCs work as part of the project—their place in the community, how the benefits actually flow back to shareholders. So I hope that you can give me some assurance that these applications aren't being discounted because, perhaps, some within the systems lack an understanding about ANCs and how they operate.

Mr. CRABTREE. I appreciate that question. I would suspect that probably, more broadly, you encounter a lot of lack of understanding——

Senator MURKOWSKI. Yes.

Mr. CRABTREE [continuing]. Of Alaska Native Corporations and the role that they play. Because we have our Arctic Energy Office, for example, on my first trip to Alaska I was fully briefed. The team actually organized a dialogue for me with representatives of the corporations. I think a greater challenge, if I may, in Alaska right now that I think my two visits and the subsequent follow-up of my team has helped, you and I talked about this in Anchorage, is that you have enormous opportunities in Alaska for regional initiatives. Turning the Cook Inlet into a carbon hub, for example.

Senator MURKOWSKI. Right.

Mr. CRABTREE. You have been mentioning the North Slope here. There is also the decarbonization of your regionally isolated grid.

Senator MURKOWSKI. Which we are really excited about.

Mr. CRABTREE. And there are enormous opportunities there, but when I—the first trip I made, I sensed there was not an appreciation for the multiple provisions in the infrastructure legislation and in the Inflation Reduction Act that could be layered together to do comprehensive projects. In my sense, that is changing. And from our DOE perspective, the Alaska Native Corporations are fundamental to all of that.

Senator MURKOWSKI. Well, I will look forward to working with you, and if you have identified something that we need to speak to, just about how the whole system knits together up there, I am happy to do that. These are exciting.

Mr. Chairman, I really appreciate that you and the Ranking Member have put this before the Committee today. I have a whole host of questions, not only for Mr. Crabtree, but Mr. Pigott, that I would like to ask to be included as part of questions for the record.

The CHAIRMAN. Absolutely. And I think you might get another chance at this real quick.

Senator King.

Senator KING. Thank you, Mr. Chairman.

I want to inject, if you will pardon the term, another factor into this discussion, and that is time. We don't have time. There has to be a sense of urgency about this. We are in a race with climate change. We are seeing the impacts accelerating year by year by year. And Ms. Barkau, you testified about the process to get to where you are today, and the well will be ready, my calculation was seven years from the time it started in 2018. That can't be the standard. And I am very disturbed by the Chairman's chart of 169 applications, no approvals. This is—if the goal is protecting the environment, we have got to get on with it. We can't be delaying and slow-walking the process in order to achieve our climate goals, whether it's CCUS or transmission lines or any other of the necessary infrastructure, to achieve a green energy future.

And so, I guess I want to start with Mr. Crabtree. Where are we on feasibility? And I am an old alternative energy/renewable energy developer. I think in terms of cents per kilowatt-hour. What are we talking about for CCUS when added to the cost of the output of a coal plant, for example?

Mr. CRABTREE. That is so site specific, but——

Senator KING. Give me a range, a ballpark. Are we talking two cents a kilowatt-hour or ten cents a kilowatt-hour?

Mr. CRABTREE. I would want to get back to you in a question for the record to show on that, but here is what I can say. For coal-powered power generation, the cost of carbon capture and storage is in the neighborhood of the 45Q tax credit. There is substantial commercial risk that increases the financing costs of projects. Some of the investments we are making, that we have been talking about, and CO_2 transport and geologic storage, will help to de-risk those commercial investments because part of the challenge is that you are not just investing in the capital—in the operations of the carbon capture equipment—you have that whole value chain of the CO_2 transport and storage.

Senator KING. Well, I would appreciate it if you could give me an answer on the numbers. In other words, will the cost of carbon capture equal the cost of producing the energy, or will it be more? Will it be less? And I just—that is a crucial factor because, again, one of the factors we are thinking about here is consumers—what they have got to pay for electricity. So I just would like that data, if you could. You don't need to answer now, but——

Mr. CRABTREE. I will definitely provide it for the record.

Senator KING. And Mr. Pigott, can we do this without damaging local communities? The objection is potential damage to local communities, water pollution—again, not a detailed answer, my time is ticking away, but can it be done in an environmentally sound manner?

Mr. PIGOTT. We believe yes, it can, Senator.

And I very much appreciate the sense of urgency that you brought to this discussion. We believe it's urgent too. That's why we are working to ensure and announce today the grant to ensure that states across the nation are able to put in place primacy applications. And we are willing to work with states, not only to provide them with the funding, but knowing on the front-end what they should expect in order to process and receive primacy.

Senator KING. Ms. Barkau testified that it took almost three years to get their primacy designation. That's not acceptable. I mean, if it takes you three years to get to the starting point, and then the state has to do the permitting, and then there is a period for construction, there has got to be a process to accelerate that primacy determination.

Mr. PIGOTT. Senator, we are working every day, and I agree with that sense of urgency to expedite our processes. There are important considerations to keep in mind. The federal programs are required to be mirrored by the states. So the legislation and the regulations have to mirror the federal regulations. So when we talk to states—and we have a four-phase application process—one, as Ms. Barkau mentioned, is the preapplication meeting. And one of the ways to speed that process up is to communicate upfront what we need from their legislature and regulations.

Senator KING. Perhaps you could produce a national template to all the states and say, here is the need, and not make it one by one. I would remind you that Eisenhower retook Europe in 11 months.

Mr. PIGOTT. Thank you for that reminder, sir, and we agree, which is why we recently put out guidance to our regions and to states to ensure that they know what needs to be embedded in their processes when they submit permit applications. And it's all on our website and available for all the states and individual applicants. But we are meeting with them in addition to that, to ensure that they have all the tools on the front-end and that things are expedited, not delayed because something is not ready.

Senator KING. And Mr. Crabtree, finally, in just the last few seconds. This is a necessary technology in order to achieve the climate goals, is it not? I looked at my ISO app a few minutes ago—eight percent of our energy in New England is now coming from renewables—eight percent. That means fossil fuels are going to be there for a while, and we have got to be able to deal with the carbon impact.

Mr. CRABTREE. Yes, it is essential, not only from a climate standpoint and for decarbonizing fossil fuels, but I would note that if you just look at industrial processes, upon which modern life utterly depends, many of them, a majority of the emissions are unrelated to the energy inputs. The actual industrial processes themselves produce CO_2, and if you don't capture and manage that CO_2, we cannot decarbonize cement, steel, chemicals. On those industries alone, we will fail to meet our climate goals without economy-wide deployment of carbon management.

Senator KING. I would summarize my questions by the term "hurry up." Thank you.

Mr. CRABTREE. Thank you, sir.

The CHAIRMAN. Senator Hoeven.

Senator HOEVEN. Thank you, Mr. Chairman. Thanks for holding the hearing today.

Good to see you, all of you. Thank you for being here and testifying today.

Secretary Crabtree, particularly good to see you—of course, our time from North Dakota, working on these important issues, and I appreciate that you are working on them now in your current role. Given that you are from North Dakota, you are aware of our projects. Obviously, the Denbury EOR project in Bowman County has been operating for quite some time. Dakota Gasification company has been operating for—I think I turned a wheel on that for the carbon to go to the oil fields about 20 years ago. Yeah, well, I wasn't far off then. Red Trail Energy, Blue Flint now. So Red Trail has been operating for a while now. Blue Flint is just added. Dakota Gasification company, now, in addition to their EOR, they are now adding sequestration. I think that they are getting very close. That will be the largest carbon capture project in the world when they have completed the next phase. And they will be capturing up to 85 percent of the CO_2 they produce at that point. Project Tundra is moving forward—a conventional coal-fired electric plant adding CO_2 capture. That one being a rural electric cooperative owned, and of course, Coal Creek, an investor-owned coal conventional plant also working to do the same thing. And undoubtedly, you are aware of the Marathon renewable diesel refinery project, which was part of the hydrogen hub for our area, probably a $2.5 billion project for carbon capture, fertilizer production, and so forth, on a renewable refinery that we have in western North Dakota.

So, as the Ranking Member said earlier, North Dakota and Wyoming, two states with primacy. I have always said primacy is very important in terms of getting projects going. And I would encourage both you and Secretary Pigott to, you know, work with more states to get the ability to get primacy. I mean, that is one way, I think—I know you have been hearing it, and rightfully so, that you need to get these projects going. One way to help yourself is to get more states primacy, I believe, as a solution to get this done. You just get, you know, it's like, you just get a lot more hands on deck. And so, I am going to come to you in a minute and ask you, Secretary Pigott, about what you think can happen there to get more states primacy. We welcome the competition.

But specifically, Secretary Crabtree, for you, and you know what's coming here—the regional partnerships. We could not be doing all these things without the work of the EERC at the University of North Dakota—Energy and Environmental Research Center at the University of North Dakota, which is the manager of the hydrogen hub for our region. Almost a billion dollars, and they will do a tremendous job, but their partnerships, the regional carbon sequestration partnership that we have with the outstanding University of Wyoming, the Cowboys, but also my partner just left, but Alaska, as well. We need those regional partnerships to be funded, and we worked very hard to appropriate funds to do that. I am also on the Appropriations Committee, as is our Chairman. And the Chairman and I recently sent a letter, and we want to know when

the FOAs are going to go out and when we are going to get that funding for '23 for those regional partnerships. And I hope, Mr. Chairman, you will agree with me, that is an absolute priority that that get done and that outstanding partnerships like ours, and West Virginia has one too, are able to continue their good work.

Would you agree with that, Mr. Chairman? I would like that to be on the record, if you would.

The CHAIRMAN. Without objection.

[Letter regarding regional partnerships follows:]

United States Senate
WASHINGTON, DC 20510

June 7, 2023

The Honorable Jennifer Granholm
Secretary
U.S. Department of Energy
1000 Independence Ave, SW
Washington, DC 20585

Dear Secretary Granholm:

We write to urge the Department of Energy (DOE) to promptly release a funding opportunity announcement (FOA) to award "not less than $20 million for the Regional Carbon Sequestration Partnerships" (RCSPs) as directed under the Fiscal Year (FY) 2023 Consolidated Appropriations Act (Public Law No. 117-328). Specifically, we request that the DOE issue a 2023 FOA consistent with the original goals and objectives of the RCSP program as outlined below and in the Congressionally-directed FOA issued in 2019. Thank you for your attention to this important matter.

As members of the Senate Committee on Appropriations, we are strong supporters of carbon capture, utilization, and storage (CCUS) research and development within the Department. This includes providing annual funding to further the mission of the nation's RCSPs to accelerate the deployment of commercial-scale CCUS in order to ensure our nation's growing energy needs are met with improved environmental stewardship. We are concerned, however, that DOE has yet to release a FOA for the RCSP program that is consistent with our intent.

Seven RCSPs were originally awarded in 2003 to help determine and implement the technology, infrastructure, and regulations most appropriate to promote carbon storage infrastructure in different regions of the United States and portions of Canada. In 2019, at the direction of Congress, DOE competitively selected four RCSPs to continue and build upon the accomplishments of the original RCSPs. The four RCSPs encompass nearly all of the United States as well as major portions of Canada and nearly all CO2-generating sources. Working with nearly 1,000 partners and stakeholders across the CCUS value chain, the RCSPs continue to make significant contributions to the science and technology of subsurface characterization, design, operation, monitoring, and best practices for geologic storage throughout their vast geographic footprint. This expertise and public-private partnerships developed by the current RCSPs over the last two decades make them ideal candidates to provide technical assistance for the development of large-scale storage facilities and regional carbon management hubs.

The RCSPs continue to focus on multi-state and multi-basin CCUS deployment, providing a vital and necessary complement to other DOE programs intended to support individual storage sites or projects. In its objectives, the 2023 FOA should continue efforts to expand regional subsurface characterization to reduce uncertainties and to address permitting and policy challenges across

federal, state and local jurisdictions. Further, it is critical that the FOA for the RCSP program maximize interest in all feasible carbon storage solutions, including projects utilizing enhanced oil recovery (EOR) technology. Permanent carbon storage combined with EOR can contribute to a project's financial viability, creating a win-win for net emission reductions while harnessing the potential for carbon-negative oil production.

The evaluation and advancement of regional carbon storage and transport opportunities is crucial to laying the groundwork to ensure the technical and commercial viability of CCUS projects, and DOE should recognize the valuable contributions of the RCSPs in taking a nationwide approach. To this end, we urge DOE to promptly issue a FOA for the RCSP program that fully leverages the capabilities of existing RCSPs with the aim of advancing safe, secure, and cost-effective CCUS deployment across the nation.

Sincerely,

John Hoeven
U.S. Senator

Joe Manchin III
U.S. Senator

Cc: The Honorable Brad Crabtree
Assistant Secretary for Fossil Energy and Carbon Management

Senator HOEVEN. Secretary Crabtree, I didn't surprise you, did I, with this question?

Mr. CRABTREE. Didn't surprise me, and let me just say, I am very——

Senator HOEVEN. Kind of a question and a bit of a statement, yeah.

Mr. CRABTREE. Yes. Very excited about the projects in North Dakota. You recall many years ago when I used to harass you as the Governor about things we could do to encourage exactly these kinds of developments. So it has taken too long, but it's very exciting.

With respect to the regional partnerships, I agree with you about their importance. As far as the funding, the NOI is out. The funding opportunity announcement will be out this year, and we will work to expedite its implementation once it is announced. That was a commitment we made to you and your staff and the Committee and we will honor that. As you know, things were challenging on the Committee. There were different views at the member level. We did not have four corners of agreement.

Senator HOEVEN. There certainly were.

Mr. CRABTREE. It strikes me from what I have seen, kind of reading the tea leaves, that maybe there is a coalescing on the Committee.

Senator HOEVEN. Good.

Mr. CRABTREE. So, as I have always told you, we have our own point of view about these things, but we will implement Congressional direction and we will gladly do it. That is our commitment to you. So I guess what I would want to emphasize though, and you were a lead sponsor of the SCALE Act, is what we are doing with the regional initiatives is now using them to drive commercial deployment of geologic storage, which is now fully commercial, and the $2.5 billion in the infrastructure bill, organizations like EERC are extremely well-positioned to lead that technical assistance effort.

Senator HOEVEN. No doubt.

Mr. CRABTREE. And so, that is what we are doing in our funding opportunity announcements. It's all about building facts on the ground—real projects, real storage. We will complement that with the CO_2 pipeline infrastructure through CIFIA and all the other things that you supported prior to the infrastructure legislation. And so this can be a tool to see these results in project development on the ground.

Senator HOEVEN. This is really happening now, you know.

Mr. CRABTREE. It is.

Senator HOEVEN. You know, you and I talked about this 20 years ago, and now it's really happening. And so——

Mr. CRABTREE. We are both a little older, Senator.

Senator HOEVEN. A little bit, yeah, a little lighter hair color and all, particularly me, but you know, your work is really important that we get this out there, so——

Mr. CRABTREE. Well, I feel the urgency of it every day.

Senator HOEVEN. Good.

Mr. CRABTREE. I agree with what Senator King said about——

Senator HOEVEN. And Mr. Chairman, I know I am over my time.

The CHAIRMAN. Senator Hawley, he will give you a few minutes——

Senator HOEVEN. Oh, Senator Hawley, will you hold for a minute?

Senator HAWLEY. Absolutely.

Senator HOEVEN. What about getting more states primacy, Secretary Pigott?

Mr. PIGOTT. Senator, we agree with the approach that we need all hands on deck.

Senator HOEVEN. So you are pushing for that?

Mr. PIGOTT. Absolutely.

Senator HOEVEN. Okay.

Mr. PIGOTT. In fact, today we are announcing the availability of that $50 million that you all authorized us to grant to states to assist in that primacy process, and we are totally on board. And we are going to get that money out so that states can get primacy, and we worked together to issue these permits.

Senator HOEVEN. Well, that's good, because the Chairman has kind of a temper. Don't tell anybody.

The CHAIRMAN. No, no, no, we have one we have been waiting for. We are just about there, hopefully. We are close, right?

Mr. PIGOTT. That is correct, sir.

The CHAIRMAN. Close.

Senator HOEVEN. Thank you. Thanks, Mr. Chairman.

The CHAIRMAN. Senator Hawley.

Senator HAWLEY. Thank you, Mr. Chairman. Thanks to the witnesses for being here.

Mr. Pigott, I am going to address my comments to you, and what I am about to talk about will probably come as no surprise to you. It's not—I want to acknowledge at the start—it's not within your remit at EPA. But I want you to carry back to your colleagues at EPA my seriousness about this issue and my consternation about it. And I am talking about the radioactive nuclear contamination in the State of Missouri, and in particular, in the St. Louis and St. Charles areas. This dates back to the Manhattan Project, when St. Louis was used as a processing site for uranium. Proudly did their duty—the residents of St. Louis contributed to that important project, but when it was over, the Federal Government didn't dispose of the waste. They left it for the people of St. Louis to deal with. Worse than that, they negligently attempted to dispose of it themselves, the government did, and what it ended up doing was, a whole bunch of it got into, ran off—it was left in oil tankers, drums—there are photos of this—that just sat in an open parking lot for years. The runoff went into a creek called Coldwater Creek, North County, St. Louis, where many, many homes were at the time, and still are. Generations of kids grew up playing in that creek. Now, many, many of them have cancer, autoimmune diseases, you name it.

Then, a whole other batch of it was put into a landfill, and that's what I want to bring to your attention, because the EPA has jurisdiction over it. It's the West Lake Landfill in Bridgeton, Missouri. That's just right outside of St. Louis. And there, for years now, that landfill has been sitting there with nuclear radioactive material underground, not cleaned up. The State of Missouri can't do anything

about it because you've got jurisdiction. And now, there is a subterranean fire that is burning. I mean, you cannot make this stuff up. There is a subterranean fire that is burning in the landfill that threatens to ignite the nuclear material. Meanwhile, the material in the landfill is very close to the water sources, to the water table.

Now, this has been going on—when I say years, I don't just mean for a few months—I mean for decades now, this has been going on for decades—decades, and it's not cleaned up at all. In 2018—2018—there has been a Superfund site, could I just say for the record, since 1990.

The CHAIRMAN. Without objection.

Senator HAWLEY. So in 2018, the EPA finally said, well, they have come up with a plan for remediation and it would take four years to remediate—2018. This is 2023. So far, no remediation has been done. The latest thing the EPA said is, well, maybe they would announce a remediation schedule to begin in 2024, but then in March of this year, the EPA announced that the contamination was worse than they thought, which the residents have been saying for years. And now they cannot provide a timeline for cleanup. I mean, this is unbelievable, which has led to my push, which I am proud to say has passed the Senate, to make sure that every resident in the St. Louis and St. Charles region who has been exposed to this nuclear contamination from their own government has their medical bills paid for. That is the only fair and just thing to do. Glad to say it passed the Senate. I hope it will soon pass the House.

But here's the deal: I need the EPA to get moving on this and clean this up. A Superfund site since 1990 and there is still nothing being done. EPA sent me a response letter on August 24th of this year in which they said they still don't have a timeline for remediation. The letter reads, in part, "Once the EPA approves the remedial design and there is an enforceable legal agreement in place with the responsible parties, then the remedial actions process can begin." Oh, my gosh.

So Mr. Pigott, I need you to communicate once again to your colleagues at the EPA that this is—people are dying. This is not an acceptable situation. It hasn't been acceptable for decades. And I will just make one other point here, and that is, it's probably no coincidence that the folks who live in this area are not big-time donors to political parties. They are not big-time party activists. These are working people. And they have been taken advantage of for years, and the government, for years, has just expected them to live with it, and when they said over and over and over, this contamination is bad, this contamination is spreading, there is a ground fire in the landfill, they were told just shut up and live with it. And they are dying in record numbers. You go look at the cancer rates in the St. Louis region, you will find them off the charts. You go look at breast cancer for women, in particular, in the St. Louis region, you will find it's the leading center of it in the nation—in the nation.

This has got to stop and we need the EPA to clean this site up. That's my message.

Thank you, Mr. Chairman.

Mr. PIGOTT. Thank you, Senator. And I promise I will deliver your message directly back to us at headquarters to ensure that everyone is aware of the concerns that you raised. As a widower of a spouse that passed from breast cancer, I certainly understand the concern with which you raise these issues, and I promise I will deliver this message.

The CHAIRMAN. Senator Hickenlooper.

Just in time.

Senator HICKENLOOPER. Thank you, Mr. Chair. Thank all of you for being here, for your service, all your hard work.

Mr. Crabtree, I will start with you. I share the view of the International Energy Agency and others, that view that we need to increase our carbon capture, our storage capabilities, to stay on track for zero emissions by 2050. We think of this in our office as a great transition. And it's part of artificial intelligence. I mean, all the technology that is changing is part of this energy transition as well, as different as they seem to be sometimes. I think what we have been lacking in the great energy transition is a business plan where we look at all the various risks and opportunities, try to be able to map out specific priorities, and why this priority over that priority. And I think that is part of why we need to get the private sector fully engaged. DOE was using funds from the Bipartisan Infrastructure Law to look at productive uses for carbon, including those uses to create revenue and hopefully generate long-term success.

So can you describe a little bit more the Department of Energy's carbon utilization program and how they can help achieve long-term economic vitality in this arena?

Mr. CRABTREE. Senator, thanks for the question. Good to see you again.

I actually really—everyone says appreciate the question—but I appreciate this question because carbon conversion has not actually received the attention it deserves. Part of it, I think, is that there are a lot of different technologies and potential business models. It's a much broader and more diverse and complex field than, say, capturing CO_2 from even the industrial sector, but especially from power plants. And it's also, relatively speaking, newer, and so, the infrastructure bill was important because it actually doubled our office's funding for carbon conversion from $50 million a year to roughly $100 million. But if you look at the relative investments across a carbon management portfolio, in the infrastructure bill, it's still a very small part of the larger puzzle. We think it could be quite a bit bigger.

And in terms of thinking about some of the pathways—first of all, it's not just CO_2, it's also carbon monoxide that comes out of industrial processes, steel production, in particular, before it is combusted to become CO_2.

Senator HICKENLOOPER. Right.

Mr. CRABTREE. And so, we are going to be providing support to things like the development of building materials from waste carbon emissions. There is a lot of attention, of course, to taking cement and then, of course, making concrete and curing, having CO_2 in that curing process. Also, substitutes for the portland cement, which is very CO_2 intensive to produce. Those are all opportunities.

We are also seeing lots of opportunities for mineralization in the production of products, taking captured carbon emissions. I am also very excited about biological pathways, but not the way most people would think—for example, taking carbon monoxide, and in effect, feeding that to microorganisms and then producing energy and products through those microorganisms.

The other thing that is exciting about carbon conversion is, in some industrial contexts, you can avoid combustion altogether, so there are environmental benefits beyond reducing carbon emissions.

Senator HICKENLOOPER. That's—I have got to cut you off.

Mr. CRABTREE. Sorry.

Senator HICKENLOOPER. I have written questions as well.

I do want to get a question to Ms. Barkau.

The U.S. Geological Survey—I have bored most of you one time or another with the fact that I am an ex-geologist. The U.S. Geological Survey was my home base for part of my life. They have estimated that as many as 130 million acres of federal land have carbon storage potential. That includes large basins in western states like Colorado. There can be complex ownership issues—some mix of federal, state lands, private ownership, many places in the west where the surface ownership is different than the mineral rights. Sometimes those mineral rights are federally owned. And so, it makes it tricky to decipher who owns the pore space, that empty space between the grains, once the oil is taken out, where carbon would be injected.

How does this ambiguity surrounding pore space on federal lands hamper carbon capture sequestration permitting, and what can we do—what can Congress do—to provide clarity?

Ms. BARKAU. Yes, it's certainly an issue that's in Wyoming. Our southwest corner of the state is a checkerboard pattern consisting of state or private lands mixed with federal lands.

Senator HICKENLOOPER. Those old railroads.

Ms. BARKAU. Yes, exactly. And it is a problem. Not understanding how to correlate the right-of-way authorizations with the Class VI permitting and financial assurance will play a part of that. The split estate is certainly an issue that we are currently seeing with some of our permits where it is a private surface owner and so, in Wyoming, the surface owner is the pore space owner. But there are federal minerals there, and what exactly their role will be when it comes to the rights-of-way and the Class VI permitting and receipt of comments from BLM for this particular situation, there needs to be further guidance on how the roles and responsibilities of the different agencies, whether it's in a state with primacy, or EPA for that Class VI permitting and the BLM so that there's not duplication of efforts during the review process is really needed.

Senator HICKENLOOPER. Duplication of efforts, not in government—I can't imagine that.

Anyway, I have more questions, and I will submit them in writing, and I appreciate all of you being here.

I yield back to the Chair.

The CHAIRMAN. Senator Daines.

Senator DAINES. Chairman, thank you. Ranking Member Barrasso, thank you as well.

Since taking office, the Biden Administration has promulgated rule after rule attacking Montana oil, Montana gas, Montana coal. At this moment in history, as we are watching what is happening in the Middle East, the world unraveling, whether it's what has happened with Putin invading Ukraine and natural gas, whether what's seen with the Biden Administration releasing sanctions on Iranian oil, at the same time shutting down Alaskan oil, shutting down the Keystone pipeline, shutting down oil and gas production wherever they can. It's insane, and it ties right back to national security.

I don't know why this Administration is not trying to do all it can to produce more made-in-America energy, coal, oil, and natural gas. We have anti-coal EPA regulations, like MATS and the Clean Power Plan 2.0. This Administration is doing everything they can to kill jobs and make my home State of Montana an energy importer rather than the energy hub it has been and would continue to be if the Administration left their hands off our state. We should be able to come together to promote carbon capture technology, to reduce carbon emissions, to maintain a stable grid, and to build jobs, but instead, this Administration is focused on an ideology that has become a religion, focused on regulate first, ask questions later.

Mr. Pigott, the EPA has proposed rules like MATS and Clean Power Plan 2.0 that seem to be directly focused on shutting down the Colstrip Power Plant in Montana. Both rules appear to give an ultimatum—install prohibitively expensive capture technology in a very short time period or shut down. Neither rule gives coal plants like Colstrip the time or the money to meet these prohibitive standards. Instead, they set unattainable requirements in hopes that Colstrip will be forced to shut down. Instead of over-regulating, we should be focused on innovation, making carbon capture technology affordable for coal plants to install to meet these carbon reduction goals.

Mr. Pigott, why is the EPA charging forward with these impossible-to-meet standards before technology like CCUS is widely commercialized and affordable?

Mr. PIGOTT. Senator Daines, thank you for the question.

I will say the issues of air quality regulations are not within my wheelhouse, so I am not prepared to answer the questions about where we are or the impact of those, but what is in my wheelhouse is the carbon capture permitting program, the Class VI program. And we are committed to ensure that we put in place the resources, which is why we are announcing today that we are getting the $50 million that you and Congress have allocated to states to assume primacy, because we believe states are critical partners in ensuring that we get these Class VI programs off the ground and running. And we are fully committed to doing so and doing it correctly.

Senator DAINES. But we can't—it's a noble statement, but it's unattainable based on the timelines that have been set here. I mean, the technology is not ready for prime time, and I recognize, I mean, you are not in that specifically at the EPA, but please help us here, because you are talking out of two sides of the mouth in this, say-

ing we want this technology to reduce carbon, but we are not going to allow the technology time to mature. I am a chemical engineer by degree. I am big in innovation. Love the idea that we continue to make coal an important part of our energy future because it will be, as we look long-term, because the sun doesn't always shine and the wind doesn't always blow.

I am not opposed to renewable energy, but we need to expand our portfolio when the world is going to need 50 percent more energy in the next 25 years than we use today. So in other words, you have to take that portfolio and go like this (hands far apart) over the course of the next 25 years, not like this (hands close together).

Mr. PIGOTT. Senator, I come from Indiana, where for 20 years I worked at the Indiana Department of Environmental Management. As you probably know, it's a coal state. And so, I am well aware of the concerns about providing reliable energy. And I am committed to ensuring that we put in place an effective Class VI program that issues permits in a timely manner. And I am happy to communicate with our folks in the Office of Air Quality of concerns that you have had.

Senator DAINES. Maybe they will watch the hearing and they will hear it directly as well. It would be helpful. It's deaf ears right now. I don't think they want to hear it, I really don't. I have been around Washington just long enough to see they really want to see these plants shut down. They think it's a noble cause as part of their belief that they are doing the right thing here for everybody in doing so.

Assistant Secretary Crabtree, the Department of Energy plays an important role in assuring grid reliability. Is the Department reviewing the EPA rules and the drastic effect they have on the reliability of the grid in places like Montana and the rest of the country?

Mr. CRABTREE. Senator, yes, as you know, we are not the regulator here, but we do provide technical input on the regulations with respect to reliability. I would urge a more optimistic perspective on the technology. As someone who has been an advocate for carbon capture for over two decades now, in the time frames that are in the regulation and what we are doing with respect to the build-out of——

Senator DAINES. With all due respect, are they talking to the folks right now—the engineers, the project managers—who are in charge of delivering this? That's the problem. I mean, there's a major disconnect here in terms of probably the time that I think it's realistically going to take versus the EPA mandates that are coming out. And it's an existential threat to our operations in Montana.

And grid reliability is really important, because if you don't have baseload power, you don't have grid reliability, as you know.

Mr. CRABTREE. Well, and that's why I think carbon capture is so important, because it allows us to decarbonize power generation and have that 24/7 dispatchable power, and I am very optimistic about—I am working with companies that literally have projects over the next decade where they hope to manage a significant portion of their emissions.

Senator DAINES. Have you meshed that with the EPA mandates that are coming down to make sure there is enough room to get both accomplished? Have you looked at that in detail?

Mr. CRABTREE. Well, our technical team has, yes.

Senator DAINES. Okay. I am out of time. Thank you.

The CHAIRMAN. Thank you, Senator.

I am going to have to go vote and then Senator Padilla is going to have his questions and then Senator Cassidy. He will be chairing the remainder of this meeting. But thank you all so much. It has been a great influence for all of us and great input from you all. We understand how important this is. And the bottom line is, we need an all-of-the-above energy policy and we need to do everything we can to make sure all the energy that we have is done in the cleanest fashion. I think we can lead the world in that. And elimination isn't going to cure the problem, but innovation can cure the problem. I think that's what we are striving for.

So with that, I turn it over to Senator Padilla.

Senator PADILLA [presiding]. Thank you, Mr. Chair.

The CHAIRMAN. You are now the Chair.

Senator PADILLA. Thank you, myself.

[Laughter.]

Senator PADILLA. So proud that California remains committed to leading the nation in the innovation that Senator Manchin just spoke of in working to reduce our greenhouse gas emissions. As part of that broad portfolio, there are currently 11 geologic carbon sequestration proposals in California undergoing review for Class VI underground injection control permits at EPA. Also pleased to hear that the Administration is carefully considering environmental justice concerns when reviewing these projects and applications. While these technologies have the potential to address disproportionate rates of illness experienced by vulnerable communities due to air pollution, we are mindful enough that we recognize it is vital that these new technologies do not inadvertently harm communities in other ways, including through harmful contamination of groundwater basins that provide drinking water to communities.

A question for Mr. Pigott: you mentioned in your testimony that the EPA has a responsibility to ensure that carbon capture and storage technologies do not contaminate drinking water. Can you elaborate for a minute on how specifically the EPA is planning to ensure these projects do not have those adverse impacts?

Mr. PIGOTT. Thank you, Senator Padilla.

Yes, I can. I know that the geological formations in the ground are very important for us to consider as we look to ensure that we put these carbon wells in the right places. We examine the geology to ensure that the area is free of fractures and faults. We look at the injected CO_2 plume—where is it expected to go, and what is the likelihood that it could spread? And then we look at the specifics of the well construction itself to ensure that the well is constructed in such a way as to operate properly.

But it does not stop there and it does not stop with just the issuance of a permit. Long after a well is closed, we ensure that there are requirements in the permits for the permittees to monitor and to put in place and have financial insurance in place, correc-

tive action plans, in the event that something unexpected happens. So there are several technical aspects that we embed within our approval of our permits. In addition to that, we—our job being to secure that people are fully protected from adverse environmental consequences—have taken several steps over this past year to ensure that communities are involved and aware of that process. These common-sense practices set out clear expectations for communities and for the project proponents so that everybody knows what the expectations are. So there is a thorough analysis of where these wells are sited, but there is a thorough participation by the communities to ensure everyone is aware and assured of the functional ability of these projects, Senator.

Senator PADILLA. I am pleased to hear about the consideration, not just during the application and approval process, but ongoing. It is a very different type of facility, but you are speaking to a Senator who lives in the shadow of the Aliso Canyon gas storage facility in Southern California, which was the source of the largest methane gas leak, I believe, in our nation's history just a couple of years ago, due to aging and not sufficiently maintained, obviously, wells and other infrastructure.

On a different topic, I know 45Q has been discussed a good amount earlier in the hearing, but I have a question with a slightly different angle to it. In 2020, the International Energy Agency published a report examining the role for carbon capture in the clean energy transition, noting that it would be virtually impossible to reach net zero without carbon capture utilization and sequestration and direct air capture technology. Now, some innovators in California and around the country are going even further in making products like cement with lower or even zero emissions. However, the 45Q tax credit only applies to companies that emit and then capture their emissions, but not companies that are directly lowering or eliminating emissions altogether.

The question is for Mr. Crabtree. How should we think about balancing current incentives for carbon capture versus rewarding innovation or innovative technologies for low or reduced emissions?

Mr. CRABTREE. Thank you, Senator.

So you have identified, obviously, what needs to be a top priority, which is if you can avoid the emissions in the first place, then you should do that. And so, I would note that outside the context of carbon management, fortunately, the infrastructure bill is comprehensive, as are the tax credits in the Inflation Reduction Act, so you mentioned the 45Q tax credit, but there is the 48C tax credit, there are other tax credits that are focused on decarbonization, as well as funding provisions in the infrastructure bill—one I would note that gets to, I think, your concern, is being implemented by the Office of Clean Energy Demonstrations, and that is the Industrial Decarbonization provision. It's a $6 billion provision in the infrastructure bill and it allows for carbon capture, but it also funds things like advanced energy efficiency in industrial settings, electrifying of different heating processes.

One of the major demands of energy and sources of emissions in the industrial sector is heat. And so, to the extent that we can electrify that heat, we are obviously avoiding emissions. That is assuming the electricity is decarbonized. And then there are just a range

of—the role of hydrogen also can be brought into industry to avoid emissions in the first place. So that is, I think, a critical area where we can make progress and avoid emissions in the first place.

Senator PADILLA. Ms. Burns, would you have anything else to add?

Ms. BURNS. Thank you, Senator.

I would say what Brad said on where we can reduce is incredibly important. And I would say also, you know, you touched on the role of California. I will say Carbon180 started out of California. We were proudly headquartered there until very recently. We are also a part of one of the direct air capture hubs projects, the Community Alliance for Direct Air Capture in the Central Valley. And I think we are particularly excited about the role that California has played in leading the nation on things like direct air capture, including the plant that is going to be unveiled next week in Tracy, California, led by Heirloom.

And so, I think, looking holistically at the innovation that we can support in the state and across the country is really essential.

Senator PADILLA. Thank you. Well, flattery will get you very far.

And just a final note before recognizing Senator Cassidy. I think the longer-term question here is, as new technologies come, we want to make sure that we are keeping up with our incentive structure that reflects new technologies that will not necessarily always fit into the categories as we structure them initially.

Senator Cassidy.

Senator CASSIDY. Thank you.

Mr. Pigott, Louisiana is seeking to get primacy for Class VI wells. I mean, this is like a year overdue. I think, literally, maybe two years overdue, but just amazing. And we were told—the Governor and I were on the phone with Mr. Regan not long ago—I guess it was a long time ago, maybe eight months, maybe six months, in which it was intimated that we were about to receive. We still haven't received. What's the holdup? Louisiana apparently is a model for many aspects of the application, and we still haven't received. Can you tell me why not?

Mr. PIGOTT. Senator Cassidy, first I want to say I appreciate your concern about the primacy process and the number of applications that are currently under review. I share that concern, and we are working hard to provide that process, and we are following the rule process that we have articulated, which is, we public-noticed the rule and now we have 66,000 comments. And we will be responding to each and every comment.

Senator CASSIDY. But you reopened the public—do I recall, did you reopen the public? I mean, you've done it. You completed that, and then you reopened it? Excuse my frustration, but I mean, I get the impression you don't want to give us primacy.

Mr. PIGOTT. Sir, we are fully committed to this primacy——

Senator CASSIDY. Then why did you reopen?

Mr. PIGOTT. We reopened it because Louisiana submitted additional documentation to us regarding the application. And we wanted to make sure——

Senator CASSIDY. That must be something that was solicited, because as far as the Governor was concerned, we were about to announce that we were going to receive it, and boom—it's reopened.

So I am thinking that there may have been something like—kind of like, we need to hear from you guys again.

Mr. PIGOTT. There was a change in the statutory provisions in Louisiana that Louisiana submitted to us. And in order to make sure that the primacy for Louisiana was fully defensible, we public-noticed that, and we did it for an additional 30 days.

Senator CASSIDY. Can I ask—my staff tells me that the filing said no changes were needed because the application addressed the changes in the law.

So I am hearing that—I am getting mixed messages here. And I am getting a sense that I am hearing an excuse as opposed to that which was actually offered. And I don't mean to be obnoxious about it, but how long does it take EPA, if you don't have—the state does not have primacy—how long does it take the EPA to permit, on average, a Class VI well?

Mr. PIGOTT. The permitting process takes approximately two years, sir.

Senator CASSIDY. So okay, so Louisiana has direct air capture. We are trying to sequester carbon. We are trying to achieve the goals that have been laid out there, and we have met all the goals, and I am told that your filing said that we had accommodated our change in law by our application. But instead, it has been reopened. Tell me why I shouldn't be incredibly frustrated with EPA.

Mr. PIGOTT. We are interested in ensuring that the primacy application is fully defensible, and now we are past the public comment period. We received 66,000——

Senator CASSIDY. And how long will it take to review those 66,000?

Mr. PIGOTT. We are in the end stages of this process.

Senator CASSIDY. So end stages. I used to talk to medical students, and they would say "about to." Can you tell me what end stages means? Is it a week? Is it two weeks? Because it has been two years. So is it a month? Can you give me a time frame?

Mr. PIGOTT. Senator, I certainly appreciate the frustration that you have with the process. And we are all very interested in——

Senator CASSIDY. Can you just tell me what is the time frame? Because I have limited time.

Mr. PIGOTT. We are hoping in the near future——

Senator CASSIDY. The near future doesn't mean anything to me. Is it a month? Is it two months? Is it a week?

Mr. PIGOTT. We will continue to ensure——

Senator CASSIDY. That is a non-answer and you know it. Can you give me a month?

Mr. PIGOTT. Senator, we are committed—fully committed to issuing primacy for Louisiana. And I want to make sure that——

Senator CASSIDY. I hear you say that, but I see no evidence of it. No evidence whatsoever, and you won't give me a straight answer.

Mr. PIGOTT. Senator, we have finished the process, except for the part where we are responding to all the public comments, which is required in that process.

Senator CASSIDY. If you have got 66,000 of them, how long does it take you to respond to 66,000 comments?

Mr. PIGOTT. Well, we have been working to do that and we will continue to work on it.

Senator CASSIDY. I'm sorry. I apologize. I have to move on because I am not getting an answer.

Mr. PIGOTT. Yes, sir.

Senator CASSIDY. And you know I am not getting an answer.

Mr. Crabtree, another bit of frustration. Louisiana had a hydrogen hub application, which made all the sense in the world to me. We have the pipelines. We actually had the guaranteed offtake of the hydrogen that we were going to make, and we have the Mississippi River, which allows us to ship it around the world. Looked pretty good to me. But it turns out only one hub was approved on the Gulf Coast, even though we have the infrastructure, we have the natural gas, we have the transportation. A bunch were in the Northeast, which is quite remarkable to me, since they don't have, typically, the advantages we do. And yet, then I heard that the merit reviewers, paid by DOE to judge applications in some cases, did not ask questions or comment upon Louisiana's application. And DOE did nothing about that.

Then we were told last week that there was no standardized way by which the questions were supposed to be formed on these applications. There isn't a uniform sending of questions or clarifications of any of the 28 hydrogen hub applications. Now, heck, I couldn't help but notice that a lot of the hydrogen hub places were blue states. Then I heard a rumor that they were just trying to spread the love as opposed to going where there was increased merit. So knowing that I am frustrated by all this, tell me why I should believe in this process when some of the reviewers didn't even comment or ask questions on the Louisiana application?

Mr. CRABTREE. Senator, so I was involved in my capacity as Assistant Secretary of the Office of Fossil Energy and Carbon Management, as many of my colleagues heading other offices were, in the development of the funding opportunity announcement for the hydrogen hubs. And we routinely do that with different provisions in the infrastructure bill. But at the point at which it was announced as a solicitation of funding opportunity announcement, my involvement in the hydrogen hubs process ceased. And as you know, a merit review process of federal civil servants takes over, and even in those funding opportunity announcements that are the province of FECM, the office I oversee, once the FOA is released, I am not personally involved as a political appointee——

Senator CASSIDY. So——

Mr. CRABTREE. I am not trying to dodge your question. I actually watched the hearing. I understand your concerns and all the arguments you laid out. And my understanding is that there is a process in place to follow up with the office that is responsible for——

Senator CASSIDY. So far, we have not heard from them.

Mr. CRABTREE. Okay, well, I can take that back, that concern, but my understanding is that you would have the opportunity to address your concerns.

The one thing I would like to address, just as someone who is deeply committed to the bipartisan implementation of the Bipartisan Infrastructure Law, we make every possible effort we can to implement these provisions equitably, fairly. And I recognize your

support and other members from both political parties for that legislation and how profoundly important it is that all regions of the country benefit. And I think if you look across the implementation of the infrastructure provisions, states like my own of North Dakota, yours, and others that are deeply red states, are very competitive and receiving significant funding in other areas.

Senator CASSIDY. I accept that, but the goal of it was not necessarily to give some to California because California has not received enough. It was to go where you are going to achieve the goals of the legislation, which is to remove carbon from the atmosphere or otherwise create lower carbon intensity products. That was actually the goal. And so, it should be upon merit, not upon let's make sure everybody gets a little piece of the pie. But whenever the Federal Government does that, we lose effectiveness.

So I am way over time and I got to go vote, but thank you all very much.

Mr. CRABTREE. Senator Cassidy, I wasn't speaking to the hydrogen provision. I was speaking more generally to our commitment——

Senator CASSIDY. I agree with that.

Mr. CRABTREE [continuing]. With the bipartisan implementation.

Senator CASSIDY. Thank you.

Senator PADILLA. Thank you, Senator Cassidy.

I want to take a minute to thank, again, all of our witnesses for joining us this morning and for such a robust discussion.

Announcement for members and their staff: members will have until close of business tomorrow to submit additional questions for the record.

And with that, this Committee stands adjourned.

[Whereupon, at 11:53 a.m., the Committee was adjourned.]

APPENDIX MATERIAL SUBMITTED

U.S. Senate Committee on Energy and Natural Resources
November 2, 2023 Hearing: ***Opportunities and Challenges in Deploying Carbon Capture Utilization and Sequestration and Direct Air Capture Technologies on Federal and Non-Federal Lands***
Questions for the Record Submitted to the Honorable Brad J. Crabtree

QUESTIONS FROM CHAIRMAN JOE MANCHIN III

Q1. The DOE Office of Carbon Management is responsible for reviewing and making recommendations on the lifecycle analyses submitted by companies to the DOE and the IRS in order to claim tax credits under section 45Q for carbon capture and utilization. The 45Q utilization program has the potential to significantly incentivize economic activities that reduce net GHG emissions. Can you provide additional details as to the content of these LCAs and characterize their level of adherence to the NETL template, how DOE is accommodating an increase in LCA requests, and whether you anticipate more rapid response times to these inquiries? Do you require any additional assistance from Congress to facilitate regular and responsive reviews?

A1. The primary focus in the lifecycle analyses (LCAs) submitted for the 45Q tax credit for carbon capture and utilization is a quantitative comparison of the taxpayer's lifecycle greenhouse gas emissions for the facility of interest to a reference process for yielding the same products. This comparison determines the amount of qualified carbon oxides that were either "captured and permanently isolated from the atmosphere" or "displaced from being emitted into the atmosphere" through use of an eligible utilization process (26 CFR 1.45Q-4(b)(1)). The LCA model and report contain documentation of the data sources utilized, representativeness of that data, and sensitivity/uncertainty in any key parameters. The majority of LCAs reviewed to-date have not adhered to the ISO standards (14040:2006 - Life cycle assessment, Principles and framework and 14044:2006 - Life cycle assessment, Requirements and Guidelines) nor the NETL template (Carbon Dioxide Utilization (CO2U) Life Cycle Analysis Guidance for the U.S. DOE Office of Fossil Energy and Carbon Management and NETL 45Q Addendum to the CO2U LCA Guidance Toolkit). For LCAs that were not in alignment with the guidance, DOE provided a review report to the IRS, which was subsequently provided to the taxpayers, that detailed inconsistencies with the guidance and recommendations for revisions. The most common issue identified as part of the critical reviews is the selection of a comparison process that is inconsistent with the NETL guidance.

DOE is leveraging technical expertise at NETL to complete the LCA reviews. The team at NETL has added staff to support this effort. DOE is now receiving dedicated funding to support reviews from the IRS through interagency fund transfer, and we are working on approaches to streamline the LCA review process to prevent iterative reviews through the development of more

standardized data as well as example LCA reports that are consistent with the NETL guidance. DOE engages in the technical review of an LCA when notified by the IRS to proceed. Once initiated, our goal is to provide the review to the IRS within 60 calendar days (timeline set out in MOU between DOE Office of Fossil Energy and Carbon Management and IRS Large Business and International Division), upon which the IRS makes the final determination of eligibility for the tax credit. To date, DOE has completed typical LCA reviews, which constitute the majority of reviews, in less than that time period.

Q2. We need to think more about what a "whole of government" approach to deploying CCUS looks like. For example, a project could need permits from EPA, the Army Corps, Department of Interior, and financial assistance from DOE. If one of these elements of the project fails, it could take down the whole project with it. What can we do to improve coordination?

A2. We agree that a "whole of government" approach would aid in faster deployment of carbon capture, utilization, and sequestration (CCUS). For this reason, this year FECM created a new Federal Partnerships Division that focuses on Federal CCUS coordination, workforce capacity building, interagency information sharing, collaboration, and technical assistance. Effective communication established working relationships among interagency partners, and clear processes and procedures all contribute to reduced permitting risks and increased efficiencies. Federal agencies have jointly made significant accomplishments over the past year and continue to implement additional strategies to improve coordination on CCUS permitting.

Over the past year, FECM has led active engagement with over 180 CCUS contacts from ten federal agencies, including EPA's Class VI program and Bureau of Land Management's Right-of-Way program. We delivered one multi-day in-person training, and 11 virtual trainings to build the technical capacity of federal staff. We initiated cross-agency teams focused on specific CCUS topics, including project development on federal lands and CO2 transportation. We also are developing interagency tools to communicate processes, facilitate coordination, and track progress. In addition, with the White House Council on Environmental Quality, DOE is preparing to convene two CCUS permitting task forces to develop recommendations for the responsible development and deployment of CCUS, one focused on Federal lands and the Outer Continental Shelf, and the other on non-Federal lands.

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In FY24, FECM requested half a million dollars to support the Federal Partnerships Division. With these resources, FECM will better identify and address the highest priority issues, leverage expertise and resources, and continue to develop interagency tools to communicate processes, facilitate coordination, and track progress. We anticipate the following outcomes from the work of the CCUS permitting task forces and FECM's Federal Partnerships division cross-agency collaboration: coordinated policy and regulatory solutions; more efficient use of agencies' resources; reduced redundancy; leveraged expertise; and more effective implementation of federal requirements, all contributing to successful execution of DOE carbon management programs and broader CCUS deployment.

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QUESTIONS FROM RANKING MEMBER JOHN BARRASSO

Q1. During the hearing, I explained that EPA has recently proposed a rule requiring power plants to capture 90 percent of their carbon dioxide emissions. I asked you to "name the commercial power plants that are currently and consistently achieving this 90-percent capture rate." You mentioned the Petra Nova demonstration project in Texas. You explained that the project was "not designed to capture all the CO2 from all the flue gas stream" of Unit 8 of the W.A. Parish coal-fired power plant. However, you went on to say, "what's important is that it is achieving 90 percent or better from that flue gas stream that it was designed to capture." For the purpose of clarifying the record, please answer the following questions with a "yes" or a "no."

Q1a. During 2017-2019 period, were the emissions from the natural-gas fired cogen facility, which powered the Petra Nova project, captured along with the portion of the flue gas stream from Unit 8?

A1a. No. CO_2 emissions from the natural-gas fired cogeneration facility were not meant to be part of the flue gas stream being treated by the existing carbon capture system. An important objective of the project was to demonstrate how a carbon capture system could be integrated to a coal fired power plant. The addition of the natural gas cogeneration facility enabled a focus on proving the solvent-based system without having to further modify the host process.

Q1b. To date, has Petra Nova's project captured, on average, 90 percent of all CO2 emissions from all units of the W.A. Parish plant, including the natural gas-fired cogen facility?

A1b. No. Petra Nova project captured CO_2 only from a 240 MW equivalent slipstream of the 640 MW unit. Through the three-year demonstration period, the carbon capture facility captured 92.4% of the CO_2 from the slipstream of flue gas processed. [1] This demonstrates that levels above 90% capture are possible with existing technologies.

Q1c. As it operated during the 2017-2019 period, would the W.A. Parish plant, including the natural gas-fired cogen facility, comply with the Environmental Protection Agency's rules proposed under section 111 of the Clean Air Act on May 11, 2023?

A1c. The answer would depend on selected compliance path. The design, construction, and operation of the Petra Nova facility is geared towards the demonstration of carbon capture system on a coal

[1] W.A. Parish Post-Combustion CO2 Capture and Sequestration Demonstration Project, DOE Award Number DE-FE0003311, Final Scientific/Technical Report, PETRA NOVA PARISH HOLDINGS LLC, March 31, 2020.

facility and the secure geologic storage of the CO2 through enhanced oil recovery (EOR), as such compliance with carbon capture requirements similar to the ones proposed in the 111(d) regulation were not envisioned. Under potential 111(d) requirements, the plant owner would need to determine if implementation of the carbon capture system, or another compliance alternative, would be the most opportune to take.

Q2. Are there currently any commercial power plants operating with carbon capture and storage technology that would comply, as they operate today, with the Environmental Protection Agency's rules proposed under section 111 of the Clean Air Act on May 11, 2023?

A2. The five carbon capture and storage (CCS) equipped commercial power plants cited in the May 2023 111(d) proposed rule – Boundary Dam Power Station Unit 3, WA Parish Generating Station Unit 8, AES Warrior Run, AES Shady Point (now owned by Oklahoma Gas & Electric Company), and Bellingham Energy Center – were designed and operated to satisfy project-specific business case objectives, not specific CO_2 emission regulations. These capture system projects demonstrate that the technology for carbon capture is available and engineering design principles can be used to design systems which could comply with the proposed regulations. Since these examples of carbon capture systems were designed and operated in a manner primarily driven by economics rather than reductions in atmospheric emissions of CO_2, they would very likely not currently be considered fully compliant with the most stringent "best system of emission reduction (BSER)" requirement included in the May 2023 111(d) proposed rule without additional system modifications. However, the incentive structure for power plants has changed significantly with the newly enhanced 45Q tax credit. New requirements and enhanced incentives under 45Q will very likely drive the deployment of carbon capture systems which have technical characteristics similar to the goals of the 111(d) proposed regulation.

Q3. Are there any commercial power plants that are currently and consistently capturing, on average, 90 percent of all CO2 emissions from the entire plant, including any cogeneration facility used to power the plant's carbon capture system?

A3. As mentioned in the response to Question 4 above, all carbon capture equipped commercial power plants cited in the proposed rule were designed and operated to satisfy project-specific business case objectives and none of the cited example designs were intended to treat the entirety

of the power plant at which the carbon capture system was constructed. Both Boundary Dam Power Station and W.A. Parish Generating Station are large, multi-unit fossil-fueled power plants and the carbon capture systems at both power plants were designed to treat flue gas ducted from a single electric generating unit at the respective plants. Moreover, the carbon capture systems at four of the five cited examples were designed to treat only a portion of the flue gas, with only Boundary Dam Unit 3 designed to treat the full flue gas flow. Even though none of the cited plants does full capture at the facility level, carbon capture systems can be designed to achieve higher flow and capture fraction levels. Additionally, the new 45Q incentive and requirement structure has changed the contours of the business case for carbon capture projects, and we will likely see future projects more closely aligned with proposed 111(d) targets.

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Questions for the Record Submitted to the Honorable Brad J. Crabtree

QUESTIONS FROM SENATOR CATHERINE CORTEZ MASTO

Q1. What is the Office of Fossil Energy and Carbon Management doing to accelerate the pace of review for lifecycle analyses submitted by companies interested in claiming tax credits under section 45Q for carbon capture and utilization? How is the Office establishing this criteria – in coordination with other Agencies within the Department of Energy and Internal Revenue Service?

A1. DOE engages in the technical review of an LCA when notified by the IRS to proceed. Once initiated, our goal is to provide the review to the IRS within 60 calendar days (timeline set out in a 2022 memorandum of understanding between DOE Office of Fossil Energy and Carbon Management and IRS Large Business and International Division), upon which the IRS makes the final determination of eligibility for the tax credit. To-date, DOE has completed typical LCA reviews, which constitute the majority of reviews, within that time period.

DOE is leveraging technical expertise at NETL to complete the LCA reviews. The team at NETL has added staff to support this effort. DOE is also working on approaches to streamline the LCA process to prevent iterative reviews through the development of more standardized data as well as example LCA reports that are consistent with the NETL guidance.

U.S. Senate Committee on Energy and Natural Resources
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QUESTIONS FROM SENATOR STEVE DAINES

Q1. Assistant Secretary Crabtree, how will DOE achieve its objectives to develop and deploy carbon recycling technologies that can use captured carbon as a feedstock to manufacture new, value-added products?

A1. Carbon dioxide is an incredibly stable molecule with little accessible energy; therefore, many conversion strategies require improvements before commercial readiness. DOE's Carbon Conversion program within FECM invests in RD&D of a broad suite of technologies to recycle CO_2 in products. This includes biological CO_2 conversion through the growth of algae, mineralization with alkaline reactants to generate inorganic aggregates and bicarbonates, and catalytic routes which convert CO_2 through electrochemical or thermochemical approaches.

In the near term, the program plans to test, evaluate, and benchmark different emerging conversion strategies and conduct pre-feasibility studies to define the engineering, technical and financial parameters of such pathways, while also supporting field testing and scale up of more established conversion routes.

To encourage the commercial adoption of products made from CO_2, FECM is administering the $100M Carbon Utilization Procurement Grants program, which provides states, local governments, and public utilities with funds to purchase products derived from CO_2. This Bipartisan Infrastructure Law program connects eligible entities with vendors of CO_2-derived goods that represent a significant net reduction in GHG emissions compared to an incumbent product via a life cycle analysis. This program is a key first step toward deploying carbon recycling technologies into the market.

Q2. Assistant Secretary Crabtree, does the current tax treatment of carbon utilization projects vs. sequestration create a disincentive to partner with utilization projects?

A2. In addition to the 45Q tax credit, once commercialized, carbon oxide utilization/conversion products may generate revenue for the taxpayer. DOE sees value in conversion technologies as they can target sources of carbon oxides that are too distributed or low volume for cost-effective centralized capture or locations without sufficient storage reservoirs.

However, this developing industry requires additional incentives to commercialize. Due to challenging economics associated with the nascent status of the industry, most carbon conversion projects are unable to economically compensate an entity capturing and supplying the CO2 as much as enhanced oil recovery operators can. There has been limited development and deployment in the carbon conversion space because 45Q is currently insufficient and too uncertain to drive private investment. There is uncertainty in the duration of the credit beyond the 12-year term in the statute as well as the value of the credit since it is not determined until the facility submits an LCA with operational data from the first taxable year.

Q3. Assistant Secretary Crabtree, in September you announced that the Department of Energy was investing in research for Carbon Dioxide Storage for Enhanced Oil Recovery. In Montana we are already leading the way with the Greencore CO2 pipeline that brings industrial sourced carbon dioxide to the Cedar Creek Anticline for enhanced oil recovery and carbon storage. Because of this project the oil produced using injected CO2 in eastern Montana is net carbon negative. While DOE seems to be supporting enhanced oil recovery as an important solution to carbon sequestration, other agencies in this administration are trying to stifle enhanced oil recovery by favoring other forms of carbon storage and placing roadblocks or disincentives. Do you agree that enhanced oil recovery should not be disincentivized and instead we should have a level playing field for all types of CO2 storage projects, including parity for tax incentives from 45Q and consistent permitting rules for CO2 injection wells and projects?

A3. The operation of a CO_2 storage injection well for dedicated saline aquifer storage requires significantly different technical and economic considerations than the storage of CO_2 through enhanced oil recovery (EOR). The current framework for tax credits under 45Q takes into account these differences by providing different credit values. CO_2 storage through EOR receives a lower 45Q credit value that reflects the significant economic advantage due to the inherent value of the captured CO2 for oil EOR operators – who pay for the CO_2 to produce incremental oil in the process of storing that CO_2 geologically – thus providing an additional revenue stream that is not available to operators of dedicated geologic storage projects that do not have hydrocarbon production. On the other hand, dedicated CO2 storage in saline formations appropriately receives a higher credit value because it does not produce a commodity or product with a revenue stream to help offset the costs of that storage.

Differences in permitting of secure geologic storage are recognized by EPA's distinct classification of Class II (which governs injection of fluids, including CO2 for storage through EOR) and Class VI (for dedicated geologic storage of CO2). EPA is authorized by the Safe Drinking Water Act to develop requirements and provisions for the Underground Injection Control program. Class VI well requirements were designed to protect public health and underground sources of drinking water from the unique nature of CO2 injection for geologic storage, including the relative buoyancy of CO2, subsurface mobility, corrosivity in the presence of water, and large injection volumes.

Q4. Assistant Secretary Crabtree, carbon utilization and carbon recycling as inputs for manufacturing of products and services is another important way to take captured carbon and put it to use in the economy. What is the Department doing to advance carbon utilization and do you agree that it's an important tool that should be on a level playing field with other methods of reducing carbon emissions?

A4. Yes, carbon utilization technology represents an important strategy toward mitigating carbon emissions in our economy. Even under ambitious scenarios of decarbonization, there are several sectors of our economy, such as heavy-duty transportation and chemicals, that may still require carbon-based solutions. Carbon utilization technologies provide a route to sustainable solutions for such sectors by leveraging inputs like waste emissions, CO_2 from the air, and renewable electricity, to generate fuels and chemicals with a low greenhouse gas footprint and widely available feedstocks. However, technical hurdles make it difficult for these products to compete in the market currently, and further RD&D is needed to bring costs down.

Recently, FECM released multiple funding opportunity announcements for carbon utilization, targeting various technology pathways. This included carbon mineralization, where CO_2 is reacted with an alkaline feedstock to produce building materials such as synthetic aggregates or concrete. Other utilization pathways funded in FY23 include the biological conversion of CO_2 through algae systems, as well as techniques that capture CO_2 directly from the air and catalytically convert it to chemicals like methanol. When carbon dioxide is viewed as a chemical building block instead of a waste, the opportunity space for how we reduce carbon emissions greatly expands.

To this end, DOE launched the Clean Fuels and Products Energy Earthshot earlier in 2023, focusing on a department-wide effort to decarbonize the fuel and chemical industries through alternative sources of carbon. This Earthshot explores cost-effective technologies to generate carbon neutral products, with the goal of enabling sustainable carbon solutions for meeting 2050 demands in the aviation, maritime, and chemicals sectors with at least an 85% GHG reduction. The launching of this high-profile Energy Earthshot demonstrates the Department's commitment to advancing carbon utilization technologies and acknowledges that such tools are essential to reducing carbon emissions.

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Questions from Chairman Joe Manchin III

Question 1: We need to think more about what a "whole of government" approach to deploying CCUS looks like. For example a project could need permits from EPA, the Army Corps, Department of Interior, and financial assistance from DOE. If one of these elements of the project fails, it could take down the whole project with it. What can we do to improve coordination?

EPA RESPONSE: Reflecting the Biden-Harris Administration's whole-of-government approach to combating climate change, EPA is committed to taking action to reduce emissions of carbon dioxide and mitigate impacts on communities with environmental justice concerns. EPA's Class VI Underground Injection Control program is one part of the larger efforts around carbon capture and geologic storage and carbon dioxide removal infrastructure programs and projects. EPA is establishing a goal to review complete Class VI applications and issue permits when appropriate within two years of receiving complete applications and EPA has made strides to streamline internal review processes. Other federal agencies are also involved, and EPA works in close and frequent coordination with them. Last year, the Chair of the White House Council on Environmental Quality named me and other key governmental partners and stakeholders to the Carbon Dioxide Capture, Utilization and Sequestration Non-Federal Lands Permitting Task Force. The task force's focus is on addressing CCUS permitting and development issues on non-Federal lands, including by improving coordination as best we can.

Questions from Senator John W. Hickenlooper

Question 1: The EPA has been attentive to the importance of a just transition as our nation embarks on a great energy transition. How can Congress support efforts to build public trust in carbon capture and utilization, and use these projects as an opportunity to promote economic development for communities that have historically been built around fossil fuels?

EPA RESPONSE: EPA has seen the excitement over sequestration build over the last few years, and we are committed to carbon storage as an essential tool to cut greenhouse gas emissions. As noted in my testimony, the Biden-Harris Administration set a goal of reducing greenhouse gas emissions 50 percent by 2030 and net zero emissions economy-wide by 2050. The growth of CCUS is expected to produce between 390,000 and 1.8 million good paying jobs, especially in those communities that have been most affected by the transition to a net zero economy.

The Agency is equally committed to fulfilling our obligation and following the steps outlined in the Safe Drinking Water Act to protect people's drinking water. That's why EPA conducts a thorough review of the plans for construction of CO_2 wells and has a goal of reviewing complete Class VI applications—and approving permits when appropriate—

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within two years of receiving a completed application. Thanks to the funding provided by Congress, EPA has been able to increase staffing so that the Agency is able to maintain our commitments to timely and thorough permit reviews as we see growth in permit applications.

Question 2: Can you speak to why science-informed decision-making is important when reviewing potential projects? For example, Class-VI wells that have many geological considerations—how does EPA evaluate geology and drinking water considerations when considering applications related to Class VI wells and big energy projects in general?

EPA RESPONSE: Permit review is a highly technical and complex process. It is a rigorous scientific process and following the science is a core value at EPA. We need to evaluate the geologic composition of the subsurface and ensure there is a competent confining layer to prevent upward movement of the carbon dioxide. It is essential to ensure that wells are constructed properly, and to do so permitting agencies and applicants need to understand the composition of the carbon dioxide stream and how the carbon dioxide will move in the subsurface. There is a need to ensure any existing wells near the proposed injection well are constructed and plugged in a manner that prevents fluid movement into sources of drinking water. Finally, it is vital to protect against seismic activity resulting from injection and, accordingly, all parties evaluate seismic and geologic factors that could give rise to problems.

Questions from Senator Steve Daines

Question 1: Principal Deputy Assistant Administrator Pigott, the EPA's final Good Neighbor Rule requires that certain pipeline engines be retrofitted to comply with emission controls. Given the 2026 deadline for compliance, did the EPA consider reliability concerns as delivery decreases with engines taken offline for retrofits?

EPA RESPONSE: As the Principal Deputy Assistant Administrator in EPA's Office of Water, I am not in the best position to respond to your question about Clean Air Act rulemakings. Should you need more information regarding this rulemaking, please reach out to the EPA's Office of Congressional and Intergovernmental Relations.

Question 2: Principal Deputy Assistant Administrator Pigott, under Section 111 of the Clean Air Act, the best system of emission reduction is required by the law to be "adequately demonstrated." How would you define "adequately demonstrated"?

EPA RESPONSE: As the Principal Deputy Assistant Administrator in EPA's Office of Water, I am not in the best position to respond to your question about Clean Air Act rulemakings. Should you need more information regarding this rulemaking, please reach out to the EPA's Office of Congressional and Intergovernmental Relations.

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Question 3: Principal Deputy Assistant Administrator Pigott, the EPA's Clean Power Plan 2.0 requires the best system of emission reduction for coal plants to install and operate CCS technology at a 90-percent carbon dioxide capture rate by 2030. How many power plants have currently operating carbon capture projects that would meet the EPA's proposal of 90-percent capture of emissions?

EPA RESPONSE: As the Principal Deputy Assistant Administrator in EPA's Office of Water, I am not in the best position to respond to your question about Clean Air Act rulemakings. Should you need more information, please reach out to the EPA's Office of Congressional and Intergovernmental Relations.

Question 4: Principal Deputy Assistant Administrator Pigott, the EPA's Clean Power Plan 2.0 would require substantial changes to infrastructure to comply with requirements. Does the EPA believe that all necessary permits and rights of way can be acquired with the timeframe set forward in the proposed rule?

EPA RESPONSE: As the Principal Deputy Assistant Administrator in EPA's Office of Water, I am not in the best position to respond to your question about Clean Air Act rulemakings. Should you need more information, please reach out to the EPA's Office of Congressional and Intergovernmental Relations.

Question 5: Principal Deputy Assistant Administrator Pigott, electric reliability is essential for American economic security. However, federal policies are creating reliability issues, as evidenced by concerns raised by national and regional reliability entities. How did the EPA consider the impact of the Clean Power Plan 2.0 on reliability?

EPA RESPONSE: As the Principal Deputy Assistant Administrator in EPA's Office of Water, I am not in the best position to respond to your question about Clean Air Act rulemakings. Should you need more information, please reach out to the EPA's Office of Congressional and Intergovernmental Relations.

Question 6: Principal Deputy Assistant Administrator Pigott, how many Class VI storage permitting applications are pending approval? What is the average length of time for approval?

EPA RESPONSE: As of November 24, 2023, EPA had received 169 Class VI permit applications. The majority of these applications were received in 2023. EPA's goal is to review complete Class VI applications—and approve permits when appropriate—within two years of receiving complete applications and, to that end, the Agency has made strides in streamlining internal review processes.

Question 7: Principal Deputy Assistant Administrator Pigott, how many units have reached the hydrogen co-firing at the levels the EPA proposes in the Clean Power Plan 2.0?

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EPA RESPONSE: As the Principal Deputy Assistant Administrator in EPA's Office of Water, I am not in the best position to respond to your question about Clean Air Act rulemakings. Should you need more information, please reach out to the EPA's Office of Congressional and Intergovernmental Relations.

Question 8: Principal Deputy Assistant Administrator Pigott, is adequate clean hydrogen available to supply power plants at the levels and in the timeframe proposed in the Clean Power Plan 2.0?

EPA RESPONSE: As the Principal Deputy Assistant Administrator in EPA's Office of Water, I am not in the best position to respond to your question about Clean Air Act rulemakings. Should you need more information, please reach out to the EPA's Office of Congressional and Intergovernmental Relations.

Question 9: Principal Deputy Assistant Administrator Pigott, how was the decision made to include carbon capture requirements on existing natural gas plants in the EPA's Clean Power Plan 2.0?

EPA RESPONSE: As the Principal Deputy Assistant Administrator in EPA's Office of Water, I am not in the best position to respond to your question about Clean Air Act rulemakings. Should you need more information, please reach out to the EPA's Office of Congressional and Intergovernmental Relations.

Question 10: Principal Deputy Assistant Administrator Pigott, the Colstrip Generating Station in Montana can produce up to 1,480 megawatts of electricity and is one of Montana's largest and most reliable energy sources. If implemented, the EPA's Clean Power Plan 2.0 would force its closure by requiring intensive capital improvements that are neither economically viable nor necessary to protect public health. How has the EPA considered the potential impact on grid reliability?

EPA RESPONSE: As the Principal Deputy Assistant Administrator in EPA's Office of Water, I am not in the best position to respond to your question about Clean Air Act rulemakings. Should you need more information, please reach out to the EPA's Office of Congressional and Intergovernmental Relations.

Question 11: Principal Deputy Assistant Administrator Pigott, what modeling did the EPA use to calculate the cost of the Clean Power Plan 2.0 on consumer electricity costs? How much did the EPA estimate that costs would increase?

EPA RESPONSE: As the Principal Deputy Assistant Administrator in EPA's Office of Water, I am not in the best position to respond to your question about Clean Air Act rulemakings. Should you need more information, please reach out to the EPA's Office of Congressional and Intergovernmental Relations.

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Question 12: Principal Deputy Assistant Administrator Pigott, how would you define a negligible increase in the cost of electricity?

EPA RESPONSE: As the Principal Deputy Assistant Administrator in EPA's Office of Water, I am not in the best position to respond to your question about Clean Air Act rulemakings. Should you need more information, please reach out to the EPA's Office of Congressional and Intergovernmental Relations.

Question 13: Principal Deputy Assistant Administrator Pigott, the EPA's proposed Mercury Air Toxics Standards would directly impact the Colstrip Generating Station in Montana and as written would force its closure. By the EPA's own calculations, Colstrip is expected to bear almost 50% of the costs of the proposal for only a 0.02% reduction in filterable particulate matter. How did the EPA consider reliability needs in Montana as this proposal was being drafted?

EPA RESPONSE: As the Principal Deputy Assistant Administrator in EPA's Office of Water, I am not in the best position to respond to your question about Clean Air Act rulemakings. Should you need more information, please reach out to the EPA's Office of Congressional and Intergovernmental Relations.

Question 14: Principal Deputy Assistant Administrator Pigott, the EPA's proposed Mercury Air Toxics Standards would replace the existing cost-effective standards, which have already been found to protect human health and safety following an eight-year technology review completed in 2020. What change in practices, processes, or control technologies and equipment justifies the corresponding change to the filterable particulate matter limit?

EPA RESPONSE: As the Principal Deputy Assistant Administrator in EPA's Office of Water, I am not in the best position to respond to your question about Clean Air Act rulemakings. Should you need more information, please reach out to the EPA's Office of Congressional and Intergovernmental Relations.

Question 15: Principal Deputy Assistant Administrator Pigott, the EPA's proposed Mercury Air Toxics Standards used selected quarterly data from 2017, 2019, and 2021 for its evaluation justifying the proposed tightening of the filterable particulate matter limit. How and why did the EPA select the specific quarterly data used for its evaluation instead of using all quarterly tests data?

EPA RESPONSE: As the Principal Deputy Assistant Administrator in EPA's Office of Water, I am not in the best position to respond to your question about Clean Air Act rulemakings. Should you need more information, please reach out to the EPA's Office of Congressional and Intergovernmental Relations.

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Question 16: Principal Deputy Assistant Administrator Pigott, the EPA's proposed Mercury Air Toxics Standards included only certain test runs in conducting its distribution analysis. What was the EPA's rationale for which test runs to include or exclude?

EPA RESPONSE: As the Principal Deputy Assistant Administrator in EPA's Office of Water, I am not in the best position to respond to your question about Clean Air Act rulemakings. Should you need more information, please reach out to the EPA's Office of Congressional and Intergovernmental Relations.

Question 17: Principal Deputy Assistant Administrator Pigott, when the EPA was evaluating filterable particulate matter to decide limits for the proposed Mercury Air Toxics Standards, did they exclude data from units that co-fire with natural gas? If not, why not?

EPA RESPONSE: As the Principal Deputy Assistant Administrator in EPA's Office of Water, I am not in the best position to respond to your question about Clean Air Act rulemakings. Should you need more information, please reach out to the EPA's Office of Congressional and Intergovernmental Relations.

Question 18: Principal Deputy Assistant Administrator Pigott, what evidence, if any, does the EPA have that demonstrates stack testing is inadequate? If none, why eliminate stack testing as a compliance measure in the proposed Mercury Air Toxics Standards?

EPA RESPONSE: As the Principal Deputy Assistant Administrator in EPA's Office of Water, I am not in the best position to respond to your question about Clean Air Act rulemakings. Should you need more information, please reach out to the EPA's Office of Congressional and Intergovernmental Relations.

Question 19: Principal Deputy Assistant Administrator Pigott, when selecting filterable particulate matter levels, the EPA selected the lowest filterable particulate matter rate from selected quarters. Do you believe that conditions that enabled the lowest filterable particulate matter measured at units to be possible at all times?

EPA RESPONSE: As the Principal Deputy Assistant Administrator in EPA's Office of Water, I am not in the best position to respond to your question about Clean Air Act rulemakings. Should you need more information, please reach out to the EPA's Office of Congressional and Intergovernmental Relations.

Question 20: Principal Deputy Assistant Administrator Pigott, the EPA recently updated the National Ambient Air Quality Standards for particulate matter. Wildfire smoke is now one of the greatest contributors to PM2.5 emissions, posing a critical threat to public health, while prescribed fire is one of the important tools that can be used to mitigate the risk of catastrophic wildfire. Studies have shown that prescribed fire produce fewer less harmful emissions than wildfire. Additionally, they do not contain the toxic chemicals that wildfires emit when they burn homes and other man-made materials. Given these benefits of prescribed fire, it is essential that

they not face unnecessary hurdles. Did the EPA consult with the Department of the Interior or the U.S. Forest Service on the potential impact of this update on their use of prescribed fire on federal lands?

EPA RESPONSE: As the Principal Deputy Assistant Administrator in EPA's Office of Water, I am not in the best position to respond to your question about Clean Air Act rulemakings. Should you need more information, please reach out to the EPA's Office of Congressional and Intergovernmental Relations.

Question 21: Principal Deputy Assistant Administrator Pigott, in the 27 states where the 2023 WOTUS Rule was enjoined, the EPA will interpret WOTUS consistent with the pre-2015 regulatory regime and the Sackett decision. How will that be implemented and when will guidance be made available to these states?

EPA RESPONSE: EPA and the Department of the Army jointly hosted trainings for states and tribes in November that covered the amended 2023 rule and the pre-2015 regulatory regime. These trainings are publicly available on EPA's website. The agencies are hosting listening sessions this winter with co-regulators and stakeholders, focusing on identifying issues that may arise around implementation. In addition, the agencies may in the future provide revised or additional administrative guidance to address implementation of the 2023 Rule, as amended, or the pre-2015 regulatory regime, consistent with the Supreme Court's decision in *Sackett v. EPA*, 598 U.S. 651 (2023).

Question 22: Principal Deputy Assistant Administrator Pigott, in context of the 2023 WOTUS Rule, what is a "relatively permanent connection" and how is this different than the "significant nexus" test that the Supreme Court overturned in Sackett?

EPA RESPONSE: Consistent with the Supreme Court's decision in *Sackett*, the September 2023 conforming rule removes the significant nexus test from consideration when identifying tributaries and other waters as federally protected. The significant nexus standard in Justice Kennedy's concurring opinion in *Rapanos v. United States* concluded that "to constitute 'navigable waters' under the Act, a water or wetland must possess a 'significant nexus' to waters that are or were navigable in fact or that could reasonably be so made." He concluded that wetlands possess the requisite significant nexus if the wetlands "either alone or in combination with similarly situated [wet]lands in the region, significantly affect the chemical, physical, and biological integrity of other covered waters more readily understood as 'navigable.'" The Supreme Court in *Sackett* rejected the significant nexus test and adopted the *Rapanos* plurality standard. The agencies will identify relatively permanent waters consistent with the *Sackett* decision using a variety of tools, resources, relevant caselaw, and existing guidance.

Question 23: Principal Deputy Assistant Administrator Pigott, in context of the 2023 WOTUS Rule, what is a "what is a continuous surface connection" and how is this different than the "significant nexus" test that the Supreme Court overturned in Sackett?

EPA RESPONSE: Consistent with the Supreme Court's decision in *Sackett*, the September 2023 conforming rule removes the significant nexus test from consideration when identifying tributaries and other waters as federally protected. The significant nexus standard in Justice Kennedy's concurring opinion in *Rapanos* concluded that "to constitute 'navigable waters' under the Act, a water or wetland must possess a 'significant nexus' to waters that are or were navigable in fact or that could reasonably be so made." He concluded that wetlands possess the requisite significant nexus if the wetlands "either alone or in combination with similarly situated [wet]lands in the region, significantly affect the chemical, physical, and biological integrity of other covered waters more readily understood as 'navigable.'" The Supreme Court in *Sackett* rejected the significant nexus test and adopted the *Rapanos* plurality standard. The agencies will identify a continuous surface connection consistent with the *Sackett* decision using a variety of tools, resources, relevant caselaw, and existing guidance.

Question 24: Principal Deputy Assistant Administrator Pigott, why did the EPA decide to forego a notice and comment period when revising the 2023 WOTUS Rule following the Sackett decision?

EPA RESPONSE: Upon review of the 2023 Supreme Court decision in *Sackett v. EPA*, EPA and the Department of the Army issued the September 8, 2023 final rule to conform the definition of "waters of the United States" to the Court's decision. The conforming rule amended the provisions of the agencies' definition of "waters of the United States" that are invalid under the Supreme Court's interpretation of the Clean Water Act in the 2023 *Sackett* decision. Because the sole purpose of this rule was to amend specific provisions of the January 2023 Rule to conform with *Sackett*, and such conforming amendments do not involve the exercise of the agencies' discretion, providing advance public notice and seeking comment was unnecessary. A notice and comment process would neither provide new information to the public nor inform any agency decision-making regarding aspects of the regulations defining "waters of the United States" that are invalid as inconsistent with the Clean Water Act under *Sackett*.

U.S. Senate Committee on Energy and Natural Resources

November 2, 2023 Hearing:
Opportunities and Challenges in Deploying Carbon Capture Utilization and Sequestration and Direct Air Capture Technologies on Federal and Non-Federal Lands

Questions for the Record Submitted to Ms. Erin Burns
Questions from Senator John W. Hickenlooper (D-CO)

Question 1: *In your testimony, you point out that there are significant research gaps on issues of importance to environmental justice communities, including the safety of CO2 transport and storage. How can Congress support efforts to build public trust in carbon capture and utilization, and use these projects as an opportunity to promote economic development for communities that have historically been built around fossil fuels?*

Answer:
Congress is well positioned to support efforts in building public trust in carbon capture and carbon removal projects.

- **Leverage existing and new federal procurement efforts to establish robust standards for carbon removal.**
    - Support DOE's first-of-a-kind pilot program to purchase carbon removal services, which can establish market standards that future public procurement efforts can adopt. The federal government has a unique role in setting high standards for the carbon removal sectors and elevating environmental justice, equity, and workforce development as key policy building blocks in any public procurement program and key criteria in project selection.
    - Pass carbon removal procurement legislation, such as the Federal Carbon Dioxide Removal Leadership Act (CDRLA) to add additional "demand side pull" to "supply side push" policies. Deployment incentives, such as the 45Q tax credit, which now offers $180 per ton of carbon removed from the ambient air and stored permanently underground, are even more valuable with a long-term public market for durable carbon removal. The same would be true for any future federal incentives or direct investments in long-duration carbon removal.
    - Maximize use of existing government procurement programs to support carbon removal. Congress can also continue to support efforts such as the Carbon Utilization Program, which provides grants to states and local governments to

procure and use commercial or industrial products that utilize captured CO_2.

- **Increase funding to support staffing constraints at DOE.**
    - Provide funding to increase DOE staffing with expertise in community engagement and environmental justice to review, assess, manage, and ensure thorough implementation of Community Benefits Plans and non-technical components of projects resulting from the 2021 Bipartisan Infrastructure Law, including the Regional Direct Air Capture Hubs and the Regional Clean Hydrogen Hubs. This recommendation was included in Carbon180's FY24 Appropriations requests.
    - Establish a technical assistance pilot program, in collaboration with universities, nonprofit organizations, and/or national labs and with external stakeholder review, to provide independent assistance through DOE contracts that helps communities better understand the science, regulatory environment, workforce needs, and policies of climate and energy issues and builds their capacity to meaningfully engage in new infrastructure, including large-scale clean energy and carbon management projects. This recommendation was included in Carbon180's FY24 Appropriations requests.
- **Invest in social science research for carbon capture, transport, storage, and utilization.**
    - Fund cross-agency research across DOE, EPA, DOI, USDA, and NSF to examine the public health impacts of direct air capture (DAC), carbon mineralization, carbon dioxide pipelines, and geologic storage, including air and water quality, seismic activity, and biodiversity, as well as the social and environmental impacts of industry expansion on public and private lands. Investments should also focus on robust, transparent, and inclusive community-based participatory research for deploying carbon capture, transport, utilization, and storage, prioritizing projects by community-based organizations, nongovernmental organizations, land-grant universities, Tribal colleges and universities, and related institutions. Investment in social science research is greatly needed to anticipate and address public concerns.
- **Establish mechanisms for accountability for federally funded projects that consider the climate, environmental, public health, and social impacts.**
    - Require federally funded carbon capture, removal, and utilization projects to integrate robust monitoring, reporting, and verification (MRV) protocols that ensure direct accounting of removals and impacts, traceability of carbon removal

over time, and data transparency.

- Ensure all federally funded projects require community benefit plans (CBPs). Currently, DOE requires CBPs for all demonstration projects funded through the Bipartisan Infrastructure Plan (BIL) and Inflation Reduction Act (IRA). This has been a step in the right direction towards building trust between the federal government and communities around large scale infrastructure.

- **Establish and enforce robust regulations around CO_2 pipelines.**
  - Establish an interagency task force that includes DOE, EPA, DOI, and others in collaboration with industry, Tribal governments, and civil society stakeholders to determine where CO2 transport pipelines may be ideally sited, how public participation would function, and the resulting labor and economic impacts. Full-scale carbon removal will require a robust system of pipelines to transport large amounts of CO2 from capture sites to storage and/or use sites. For public health and safety, this pipeline network must be safe, secure, and carefully sited.

  - Provide funding to Pipelines and Hazardous Materials Safety Administration (PHMSA) to issue and enforce detailed, comprehensive standards for CO2 pipelines, based on the best available science and the precautionary principle.

CARBON CAPTURE COALITION

Carbon Capture Coalition Statement for the Record

United States Senate Committee on Energy and Natural Resources
Full Committee Hearing to Examine Opportunities and Challenges in Deploying CCUS and DAC Technologies on Federal and Non-Federal Lands

November 2, 2023

The Carbon Capture Coalition (the Coalition) appreciates the opportunity to submit this statement for the record for the Senate Energy and Natural Resources Committee hearing to examine opportunities and challenges in deploying Carbon Capture, Utilization, and Storage (CCUS) and Direct Air Capture (DAC) technologies on federal and non-federal lands. Carbon management technologies are essential tools in a broader federal strategy to reduce greenhouse gas emissions, while simultaneously providing benefits to affected communities and regional economies through associated air quality benefits as well as the preservation and creation of family-sustaining jobs.

The Carbon Capture Coalition is a nonpartisan collaboration of more than 100 companies, unions, conservation and environmental policy organizations, building federal policy support to enable economywide, commercial scale deployment of carbon management technologies. This includes carbon capture, removal, transport, reuse, and storage from industrial facilities, power plants, and ambient air. Coalition members recognize that economywide adoption of carbon management technologies are critical to achieving net zero emissions to meet midcentury climate goals, strengthening and decarbonizing domestic energy, industrial production and manufacturing, and retaining and expanding a high-wage jobs base. Successful commercial deployment of these technologies requires prioritizing meaningful engagement and consultation with local communities as well as associated workforce development.

Building off the historic support provided to carbon management technologies in the 117th Congress, lawmakers can reinforce and grow the role of American leadership in the development and deployment of these technologies throughout the remainder of this decade. This statement details a slate of near-term federal policy opportunities for the committee to consider to catalyze the deployment of carbon management technologies across the economy. The below recommendations address the current economic, financing and project permitting challenges carbon management projects face in today's policy landscape. Enacting these recommendations would further enable these technologies to fulfill their emissions reduction potential, while strengthening American manufacturing and industrial production, and providing communities with tangible economic and health benefits. Specifically, this includes small-scale adjustments to the federal Section 45Q tax credit, the foundational policy mechanism for incentivizing carbon management projects and, critically, considerations for reforming aspects of the permitting process to provide clear and transparent parameters for project developers to abide by as this sector scales in a safe, efficient and responsible manner.

Ensuring Investment Certainty Under Federal Section 45Q

Over the course of the 117th Congress, the Coalition and its members played a central role in ensuring that key carbon management priorities were reflected in broadly bipartisan pieces of legislation, and eventually included in larger legislative vehicles like the 2021 Bipartisan Infrastructure Law (BIL) and the 2022 Inflation Reduction Act (IRA). Today, the U.S. policy framework is now recognized as the most comprehensive and robust federal policy support for carbon management technologies in the world. Moreover, this wave of increased federal policy support since the 2018 restructuring of the 45Q tax credit has resulted in the public announcement of more than 150 carbon capture projects under development, with many more in the development pipeline.

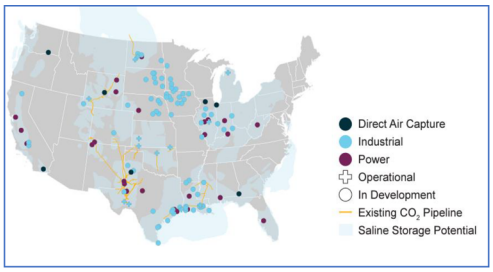

*Figure 1 – **Publicly Announced Carbon Management Projects.** These projects span the development cycle from early stages of development to project construction.*

These announced projects span the carbon management value chain and include projects at various stages technology development and deployment—from pilot scale, feasibility (front end engineering and design studies) up to commercial scale projects, signaling that increased federal policy support for carbon management technologies will translate into real-world projects. It remains clear that in order to deploy projects at a scale in keeping with ambitious midcentury climate targets, 45Q must work wholistically for projects across the value chain.

With crucial enhancements to the 45Q tax credit now enshrined in law, along with a portfolio of complementary policies enacted throughout the course of the 117th Congress, project proponents have a strong foundation to bolster the widespread deployment of carbon capture, removal, reuse, and transport and storage technologies in central sectors including heavy industry, power, and direct air capture. However, further adjustments to the tax credit will be necessary to ensure investment certainty and business model flexibility.

- **Index 45Q for Inflation:** Increased credit values provided to projects developed in the industry, power, and direct air capture sectors represent the cornerstone of the recent enhancements made to 45Q. However, unlike other low- and zero-emissions technology tax credits recently reformed under the 117th Congress which adjust for inflation beginning in 2022 and 2023, the 45Q tax credit value is not adjusted for inflation until 2027, putting carbon management projects at a significant disadvantage. Already, much of the value increase realized in 2022 has been eroded due to significant inflation in both capital goods costs and energy prices. In numbers, the 2022 Consumer Price Index (a standard metric of inflation) rose by 7 percent. Therefore, value of an $85 per metric ton 45Q credit would now be only $74 per metric ton as measured in 2020 dollars, and early modeling suggests by 2026 the value of the credit could diminish by 30 percent. Ignoring these inflationary pressures on 45Q jeopardizes not just the bipartisan investments already made under the 117th Congress, but the economic and environmental returns expected from those investments, including the creation and retention of family-sustaining jobs and tangible health benefits.

- **Create Parity Between Credit Levels for Carbon Storage and Carbon Reuse:** Increasing credit levels for the nascent carbon reuse sector, which is the conversion of carbon oxides to produce commercial products, is necessary to realize commercial viability for this portfolio of technologies. While enhancements to 45Q increased credit levels across the board in 2022, the credit was bifurcated between permanent storage of captured CO_2, and the utilization of CO_2 as a feedstock for commercially valuable products, or to produce additional oil in depleted oil and gas wells. Relative to using CO_2 for the purposes of producing additional oil, reusing carbon to produce valuable products is not yet cost competitive with incumbent technologies. Under the current statute, there is a $25 per ton disparity between those projects that reuse carbon emissions versus those that securely and permanently store the captured carbon. This disparity effectively disincentivizes the development and deployment of relatively new carbon reuse technologies, essentially acting like a tax on such operations. This disparity rises to $50 per ton in relation to direct air capture projects.

  Luckily, there is already bipartisan support for creating parity between these two credit levels in the 118th Congress. In February 2023, the bipartisan Captured Carbon Utilization Parity Act was introduced by Senators Sheldon Whitehouse (D-RI) and Bill Cassidy (R-LA), aiming to increase the credit levels provided for carbon utilization to $180/ ton for products sourced from direct air capture and $85/ton for those products sourced from industry and power – thereby matching credit levels provided

for geologic storage of CO_2 and making the carbon reuse sector more economically competitive. Properly incentivizing the deployment and innovation of carbon reuse applications to create low- and zero-carbon products, including fuels, chemicals, and building materials is important to provide an alternative pathway to address sources of emissions that are too small to be economically captured and transported, or too far removed from appropriate storage sites. Current estimates on the potential uptake of CO_2 reuse to make valuable products range from 5 to 10 percent of global emissions, or several gigatons per year. Put simply, carbon reuse is an important, complementary effort to storing captured CO_2 in secure geologic formations. Federal tax incentives should more appropriately reflect carbon reuse's role in a broader portfolio of strategies to reduce greenhouse gas emissions, decarbonize and introduce circularity to the American economy, and create new manufacturing sectors resulting in the creation of family-sustaining jobs.

Considerations for Overcoming Permitting Challenges

Unprecedented federal bipartisan investments in carbon management technologies have set the stage to scale deployment, but building out associated infrastructure will require efficient and effective permitting, grounded in robust environmental protections and community engagement. Improvements to the current permitting system will be central to help facilitate the build-out of climate-essential projects and encourage private investment. Though the Coalition understands that it is not true in all cases that federal and state agencies will have permitting and siting authority over carbon management projects, Coalition members have developed a set of guiding principles for consideration as permitting reform is discussed amongst lawmakers at the federal level. These principles are meant to represent important considerations for responsible and successful project deployment and would further ensure the benefits associated with deployment flow to the communities that host these diverse projects and the workers that build them.

With this in mind, the Coalition has developed a set of six guiding principles for permitting reform to catalyze the safe, effective and responsible deployment of carbon management communities which centers around the themes of clarity, transparency and efficiency including:

- Ensure federal and state agencies have the resources, staffing, technology, and training to efficiently complete a growing number of reviews and community engagement processes as carbon management projects scale in deployment;
- Ensure early, robust, meaningful, and timely public engagement and input from affected communities is reflected in decision making;
- Ensure environmental standards and protections are maintained, and environmental outcomes are strengthened;
- Direct agencies to appropriately use programmatic review and categorical exclusions for carbon management infrastructure;
- Create a pathway for federal siting authority for interstate CO_2 pipelines, creating appropriate parity for all types of interstate linear infrastructure; and
- Ensure review of Class VI state primacy applications, as well as individual Class VI well applications, occur on a reasonable and predictable timeframe.

Robust infrastructure to safely transport and store captured CO_2 in secure geologic formations is an essential component of any broader strategy to put America firmly on a path toward net-zero emissions reductions. Carbon management projects, like many of their clean energy counterparts, are complex – and ensuring all pieces of a project come together is necessary to scale deployment of these technologies across the economy. While the nation's current permitting regime has been in place for decades, as this industry continues to expand in the near-term, gaps in policy for permitting these projects, among others in the energy sector, have created delays and bottlenecks at critical junctures of project deployment. One example of this is with regard to the buildout of regional CO_2 transport infrastructure systems.

Currently, siting authority for interstate CO_2 pipelines rests with individual states while, in contrast, there is federal siting authority for interstate natural gas pipelines under the Natural Gas Act. Over the course of the past year there has been active discussion in the context of permitting reform over federal siting authority for interstate transmission lines and interstate hydrogen pipelines. Absent from the debate, however, has been providing similar siting authority for CO_2 pipelines. **Establishing a pathway for federal siting authority for interstate carbon dioxide pipelines to provide similar parity for all linear infrastructure types, where appropriate, that face similar siting challenges should be prioritized to allow recent federal historic investments dedicated to carbon management infrastructure to enable efficient and responsible buildout of the necessary CO_2 pipeline network**. Such parity would also enable better coordination, planning, and siting across federal agencies to lower impacts for wildlife and local communities. However, lines that are well served by the current state by state regulatory siting authority should be allowed to continue with that process.

As evidenced by multiple international climate assessments and recent historic levels of bipartisan federal policy support to incentivize the scale up of carbon management technologies, a substantial buildout of CO_2 pipeline infrastructure is necessary to transport large quantities of CO_2 from industrial facilities, power plants and direct air capture facilities to points of reuse and/or permanent geologic storage. For that to occur, there must be full public and policymaker confidence in the safety of CO_2 pipelines and assurances that appropriate regulations and protocols are in place to prevent incidents of pipeline failures.

The Carbon Capture Coalition has long-supported rigorous safety design, inspection and maintenance protocols associated with CO_2 capture, transport and storage infrastructure and recognizes the excellent historical safety record of such infrastructure—one that surpasses other climate-essential energy infrastructure—including electric transmission and distribution systems. CO_2 pipelines have been operating safely in the United States for more than 50 years. Currently, 50 operating pipelines span over 5,000 miles with individual pipelines safely transporting millions of tons of CO_2 annually over hundreds of miles and across entire regions of the country. Safety data reported by the Pipeline and Hazardous Materials Safety Administration (PHMSA), the agency charged with overseeing CO_2 pipeline safety, shows that CO_2 pipelines have been and can be operated at the highest level of safety by best-practice operators. While CO_2 pipelines have had a strong safety record, a rare but serious pipeline failure in Satartia, Mississippi in 2020 has increased public and policymaker concerns about pipeline safety and the overall reliability of these systems as they scale.

As we anticipate additional proposed CO_2 pipeline regulations from PHMSA in the near-term, and Congress prepares to consider reauthorization of the nation's pipeline safety laws, including key operating procedures and policies related to PHMSA, the Coalition offers the following recommendations to policymakers, as identified in our consensus 2023 Federal Policy Blueprint:

- Expanding first responder training for CO_2 pipeline safety incidents;
- Requiring that project proponents more rigorously consider potential geohazard impacts on CO_2 pipelines during design, siting, construction, and maintenance;
- Requesting that PHMSA conduct additional reporting on the public safety record of CO_2 pipelines; and
- Carrying out a national assessment of the CO_2 network necessary to meet net-zero emissions.

The Coalition champions common-sense steps to build upon comprehensive existing CO_2 pipeline regulations and looks forward to continuing to engage with PHMSA and bipartisan members of Congress to take steps to support the responsible buildout of these systems.

In addition to the responsible buildout of CO_2 transport systems, it is equally as important to ensure the timely and efficient review of Class VI state primacy applications and individual Class VI well applications to prevent project delays. Federal and state authorities are tasked with ensuring safe and permanent storage in appropriate geologic formations through the Environmental Protection Agency's (EPA) Underground Injection Control (UIC) Class VI injection well program. Class VI wells are used to inject CO_2 into deep geologic formations solely for the purpose of permanently storing CO_2. Before potential storage sites are allowed to

move forward, they must provide highly detailed models to federal or state regulators, depending on which entity has authority over Class VI wells.

EPA can grant primary enforcement authority—referred to as primacy—to individual states, territories, or Tribal nations, which delegates authority to administer certain injection well classes. Granting primacy empowers states to manage and regulate Class VI injection wells within their jurisdiction, while upholding the same or more rigorous environmental and public engagement standards as the EPA. States, territories, or Tribal nations can be approved for this delegation of primacy only when their regulations meet or exceed the federal UIC requirements. A well-understood and commercial practice in the U.S. and in certain regions of the world, scaling up development and responsible permitting of secure geologic storage at gigaton scale is key to getting industries on track to be able to reach net-zero emissions targets and midcentury climate goals. Through these programs, EPA and established state primacy programs maintain a robust system of monitoring, reporting, and verification to validate secure geologic storage to claim the 45Q tax credit, the cornerstone policy enabling the scale up of carbon management projects.

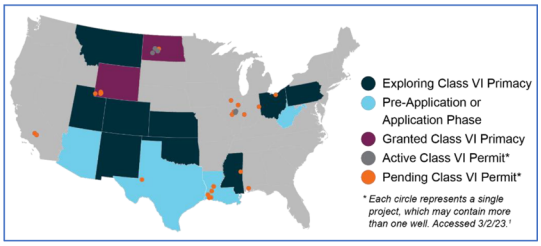

*Figure 2 – **Class VI Well State Primacy Status and Pending Well Applications at EPA***

As stated earlier, due to the groundswell of federal policy support now available to carbon management technologies thanks to recent historic investments from Congress, more than 150 carbon management projects have been publicly announced since 2018 with more than half of those intending to store their CO_2 in dedicated saline storage sites. This enormous uptick in carbon storage projects reinforces the importance of ensuring that EPA's Class VI permitting program has adequate staffing and resources to responsibly and efficiently permit worthy projects. To date, EPA has permitted two Class VI wells, with two additional wells in the pre-construction phase; an additional 57 projects, along with a total 163 individual well applications are undergoing more preliminary review stages with the EPA. Additionally, North Dakota and Wyoming have been granted primacy, with North Dakota having permitted two Class VI well applications, and Louisiana's final determination on primacy from EPA expected imminently. **The notable increase in project applications to obtain Class VI Well permits, as well as the growing interest from states in applying for primacy, highlights the importance of federal and state efforts to prioritize the timely review of state primacy and individual Class VI well applications. Timely decisions on Class VI Well applications are necessary to provide the certainty needed to encourage necessary private investment.**

In recognition of the important role permitting plays in the successful deployment of carbon management technologies, the White House Council on Environmental Quality (CEQ) is moving forward with a mandate from the Coalition-endorsed Utilizing Significant Emissions with Innovative Technologies (USE IT) Act, which included the formation of two regional task forces to improve the performance of the permitting process for carbon management projects on federal and non-federal lands. In March, the White House announced the members of these taskforces, including several individuals representing Coalition member organizations. The Coalition looks forward to engaging with these task forces and reviewing recommendations they may develop to ensure the permitting process works for all stakeholders impacted by and involved in the deployment of these projects.

Finally, following the historic investments in carbon management and associated infrastructure in the 117th Congress, we are now presented with the opportunity to place carbon management technologies at the heart of a national strategy for job creation and retention, workforce development and training, economic renewal, and climate stewardship. For example, through a 2021 report commissioned by the Great Plains Institute, Rhodium Group found that carbon capture retrofit opportunities at industrial and electric power facilities across

a 21-state region have the potential to create 70,000 to 100,000 jobs per year over the next 15 years. **Up to nearly 20,000 additional jobs would be created per year over this period by the buildout of a regional and national network of CO_2 transport and storage infrastructure.**

Conclusion

Carbon capture, removal, transport, reuse and storage technologies are essential tools for achieving emissions reduction goals in critical-to-decarbonize sectors, increasing domestic energy production, protecting and growing a high-wage jobs base, and fulfilling our climate obligations. The groundbreaking policies to scale deployment of associated CO_2 transport and storage infrastructure enacted as part of the Bipartisan Infrastructure Law and subsequent enhancements to the foundational 45Q policy framework are essential to placing America's energy, industrial and manufacturing sectors on track to reach net-zero emissions by 2050. At the same time, these will ensure the long-term viability of vital industries that provide millions of existing high-wage jobs, which represent the lifeblood of American workers, their families and communities, and regional economies. Combined with responsible and timely permitting reforms, these incentives will provide certainty to investors in carbon management technologies and create a favorable environment for scaling projects.

The Carbon Capture Coalition appreciates the opportunity to comment on the important topics of today's hearing and the Committee's continued support in advancing federal policies to enable greater deployment of carbon management technologies and associated transport and storage infrastructure. We look forward to working with the Committee in a bipartisan manner to identify the appropriate next steps to ensure these technologies can scale across the economy. Should you have any questions about anything outlined in this statement, please contact Madelyn Morrison, Director of Government Affairs, Carbon Capture Coalition at mmorrison@carboncapturecoalition.org.

PCA Since 1916
America's Cement Manufacturers™

Portland Cement Association
200 Massachusetts Ave NW, Suite 200
Washington D.C., 20001
202.408.9494 Fax: 202.408.0877
www.cement.org

November 2, 2023

The Honorable Joe Manchin
Chairman
Energy and Natural Resources Committee
Washington, D.C. 20510

The Honorable John Barrasso
Ranking Member
Energy and Natural Resources Committee
Washington, D.C. 20510

Dear Chairman Manchin and Ranking Member Barrasso:

The Portland Cement Association (PCA)[1] appreciates you holding the hearing titled, *Opportunities and Challenges in Deploying CCUS and DAC Technologies on Federal and Non-Federal Lands*. This hearing is necessary to evaluate the progress made in and the challenges in developing carbon capture technologies and the significant federal policy actions Congress should take to deploy carbon capture technologies across the economy.

The cement and concrete industry continues to decrease the carbon intensity of its operations and products, is fully committed to decarbonization, and has pledged to become carbon neutral across the cement and concrete value chain by 2050. On October 12, 2021, PCA released its "Roadmap to Carbon Neutrality," providing a detailed outline of technical, market, and policy levers central to achieving the industry's 2050 carbon neutrality goal.[2] CCUS is one of the emerging technologies that is integral to the cement industry's efforts to achieve its goal of carbon neutrality across the concrete supply chain by 2050.

Our members represent the majority of cement production capacity in the United States and serve nearly every congressional district. The cement and concrete industry contributes over $100 billion to the U.S. economy and employs over 600,000 people.

By way of brief background, cement manufacturers face a unique chemical fact of life. The chemical process required to convert limestone and other raw materials into clinker, the primary ingredient in cement, generates carbon dioxide (CO2) as an unavoidable byproduct during pyro-processing. Currently, roughly 60 percent of all emissions from the cement sector come from these manufacturing process emissions, separate and distinct from energy-related emissions. While the industry expects to make great strides in reducing carbon emissions through measures like using carbon-free fuel/heating technologies and low-carbon/carbon-free raw materials, the full elimination of CO2 generated from raw materials during pyro-processing is not possible. Given this chemical fact of life, adopting CCUS technologies is key to achieving deeper decarbonization in the cement industry.

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[1] PCA conducts market development, engineering, research, education, technical assistance, and public affairs programs on behalf of its member companies. Our mission focuses on improving and expanding the quality and uses of cement and concrete, raising the quality of construction, and contributing to a better environment.

[2] https://www.cement.org/docs/default-source/roadmap1/pca-roadmap-to-carbon-neutrality_final.pdf

The cement industry is facing significant obstacles to implementing CCUS at its plants. Currently, there are no commercial-scale CCUS installations at any cement plant within the U.S. CCUS cannot be widely implemented at cement plants until there is a clear path to siting and permitting these technologies. In addition, significant infrastructure investment is required for the capture, compression, storage, and transportation of CO2. Part of that infrastructure will need to supply water and energy for the carbon-capture units and associated auxiliary equipment, as well as the energy required for the ultimate delivery of the captured CO2 to its final end-use. However, with substantial research and the implementation of appropriate federal and state policies, CCUS technologies could become scalable within the next ten years, provided a technology can be proven or demonstrated at scale.

While many promising technologies are under development domestically and overseas, significantly more research and federal funding is needed for CCUS technologies to reach the commercial development stage for the industrial sector, including cement. The cement industry is conducting research on capture technologies, including a variety of solvent, sorbent, and membrane technologies, carbonation, mineralization, calcium (or carbonate) looping, oxyfuel combustion and calcination, cryogenic capture, and algae capture as carbon reduction and removal technologies to hasten the industry's decarbonization efforts. The cement industry is pursuing various potential technologies because each cement plant and cement kiln is different. Their differences include numerous variables, including plant design, emission control requirements, space constraints, water availability, energy availability, and process parameters, each of which will influence the viability of specific carbon removal and reduction technologies. No single off-the-shelf CCUS commercial design or technology will work for every cement plant, and many plants will likely require a combination of capture technologies. It is essential that federal research and funding be directed at multiple technologies so CCUS can feasibly be implemented for the cement industry promptly.

In addition to scaling up CCUS technologies and bringing the costs down to a level where the technology can be implemented at cement plants, the associated pipeline and energy infrastructure must be in place so CO2 can be captured, transported, and ultimately utilized or sequestered. Without the necessary pipeline infrastructure connected to our cement plants, there is no economically feasible method to transport the captured CO2. Likewise, the energy needed to operate a CCUS system, including energy for scrubbers, separation units, compressors, and chillers, is almost equivalent to what is required to operate a cement plant, therefore national power grids will need to be able to handle significant increases in energy usage by CCUS systems.

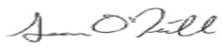
Given the challenges in decarbonizing the entire cement and concrete value chain, the cement industry will be unable to reach its carbon neutrality goal by 2050 alone. We can only achieve this goal with significant policy support from the federal government to assist with eliminating regulatory hurdles once carbon technologies are commercialized. Needed policy support includes measures to modernize the permitting programs that cover the installation of carbon capture and energy efficiency technologies, carbon transmission infrastructure, and electricity generation. Federal permitting remains an obstacle to the planning, construction, and installation of carbon capture technologies and the infrastructure needed to sequester or utilize the captured carbon. First, there are regulatory obstacles to installing new energy-intensive carbon capture equipment

at cement plants and other facilities. The New Source Review (NSR) Program, established under the Clean Air Act Amendments of 1977, presents regulatory barriers for cement facilities to make greenhouse gas (GHG) reduction and energy efficiency improvements. Under the NSR Program, installing CCUS, investing in significant energy efficiency projects, or other major capital investments to reduce GHG emissions at cement facilities result in extended and costly permitting processes and potentially unrealistic emissions and monitoring requirements. The federal government will need to enact policy reforms to reduce these barriers under the NSR Program to ensure that cement plants can install major GHG reduction and energy efficiency technologies, including CCUS technologies, without unnecessary impediments.

All the above-mentioned needs are currently regulated by numerous federal environmental laws with inconsistent guidance, permitting processes, and agency interpretations.

We encourage the Committee to use this hearing to evaluate future federal permitting and regulatory reform along with the investments needed to ensure the full deployment of carbon capture technologies across the economy. Such action is necessary to enable the industry to reach its goal of carbon neutrality across the concrete supply chain by 2050. We look forward to working with the Committee on legislation and agency oversight as it considers its next steps. If you have any further questions, please contact me at soneill@cement.org or 202.719.1974.

Sincerely,



Sean O'Neill
Senior Vice President, Government Affairs
Portland Cement Association

Verde Co2
3000 Smith Street, Suite 1
Houston, Texas 77006
(713) 226-9300

November 10, 2023

The Honorable Joe Manchin
Chairman
Senate Committee on Energy
and Natural Resources
304 Dirksen Senate Office Building
Washington, DC 20515

The Honorable John Barrasso
Ranking Member
Senate Committee on Energy
and Natural Resources
304 Dirksen Senate Office Building
Washington, DC 20515

RE: Statement for the record for the November 2nd, 2023 oversight hearing to "Examine Opportunities and Challenges in Deploying CCUS and DAC Technologies on Federal and non-Federal Lands."

Dear Chairman Manchin and Ranking Member Barrasso:

I write to you to introduce Verde CO2, a Houston-based full service Carbon Capture and Sequestration company focused on directly capturing, transporting, and permanently storing carbon dioxide emissions from large industrial facilities. Verde CO2 is partnering with several large industrial facility operators along the Texas and Louisiana Gulf Coast to capture and store emissions.

We have targeted and acquired access to the most suitable subsurface in the country. These acres exist in southeast Texas, and southcentral and southwest Louisiana. In Texas, our projects have the capability to sequester over 100 million tons of CO2 from large emitters that populate Houston shipping channels. In Louisiana, our projects possess similar capabilities and exist on private land. Like many of the publicly announced projects, Verde CO2 operations will create hundreds of jobs throughout these corridors. Verde CO2 is also planning investments in Texas county infrastructure, such as libraries, schools and recreational facilities, and an investment in vocational training for the emerging CCS workforce in Louisiana. Verde CO2 continues to explore other ways to support the community through high school career days, STEM education outreach, and more.

Verde CO2 has been referenced as a "model for community engagement" by federal and state agencies, most recently by the Texas Railroad Commission as they are crafting the state's environmental justice standards and best practices to follow for the CCS industry and is the only company in southeast Texas in particular that is proactively engaging the community it will operate in on multiple levels. Verde CO2 community engagement plan is sophisticated and includes a myriad of outreach mechanisms including traditional mailers and social media outreach, face-to-face meetings with elected officials and a series of open houses held with our company leadership and our engineers who have been able to answer meaningful questions from the public about CCS. Our program is also crafted to reflect cultural values as our outreach is conducted in both English and Spanish.

We strongly believe our ability to operate is only as good as our public trust; therefore, we have taken the approach of communicating early and often about the status, technical features, and structural integrity of our projects. We have committed to delivering meaningful direct benefits to local communities and hiring a significant portion of our workforce within the community. The Verde CO2 Texas projects have been highlighted in several media publications, including the Wall Street Journal, and Verde CO2 representatives, including myself, have written several op-eds and features for local Texas newspapers, including the Houston Chronicle, touting the benefits of carbon capture and the importance of community engagement.

We agree with many of your statements during last week's hearing urging more certainty in the processing and approval of relevant permits for carbon storage, specifically Class VI permits under the Safe Drinking Water Act. Given the existing structure in place in state governments for regulating nearly every other class of underground injection wells, we continue to believe and agree with you that states are best suited to assume authority to manage the Class VI program.

To be clear, while carbon capture utilization and storage is becoming much-more competitive and is an exciting opportunity that will benefit our workforce and planet, the single biggest challenge that must be overcome is the bottleneck of permits at the Environmental Protection Agency. States with generations of mineral and pipeline oversight experience are well-suited to work with the federal agency and safely administer this program.

Many states have crafted or are developing Class VI programs that carry more robust environmental standards, technological requirements, and transparency than the existing Federal program. In particular, Louisiana, after adoption of HB 571 in the most recent legislative session, carries statutory liability requirements for operators of storage facilities for 50 years. Texas is closely monitoring Louisiana's application and is making great headway in following suit.

For these reasons, we greatly appreciate your oversight over the CCUS federal programs impacting both federal and non-federal lands. We encourage your continued support for primacy approval for states and encourage more certainty in this process for all. I offer myself and the Verde C02 team to you as a resource as you continue to support this important field.

Sincerely,

CHARLES FRIDGE
Chairman and CEO
Verde CO2

○