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EXAMINING THE DEVELOPMENT OF PROJECTS AND IMPLEMENTATION OF POLICIES THAT SUPPORT CARBON CAPTURE, UTILIZATION, AND STORAGE (CCUS) TECHNOLOGIES

HEARING

BEFORE THE

COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS

UNITED STATES SENATE

ONE HUNDRED SEVENTEENTH CONGRESS

SECOND SESSION

JULY 27, 2022

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ONE HUNDRED SEVENTEENTH CONGRESS

SECOND SESSION

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EXAMINING THE DEVELOPMENT OF PROJECTS AND IMPLEMENTATION OF POLICIES THAT SUPPORT CARBON CAPTURE, UTILIZATION, AND STORAGE (CCUS) TECHNOLOGIES

WEDNESDAY, JULY 27, 2022

U.S. SENATE,
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS,
Washington, DC.

The Committee, met, pursuant to notice, at 10:02 a.m. in room G–50, Dirksen Senate Office Building, Hon. Thomas R. Carper (Chairman of the Committee) presiding.

Present: Senators Carper, Capito, Cardin, Whitehouse, Merkley, Kelly, Padilla, Cramer, Lummis, Boozman, and Ernst.

OPENING STATEMENT OF HON. THOMAS R. CARPER, U.S. SENATOR FROM THE STATE OF DELAWARE

Senator CARPER. Let us now proceed with this morning's hearing.

Again, I want to thank everybody who has made it, enabling us to do that much business, thank you.

Let us turn now to today's hearing.

We are here today to discuss the potential for carbon capture and storage to help us address climate change, create American jobs, and support economic growth. My sincere thanks to our Ranking Member, Senator Capito, and her staff for requesting this hearing. It is a good idea and a timely hearing. We are grateful for her suggestion and participation in the hearing itself.

As all of us know, this Committee has a history of coming together to advance solutions to some of our biggest environmental and infrastructure challenges. I can think of no greater challenge that we face today, as a planet and as a Nation, than the climate crisis. We are reminded of that every day.

The crisis is here now, and we are increasingly feeling its impact, especially in the form of extreme weather events like heat waves. Last weekend, roughly 85 million Americans from the Southern Plains to the Northeast, 85 million, were under excessive heat warnings and heat advisories. Just yesterday, St. Louis broke its previous single day record for rainfall from 1915. Today, much of the Pacific Northwest continues to experience record breaking high temperatures, putting lives at risk.

It is worth noting that extreme heat is the leading case of weather related deaths in our country. The 20 most costly extreme weather events last year alone resulted in the deaths of almost 700

people in our country, according to data from the National Oceanic and Atmospheric Administration, or NOAA.

Extreme heat is also exacerbating drought conditions across much of the western United States, threatening critical sectors of our economy like never before. This includes the agricultural sector, which is important to all of our States, and certainly to my State of Delaware.

According to the American Farm Bureau Federation, severe drought in the West forced 40 percent of farmers to sell off part of their cattle herds last year, 40 percent. This year, farmers in California have been forced to cut back production on produce such as cherries and almonds amidst the worst drought in 1,200 years. That is years, not weeks, not months, 1,200 years.

The science is clear: Climate change is here, and these costly extreme weather events are continuing to worsen. If we fail to act now and support a clean energy transition, we do so at our own peril. That is why it is incumbent upon us to comprehensively address this issue, using all of the tools in our toolbox.

Carbon capture, utilization, and storage, or CCUS, are critical tools in reducing the amount of planet warming greenhouse gases in our atmosphere and keeping global warming below 1.5 degrees Celsius. Don't just take my word for it. Analysis by the International Energy Agency, the United Nations Intergovernmental Panel on Climate Change, and other respected organizations say as much.

Last Congress, thanks to the leadership of our former Chair, Senator John Barrasso, along with Senator Capito, Senator Whitehouse, myself, and others on the Committee, we enacted the Utilizing Significant Emissions with Innovative Technologies Act. As you know, there is an acronym that goes with that. It is called the USE IT Act. We worked together on passing this bipartisan legislation to lower the regulatory barriers preventing the widespread development and deployment of carbon capture.

Today, the Biden administration's ongoing implementation of the USE IT Act, coupled with new funding for carbon management projects and Federal programs through the Bipartisan Infrastructure Law, continue to support CCUS research and deployment throughout our country. Just today, the Council on Environmental Quality, known as CEQ, announced that it is seeking nominations to head two new task forces required by the USE IT Act. These task forces will provide input to inform the responsible deployment of carbon capture, utilization, and storage on Federal lands, the Outer Continental Shelf, as well as non-Federal lands.

When we talk about responsible deployment of CCUS projects, it is important to emphasize the key role that equity must play here. I have been pleased to see that CEQ's guidance for carbon capture projects has reiterated the need to develop robust tribal consultation and stakeholder engagement plans, while also encouraging agencies to prioritize environmental justice in the development of best practices for CCUS efforts. Doing so protects overburdened communities from the potential negative impacts of these projects, and ultimately, helps ensure that those most vulnerable to climate change benefit from our clean energy investments.

Investing in carbon capture is necessary if we are going to meet our climate goals and create economic opportunity at the same time. Still, carbon capture alone is not enough to avoid a future plagued by deadly heat waves, devastating storms, and other extreme, climate related events like those that we are experiencing right now.

We must also facilitate the widespread deployment of wind, solar, nuclear, advanced nuclear, modular nuclear, hydrogen, clean hydrogen, and other forms of energy. Together, these technologies hold the key to saving our planet and creating good paying jobs across our Nation. I hope more of our colleagues engage in policy debates on how best to do so before it is too late.

With that, let me thank our panel of witnesses for joining us today. We look forward to hearing from you as part of today's discussions.

Before doing so, let me turn to our Ranking Member, Senator Capito, for her opening statement, and say once again, thank you for suggesting that we have this hearing. This is a great idea. Thank you.

Senator Capito.

OPENING STATEMENT OF HON. SHELLEY MOORE CAPITO, U.S. SENATOR FROM THE STATE OF WEST VIRGINIA

Senator CAPITO. Thank you, Chairman Carper, and thank you for calling today's hearing. I think it will be very interesting.

This is a topic I am very passionate about, and I am glad our Committee is having this hearing on carbon capture, utilization, and storage, better known as CCUS.

I also want to thank our witnesses, and I see our fellow Senator down there, all the way down there, in preparation for introductions.

Despite what headlines suggest, climate change is an area where we have found bipartisan solutions. Over the last few years, the Committee has developed bipartisan legislation that protects the interests and livelihoods of our constituents, no matter where they live or where they work.

The EPW Committee has led the way in developing climate win after climate win. From the Nuclear Energy Innovation and Modernization Act in 2018 to the USE IT Act and AIM Act in 2020, to the climate title of the surface transportation bill that was signed into law as part of the IIJA last year, we have performed well here at EPW, both on the legislation in our Committee and outside our jurisdiction. I want to recognize the leadership of Chairman Carper and Senator Whitehouse in those achievements.

When it comes to CCUS, we have secured passage of the FUTURE Act that significantly expands the 45Q tax credit for CCUS, enacted the previously mentioned USE IT Act to require the Council on Environmental Quality to expedite the permitting and development of projects, and enacted the SCALE Act to support the transportation of carbon dioxide through additional financing tools. These are all important pieces of legislation now signed into law that are helping to enable a build out of carbon capture technologies.

Groups from the Intergovernmental Panel, and the Chairman quoted from them as well, Intergovernmental Panel on Climate Change at the U.N. to the United States Department of Energy have recognized that CCUS is an essential tool in reducing carbon dioxide emissions. CCUS and other technologies, like hydrogen and advanced nuclear, afford us an opportunity to leverage private sector innovation in the next phase of decarbonization. Significant further reductions in emissions will come from private sector innovation, not top down government mandates.

The Biden administration's support for CCUS us crucial to deploying these technologies. In particular, I am encouraged that the Administration has been actively working to implement the USE IT Act. I commend CEQ for taking the recent step of issuing draft guidance, along with a report issued last year, but there is still so much more to do.

I wrote a letter, joined by several colleagues, to Chair Brenda Mallory, asking that any final guidance issued by CEQ be more explicit and detailed. While my staff has been informed the interim guidance will not be updated based on comments submitted, I urge CEQ to reconsider this decision. This CCUS guidance needs to provide direction to Federal agencies that will actually expedite project delivery, which was the intent of Congress.

I also understand CEQ is finally starting the process to convene the task forces that were established in the bipartisan bill. I urge CEQ to move quickly to get a range of perspectives on these task forces in order to provide needed feedback on challenges and successes faced by these projects and on ways to improve the permitting process.

In addition to the USE IT Act, I have been closely following the implementation of CCUS provisions in the IIJA. IIJA included the SCALE Act, a bill to support the build out of infrastructure to transport carbon dioxide to locations where it can be used in manufacturing or stored safely and securely underground. Pipeline infrastructure is essential to decarbonizing industrial clusters all around this country and moving the carbon to where it can be safely stored or used in products.

The Infrastructure Bill also includes important funding for Class 6 wells, which is part of a program called the Underground Injection Control Program at EPA. These wells are used to inject carbon dioxide into deep rock formations for permanent storage. The Class 6 permitting program can be administered by EPA or by a State, once EPA has granted primacy to the State.

Part of the IIJA funding for Class 6 wells was included to help the agency process applications from States for primacy and enable States to administer their own programs. Right now, only two States have Class 6 carbon sequestration wells: North Dakota and Wyoming. Other States are following suit.

Primacy is something that the State of West Virginia is working on and something the State of Louisiana has been working on as well, and I look forward to hearing more about their experience.

In many States across the country, CCUS is on the cusp of a revolutionary leap in deployment; however, I want to clarify that the progress we are beginning to see should not be the basis for more regulations or mandates. Practically speaking, a heavy hand will

stifle this nascent technology in the crib and prevent the emissions reductions we have already see are possible when the American economic engine is brought to bear on a problem, even one as big as climate change. Requiring CCUS also would not be lawful under the Clean Air Act's standard setting provisions.

I look forward to hearing from our panel, again, thank you, about what specific actions are being taken at the private, State government, and Federal levels to advance deployment of CCUS as well as what issues Congress should be focused on to reduce and maximize the opportunities of this exciting technology.

Thank you, Mr. Chairman, and I look forward to the panel.

Senator CARPER. Thank you, and thanks again, Senator Capito, for suggesting we hold this hearing today.

I was thinking earlier today that this is not a new idea. I came here in 2021, after stepping down as Governor of Delaware, and I remember well a conversation I had with another Senator from West Virginia, who was actually born in North Carolina. At the time, I was the only native West Virginian serving in the Senate.

Robert Byrd, one of the things he mentioned to me when he was trying to teach me how to preside over the Senate, one of the things he mentioned was working on the ability to really capture and sequester carbon dioxide. You have all heard the old saying, somebody who has passed away, they are rolling over in their grave. Well, Robert Byrd today is not rolling over in his grave. He is cheering. He is cheering your good work and recommendations.

Now I am turning over to our esteemed panel of witnesses. We are going to hear from them in a minute in this order: First will be Jason Albritton, the Director of the U.S. Climate and Energy Policy at The Nature Conservancy.

Welcome.

Second, we are going to hear from Brad Townsend, Vice President for Policy and Outreach for the Center for Climate and Energy Solutions; and third, we will hear from Jason Lanclos. Jason Lanclos is the Director of the Technology Assessment Division of the State Energy Office of the Louisiana Department of Natural Resources.

Last but not least, we will hear from John Harju. He is Vice President for Strategic Partnerships at the Energy and Environmental Research Center at the University of North Dakota.

Again, to our witnesses, thank you all for your willingness to appear before our Committee today.

Before our witnesses begin their testimony, we are going to turn it over to our colleague, Senator Cramer, to introduce one of our witnesses.

Senator Cramer, thanks so much for bringing in a good witness for us. We look forward to hearing from John.

Senator CRAMER. Thank you, Chairman Carper, Ranking Member Capito, for having this important hearing on a topic that we are all interested in. It is one of the times Senator Whitehouse and I really get to dig in on the same side of something.

CCUS is clearly a topic near and dear to North Dakota, as is obvious by one of our witnesses. We have been at this for a couple of decades. I was an economic development director when a re-

gional organization called PCOR was formed, and John Harju was at the forefront then at EERC, and it is starting to bear some fruit.

North Dakota has been implementing carbon capture, utilization, and storage now for a while. Just last month, Retro Energy, an ethanol producing company in western North Dakota, started injecting CO_2 in western North Dakota, deep into our geology, removing nearly all of the associated carbon emissions involved in the production of ethanol at the plant.

Recently, Denbury Resources, you talked about the two States, Senator Capito, that have Class 6 primacy, there is a gas producing facility in Wyoming that pipes CO_2 to North Dakota for utilization for tertiary oil recovery.

Critical to helping all of this, of course, achieve their accomplishments, is our witness today, John Harju, and the rest of his team at the Energy and Environmental Resource Center at the University of North Dakota, otherwise known as the EERC. They are a premier research entity on all fossil fuels, as well as renewable and alternative fuels, and have become a world leader in the field of CCUS, consulting on projects, not only in North Dakota, but throughout the country.

I want to reiterate a point and brag about them a little bit. John and his team are not just consultants. They are engineers who build and test components, they analyze core samples, perform modeling, advocate for public policy at the local, State, and Federal level, and help projects navigate the bureaucracies. They do it all. Colleagues, whatever curiosities you may have, you will not find a better resource than the EERC.

John, in particular, is a familiar face from North Dakota and has been an excellent resource and an important friend to me and to my office. He serves as the Vice President for Strategic Partnerships at the EERC and leads the Center's efforts to build working relationships with industry, government, and research entities globally in support of EERC's mission to provide solutions to the world's energy and environmental challenges.

I am just really grateful for his willingness to be here today and for his good work and look forward to his testimony and to answering our difficult questions.

Senator CARPER. Thanks so much for the introduction of John Harju.

I am now pleased to welcome and to recognize Senator Cassidy, who is joining us today to introduce another one of our witnesses that he knows from his home State of Louisiana.

Senator Cassidy, please proceed.

STATEMENT OF HON. BILL CASSIDY, M.D., U.S. SENATOR FROM THE STATE OF LOUISIANA

Senator CASSIDY. Thank you, Mr. Chairman.

Thank you, Madam Ranking Member.

I am pleased to introduce Jason Lanclos. He serves as the Director of the Louisiana Energy Office, Technology Assessment Division, within the Louisiana Department of Natural Resources. He serves on the State's Climate Task Force. He is with the Carbon Capture Coalition and an Executive Board Member for the National Association of State Energy Officials.

He will be discussing the implementation of policies related to Class 6 primacy for carbon sequestration wells and other policies to support carbon capture utilization and storage.

The theme of your hearing is the balancing of economic development with how we do address climate. For Louisiana, this is an existential issue. The Chairman will relate to this. Louisiana has lost the equivalent of the land mass of Delaware to relative sea level rise. But at the same time, we are America's energy coast, providing the chemicals, the plastics, and the fuels that allow modernity to exist. And along the way, these industries employ thousands of Louisianians, providing them with a better living and a better future.

The relative sea level rise and the need to continue to power our economy and to power the families that are creating that economy is in balance in Louisiana, and no one can speak to that tension and how to balance it better than Mr. Lanclos.

Thank you very much for having him. Thank you for allowing me to speak. With that, I yield.

[The prepared statement of Senator Cassidy follows:]

Senator Bill Cassidy
Introduction of Mr. Jason Lanclos
Environment and Public Works Committee
July 27, 2022

I am pleased to introduce Mr. Jason Lanclos for this hearing. Mr. Lanclos serves as the Director of the Louisiana Energy Office, Technology Assessment Division within the Department of Natural Resources. Mr. Lanclos also serves on the state's Climate Task Force. Additionally, Mr. Lanclos is involved with the Carbon Capture Coalition and serves as an Executive Board Member for the National Association of State Energy Officials.

Mr. Lanclos and the Louisiana Department of Natural Resources have worked closely with myself and my office to promote smart solutions to the issues facing Louisiana. His work with us on Class VI primacy for carbon storage sequestration wells, as well as the implementation of the bipartisan infrastructure deal, has positioned Louisiana as a leader in expanding energy production and manufacturing while achieving long-term carbon intensity reductions.

Today Mr. Lanclos will discuss the topic of the development of projects and implementation of policies to support carbon capture, utilization, and storage.

I can think of no one better positioned to highlight the impacts CCS could have in states like Louisiana, the benefits of the infrastructure bill, as well as the difficulties we have faced in dealing with the EPA and other regulatory bodies as we seek to grow carbon capture in Louisiana.

Thank you and with that I yield.

Senator CARPER. Thank you so much. You mentioned the size of land lost in Louisiana the size of Delaware. It is huge. I think my recollection is, for every 100 minutes, Louisiana loses another piece of land to the ocean the size of a football field. Serious stuff, serious stuff. Thank you so much for joining us and for introducing Jason.

Now, we are going to start our witness testimony.

Mr. Albritton, I am going to ask you, if you will, to please proceed with your statement when you are ready.

Mr. Albritton.

STATEMENT OF JASON ALBRITTON, DIRECTOR OF CLIMATE AND ENERGY POLICY, THE NATURE CONSERVANCY

Mr. ALBRITTON. Good morning, Chairman Carper, Ranking Member Capito, and members of the Committee. Thank you for the opportunity to speak to you today.

As you said in the introduction, I work for The Nature Conservancy, which is a global conservation organization. We have chapters in all 50 U.S. States and 79 countries and territories around the world. We are an organization that relies on a science based approach and a collaborative approach, and we believe that climate change poses a significant threat to our communities, our economy, and to nature itself.

Our best chance to limit the worst impacts of climate change is to ensure that, by 2050, we have reached net zero carbon emissions both in the United States and around the world. And this will require significant decarbonization of our global economy in less than 30 years.

In the United States, the transition to cleaner technologies and a cleaner economy is already underway, yet we need to significantly increase the pace of this transition. Carbon management technologies, like carbon capture and storage and direct air capture are important tools and can play a critical role alongside reducing emissions and harnessing the power of nature to capture carbon.

As both of you said in your opening statements, analysis by the Intergovernmental Panel on Climate Change, the IPCC, demonstrates the important role that carbon capture technology can play in meeting climate goals. In the IPCC's most recent report, six of the seven scenarios they evaluated required carbon capture in order to limit warming to less than 2 degrees Celsius.

Carbon capture is particularly important for reducing emissions from the industrial sector, where it can contribute nearly one-fifth of the emissions reductions needed to meet targets under the Paris Agreement. Industrial processes, such as the production of cement and steel, are central to modern life, but often lack options to reduce their carbon emissions, which is why carbon capture technologies can play such an important role.

Direct air capture must also be a priority for development. Even as we reduce our greenhouse gas emissions, we will likely need large scale removal of carbon dioxide from the atmosphere to limit global temperature rises to safe levels. This technology, when combined with proven natural solutions, offers a way to address legacy carbon pollution that has been building in the atmosphere for more than a century.

The good news, as has already been mentioned, is that Congress has taken important actions in recent years to spur carbon management technologies. The USE IT Act, which this Committee developed and advanced, passed, along with other carbon capture provisions in the omnibus spending bill in 2020, and then last year, the Bipartisan Infrastructure Investment and Jobs Act doubled down by investing over $12 billion in carbon management technologies and related infrastructure. These investments really lay the foundation for rapid scaling of carbon capture, utilization and storage, and direct air capture. Quickly investing these funds and implementing the new authorities that Congress has provided is absolutely essential.

We will also need additional economic incentives, such as the 45Q tax credit that will play a key role in the widespread commercialization and deployment of these technologies. A long term extension of 45Q, coupled with enhancements such as increased credit values for direct air capture and direct pay options, are critical for building on the momentum that we are already seeing. We urge Congress to pass these critical changes to the 45Q credit.

Moving forward, increased attention should be placed on delivering carbon capture projects and carbon utilization and direct air capture projects on the ground and ensuring that deployment is done in a quick, yet thoughtful and careful, way. To achieve this, there are a couple of actions that we can take.

One is what we would refer to as "smart from the start" land use planning, really considering the impacts up front to expedite deployment. This will help ensure that CCUS is deployed with as little impact as possible to natural lands, cultural resources, recreation, and other conservation values.

Early engagement of communities is also essential to help avoid unexpected conflicts that will lead to delays in project delivery.

Finally, improved coordination among permitting authorities will also enable more efficient approvals. Together, these steps are critical for rapid and responsible deployment.

We must also seriously consider the concerns and potential impacts to communities that have historically experienced the worst impacts of pollution. Community input will help avoid repeating the mistakes of the past and build the local support that is absolutely essential to rapidly deploy these technologies.

Finally, Federal agencies responsible for approving carbon management projects will need adequate, sustained funding, staffing, and resourcing for doing this community engagement and permitting.

To wrap up, time is of the essence when it comes to climate change. We must act now, using all of the solutions at our disposal, including carbon capture, utilization and storage, and direct air capture. Federal support, coupled with agency coordination, thoughtful planning, and early, effective stakeholder engagement will help ensure these solutions are available at the scale and within the timeframe that we need.

We appreciate the bipartisan leadership on this issue in this Committee and look forward to continuing to work with you to advance these and other important climate solutions.

Thank you, and I look forward to your questions.

[The prepared statement of Mr. Albritton follows:]

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TESTIMONY OF JASON ALBRITTON
DIRECTOR OF US CLIMATE AND ENERGY POLICY
BEFORE THE
SENATE COMMITTEE ON ENVIRONMENT & PUBLIC WORKS
JULY 27, 2022

Chairman Carper, Ranking Member Capito, and members of the committee, thank you for the opportunity to speak to you today.

The Nature Conservancy is a global conservation organization. We have chapters in all 50 states and our work extends around the globe into 79 countries and territories. As an organization that relies on a science-based, collaborative approach, we believe the science is clear that climate change poses a significant threat to our communities, our economy, and to nature itself. That is why we must address climate change right now, with diligence and urgency. Our best chance to limit the worst impacts of climate change is to ensure that by 2050, we have achieved "net zero" carbon emissions both in the United States and around the world. This will require significant decarbonization of our global economy in less than 30 years.

In the United States, the transition to a clean energy economy is underway, yet still we need to significantly increase the pace. We must first reduce and avoid emissions of greenhouse gases, which entails a rapid and thoughtful deployment of renewables and other zero-emitting energy to power our homes, drive our cars, and run our factories. Our farms and forests will also play an important role. Up to a fifth of the emissions reductions we need in the U.S. can be achieved using natural climate solutions—land use practices that increase the amount of carbon stored in forests, wetlands, and soils. Alongside these important climate solutions, carbon management technologies are important tools in the suite of approaches we need to rapidly deploy to avoid the worst impacts of climate change. These include carbon capture, utilization and storage (CCUS) and carbon removal technologies, like direct air capture (DAC).

Analyses by the International Energy Agency (IEA) and Intergovernmental Panel on Climate Change (IPCC) demonstrate that utilizing carbon capture technology is vital to meet climate goals. In the IPCC's recent Working Group III (WGIII) report, six of the seven scenarios evaluated required carbon capture in order to limit temperature rises to under two degrees Celsius. The one scenario that did not require carbon capture assumed massive, ambitious reductions in energy use. Avoiding increasingly harmful climate impacts requires us to make important and timely investments in these technologies.

Carbon capture is particularly important for reducing emissions from the industrial sector where it can contribute nearly one-fifth of reductions needed to meet targets under the Paris Agreement. Industrial processes, such as the production of cement and steel, are

central to modern life but often lack other alternatives for carbon mitigation, which is why we need to invest in CCUS technologies.

Direct air capture—an emerging technology that removes carbon from the atmosphere—must also be a priority for development. Even as we rapidly reduce greenhouse gas emissions, we will likely need large-scale removal of carbon dioxide from the atmosphere to limit global temperature increases to safe levels. This technology, when combined with proven natural solutions, offers a way to address legacy carbon pollution that has been building in the atmosphere for over a century. While we can and should work to rapidly mitigate today's sources of greenhouse gases, that alone will not address the threat presented by the emissions already in the atmosphere. We must prioritize direct air capture, not as a substitute for deployment of clean energy technologies, but as a parallel strategy.

Congress has taken important actions to spur carbon management technologies in recent years. The USE IT Act, passed along with the EFFECT Act and other carbon capture provisions as part of the omnibus spending bill in 2020, was the first of many recent steps to advance research, development and commercialization and address barriers to widespread deployment. Last year, the bipartisan Infrastructure Investment and Jobs Act (IIJA) doubled down by investing $7.1 billion for carbon capture and removal equipment deployment, $2.2 billion for carbon transport, $2.9 billion for carbon storage and use, and over $6.5 billion on natural carbon storage provided by farms and forests. This funding supports scaling up these important technologies by –

- creating direct air capture hubs where clusters of industries can leverage existing and shared infrastructure;
- providing the Environmental Protection Agency with more resources for review and approval of wells to inject carbon dioxide into deep rock formations through its Class VI permitting program;
- creating a new program for flexible financing of carbon dioxide transport infrastructure; and
- increasing research into utilization and sequestration options.

These investments lay the foundation for rapid scaling of carbon management technologies and availability of the associated infrastructure.

Additional economic incentives, such as the 45Q tax credit, will play a key role in widespread commercialization and deployment. The short-term extension of the 45Q tax credits at the end of 2020, coupled with the federal investments in large-scale pilots and demonstration projects are already driving investment. Over seventy CCUS projects have been announced since the beginning of 2021. A long-term extension of the 45Q tax credit coupled with enhancements such as increased credits for direct air capture and industrial and power applications, direct pay options, and reduced annual capture thresholds are critical for building on the current momentum. Support for the 45Q tax credit and enhancements is bipartisan, as demonstrated by the Carbon Capture Utilization and Storage Tax Credit Amendments Act, and we urge Congress to act on these policies as soon as possible.

Carbon management technologies are important to transition the United States to a net zero emissions economy, but they must be deployed in a careful and thoughtful way. There are currently about 5,000 miles of carbon dioxide transport pipelines in the United States and some projections suggest over 29,000 miles of pipelines will be needed in the coming decades. As the demand for carbon capture increases, it is essential that we prioritize protection of natural resources and ensure robust community engagement when siting these projects. Smart-from-the-start land use planning will help ensure CCUS is deployed with as little impact as possible to natural lands, cultural resources, recreation, and other conservation values. Early engagement of communities can help avoid unexpected conflicts and delays. And improved coordination among permitting authorities will support more efficient approvals. Together, these steps are critical for rapid and responsible deployment.

The concerns and potential impacts to communities that have historically experienced the worst impacts of pollution are essential considerations in siting specific projects and broader deployment of carbon management technologies. While important, these technologies are not a "silver bullet" and are not appropriate everywhere. When the Council for Environmental Quality (CEQ) issued its draft guidance to federal agencies on the deployment and responsible development of CCUS, as required by the USE IT Act, CEQ appropriately focused on societal net benefits and acknowledged those net benefits include not only atmospheric impact but also impact on local air pollutants and other considerations. CEQ highlights the importance of "significant and ongoing community consultation to ensure communities near CCUS facilities do not experience harm related to the deployment of CCUS technology."

To be effective, federal agencies responsible for approving carbon management projects will need adequate, sustained staffing and resourcing for community engagement and permitting. For example, the recent Princeton Net Zero America study found that we will need to invest $13 billion by 2035 for stakeholder engagement, site characterization and permitting to ensure sufficient geologic sequestration sites are available for rapid deployment of carbon capture technology.

Time is of the essence when it comes to climate action. We must act now to secure a future for our planet and the generations that will come after us, and we must do so using all the solutions at our disposal, including carbon capture, utilization and storage and direct air capture. Federal support coupled with agency coordination, thoughtful planning, and early, effective stakeholder engagement will help ensure these solutions are available at the scale and within the timeframe we need them.

We appreciate the bipartisan leadership on this issue in this committee and look forward to continuing to work with you to advance these and other important climate solutions. Thank you for your consideration of our views, and I look forward to your questions.

Senate Committee on Environment and Public Works
Hearing Entitled, *"Examining the Development of Projects and Implementation of Policies that Support Carbon Capture, Utilization, and Storage (CCUS) Technologies."*
July 27, 2022
Questions for the Record for Jason Albritton

Chairman Carper:

1. Do you agree with legal scholars, including the legal experts at the Congressional Research Service, that the Supreme Court in its West Virginia v. EPA decision did, in fact, reaffirm EPA's authority to regulate greenhouse gas emissions under the Clean Air Act?

   We agree with experts that the Supreme Court's ruling in West Virginia v. EPA does not revoke EPA's authority to regulate greenhouse gas emissions and that, as CRS stated, "the EPA retains the ability to regulate greenhouse gas (GHG) emissions from power plants and other sources…"[1]*, using approaches other than those employed in the Clean Power Plan.*

2. Is there anything else you would like to provide the Committee that was not included in your testimony or discussed during the hearing?

   The recently-passed Inflation Reduction Act of 2022 (IRA) provides support and incentives for a comprehensive set of climate and clean energy solutions, including long-term extension and other enhancements to the 45Q tax credit for Carbon Capture, Utilization and Storage (CCUS) and (DAC). These critical improvements to 45Q offer greater certainty and flexibility to companies seeking to adopt these technologies, helping to drive investment, expand deployment and make CCUS and DAC even more viable. Investments in CCUS, DAC and other clean energy technologies not only get the United States closer to our 2030 emissions reduction goals, but also represent significant economic opportunities. Analysis conducted by BW Research Partners for The Nature Conservancy found significant economic impacts from these investments—$50.6 billion added to the US economy and over a half million jobs supported every year for the next decade.[2]

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[1] Bowers, Kate. "Supreme Court Addresses Major Questions Doctrine and EPA's Regulation of Greenhouse Gas Emissions." Congressional Research Service, 12 July 2022, https://crsreports.congress.gov/product/pdf/LSB/LSB10791#:~:text=Gas%20Emissions,-July%2012%2C%202022&text=On%20June%2030%2C%202022%2C%20the,policy%20decisions%20to%20executive%20agencies.

[2] BW Research Partnership. Inflation Reduction Act Climate Policies: An Economic Impact Analysis Report. August 2022. https://www.nature.org/cleanenergyeconomy.

Senator Inhofe:

1. Do you agree that the Council on Environmental Quality (CEQ) should support expediting Carbon Capture, Utilization, and Storage (CCUS) permitting in the U.S. which would encourage and support carbon capture projects?

    a. How can the federal government additionally help better support CCUS projects?

In response to the USE IT Act, the Council on Environmental Quality (CEQ) has taken important steps to improve the review and permitting of CCUS projects. CEQ should continue its efforts to implement provisions in the USE IT Act, including establishing regional permitting task forces required by the legislation.

As the demand for carbon capture increases and deployment accelerates, efficient and effective permitting will help ensure these technologies and related infrastructure are available when and where they are needed. It is essential that we prioritize protection of natural resources and ensure robust community engagement when siting these projects. Maintaining and enhancing public and stakeholder engagement early in the review process will help avoid delays and contribute to a more efficient, effective permitting process. That process also requires adequate resourcing and capacity building. Congress recently approved more than $1 billion to support environmental reviews by federal agencies. More will likely be needed. The Princeton Net Zero America study found that $13 billion will be needed between now and 2035 for stakeholder engagement, permitting and site characterization for CCUS projects. If we don't invest in this, we will not see rapid deployment.

In the last few years, Congress has taken multiple steps to support the deployment of CCUS and DAC. The federal investments and policy changes passed in the omnibus spending package in 2020 and the Infrastructure Investment and Jobs Act (IIJA) in 2021 complement the more recently enacted updates to the 45Q tax credits. This mix of incentives and support for both the technologies and related infrastructure will drive an uptick in new projects. Over seventy CCUS projects have been announced since the beginning of 2021.[3] For this pace to continue, federal agencies must act quickly on the legislation passed by Congress. For example, IIJA funding must be distributed rapidly and efficiently, and where necessary, the IRS must update guidance to address recent changes to the 45Q tax credit to maintain clarity and certainty for project developers.

[3] Clean Air Task Force, U.S. Carbon Capture Activity and Project Map, August 2022, https://www.catf.us/ccsmapus/.

Senator CARPER. Mr. Albritton, thank you very much for joining us and for your testimony. We look forward to asking you some questions in just a couple of minutes.

Let us now turn to Mr. Townsend.

Mr. Townsend, please proceed. I think you are joining us remotely. Is that correct?

Mr. TOWNSEND. That is correct, sir.

Senator CARPER. Where are you today?

Mr. TOWNSEND. I am in Columbus, Ohio.

Senator CARPER. Glad you could join us from Columbus, Ohio. We would ask you to please proceed.

STATEMENT OF BRAD TOWNSEND, VICE PRESIDENT FOR POLICY AND OUTREACH, CENTER FOR CLIMATE AND ENERGY SOLUTIONS

Mr. TOWNSEND. Good morning, Chairman Carper, Ranking Member Capito, honorable members of the Committee. Thank you for the opportunity to speak with you today about the critical importance of carbon capture, utilization, and storage, or CCUS, in carbon dioxide removal technologies.

My name is Brad Townsend, and I am the Vice President for Policy and Outreach at the Center for Climate and Energy Solutions, or C2ES. We are a nonpartisan, nonprofit think tank based in Arlington, Virginia, whose mission is to secure a safe and stable climate by accelerating the global transition to net zero greenhouse gas emissions and a thriving, just, and resilient economy.

As the impacts of climate change continue to mount, with extreme weather events affecting every region of the country, we believe a technology inclusive approach that draws on all available means to accelerate this transition will be needed to avoid the worst impacts of a changing climate.

There are three key points I would like to make during the course of this testimony. First, carbon capture, utilization, and storage, as well as carbon removal technologies, must play a crucial role in helping to decarbonize the global economy. It is important to emphasize at the outset that these technologies are not silver bullets. CCUS is a vital tool to mitigate emissions, and carbon removal technologies hold considerable promise for balancing emissions from particularly hard to abate sectors. Neither technology will allow us to continue with business as usual.

The deployment of these technologies will only succeed if we rapidly reduce our dependence on fossil fuels and accelerate the transition to zero carbon forms of energy. Still, in a recent report, the International Energy Agency wrote, "Reaching net zero will be virtually impossible without CCUS."

These technologies can cost effectively address emissions from existing power and industrial facilities, help maintain power sector reliability, and tackle hard to abate subsectors. These technologies also provide a foundation for the development of carbon removal technologies, which can help lower long lived greenhouse gas concentrations.

Indeed, the National Academy of Sciences has estimated that the U.S. will need to remove one gigaton of carbon dioxide per year by 2050, equivalent to the energy related CO_2 emissions from Texas

and California combined. The work of the Intergovernmental Panel on Climate Change, or IPCC, similarly suggests that most pathways to limit global warming to 1.5 degrees Celsius will include the use of carbon dioxide removal.

Second, the United States can lead the world in the development and deployment of these technologies, which would support the competitiveness of domestic sectors like cement, steel, and chemicals while creating opportunities to export new technologies that can help the rest of the world decarbonize.

CCUS and carbon removal projects must build on a foundation of early and continuous community engagement and meaningfully address stakeholder concerns. Doing so can provide significant economic benefits for communities, including job creation and tax revenues.

A recent study estimated that carbon capture retrofits at existing industrial and power facilities could create up to 64,000 jobs by 2035, and as many as 78,000 additional jobs by 2050. Large scale deployment of direct air capture could create at least 300,000 new jobs nationwide across construction, engineering, and equipment manufacturing sectors, while supporting communities that have helped build the country and developed skills in fossil fuel production to leverage those competencies in a net zero future.

Third, we will need a comprehensive policy framework that builds on recent legislative investments to support the entire innovation ecosystem for CCUS and carbon removal. There are three primary areas that Congress can focus on to support these technologies.

First, make further upstream investments in innovation, including research, development, and demonstration. Second, enact downstream policies like the extension and expansion of 45Q that can help to create and grow markets for these technologies. Third, facilitate enabling policies and infrastructure that can provide a bridge to market for promising technologies. All three areas of policy are necessary.

Supporting technological innovations through RD&D spending without creating market demand will strand new technologies in the labs or at the demonstration phase, while providing market incentives without the necessary enabling policies risks letting deployment stall below its potential as projects run up against non-market barriers.

Robust policy support across the entire innovation ecosystem can help accelerate the development and deployment of CCUS and carbon removal technologies and help the United States meet both climate and economic objectives.

Thank you, Chairman Carper and Ranking Member Capito, for hosting this hearing and for the opportunity to speak with you today. I look forward to your questions.

[The prepared statement of Mr. Townsend follows:]

C2ES CENTER FOR CLIMATE AND ENERGY SOLUTIONS

HEARING BEFORE THE SENATE COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS

Testimony of

Brad Townsend, Vice President – Policy and Outreach at the Center for Climate and Energy Solutions (C2ES)

July 27, 2022

Chairman Carper, Ranking Member Capito, honorable members of the committee: Thank you for the opportunity to speak with you today about the critical importance of carbon capture, utilization, and sequestration (CCUS) and carbon dioxide removal technologies. My name is Brad Townsend, and I'm the vice president for policy and outreach at the Center for Climate and Energy Solutions, or C2ES. We are a nonpartisan, nonprofit think tank based in Arlington, Virginia, whose mission is to secure a safe and stable climate, by accelerating the global transition to net-zero greenhouse gas emissions and a thriving, just, and resilient economy.

C2ES works with companies and policy makers to inform and educate business leaders, strengthen corporate action, and mobilize business support for effective climate policy. Our Business Environmental Leadership Council, a group of 41 primarily Fortune 500 companies, provides C2ES with expertise from across the economy, including the electric power sector, aluminum, cement, chemicals, automotive, oil and gas, manufacturing, finance, and information technology sectors. Our combination of policy and analytical expertise, longstanding relationships with leading businesses, and reputation as a trusted convener helps C2ES answer pressing questions, identify roadblocks to progress, and forge new solutions. We have long advocated for a technology inclusive approach to climate and energy issues, focused on the whole of our economy. We were among the first climate and energy organizations to advocate for policies, including the Section 45Q tax credit, which support the broad set of technology solutions needed to address climate change.

Carbon capture, utilization, and storage, as well as carbon removal technologies, must play a crucial role in helping to decarbonize the global economy. These technologies can cost-effectively address emissions from existing power and industrial facilities, help maintain power sector reliability, tackle hard-to-abate subsectors, and remove residual emissions to lower long-lived greenhouse gas concentrations. Leading the world in the development and deployment of these technologies supports the competitiveness of domestic cement, steel, and chemical sectors, while creating opportunities to export new technologies that can help the rest of the world decarbonize. Further, with early and continuous community engagement, their deployment can mean significant economic opportunity, including in regions that have been long involved in the production of fossil fuels. Recently enacted legislation, including the Energy Act of 2020 and the Infrastructure Investment and Jobs Act have both provided significant support for CCUS and carbon removal technologies. Yet, a comprehensive, long-term framework is needed to provide the comprehensive policy support needed to advance these technologies. This should include "upstream" policies to support innovation, including

research, development, and demonstration; "downstream" policies that can help to create and grow markets for these technologies; and enabling policies and infrastructure that can provide a bridge to market for promising technologies.

There is strong scientific evidence in support of the potential and need for carbon capture and carbon removal technologies to meet our climate goals. The development of both technologies also offers a significant economic opportunity for the United States. Nonetheless, it's important to emphasize at the outset that these technologies are not silver bullets. CCUS technologies are vital tools to mitigate emissions, but they do not mean we can continue with business as usual. The deployment of these technologies will only succeed if we rapidly reduce our dependence on fossil fuels and accelerate the transition to zero-carbon forms of energy. Carbon removal technologies hold considerable promise as a vital means of balancing emissions from particularly "hard to abate" sectors, but in no way should be considered a substitute for reducing emissions across the economy as quickly as possible. As the impacts of climate change continue to mount, with extreme weather events affecting every region of the country, we must draw on all available means to successfully transition to the United States to a thriving, just, and resilient net-zero economy.

The importance of CCUS and carbon dioxide removal technologies in the U.S. climate toolkit

In a recent report on the role of carbon capture, utilization, and storage (CCUS) in the clean energy transition, the International Energy Agency (IEA) made it clear that "reaching net-zero will be virtually impossible without CCUS."[1] CCUS technologies have several important roles to play in decarbonization. CCUS technologies can be retrofitted to existing power and industrial facilities, which left unabated, would otherwise emit 600 billion tons of carbon dioxide over the next 50 years.[2] Moreover, keeping more firm, dispatchable power plants on the grid can help balance increasing quantities of renewable electricity, maintaining system reliability and avoiding the buildout (to some extent) of challenging, transmission infrastructure. CCUS can also help to address hard-to-decarbonize industrial sectors. For example, cement production would still emit carbon dioxide even if it were powered by clean energy sources since almost 60 percent of the carbon dioxide emissions from a cement plant are generated from the calcination process. Carbon capture will be needed to address these emissions. Further, CCUS technologies for mitigation provide a foundation for the development and deployment of carbon removal technologies that will be crucial to address residual emissions and lower, long-lived atmospheric concentrations to help avert the worst impacts of a changing climate.

Similarly, carbon dioxide removal technologies, including both nature-based removals (such as restoring forests and managing croplands and rangelands to store more carbon in soils) and engineered approaches

[1] IEA, "CCUS in Clean Energy Transitions", 2020, https://www.iea.org/reports/ccus-in-clean-energy-transitions
[2] Energy Futures Initiative. "Workshop Summary: The Critical Role of CCUS: Pathways to Deployment at Scale." February 2021. https://static1.squarespace.com/static/58ec123cb3db2bd94e057628/t/603d3bd74d006a4004a9a88b/1614625758081/CCUS+Workshop+Summary+030121.pdf



such as direct air capture (DAC), have a vital role to play in meeting our net-zero goals. The National Academy of Sciences estimated that the United States needs to remove 1 gigatons of carbon dioxide per year by mid-century to reach net-zero emissions. This is equivalent to the carbon emissions of every coal plant in the United States, or the total emissions of Germany and the UK combined. Globally, we will need to scale these technologies to support 10 gigatons of carbon dioxide removal annually by 2050.[3] The work of the Intergovernmental Panel on Climate Change (IPCC) suggests most pathways to limit global warming to 1.5 degrees Celsius by the end of the century will include the use of carbon dioxide removal.[4]

Even with rapid scale-up of decarbonization efforts (e.g., renewable energy, electrification, energy efficiency, etc.), the United States will still need removal technologies such as direct air capture to meet its net-zero target by 2050. Given practical constraints on the scale of nature-based removals (e.g., available land area for afforestation and limits on the storage capacity of agricultural soils), engineered technologies will play a critical role. Depending on the pace of decarbonization, carbon dioxide removal technologies (e.g., direct air capture and bioenergy with carbon capture and storage) will be needed to cumulatively remove between 1.1 billion tons of carbon dioxide (rapid decarbonization scenario) and 1.9 billion tons of carbon dioxide (slow decarbonization scenario).[5] Of these sums, it is anticipated that direct air capture will need to account for roughly 50 to 90 percent of the total.[6]

The business and economic case for CCUS and carbon dioxide removal technologies

As markets increasingly demand low-carbon goods and products, the ability of companies to reduce emissions in the direct production of goods and services, as well as throughout their value chains, will be critical for U.S. companies to retain or even enhance their competitiveness. However, enabling private sector investment at the scale necessary will require policy that values the greenhouse gas emission reductions that these technologies provide. CCUS technologies can support those efforts, particularly in hard to abate sectors like cement, chemicals, metals, and aviation. We at C2ES have seen a great deal of leadership and interest from industrial companies in pursuing these technologies, including those in our Business Environmental Leadership Council, and through efforts like the Carbon Capture Coalition.

An important, emerging trend in the deployment of CCUS and carbon dioxide removal technologies is the shared utilization of transportation and storage infrastructure. Due to the lack of widespread deployment and diffusion of these technologies and their associated infrastructure, economic viability for projects often hinges on the ability to capitalize on economies of scale. This has generally meant that only larger scale projects were

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[3] National Academies of Sciences, Engineering, and Medicine (NASEM), "Negative Emissions Technologies and Reliable Sequestration: A Research Agenda"; The National Academies Press: Washington, DC, 2019, https://nap.nationalacademies.org/catalog/25259/negative-emissions-technologies-and-reliable-sequestration-a-research-agenda

[4] IPCC, "Mitigation Pathways Compatible with 1.5°C in the Context of Sustainable Development. In: Global Warming of 1.5°C", 2018, https://www.ipcc.ch/site/assets/uploads/sites/2/2019/02/SR15_Chapter2_Low_Res.pdf

[5] Rhodium Group, "Capturing Leadership: Policies for the US to Advance Direct Air Capture Technology", 2019, https://rhg.com/wp-content/uploads/2019/05/Rhodium_CapturingLeadership_May2019-1.pdf

[6] ibid



likely to be economically viable. However, implementing a cluster approach, which involves the sharing of transportation and storage infrastructure, reduces individual project costs, and enables a far greater number of smaller projects to become economically viable. Shared carbon management infrastructure, like the interstate highway system can enable a vast amount of low-carbon commerce.

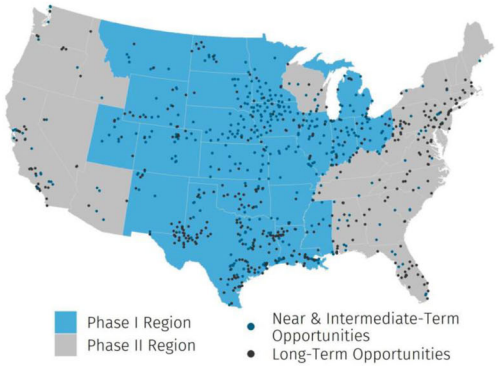
A vital component to the success of any CCUS or carbon dioxide removal project will be the early and continuous engagement of communities throughout the project lifecycle. Many of these projects, due to the location of power and industrial facilities, will be located near frontline communities which have been historically marginalized. Genuinely engaging and addressing the concerns of frontline and historically underrepresented stakeholders throughout the process can not only ensure that those communities – through mechanisms such as community benefits agreements – can share the benefits of these projects but can also meaningfully reduce community opposition to projects.

When built on a foundation of community engagement, CCUS and carbon dioxide removal projects can also provide significant economic benefits for communities, through job creation and associated tax revenues. A recent study estimated that carbon capture retrofits at existing industrial and power facilities could create up to 64,000 jobs between now and 2035 and as many as 78,000 additional jobs from 2035–2050.[7] It is also estimated that large-scale deployment of direct air capture, could create at least 300,000 new jobs across construction, engineering, and equipment manufacturing sectors.[8] And, these opportunities are widely dispersed across the country.

[7] Rhodium Group, "The Economic Benefits of Carbon Capture: Investment and employment opportunities for the contiguous United States", 2021, https://rhg.com/wp-content/uploads/2021/04/The-Economic-Benefits-of-Carbon-Capture-Investment-and-Employment-Opportunities_Phase-III.pdf
[8] Rhodium Group, "Capturing New Jobs: The employment opportunities associated with scale-up of Direct Air Capture (DAC) technology in the US", 2020, https://rhg.com/wp-content/uploads/2020/06/Capturing-New-Jobs-Employment-Opportunities-from-DAC-Scale-Up.pdf

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Figure 1: Carbon capture retrofit opportunities at existing industrial and power facilities



Carbon capture retrofit opportunities at existing industrial and power facilities in the near- and intermediate-term (2021 – 2035) and long term (2036 – 2050). Phase I refers to industrial and power sector opportunities in 21 states in the Midwest and Western region that participate in the Regional Carbon Capture Deployment Initiative. Phase II refers to industrial and power sector opportunities in Eastern and Western States. The economic benefits considered include employment opportunities in construction (e.g., engineering, equipment, materials) and operations (e.g., maintenance, chemicals, energy, water treatment)

Source: Rhodium Group, 2021.

As we transition to a low-carbon economy, it is also important to recognize the contribution that communities and workers involved in the production and utilization of fossil fuels have and continue to make to our nation; we must support them and help them successfully navigate this transition. We should also recognize the value of the myriad skills and competencies that these communities can bring to the transition and look to align them with regionally salient low-carbon economic opportunities in emerging industries like CCUS and carbon dioxide removal. Many of the skills required for jobs in these sectors require similar skill sets to those in the mining and oil and gas sectors, making the emerging carbon management sector a great opportunity to facilitate the transition while leveraging, rather than sacrificing, years of knowledge and capacity building.

With proper support from policymakers, CCUS and carbon removal technologies can support the competitiveness of domestic industry in rapidly evolving global markets and encourage the utilization of shared infrastructure, while facilitating the community input and engagement that will be necessary to ensure a just and equitable transition.

Recent legislative developments

Congress has taken several important steps in recent years to support the development of CCUS and carbon dioxide removal technologies. The Energy Act of 2020 included a two-year extension of the Section 45Q tax



credit, which provides incentives, in the form of tax credits, to encourage companies to invest in carbon capture and storage solutions that reduce carbon emissions to the atmosphere. The extension enables facilities that begin construction by 2025 to access this important credit. It also authorized more than $6 billion for ambitious research, development and demonstration provisions for carbon capture, removal, utilization, and geologic storage programs over a five-year period. Similarly, the bipartisan Infrastructure Investment and Jobs Act made the single largest investment in carbon management provisions in history. Specifically, it funded four key areas of carbon management policy: CCUS research, development, and demonstration (RD&D); carbon transport and storage infrastructure and permitting; carbon utilization development; and carbon removal. These important pieces of legislation have laid the groundwork for a growing carbon management sector to help the United States meet its mid- and long-term climate objectives, enhance the competitiveness of domestic industries and leverage the skills and ingenuity of American workers to capitalize on the economic growth opportunity that the transition to a net-zero economy can provide for communities across the country.

Policy will be essential to the deployment of CCUS and carbon removal technologies

To help keep the United States on track to reach net-zero by 2050, the current level of deployment of CCUS technologies must increase by a factor of ten by 2030.[9] While recent legislative developments have laid a vital foundation for CCUS and carbon removal technologies moving forward, to facilitate the necessary growth, more policy incentives are needed to attract even greater private sector investment and scale CCUS and carbon removal technologies.

A policy framework that supports the entire innovation ecosystem for these technologies is essential for their long-term development. Congress should 1) make further "upstream" investments in innovation, including research, development and demonstration, 2) enact "downstream" policies that can help to create and grow markets for these technologies, and 3) facilitate enabling policies and infrastructure that can provide a bridge to market for promising technologies. All three areas of policy are needed for success. Supporting technological innovation through RD&D spending, without creating market demand, will strand new technologies in the labs or at the demonstration phase. Providing market incentives without the necessary enabling policies risks letting deployment stall below its potential as projects run up against nonmarket barriers.

First, policymakers have made significant, recent investments in "upstream" innovation for the research, development and demonstration of CCUS and carbon removal technologies, particularly in the Infrastructure Investment and Jobs Act. It will be imperative to leverage and sustain these investments in innovative technologies. Further research into increasing the efficiency of separation technologies (liquid absorbents, solid adsorbents, membranes), regeneration and reuse of materials used to capture carbon dioxide, and the potential of hybrid separation systems can help to advance a broad range of technologies. Importantly,

[9] National Academies of Sciences, Engineering, and Medicine, "Accelerating Decarbonization of the U.S. Energy System", 2021, https://nap.nationalacademies.org/catalog/25932/accelerating-decarbonization-of-the-us-energy-system



additional, expanded support for research and development of utilization approaches could help tap sizeable markets for products like low carbon fuels (utilization potential of 1,000–4,200 $MtCO_2$/year by 2050), chemicals (300–600 $MtCO_2$/year by 2050), and building materials (100–1,400 $MtCO_2$/year by 2050).[10]

Policymakers should also look to build on recent efforts in the Infrastructure Investment and Jobs Act to support four direct air capture hubs, to advance a regional, shared infrastructure approach for CCUS and carbon dioxide removal transportation and storage networks that can create opportunities to lower project costs and accelerate adoption and commercialization of new technologies. Coordinating and underwriting the development of industrial hubs can help advance these technologies and their associated benefits.

Second, a number of demand side, or "downstream" policies will also be needed to facilitate the growth of markets for carbon capture, utilization, storage, and removal technologies. Comprehensive, market-based approaches like carbon pricing would send an important signal across the economy, encouraging emission reductions, enhancing innovation and bolstering the impact of other policies by aligning economic incentives with decarbonization efforts. Over the long-term, a price on carbon will be an essential tool for advancing CCUS and carbon removal technologies.

Procurement policies which prioritize these products are a key lever for advancing the deployment of CCUS and carbon removal technologies. Offtake agreements, in which an off taker commits to purchasing all or a substantial portion of the output from a facility, can provide crucial revenue streams that support a project financing. Whether from the private or public sectors, procurement will be crucial to help these sectors, especially direct air capture, to grow at the speed and scales necessary to meet decarbonization goals and capitalize on emerging global markets for these technologies.

Significantly extending and expanding the Section 45Q tax credit would send an important, long-term market signal. Since the initial enactment of this tax credit, half of all global carbon capture and storage projects have been developed in the United States.[11] Policymakers should prioritize: extending the commence constructure deadline for carbon capture, direct air capture and carbon utilization projects through at least 2031; increasing the credit value for industry and power projects to $85/ton for storage in saline geologic formations, and; increasing the credit value for direct air capture projects to $180/ton, for storage in saline geologic formations. The Section 45Q tax credit has thus far been instrumental in making the United States a global leader in the deployment of CCUS and carbon dioxide removal technologies. But it could be further leveraged to maximize the potential of these technologies in the United States and further cement our global leadership on these important technologies.

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[10] Hepburn, C., Adlen, E., Beddington, J. et al., "The technological and economic prospects for CO2 utilization and removal", Nature 575 (November 2019): 87–97 https://doi.org/10.1038/s41586-019-1681-6

[11] Turan, G., Zapantis, A., et al., "Global Status of CCS 2021", (October 2021) Global CCS Institute, Washington D.C., 20037 https://www.globalccsinstitute.com/wp-content/uploads/2021/11/Global-Status-of-CCS-2021-Global-CCS-Institute-1121.pdf



Third, a suite of enabling policies and actions, including those to advance necessary infrastructure, will be needed to help bridge the gap between early innovation and full market diffusion of CCUS and carbon removal technologies. Crucially, policymakers should support and prioritize the facilitation of early and continuous engagement between companies and communities throughout a project's lifecycle and seek to credibly address community concerns, including those centered on non-carbon dioxide air pollutants. Further research will be crucial to better understand the impacts of CCUS retrofits on criteria air pollutants, which have and continue to represent significant pollution burdens for frontline communities. For example, a recent study on the impacts of adding carbon capture to a cement plant in Canada found significant reductions in sulfur dioxide (100 percent), nitrogen oxides (56 percent), and particulate matter (92 and 70 percent for PM_{10} and $PM_{2.5}$ respectively).[12] Helping to better characterize these impacts, across a range of technology applications will be crucial to building the community support that will ultimately be necessary to deploy CCUS technologies.

Policymakers should also prioritize support for the development of carbon management infrastructure, which needs to be accelerated as quickly as possible to enable these technologies to scale and reach the capture levels needed to meet long-term decarbonization goals. For example, scaling up and optimizing regional carbon transportation and storage infrastructure could help facilitate the capture and storage of more than 350 million tons of carbon dioxide annually, more than a fifteenfold increase of the current carbon capture rate in the United States.[13]

Policymakers also need to ensure transparent and efficient permitting processes that allow for meaningful public engagement can build the necessary confidence among investors and community stakeholders for the sector to grow. A crucial need is building administrative capacity at the state and federal levels to provide greater regulatory certainty and allow for significant growth in the sector. For example, building state regulatory capacity could support state primacy applications as part of EPA's Class VI well permitting program, which was established by the EPA to provide specific regulations for dedicated geologic storage of carbon dioxide. The Infrastructure Investment and Jobs Act made a significant down payment toward building this capacity at the state level, as well as within EPA, which should pay dividends over the next several years. Congress should monitor this effort and provide additional resources as necessary to support the sector as it grows.

Climate action and economic opportunity are aligned

Carbon capture, utilization, and storage, as well as carbon dioxide removal technologies have an indispensable role to play alongside urgent efforts to reduce greenhouse gas emissions as quickly as possible across our economy. Doing so will not only help us meet our long-term climate goals, but also enhance the competitiveness of domestic industries, particularly those with hard to abate emissions like steel, cement, and

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[12] International CCS Knowledge Center, "Summary for decision makers on large-scale CCS on cement", 2021, https://ccsknowledge.com/resources/featured
[13] Great Plains Institute, "Transport Infrastructure for carbon capture and storage", 2020, https://www.betterenergy.org/wp-content/uploads/2020/06/GPI_RegionalCO2Whitepaper.pdf



chemicals. Building on recent, historic investments, Congress can and should provide additional support to capitalize on the alignment of climate and economic goals and ensure that the U.S. leads the world in the transition to a clean energy future.

Senate Committee on Environment and Public Works
Hearing Entitled, *"Examining the Development of Projects and Implementation of Policies that Support Carbon Capture, Utilization, and Storage (CCUS) Technologies."*
July 27, 2022
Questions for the Record for Brad Townsend

Chairman Carper:

1. You mention in your testimony that the creation of market demand for downstream uses of carbon dioxide is critical to the success of carbon capture, utilization, and storage (CCUS). In particular, we need make products and markets for carbon dioxide a priority in order to sustain CCUS deployment.
    a. Given the importance of identifying downstream markets for captured carbon, what potential end-use markets would provide the greatest reductions in carbon emissions using CCUS technologies?

    Answer: There are several markets that offer significant potential opportunities for substantial carbon utilization and associated reductions in carbon emissions. These markets include chemicals (300 – 600 $MtCO_2$ per year), fuels (1,000 – 4200 $MtCO_2$ per year), food and beverage (up to 100 $MtCO_2$ per year), and concrete and building materials (100 – 1,400 $MtCO_2$ per year).[1]

    b. What actions should Congress consider to develop these markets?

    Answer: Congress should consider procurement policies that prioritize low-carbon products. Climate-based procurement policies, which are often referred to as "Buy Clean" policies, can be used to set limits on the embodied emissions of materials that can be used in public projects. These policies can create demand-pull for CCUS technologies both by incentivizing deployment by industrial sectors to reduce the life cycle embodied emissions of their products and by supporting markets for utilization of the captured carbon dioxide. There is also a need for utilization-specific RD&D policies. These efforts can reduce the costs and improve the efficiency of carbon utilization technologies, which would push more low-carbon products to the market.

    Congress has provided important support for carbon management solutions by passing the Inflation Reduction Act of 2022 which extended the 45Q tax credit and increased the credit value to scale up CCUS deployment. These enhancements will enable the U.S. industrial and power sectors to address their emissions and enhance their competitiveness while creating thousands of new jobs. Further, instituting a robust carbon price or carbon constraint would boost CCUS/CDR's cost competitiveness, which in turn would help further develop these markets.

[1] Hepburn, C., Adlen, E., Beddington, J. et al., "The technological and economic prospects for CO_2 utilization and removal", *Nature 575* (November 2019): 87–97 https://doi.org/10.1038/s41586-019-1681-6

Further research will be crucial to better understand the impacts of CCUS retrofits on criteria air pollutants, which have and continue to represent significant pollution burdens for frontline communities. For example, a recent study on the impacts of adding carbon capture to a cement plant in Canada found significant reductions in sulfur dioxide (100 percent), nitrogen oxides (56 percent), and particulate matter (92 and 70 percent for PM_{10} and $PM_{2.5}$ respectively).[2] Further rigorous and credible studies on this topic are a foundational step toward addressing the concerns of frontline communities and fostering public trust and long-term support for CCUS and CDR technologies. Real-world impacts also have to be tracked, which means monitoring, reporting, and verification will be critical.

2. Is there anything else you would like to provide the Committee that was not included in your testimony or discussed during the hearing?

Senator Inhofe:

1. Do you agree that the Council on Environmental Quality (CEQ) should support expediting Carbon Capture, Utilization, and Storage (CCUS) permitting in the U.S. which would encourage and support carbon capture projects?

Answer: To enable wide-scale deployment of the full range of technologies needed to meet our climate goals, we need to take steps to significantly increase the efficiency and transparency of permitting processes. These projects and the processes that permit them will also still need to include meaningful public engagement to build the necessary confidence among investors and community stakeholders for the carbon management sector – and the clean energy economy writ large – to grow. Recent guidance from the Council on Environmental Quality articulated a 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.

Realizing this framework's potential will require building the administrative capacity needed to expedite permitting, the use of tools like categorical exclusions and a commitment to procedural justice that is reflected in early and continuous stakeholder engagement. The Infrastructure Investment and Jobs Act, made a significant down payment on building the administrative capacity needed to expedite permitting, however, additional administrative capacity will be needed at the state and federal levels to provide greater regulatory certainty, and support robust stakeholder engagement processes. An efficient, transparent and collaborative permitting process will be the most

[2] International CCS Knowledge Center, "Summary for decision makers on large-scale CCS on cement", 2021, https://ccsknowledge.com/resources/featured

successful one, enabling private sector investment at scale and allowing for significant growth in the sector.

2. How can the federal government additionally help better support CCUS projects?

Answer: A potential area of improvement to the existing regime is for federal agencies to fully implement their respective authorities, as established under the Title 41 of the Fixing America's Surface Transportation (FAST-41), meant to improve the timeliness, predictability, and transparency of the Federal environmental review and authorization process for significant infrastructure projects. The Department of Transportation (DOT) should identify potential opportunities for pipelines or other forms of carbon dioxide transportation for regional CCUS networks. Also, DOT and the Pipeline and Hazardous Materials Safety Administration (PHMSA) should coordinate their efforts to issue guidance on the construction and safe operation of carbon dioxide pipelines to facilitate scaling up the U.S. carbon dioxide infrastructure.

Federal agencies should contribute to local capacity building by providing trainings on environmental justice tools and resources to support local communities in developing informed decisions about projects. They should also share best practices for community engagement so that project developers can perform rigorous community engagement programs that enable responsible development of these technologies. The widescale deployment of carbon management projects will depend on a broad social license to operate. Without meaningful and continuous engagement in communities, project developers are unlikely to create or maintain the credibility they need to successfully operate projects.

Senator CARPER. Thanks so much.

Are you familiar with the facility at Ohio State University; I think it used to be called the Polar Research Center? I want to say there are two renowned Ph.D.s, I think, from West Virginia. I call them the Thompson twins. They have led excursions to some of the highest mountains on the planet, along the equator. Does that ring a bell with you?

Mr. TOWNSEND. It does not, off the top of my head.

Senator CARPER. Yes, I just received, earlier this year, a publication, like a regular publication from Ohio State University, where I was a Navy ROTC midshipman, and they had their pictures on the front of it. Just a great story. A love story, but also a great story about their courage and roots in West Virginia and how they found their fame and fortune in Columbus, Ohio.

OK, thank you.

Senator WHITEHOUSE. Mr. Chairman, I have visited their lab.

Senator CARPER. Have you really? Oh, good.

Senator WHITEHOUSE. They have core samples from glaciers that no longer exist.

Senator CARPER. They are able to look back in time, like, hundreds of thousands of years to see what the carbon levels were all those years ago. It is amazing stuff. They did these trips down to these mountains in their 80s. Just extraordinary stuff, amazing people.

Mr. Lanclos is next.

I am told you pronounce your name Lan-close. Is that true?

Mr. LANCLOS. Yes, sir. Actually, the "s" is silent, so it is Lan-clo, but you did a fantastic job. I have heard many different variations of it.

Senator CARPER. I am half-right, good. Thank you, Mr. Lanclos. Welcome.

STATEMENT OF M. JASON LANCLOS, P.E., DIRECTOR, LOUISIANA DEPARTMENT OF NATURAL RESOURCES, TECHNOLOGY ASSESSMENT DIVISION, LOUISIANA STATE ENERGY OFFICE

Mr. LANCLOS. Chairman Carper, thank you so much for having me today, and Ranking Member Capito, and members. This is just an unbelievable opportunity to tell you a little bit about Louisiana. I am thrilled to be here today.

I feel like a lot of the coastal talking points, Senator Cassidy and Senator Carper, have a very good appreciation for really, what we are facing in Louisiana, and you hit the nail on the head. That was something I was going to say this morning. We are losing land in Louisiana, and that statistic, 100 minutes, a football field size, it is astronomical what Louisiana has lost in the last 20, 30, 40, 50 years. You look at the maps, and we have seen significant changes.

I had the benefit of being able to work for the Coastal Protection Restoration Authority prior to coming over to Energy and really being at the forefront of what I would call really big changes happening in Louisiana. It gave me just an unbelievable appreciation for climate and for looking for solutions of things that we needed to do to move Louisiana in the right direction.

As Senator Cassidy mentioned, we have an unbelievable manufacturing and refining base in Louisiana. We refine about a fifth of the Nation's oil capacity, so these industries are super important. They are weaved into the mix, but they are also located along the coast, so it is very much of a working coast. We have a lot of people who live in these areas that have been impacted directly by climate change.

So when I came over in 2018 and sat down with Secretary Harris, we had some very, very, what I would call, just in depth discussions about things that we could do to move our department forward, but also to start looking for solutions.

One of the things that we were working on when I was at CPRA was called the verifiable carbon standard, more on the ecological side of carbon management, and we took a step back, and we said, there is really an opportunity for us to be able to apply this to industry and to look at our emission profile.

What I mean by that is, when you look at our emission profile, we have a very difficult emission profile to decarbonize. And part of that is that of the 200 million, or 220 million metric tons, most of our emissions are about 60 or 65 percent are from our industrial base users. So some of these industries, like ethanol and methanol, have a very pure stream of CO_2, but some of them also have a very mixed stream of emission profile which causes, when you look at carbon capture, it is a very expensive mechanism to capture. So for us, we quickly realized that we needed to work with industry to look for solutions.

So, CCUS has been something that we have put a lot of time and energy into. We recognized that we had the staff in house. When you look at our Office of Conservation, we have about 38 folks in that office. We have applied for regulatory primacy with the Environmental Protection Agency. We are very close, we feel, to getting primacy.

We will be the third State in the Nation to get regulatory primacy. The reason that that is so important is that our staff, we have a great group of geologists and engineers who are very, very excited about working in carbon management. We have actually hired an additional six people just to focus on carbon management who are going to be working with these industry and industrial operators to get their permits out of the door. We prioritize resources, and we have made this something as a major focus of our long term management of emissions.

The thing that really put this in perspective and really illustrated to us that it would be an unbelievable solution for Louisiana is our Governor signed an executive order in August 2020 to create the Climate Initiatives Task Force. So you can imagine, in a Gulf Coast State such as Louisiana, a climate plan is something that was very innovative at the time.

I was the designee for our department on that task force.And those conversations, as you can imagine, were not always easy. You are meeting with a lot of stakeholders across the board who have very different opinions on what the best solutions for our long term management of emissions are.

For us, we felt comfortable as a department that the things that we were pursuing, like hydrogen production and trying to rapidly

scale up hydrogen production, carbon management through CCUS, offshore wind and solar, all of those things have to work together.

At the end of the day, there is not a singular solution that is going to solve all of our problems. We continue to go back to looking at long term management of emissions.

CCUS has shown unbelievable promise. I am here today to tell you that over the last several years, the first meeting that we did, what we call our industry days, when we talked about CCUS, we actually had to get some of our friends to come to the meeting, because there wasn't a lot of interest.

Over the last 3 years, the interest is unprecedented. The companies who want to do this and who want to look at this as a long term solution, they are here, and they are telling us that basically, the FUTURE Act that a lot of your members of this Committee put forward and a lot of staff have worked so hard on has really been a complete game changer to making this something that is going to be a viable technology and solution in the future.

I am here today to tell you that we are extremely excited about the opportunities for CCUS in Louisiana. And there is tremendous opportunity for us to work together.

I will leave you with the thought that the USE IT Act and the other things that have been put forth by this Committee that are actually getting Federal agencies to work together on solutions have been instrumental in moving the needle forward. And the more that we do that, and the more that we come up with common solutions to move this forward and to handle our emissions, I think that we are all going to win at the end of the day.

Thank you so much for giving me the opportunity to tell you a little bit about Louisiana, and I really appreciate being here today and having that opportunity.

[The prepared statement of Mr. Lanclos follows:]

CCUS as part of climate change strategy

Louisiana is at an energy and manufacturing crossroads. We can continue down the path of traditional production and manufacturing of products goods and services, or we can begin to transition to cleaner, more sustainable forms of energy production and manufacturing. The former leads to what some analysts and research indicates will be a dramatic reduction in workforce and manufacturing in 15-20 years or Louisiana can choose to be bold and pivot and develop strategies and policies that focus on transition and putting Louisiana on a pathway to the production of lower carbon intensity products and fuels that the world uses and will continue to demand. This transition cannot be singular in focus. It cannot be only about climate, equity, sustainability or resilience. This transition defines how Louisiana moves forward and where we choose to be in 15-20 years. If the companies who do business in our state and the political leaders and NGO's want solutions to meeting long term energy demand, we must act decisively and definitively and employ technologies that reduce carbon, focus on communities and put our state in position to be viable in an ever changing geopolitically connected world. There is not a one size fits all or single solution to meeting energy demand. Our transition to renewable energy will take time and will require extensive capital investments. We have to be strategic and decisive about how we move forward and focus on the most promising technologies that support continued production of energy but also focus on reducing carbon and keep communities in clear focus as we make decisions.

A great deal of the concern we hear about using CCUS as a means to manage carbon in combating climate change seems to start from a set of mistaken assumptions that it is the primary strategy, if not the only one; that it is intended to be the permanent solution with nothing else changing in hydrocarbon use; and that the activities that create carbon emissions are not already happening without advanced strategies for carbon management. In Louisiana's case, CCUS is expected to be a tool in the overall climate change toolbox – a part of an overall long-term strategy to reach net-zero in carbon emissions. It is a strategy that includes building out electric vehicle infrastructure, encouraging greater use of hydrogen as a fuel and encouraging the growth of the wind and renewable energy industry both offshore and onshore. Louisiana has and will continue to employ a comprehensive approach to energy production paying special attention to using and employing any and all available technologies to reduce or eliminate emissions while focusing on workforce and having a plan for the future.

In terms of state, regional and national energy and economic needs, the chain of events we have seen since the Russian invasion of Ukraine has amply demonstrated that the people and economies of both the U.S. and our greater global community of nations still depend heavily on traditional fuels and feedstocks provided by oil and natural gas. The disruption in previous oil and gas distribution networks and reduction of Russia's energy exports to the U.S. and other nations, while a necessary response to Russian aggression, has created significant hardship on America's people and businesses as rising energy prices hobble the post-pandemic recovery – and those cost increases for basic daily expenses hit our most vulnerable populations and communities the hardest. Without question, this makes a case in the longer term for diversifying our energy sources and incentivizing development of renewables, but it also illustrates the continued need for our traditional sources until alternative energy sources are sufficiently available and affordable to take on the load. At present, the entire U.S. renewable supply makes up only about 12 percent of total domestic energy consumption (U.S. Energy Information Administration, Monthly Energy Review, Table 1.3 and 10.1, April 2022).

One of the primary arguments of those who oppose the concept of CCUS is that processes utilizing it in creating fuel and feedstock and drawing on traditional energy sources do not provide

the same reduction in carbon that energy sources such as wind or solar do. While that statement may be true as far is it goes, it ignores two critical facts – that the energy/feedstock production is already happening without any additional carbon controls and that the low-to-no-carbon options such as wind and solar are nowhere near a posture to support the energy consumption currently covered by traditional fuels.

It is probably one of the most perfect examples that can be found of the old adage that "the perfect is the enemy of the good." It is well understood that CCUS is not a one-and-done solution to management of carbon and other greenhouse gas emissions, and we have to move toward a future with greater availability of renewable and low-to-no carbon energy sources. But while the technology and infrastructure and investment to build out those energy sources to make up more than a rough tenth of our current energy consumption, CCUS can certainly be a strategy to reduce the amount of carbon put into the atmosphere from the processes we are already dependent on. The arguments against CCUS seem to hinge on the assumption that if it does not cut carbon emissions completely and immediately, then it is not worth trying at all.

Examples of this can be found in recent studies calling into question the process known as "blue hydrogen" production – hydrogen produced from steam methane reforming with the waste carbon injected into underground layers. The idea behind "blue hydrogen" is that hydrogen can be produced with carbon capture and sequestration elements to cut emissions, and then used as an industrial feedstock or as a clean-burning fuel source, either on its own or mixed with a traditional fuel, such as natural gas, to cut the carbon footprint. Some of those studies claim that the "blue hydrogen" processes do not capture as much carbon as they were projected to or that they actually make greenhouse gas emissions worse because they still use natural gas as the supply for production and natural gas is likely the fuel used to generate the electricity such a facility uses. It is also often noted that "green hydrogen" production, using an electrolysis process on water, would be a much lower carbon process, especially if the energy provided was from solar or nuclear or other alternative sources. Those points sidestep the reality that the "green hydrogen" concept is not currently commercially viable on a wide scale and that hydrogen production is happening already, and will continue to happen, whether we use CCUS to cut those carbon emissions by any amount they can be cut or simply do what has always been done, producing it with relatively unchecked carbon emissions while waiting for the perfect zero-carbon solution.

Currently, the U.S. produces about 10 million tons of hydrogen per year, mostly through steam methane reforming, and that production is anticipated to grow, particularly as hydrogen is embraced as a significant clean fuel option. When the current 90 million tons of global hydrogen production, overwhelmingly steam methane reformation, is considered, CCUS seems to be an obvious opportunity to gain some ground on carbon emissions as the transition to newer energy sources and production practices advances. Louisiana is leading the bipartisan three state HALO effort (Hydrogen – Arkansas, Louisiana, Oklahoma) which is fundamentally founded on the concept that to build a regional hydrogen hub, you first need usable hydrogen. We all want to get to green and lower carbon production of hydrogen but to move the industry forward and develop economies of scale to drive down production costs, hydrogen needs to be available and infrastructure needs to be developed to support this build out. CCUS supports this buildout of hydrogen and puts Louisiana on a pathway to production of lower carbon intensity hydrogen which directly contributes to emission reduction and positive community impacts.

We have also heard the argument that pursuing CCUS options somehow instantly stifles the momentum toward investing in and building out other cleaner-energy alternatives. The reality is that investment in clean energy is gaining momentum, with the International Energy Agency (IEA) noting in its World Energy investment 2022 report that "Clean energy investment is – finally –

starting to pick up and is expected to exceed USD 1.4 trillion in 2022, accounting for almost three-quarters of the growth in overall energy investment. The report notes that, while clean energy investment growth has only been about 2% from 2015 to 2020, it has accelerated to 12% since. The report also notes that the U.S. clean energy investment in 2021 was $215 billion.

It is possible, even necessary, to engage on many fronts in the transition to a lower-carbon future, and our current emphasis on CCUS is not indicative that it is the only, or even our primary, weapon in combatting climate change. It is simply a reflection of the fact that CCUS is the most mature and closest to ready for market of the options we see in the near term, and it has the potential to be a very effective tool in the transition from what we have always known to what comes next.

What CCUS offers is a great opportunity to act as a bridge between the era of relatively unchecked carbon emissions and the move toward low-carbon and no-carbon processes – a means of easing the transition from what we have done in the past to what we will be doing in the future.

CCUS in Louisiana

For more than a century, Louisiana has been among the nation's leaders in the production of traditional crude oil and natural gas for fuel and manufacturing feedstock, and a significant refining and petrochemical manufacturing footprint has grown in our state because of it. This has provided regular employment for our people and been an economic mainstay for generations. But, as with so many things, there were prices to be paid that we were not aware of until long after we had incurred the debt – in this case being an overreliance on traditional sources for too much of our energy and the dawning realization of the impact to our environment.

In Louisiana, we know very well the impacts of climate change, and the role that lack of carbon management has played in accelerating it. With four significant hurricane strikes in the past two hurricane seasons, and a coastline that erodes more every day, we understand that the threat of climate change is heavily driven by past practices at all levels that did not make management of carbon and other greenhouse gases a priority. This is why we have been working collaboratively with stakeholders, including environmental groups and the energy industry, to build lasting plans to address the challenges of climate change through the development and implementation of our $50 billion Coastal Master Plan. And we have expanded on that effort by launching our own Climate Initiatives Task Force, setting ambitious goals for reducing carbon emissions to net zero by 2050.

As we move forward with those efforts, we understand that reaching those climate goals is a process, during which we will still rely a great deal on our traditional energy sources in a measured transition from the energy mix we currently have to what comes next, avoiding as best we can sudden shocks to a domestic and global energy matrix that has shown itself to be highly sensitive to supply and price instability, with undeniable ripple impacts to all sectors of the shared economies.

The EIA regularly ranks Louisiana in or near the top five states in annual carbon emissions, be that total or per capita – we believe that means that we have a great opportunity to take action that can make a real difference in the climate change fight and we want to start making that difference as soon as possible.

That is why Louisiana has made such an effort to set itself up to host potential CCUS operations – because that strategy is the closest to being ready to make a dent in our carbon output and Louisiana does not believe that our state or the nation have time to waste in doing what we can

as soon as we can. It represents an opportunity to not only make a big change in Louisiana's carbon footprint, but a noticeable difference in the nation's total carbon emissions.

Louisiana has extraordinarily favorable geology for injection, with strong confining layers of shale and clay; comparatively young geology that is less brittle than other areas of the country; almost no seismic activity; and deep sand layers with the thickness, horizontal extent, porosity and permeability to accept and hold injected carbon dioxide safely.

Our state also has thousands of miles of pipelines already in place and operating, some of which are already transporting CO2 across our state and to and from other states, and more of which could be upgraded. Beyond that, the established rights-of-way and pipeline routes will make for readily accessible connections between CO2 emitters and suitable sites for sequestration facilities. In addition to that infrastructure, our state is home to a wealth of companies and workers with generations of expertise in pipeline operations, including decades of lessons learned and best practices.

In addition to pipeline transportation expertise, Louisiana's Office of Conservation has also maintained state primacy of our Underground Injection Control (UIC) program since the early 1980s, under the oversight of the U.S. Environmental Protection Agency (EPA). This gives Louisiana a staff with a deep background in dealing with our state's unique geology and how best to engineer injection wells and facilities to maximize protection of the public and the environment. In anticipation of the potential interest in CCUS, our Office of Conservation submitted an application to the EPA in fall 2020 for state regulatory primacy over carbon sequestration wells, also known as Class VI injection wells. Our staff worked closely with the EPA over the course of several years in crafting a set of Class VI injection rules that not only meet the standards set by the EPA's baseline Class VI rules, but exceed them.

At the most basic level, our Class VI injection rules mostly mirror the EPA's Class VI rules, but our Office of Conservation has made additional requirements and restrictions for prospective operators based on Louisiana's history with injection and specific knowledge of our state's geology. The core tenet of any UIC program is protection of Underground Sources of Drinking Water (USDW), ensuring that sufficient confining layers that do not allow for upward migration of injected gases or fluids to the base of a USDW, ensuring that the injection zone is appropriate for the type and amount of fluid or gas being injected and that the pressure created by injection is not enough to fracture the formation or its upper confining layers.

To start the process of getting a permit to construct a Class VI well, Louisiana's rules require establishment of an Area of Review (AOR) that is bounded not only by the edges of the area the injected CO2 is expected to permeate, but beyond that to the edges of the area the excess pressure and displaced fluids created by the injection is expected to be felt. In simpler terms, we are not just looking for the splash, but also the ripple.

Within that AOR, the site must be thoroughly characterized in terms of geologic structures, stratigraphy, lithology and faulting in the injection zone and confining layers. This also includes well penetrations assessment, actual core samples of the injection zone and confining layers to verify assumptions on those characteristics. This information must be used by the applicant in generating computer modeling of how the proposed well and geologic formations will respond to the planned rates and amounts of injection. This modeling process must be repeated at least every five years with the latest available data (including injection volumes and pressures), or more often if there are substantive changes to the operation or if the Office of Conservation directs it.

Once an operation is granted permits to construct and to inject, monitoring is required for integrity of the well, analysis of the CO2 stream, injection rates and pressures, corrosion of the well casing, ground water quality above the injection site and tracking of the CO2 plume and the overall pressure front.

Generally speaking, these rules are the same as the EPA's, but aspects of Louisiana's Class VI rules also include:

- A requirement that all reports, plans, evaluations and other submittals by applicants/operators be prepared, sealed and signed by a licensed Professional Geoscientist, in the case of geoscience work, or a licensed Professional Engineer, in the case of engineering work – not a requirement of EPA
- Denial of confidentiality on information that deals with presence of contaminants in ANY formation outside the injection zone – EPA denies confidentiality only on information about contamination in USDW
- Not allowing waivers of injection depth requirements for Class VI wells – EPA allows waivers
- Not allowing Class VI permitting by rule (i.e. "grandfathering in" wells), area permits for multiple wells or automatic transfers of class VI well permits – EPA allows each of those
- When a permit is modified by Office of Conservation, the entire permit may be re-opened and subject to revision – EPA may only re-open specific permit conditions subject to the modification
- Office of Conservation may require permit modifications based on information received, whether the information was available to the operator at the time of permitting or not – EPA may only do so if the information was available at the time of permitting
- Requiring injection to cease immediately upon Office of Conservation giving notice of lack of mechanical integrity in a well – EPA does not specify course of action
- Not allowing CO2 sequestration in solution-mined salt caverns – EPA does not have this restriction
- Requiring tabulation of all wells penetrating USDW for site characterization – EPA only requires wells that penetrate injection or confining zones

The Office of Conservation's Class VI rules also require applicants to conduct and submit an environmental justice review of any communities located within the established AOR, where the EPA does not have an equivalent requirement. The results of that review will be part of the determination as to whether to implement an enhanced public comment period, with a more inclusive public participation process, involving targeted public outreach. In addition to the environmental justice review, a weighing of siting, environmental effects and cost-benefit analysis is required, based on the Louisiana legal precedent set by the "Save Ourselves Inc. vs Louisiana Environmental Control Commission" Louisiana Supreme Court case of 1984. That decision guides nearly all environmental regulatory permitting actions in the state since it came down and, in part, requires that certain questions, commonly referred to as the "IT questions," be answered:

- Have the potential and real adverse environmental effects of the proposed project been avoided to the maximum extent possible?
- Does a cost benefit analyses of the environmental impact costs versus the social and economic benefits of the proposed project demonstrate that the latter outweighs the former?
- Are there alternative projects which would offer more protection to the environment than the proposed project without unduly curtailing non-environmental benefits?

- Are there alternative sites which would offer more protection to the environment than the proposed site without unduly curtailing non-environmental benefits?
- Are there mitigating measures which would offer more protection to the environment than the proposed project without unduly curtailing non-environmental benefits?

These additional safety and environmental measures are part of the reason that the Office of Conservation has sought primacy from the EPA for Class VI wells. Additionally, Louisiana believes its own Office of Conservation is better positioned to effectively regulate injection and sequestration operations just as a matter of having more subject-matter-specific science and inspection staff (including gaining legislative approval to expand that staff) to concentrate on operations in our state, than the EPA's Region 6 Office has for our area – where it has 5 states to cover, including Texas. Obviously, when and if Louisiana received primacy for Class VI wells, the EPA will still have oversight over the program and the Office of Conservation will continue to work closely and communicate regularly with our federal partners.

Louisiana CCUS near-term outlook

Over the past few years, potential operators and support industries have made regular contact with the Office of Conservation about interest in the future of CCUS and progress of state legislation, rulemaking and progress toward primacy. At present, we are aware of more than a dozen Class VI permit applications filed with the EPA for our state, with more likely to come.

Operators have also reached out to Louisiana to arrange for use of injection pore space for sequestration operations below state-owned lands and water bottoms – and just last fall, Louisiana engaged in the first two operating agreements in the history of the state for use of the state's subsurface for sequestration of CO2 – one of the agreements for a hydrogen production facility that will sequester its waste carbon and the other for a biofuels facility that will do the same thing.

Other proposed projects with CCUS aspects we have been made aware of include, LNG liquefaction and export, other biofuels projects and at least one project that would be a general commercial-use facility for sequestering industrial waste carbon.

CCUS is also seen as a linchpin process for the success of initiatives encouraging the wider use and accessibility of hydrogen as an energy source, as steam methane reforming is currently the most-effective manner of hydrogen production – and hydrogen has been identified as a focus area for Louisiana going forward.

As stated before, Louisiana recognizes that CCUS is not the turnkey solution for carbon management, but it must also be recognized that our nation and the wider global community are still heavily dependent on traditional fuels and feedstock and will continue to be for some time, even as the transition to low-carbon and no-carbon continues. And it should also be understood that there will probably always be a need for at least some hydrocarbon-intensive processes with the potential to emit carbon into the atmosphere, and CCUS will continue to be a valuable tool to help manage that in the future.

As we move forward and focus on this energy transition, it is imperative that our Federal partners across the board continue to focus time and resources to the build out of clean energy infrastructure and ensure that permitting is done in reasonable time frames. Louisiana does not want to cut corners on permitting, we want to ensure that the Agencies that are reviewing clean energy projects are staffed and have the resources to deliver on timelines to move projects

forward. The 45Q provisions and tax credits that were passed in 2018 have led to unprecedented interest from companies who want to do business in Louisiana. Although these tax credits are generating tremendous interest in CCUS we must continue to monitor costs of capture equipment and capital costs of these projects to ensure that this build out of cleaner energy continues and dramatically reduces our carbon dioxide emissions. We will only be successful if these projects work and have the infrastructure and permitting support to happen. Our industries are at the table and the time to act is now to move our state and our nation forward so that our future generations have an area to live that not only has an economy, but has energy that is clean, affordable and sustainable for generations to come. We need every tool in the tool box to make this happen, and like we saw on our climate task force, people need to work together on solutions and our communities need to be informed and continue to be first in focus.

Senate Committee on Environment and Public Works
Hearing Entitled, *"Examining the Development of Projects and Implementation of Policies that Support Carbon Capture, Utilization, and Storage (CCUS) Technologies."*
July 27, 2022
Questions for the Record for Jason Lanclos

Chairman Carper:

1. Would more resources for federal and state agencies to review and approve carbon management projects help expedite the permitting process? If yes, why?

   More resources in the form of funding and/or staffing to review and make determinations on carbon management projects would absolutely help expedite the permitting process. The Louisiana Office of Conservation's Injection and Mining Division (IMD) expects that each application for a Class VI project will take 1,000 to 2,000 staff-hours to review, and more than a dozen projects have been discussed or formally proposed at this point.

   While we have increased our IMD staff in expectation of granting of primacy, our Office of Conservation is anticipating a need for additional workforce and has made provisions for utilizing outside contractors to aid in making the review process as efficient and timely as possible without sacrificing our regulatory standards. Additional resources to boost IMD staffing or assist in funding contract work for review of projects could only benefit our efforts to deal with expected initial rush of projects, as well as monitoring and overseeing approved projects over their operational lifespans.

   Louisiana's Class VI rules, if and when granted primacy, make many requirements on operators for site monitoring and modeling even after an initial permit would be approved, with the potential for regulatory adjustments to the project over time. To our knowledge, the EPA has increased staff to oversee Class VI projects, but we would assume additional resources could be well utilized in regional offices where Class VI activities are being proposed to assist in oversight of states with primacy and in processing applications in areas where states have not sought primacy.

2. Is there anything else you would like to provide the Committee that was not included in your testimony or discussed during the hearing?

   We would like to see further exploration of the topic of carbon sequestration in the state offshore waters and federal OCS. There appears to be great potential for geologic structures that are suitable for sequestering carbon in areas offshore that would immediately resolves issues that could cause issues with certain onshore project areas, such as environmental justice concerns about proximity to vulnerable populations or sorting issues of land/mineral rights ownership for pore space.

While there are certainly technical and engineering challenges associated with carbon sequestration operation in the state offshore region and federal OCS, they are issues that, for the most part, are common to existing operations such as production and transportation of our traditional fuels. Drilling, establishing platforms, installing, maintaining and operating pipelines are all regular matters of business in the Gulf of Mexico and have been for decades. There is a great deal of existing expertise that could be drawn on to establish safe and responsible carbon sequestration operations in offshore areas, as well as a nearby grouping of carbon-intensive industries that could make use of it and help make a real difference in managing our shared carbon footprint.

Ranking Member Capito:

1. The Infrastructure Investment and Jobs Act included funding for the Class VI well program, including a specific set-aside to support state primacy applications. What steps do you believe EPA should take to ensure these funds are being spent effectively?

   Our Office of Conservation believes that the EPA could establish a process very similar to what it did when Louisiana was preparing its application for primacy, in which the EPA set up an in-house committee to help steer and monitor the progress as we took each step toward finalizing the application. Representatives of both EPA headquarters and the EPA Region 6 office were a part of that committee and met with us periodically to track progress and discuss potential concerns. Our agency found it an excellent means of maintaining engagement with the EPA and keeping both agencies informed.

   Just so, setting up a similar in-house committee structure, either region/state-specific or a centralized group that rides a circuit, would be a very effective tool in oversight of use of resources and a source of best practices and efficiencies going forward as more states seek primacy. That committee could serve as a repository of knowledge for individual states, EPA regional offices and EPA headquarters on potential sticking points and areas where extra attention should be paid when crafting state law and regulations to meet EPA standards for primacy.

2. Aside from any permitting issues related to the UIC program and Class VI wells, are there any other federal issues delaying the deployment of CCUS projects?

   From our perspective, the key delay in deployment of the CCUS projects being proposed and considered in our state is the matter of state primacy in Class VI permitting. As noted in response to Sen. Carper's question about more resources improving the speed and efficiency of reviewing proposed projects, we absolutely believe that to be the case and have already put our Office of Conservation in a posture to be ready to do so through additional staffing.

   We believe our own Office of Conservation is better positioned to effectively regulate injection and sequestration operations just as a matter of having more subject-matter-specific science and inspection staff (including having gained state legislative approval to expand that staff) to concentrate on operations in our state, than the EPA's Region 6

Office has for our area – where it has 5 states to cover, including Texas. Obviously, when and if Louisiana receives primacy for Class VI wells, the EPA will still have oversight over the program and the Office of Conservation will continue to work closely and communicate regularly with our federal partners.

Senator CARPER. Good. Mr. Lanclos, thanks so much.

That is a very sobering thought. We are going to be in this hearing today for about 100 minutes. During that period of time, another piece of land the size of a football field is lost by the State of Louisiana. Very sobering. Thank you. We can do something about it, and that is what we are here to discuss today.

Finally, we are going to ask for Mr. Harju to deliver his testimony.

Mr. Harju, great to see you, and thank you for joining us.

STATEMENT OF JOHN HARJU, VICE PRESIDENT FOR STRATEGIC PARTNERSHIPS, ENERGY AND ENVIRONMENTAL RESEARCH CENTER, UNIVERSITY OF NORTH DAKOTA

Mr. HARJU. Thank you, Chairman Carper, Ranking Member Capito, and members of the Committee, and Senator Cramer for the kind words and introduction.

My name is John Harju. I am the Vice President for Strategic Partnerships at the University of North Dakota's Energy and Environmental Research Center. Thank you for the invitation to provide testimony concerning current challenges and opportunities in deploying carbon capture, utilization, and storage technology, or CCUS.

The EERC is a business unit of the University of North Dakota, and we are focused on practical solutions to the world's vexing energy and environmental challenges. The EERC was initially founded in 1951 as the Robertson Lignite Research Laboratory under then President Truman and the United States Bureau of Mines. With the creation of the United States Department of Energy in 1977, we became one of the Nation's five energy technology centers, and we have been part of the University of North Dakota since 1983.

Our mission has evolved considerably over that time, from one focused exclusively on the utilization of the low rank coals that predominate our Nation's resources west of the Mississippi River to one that focuses on all fossil fuels, as well as renewables and alternatives and on the attendant environmental challenges associated with development and utilization of energy technology.

As global population continues to grow and nations with underdeveloped economies strive to improve their citizens' quality of life, the need for reliable, affordable energy only grows. Given the limited ability of renewables alone to meet growing energy demand in these coming decades, the continued use of fossil fuels will be needed to maintain our standard of living. The only way to meet the demand for more energy and lower carbon intensity is with an all of the above energy strategy, with a mix of resources, including oil, gas, coal, nuclear, and renewables, such as wind and solar.

CCUS is a critical and versatile technology, and any meaningful attempt to mitigate carbon accumulation in the atmosphere and to reduce the carbon intensity of the American, and in turn, the global economy.

In the arena of CCUS, the EERC has had the privilege of serving not only the Department of Energy, but also more than 200 non-Federal partners across the entire CCUS value chain. Our field experiments and commercial scale operations have added to the

wealth of knowledge regarding the full life cycle of CCUS projects, from permitting to construction to operation, and ultimately, to site closure. These projects were made possible because of ongoing, robust financial support via the Department of Energy's Fossil Energy, now Fossil Energy and Carbon Management Program, and our more than 200 partners and the States that we work with.

The DOE selected the EERC as one of the original seven regional carbon sequestration partnerships in a region that ultimately spans all or part of ten U.S. States and four Canadian provinces. We call this the Plains CO_2 Reduction Partnership, or the PCOR Partnership. Our current goal is to use the knowledge and experience gained over these previous decades to address the current challenges and to accelerate commercial deployment.

Each of these areas within the PCOR Partnership has an economic engine, and each of these economic engines represents the primary emission of CO_2. It was apparent, by engaging our stakeholders, that with each of these economic bases, there is significant opportunity to accelerate deployment of CCUS technology and deploy it commercially.

To further the opportunity, we needed to develop economically motivated carbon management strategies. Even though we have economic drivers such as 45Q and low carbon fuel standards, there are business cases and unprecedented interests here in the United States and globally.

The economic drivers are really only one factor. Comprehensive rules regarding the legal aspects, such as pore space ownership and long term liability, as well as clearly defined communication pathways and an ability to directly interact with regulatory agents, are key tools in facilitating commercial deployment.

To aid in this endeavor, North Dakota was the first State to be granted primacy for the EPA's Class 6 Program. As of today, only Wyoming has joined us with that primacy, as we heard from Mr. Lanclos. We are hopeful that Louisiana will join that exclusive club soon.

My team has been helping with a number of States as they either contemplate or apply for that primacy, sharing our experiences and achieving it. These States include Texas, West Virginia, Alaska, Utah, Colorado, Louisiana, Nebraska, Montana, and Kansas, and again, including Mr. Lanclos' team.

I can testify, commercialization is beginning. Real world examples are numerous. An essential component is transporting CO_2 from where it is captured to where it is stored. A pipeline is the most efficient way to do this. Pipelines for CO_2 have been operating in the U.S. since the 1970s and have been shown to be safe. They pose manageable risk, and they have an established legal and regulatory framework for their construction and operation at both the State and Federal levels.

Again, I thank you for your time today, and thank you for the invitation to be with you.

[The prepared statement of Mr. Harju follows:]

Testimony of John Harju, Vice President for Strategic Partnerships
University of North Dakota Energy & Environmental Research Center
Before the Senate Committee on Environment and Public Works
July 27, 2022

Good morning, Chairman Carper, Ranking Member Capito, and members of the committee. My name is John Harju, and I am the Vice President for Strategic Partnerships at the University of North Dakota's (UND's) Energy & Environmental Research Center (EERC). Thank you for the invitation to provide testimony concerning current challenges and opportunities in deploying carbon capture utilization and storage (CCUS).

The EERC is a business unit of UND focused on practical solutions to our world's vexing energy and environmental challenges. The EERC was initially founded in 1951 as the Robertson Lignite Research Laboratory under the U.S. Bureau of Mines. With the creation of the U.S. Department of Energy (DOE) in 1977, we became one of the nation's five energy technology centers and have been part of UND since 1983. The EERC's mission has evolved considerably since that time, from a mission focused exclusively on the utilization of the low-rank coals that predominate our nation's resources west of the Mississippi River to a mission that focuses on all fossil fuels, as well as renewable and alternative fuels, and on attendant environmental challenges associated with their development and utilization.

As global population continues to grow and nations with underdeveloped economies strive to improve their citizens' quality of life, the need for reliable, affordable energy will only grow. In addition to this demand, recent international events have highlighted the importance of energy security and reliability to the

United States and its allies. Meanwhile, there is also a societal call for dramatic reductions in carbon intensity as a means of mitigating climate change. Given the limited ability of renewables alone to meet energy demand in the coming decades, continued use of fossil fuels will be needed to maintain our current standard of living. The only way to meet the demand for more energy and lower carbon intensity is with an "all-of-the-above" energy strategy with a mix of sources, including coal, oil, natural gas, nuclear, and renewables such as wind and solar. CCUS is a critical and versatile technology in any meaningful attempt to mitigate carbon accumulation in the atmosphere and reduce the carbon intensity of the American economy. CCUS works in many contexts, including fossil fuel applications, direct air capture (DAC), hydrogen and ammonia production, as well as industries such as cement, steel, and agricultural production.

In the arena of CCUS, the EERC has had the privilege of serving not only DOE, but also more than 200 nonfederal partners across the entire CCUS value chain. With support and guidance from DOE and these partners, the EERC has conducted projects focused on CO_2 capture and geologic storage. These projects range from reconnaissance-level assessments to field validation of geologic CO_2 storage, as well as laboratory and pilot-scale testing of capture technologies and field campaigns evaluating the performance of full-scale commercial CCUS implementation. These tests have ranged in size from pilot-scale tests involving the capture or injection of hundreds of tonnes of CO_2 to commercial-scale operations involving millions of tonnes of CO_2. And each of these field experiments and commercial-scale operations has added to the wealth of knowledge regarding the full life cycle of a CCUS project, from permitting, to construction, to operation, to site closure. These projects were made possible

because of ongoing, robust financial support via DOE's Fossil Energy and Carbon Management Program and our 200+ partners.

To provide further background on the EERC's CCUS experience, in 2003 DOE released a solicitation for the establishment of a series of Regional Carbon Sequestration Partnerships to develop an inventory of our nation's major stationary CO_2 emission sources, as well as regional storage reservoirs, or "sinks." My team at the EERC was fortunate enough to be selected as one of the original seven partnerships in a region that ultimately spanned all or part of ten U.S. states and four Canadian provinces, which we refer to as the Plains CO_2 Reduction Partnership, or PCOR Partnership. In 2019, the EERC was awarded funding from DOE to continue the PCOR Partnership, with the goal of using the knowledge and experience gained over the previous two decades to address current challenges and accelerate commercial CCUS deployment.

What has become apparent over the course of PCOR Partnership activities is that while our region has astounding potential for geologic CO_2 storage, our region's emissions are inextricably linked to our economic bases—from the mining, manufacturing, and industrial centers around the Great Lakes and Mississippi River Valley; to the agribusinesses of Iowa, Minnesota, Nebraska, and the Dakotas; and to the oil-, gas-, and coal-producing regions of North Dakota, Wyoming, Montana, Alaska, and the Canadian provinces. Each of these distinct areas has an economic engine, and each of those economic engines represent the primary emission of CO_2. What also became apparent was that engaging key stakeholders within each of those economic bases creates significant opportunity to accelerate development of CCUS technologies and deploy them commercially.

With that as a backdrop, we set out to find and develop economically motivated carbon management opportunities.

Today's economic drivers such as 45Q tax credits and low-carbon fuel markets have created business cases that are driving unprecedented interest in the PCOR Partnership's CCUS knowledge base and spurring the implementation of the region's first commercial CCUS projects.

However, the emergence of these economic drivers is only one side of the equation for accelerating CCUS deployment. Comprehensive rules regarding legal aspects such as pore space ownership and long-term liability, as well as clearly defined communication pathways and the ability to directly interact with regulators, are key tools in facilitating rapid commercial deployment. These tools become readily available when a state has primary enforcement authority (or "primacy") over CO_2 injection and storage. Efforts of the PCOR Partnership, in conjunction with numerous additional stakeholders, supported North Dakota's development of comprehensive geologic storage rules for CO_2, ultimately leading to North Dakota being the first state to be granted primacy for the U.S. Environmental Protection Agency's (EPA's) Class VI Program. As of today, North Dakota and Wyoming remain the only states with this primacy. The value of state primacy is evidenced by the number of calls the EERC gets from state agencies, both in and outside of the PCOR Partnership region, asking for help and guidance as they consider the prospect of applying to EPA for Class VI primacy. These states include Texas, Alaska, Utah, Colorado, Louisiana, Nebraska, Montana, and Kansas.

I can testify that commercialization of CCUS is beginning. Nowhere is this more evident than in the PCOR Partnership region. Real-world examples of the

region's emerging CCUS industry are numerous. Red Trail Energy, an ethanol production facility in Richardton, North Dakota, began commercially injecting CO_2 for storage in June of this year, with a goal of injecting 180,000 tonnes a year over 20 years. Summit Carbon Solutions has publicly announced plans to capture approximately 10 million tonnes of CO_2 per year from over 30 ethanol plants located in multiple states in our region and transport it via pipeline to North Dakota for geologic storage. Minnkota Power Cooperative has secured a CO_2 storage facility permit to allow CO_2 from a coal-fired electric generating facility to be geologically stored in central North Dakota. In Wyoming, Basin Electric Power Cooperative has been working with the University of Wyoming and the EERC to determine the feasibility of applying CCUS to Dry Fork Station, a coal-fired power plant near Gillette, Wyoming. Finally, Denbury Resources' recent initiation of enhanced oil recovery operations in North Dakota promises the production of expanded amounts of lower carbon domestic oil, due to the concurrent storage of industrially sourced CO_2 that is injected during its production. Denbury estimates that more industrially sourced CO_2 will be stored over the life of this project than will be emitted from its operations and from the oil that is produced. All of these companies have been financial supporters of the EERC's PCOR Partnership and have been critical collaborators in helping lead us toward a world with abundant, affordable, reliable, secure, domestically sourced energy with the lowest possible carbon footprint.

It is important to note that an essential component of these projects, and the CCUS industry as a whole, is transporting the CO_2 from where it is captured to where it is stored. A pipeline is the most efficient way to do this. Pipelines for CO_2 have been operating in the United States since the 1970s. They have been shown

to be safe, posing manageable risk, with an established legal and regulatory framework for construction and operation at both state and federal levels. Given their importance to developing a nationwide CCUS industry, pipelines should be treated fairly in the greater context of carbon management and permitting.

Historically, Congress has been a staunch supporter of research and development programs focused on CCUS. We see the fruit of this support in the emergence of a nascent commercial CCUS industry. While this success is encouraging, challenges remain. A few, but not all, of these challenges include the high costs of CO_2 capture technology and long-term CO_2 monitoring, orderly development of close-proximity large-scale projects, lack of a clear process for using federal lands for CO_2 storage, and public acceptance. We encourage Congress to maintain a robust level of financial support for CCUS research that includes funding the existing Regional Carbon Sequestration Partnerships, which provide invaluable knowledge centers to our nation.

In terms of the Executive Branch of the Federal Government, we beseech a return to the all-of-the-above energy strategy for the United States, one that recognizes the importance of the environment, through lowering carbon intensity, as well as our economic and national security. We can immediately begin this effort by establishing policies that support developing and deploying commercial CCUS technologies.

None of the outstanding research and development work performed by the EERC would have been possible without the foresight of this key committee, your counterparts on the Energy & Natural Resources Committee and Appropriations Committees, and DOE. With your direction and leadership, I believe that we are

poised to continue our nation's progress toward broad, economically viable carbon management.

Thank you, again, Chairman Carper, Ranking Member Capito, and members of the committee for your invitation to provide these remarks. I would be happy to answer any questions you might have regarding my testimony and my views on carbon management.

Senate Committee on Environment and Public Works
Hearing Entitled *"Examining the Development of Projects and Implementation of Policies that Support Carbon Capture, Utilization, and Storage (CCUS) Technologies"*
July 27, 2022
Questions for the Record for John Harju

Ranking Member Capito:

1. Are there any regulatory risks associated with delaying the deployment of CCUS projects?

Decisions regarding the granting of states' applications for Class VI primacy seem to take a phenomenal amount of time. I think it is important to note the length of time for states to prepare and apply for primacy (preapplication process). This is a multiyear process that includes state legislation, EPA (regional and Headquarters) engagement, administrative rule making (12 months), etc., before a state can apply for Class VI authority. States are required to have Class VI stringency regulations codified before the primacy application can be submitted.

2. Are there any other federal issues impeding the deployment of CCUS projects?

Federal land access is a major impediment to projects in the western United States. NEPA-related matters pose additional challenges to implementation timelines. Finally, my team has had the privilege of running one of the DOE Regional Carbon Sequestration Partnerships (RCSPs) since 2003. Unfortunately, DOE has recently released Notice of Intent (NOI) DE-FOA-0002799 regarding FY2022 funding for that program. That NOI denotes DOE's intention to recompete funds for the RCSPs that were appropriated in FY2022. A similar competition was just completed following passage of the FY2019 appropriations package. This introduces uncertainty for teams such as mine, diverts our attention from aggressively pursuing projects, and delays the availability of federal funds that would otherwise support the numerous commercial partners that are engaged in the RCSP Program.

Senator Inhofe:

1. As we both support carbon capture, utilization, and storage (CCUS) projects, do you believe a "one size fits all" is the best regulatory approach moving forward?

    a. How can the use of CCUS be encouraged to consider local conditions and availability of resources prior to considering issues such as site selection?

1) I do not believe "one size fits all" is an advisable or viable regulatory approach.
    a. I believe that states should be encouraged to pursue primacy for the Class VI program. Securing primacy will facilitate local dialogue and decision making on the part of the public, the developer, and the most appropriate and knowledgeable regulatory jurisdiction. In turn, I believe local conditions and resource availability will have the highest likelihood of appropriate consideration early in project development.

Senator CARPER. We thank you. It was great of you to join us.

In terms of the questioning today, we are going to start off with Senator Whitehouse, Senator Capito, Senator Cardin, Senator Cramer, myself, Senator Lummis. We will start off with Sheldon, and then back to Senator Capito.

Senator WHITEHOUSE. Thank you so much, Chairman. I have a commitment in another committee.

Senator CARPER. We know what that is like.

Senator WHITEHOUSE. I appreciate you taking me out of turn.

It is really indisputable, right now, that we will overrun our climate safety barriers, particularly at 1.5 degrees, and because of that, we must be able to remove CO_2 from the atmosphere. Once you are out of the safety zone, going to zero emissions doesn't help you any longer. You actually have to claw back the excess legacy carbon dioxide to get to safety. That, to me, is just a given as we forge a pathway to safety here.

This is a pretty well established technology. I think the Boundary Dam Project in Saskatchewan kicked off in 2014 and proved the viability of carbon removal. Of course, they use it for enhanced oil recovery, which, to me, is a very disfavored use, because it plugs carbon back into the system after having removed it. And I think direct air capture, as the witnesses have mentioned, is absolutely essential, because again, you don't get to a positive outcome if all you are doing is stripping carbon dioxide out of carbon emitting smokestacks. Direct air capture has to be an absolute priority in this work.

In that framework, we have done some good preliminary efforts here in the Senate, good bipartisan preliminary efforts here in the Senate, to solve the fundamental problem of this industry, which is that it lacks revenue. It is really hard to get innovation happening if there is no reward for the innovation. If there is no revenue proposition at the end of the day for the people who invest in, design, and build these plants.

So we have done that through 45Q. We have done that using public tax deductions as the revenue source, but obviously, that is limited to the scope of the program. I hope to see it continue to grow, but at the end of the day, it is still going to be a limited program compared to having the market operate the way it should.

I also have a CDR bill with Senator Coons that I hope will be able to move pretty quickly, where the U.S. Government comes in in its proprietary capacity as a buyer of carbon. Those are two ways, by making the U.S. a customer and by providing tax benefits, that we can begin to establish at least the framework for a revenue proposition that gets us through some of the early stage incubator moments that this industry needs.

At the end of the day, the real solution has to be carbon pricing. Without that, you take away from the market the market signal. I think that if you connect a carbon price to carbon border adjustment, what you end up seeing is huge net value for the American economy. Because the carbon border adjustment, even if we do nothing and just pay the tariff, let's say, to the EU when CBAM comes, let us just say we are losers, and we don't keep up, and we just pay the tariff. On balance, we are still winners because al-

though we lose in the tariff exchange with the EU, we gain an enormous amount, because the EU is also tariffing China.

It is also tariffing India. It is tariffing other countries where manufacturing takes place, and it is creating a price differential that will cause a move of manufacturing to the United States. And that is a win for the American economy. So at the end of the day, if we don't get carbon pricing and carbon border adjustment done, we are just whistling. We like to talk big on innovation here, but you can't do innovation while stifling the policies that give innovation its oxygen, which is a revenue proposition.

If I could ask, in the seconds remaining, Mr. Albritton or Mr. Townsend, to say a word on the importance of having a robust, lasting market revenue proposition to support this industry.

Because my time will run out, maybe if we do that as a question for the record to all the witnesses. If you would like to comment on what I have said, I would appreciate it. That answer, in writing, will go into the record of this hearing, and that way, I won't have to hold up my colleagues any longer. Would that be all right?

Mr. ALBRITTON. Yes, I would be happy to do that.

Senator WHITEHOUSE. Great. Much appreciated. Thanks for being here. We have a big bipartisan opportunity, and I look forward to taking advantage of it. This Committee can forge compromises that will make a big difference.

Senator CARPER. Thanks for that tutorial. We look forward to the responses from our witnesses.

With that, Senator Capito, your turn.

Senator CAPITO. Thank you, Mr. Chairman.

Mr. Lanclos, it is clear from your testimony that there are a number of projects that are looking to locate in Louisiana because of how Louisiana has translated its expertise in oil and gas development into expertise on carbon capture and storage. Are companies looking at geologic storage onshore and offshore? How is that split?

Mr. LANCLOS. Thank you, Senator Capito. At the present time, the State has two pore space agreements, one with a major hydrogen facility and another with a sustainable aviation fuels facility that are both located on State land. Those were two of the first pore space agreements that were done in the State, very innovative agreements that have kind of set the standard for going forward on how that is going to look.

We have interest in offshore. Right now, we are working with our Federal family to try to look at how that permitting structure is going and what agency is going to be leading it. So right now, we have 3 miles offshore we can currently inject carbon dioxide. We do not currently have any projects that are looking specifically at doing that, other than right now, just kind of saying that this might be a viable option.

We haven't done pore space agreements, but we have interest, mostly, from our LNG facilities in western Louisiana that are looking at doing offshore. But most of the interest, I would say probably 90 percent, has been on onshore, in terms of injections right now. But we are looking at long term management of making offshore resource something that we can put carbon dioxide into.

Senator CAPITO. Thank you. Could you also discuss what having the proximity to conventional oil and gas operations like refineries and petrochemical facilities affects the economy of scale of CCUS? We know how expensive it is. Does this proximity also provide you with a ready work force, since there is a custom to working in the kinds of projects and environment?

Mr. LANCLOS. Absolutely. Our industrial corridor provides what I would call an unprecedented opportunity, because most of the source material is located in a geographical area where the sinks are located. So investment and infrastructure will still have to happen, but the piping distances aren't hundreds of miles. We are talking about probably 10 or 20 miles, so that helps tremendously when the pore space is located close to it.

As we are looking at decarbonizing with 62 or 63 percent of our emissions coming from the industrial corridor and all of our industry combined, it is very helpful for us to have these sources located close to each other. So we are hoping that, as we continue to roll projects out, that we can start getting facilities into really the mindset to take carbon dioxide out and potentially to bring hydrogen into those facilities to help with long term management of emissions.

I think that, for us, that has been really strategic in terms of how we are looking at projects. We have had a lot of developers that have put information together that are looking at really coupling sources across that whole corridor.

Senator CAPITO. Do you have any projects of enhanced oil recovery using carbon net going on right now?

Mr. LANCLOS. We do. My understanding is that we have three, I think, two still being active, so one is in an agreement. Most of the interest that we have seen in terms of CCUS has been, I would say that probably 98 percent has been on geological storage. So there are some opportunities, I think, in the Haynesville Shale, where operators potentially have looked at EOR, but the bulk of our interest is in geological storage.

Senator CAPITO. Mr. Harju, congratulations on North Dakota being the first State in the Nation to get the primacy on the Class 6 wells, so well done. Thank you for mentioning our State. I know we are interested in this.

How has that specifically helped your State, and is it encouraging more additional project development? Has it increased efficiency in moving projects along? What kind of effects are you seeing since you were able to make this achievement?

Mr. HARJU. Thank you for the question, Senator Capito. Yes, we have seen pretty substantial proliferation of project proponents in the State. At this point, the State has already issued three facility permits. We have our first commercial project operating. We have about a half a dozen more permits either with a decision pending or permit applications ready to be filed. So these range from power generation to backside of gas processing to ethanol facilities, and from facilities bringing CO_2 in from out of State.

Senator CAPITO. You mentioned you have one that is presently working. Is that correct?

Mr. HARJU. Yes.

Senator CAPITO. Could you describe that one, just for a good example of how this is moving? Could you describe that one for me?

Mr. HARJU. Yes, Senator Capito. The first Class 6 well operating in the State is associated with an ethanol producing facility, namely the Red Trail ethanol facility near Richardton, North Dakota. We also have a series of Class 2 wells where CO_2, and both of these were mentioned by Senator Cramer earlier, but Denbury Resources is injecting CO_2 into one of our most prolific formations in the State for enhanced recovery. We expect many tens of millions of tons of CO_2 to be stored in conjunction with that project.

Senator CAPITO. Did you have to build new pipelines to carry the CO_2?

Mr. HARJU. Senator Capito, yes. The pipeline from Wyoming into southwestern North Dakota was recently extended by about 125 miles from southeastern Montana, actually, from a project that my team had worked closely with Denbury on since 2000, well, Denbury's predecessor, Encore Oil and Gas, since 2005. So we have been at this a very, very long time.

Senator CAPITO. Right, thank you.

Thank you, Mr. Chair.

Senator CARPER. You are welcome. Thank you very much.

Senator Cardin, please.

Senator CARDIN. Thank you, Mr. Chairman.

Let me thank all of our witnesses for this very important hearing. I am very proud of the work being done in the State of Maryland. The Maryland Legislature passed a pretty aggressive plan to deal with carbon emissions, reducing greenhouse emissions by 40 percent by the year 2030 and to reach 100 percent clean electricity by 2040.

I might say that is well ahead of the commitments that we have made as a Nation in regard to the international climate meetings.

We know there is not one particular way that we can reach those targets, so CCUS is a very important part of the overall strategies for Maryland and for our Nation in regard to carbon. As we point out, there is no one tool. I just want to associate myself with Senator Whitehouse's comments. A price on carbon would not only accelerate CCUS; it would accelerate our ability to reach our carbon goals.

I want to talk about a couple other issues here. In Maryland, we have put a good deal of confidence in restoring wetlands. Wetlands are a natural ability to sequester excess carbon. To me, it is low hanging fruit. We have used our dredged materials to restore Poplar Island and now Mid-Bay, which we have been able to get a recognition of the economic benefit, environmental benefit cost associated with traditional locations for dredged sites. We have also now looked at using dredged material in Blackwater to restore the wetlands in Blackwater. And yes, it will have a plus advantage from the point of view of the environment generally, but it will also sequester carbon as part of this.

So, Mr. Albritton, let me just ask you, if I might, as we look for ways to sequester carbon, shouldn't we look at ways in which we can utilize restoration projects such as wetlands as a way to assist us in reaching these goals?

Mr. ALBRITTON. Absolutely. I think, as you pointed out, we need all of the solutions, and natural solutions are a key part of that. The Nature Conservancy's own research shows that up to a fifth of our emission goals by 2030 can be achieved by these natural solutions. That includes restoring our wetlands, better management of our forests, reforestation, also agricultural lands, storing more carbon in the soil. We see a lot of opportunity here. These can complement the technological solutions we are talking about today, but we definitely need all of them, and it is a smart place to start.

Senator CARDIN. I would also suggest an area that might be a little more controversial. We should look at the NEPA process and use that to establish the real cost associated with transportation infrastructure, including its impact on climate. That would be, I think, a good start also, using another tool to help us reach these goals on carbon emissions.

In Maryland, we have also worked in conjunction with six other States in regard to the Midwest Regional Carbon Sequestration Partnership. Mr. Albritton, you may want to comment on this as to how States can work together to advance new technologies and knowledge and how the Federal Government could encourage that type of cooperative efforts among our States.

Mr. ALBRITTON. I think that is absolutely critical when we think about how we are going to transition to these cleaner technologies. Transport of CO_2 has come up a few times. That inevitably crosses State lines in many instances, so that coordination is critical. I think the Federal Government can play an important role in trying to bring States together and foster that collaboration.

One of the provisions in the USE IT Act that was already mentioned is this idea of these task forces to look at some of these issues and get regional input into how we can do that better. So I think there are a lot of opportunities there, but while State leadership is important, we have got to look beyond one State, too, and how States can work together to advance some of these technologies and some of these solutions.

Senator CARDIN. Thank you.

Mr. Chairman, I think my point is this: We do need Federal policies. They are critically important. We need our States to innovate, as we have seen in Louisiana and other States. We need regional compacts in order to work together in regions, and we need the private sector helping us if we are going to be able to reach our targets on carbon emissions.

I thank our witnesses for their contributions to this debate.

Senator CARPER. Senator Cardin, thank you for those questions, and thank you for your leadership on these issues. It is so important. You are so thoughtful, really, and inclusive as we approach this challenge.

OK. I think, next, North Dakota.

Senator Cramer, thank you.

Senator CRAMER. Thank you, Chairman Carper, again, and I thank you, witnesses.

I want to add one point to the Denbury example that John Harju talked about in response to Senator Capito's question, especially since my friend from Wyoming is sitting right next to me, that that example actually generates now net negative carbon oil in North

Dakota, as a result of injecting into old wells. A very important point, I think, that we haven't brought up yet.

There are so many things I want to get to, but Mr. Harju, I want to ask you, Senator Whitehouse talked about a value proposition, which we know he is talking about some sort of profit opportunity in all of this.

With regard to the tax credit system, there are different values. Not every credit is created equally. Not every carbon reducing technology is created equally. Have you ever done an analysis on the benefit of, say, a 45Q credit versus a credit for, say, electric vehicles, for example, in terms of a dollar per ton or a ton per dollar comparison?

Mr. HARJU. Senator Cramer, yes, thank you for the question. Actually, I was recently asked to give a comparative assessment of a conceptualized $10,000 ton EV credit in terms of what that would equate to a ton of carbon basis. My valuation gave me a price of somewhere between $200 and $300 per ton of CO_2 avoided over the life of that vehicle. The average vehicle, if you consider that they are going to run somewhere in the neighborhood of about 120,000 miles, that they will have a fuel efficiency of about 23 miles per gallon, a gasoline fired vehicle will emit about 50 tons of CO_2 over its entire lifetime.

Electric vehicles are not zero, so considering that they take their power from the grid, if you used just normalized grid signatures, and the fact that there is a life cycle associated with production of batteries and so on, they will actually emit somewhere in the neighborhood of about 15 tons of CO_2 over the life of that vehicle, again, on a normal life.

So, your net savings would be about 35 tons and at $10,000, you are approaching $300 a ton there.

Senator CRAMER. So, versus a 45Q, which is today?

Mr. HARJU. Fifty dollars a ton for geologic storage, $35 for CO_2 stored in conjunction with a——

Senator CRAMER. So even if we went up to $80, it would still be a bargain?

Mr. HARJU. I think it would be a relative bargain.

Senator CRAMER. Yes. I want to also follow up with something Senator Capito asked you about, and that is, of course, the primacy that North Dakota has, now Wyoming has, and others are trying to get. Since you work across the country and with the Federal Government, can you give us a little bit of a comparison as to why is this primacy important to a State, what is the benefit versus, say, States that don't have it, versus say, the Federal Government's response to all of this?

Mr. HARJU. Sure. Well, I think the proof is in the permits. To the best of my knowledge, I believe the Federal Government has issued one Class 6 permit. The State of North Dakota has issued three, with several pending. We have only had that primacy since 2017.

Senator CRAMER. So, why is that, do you think? Why is the State doing better than the Federal Government?

Mr. HARJU. I think, in the case of States, they are much more familiar with their local geology and the opportunities that the State affords. Regardless of the permitting authority, the Federal

oversight is really on the wells themselves. So the Class 6 Program really does not deal with pore space access and some of the other ancillary things that are necessary for the construction and operation of a CCUS site.

Our State actually passed comprehensive geologic storage rules prior to the existence of the Class 6 Program, and ultimately, needed to go secure that primacy, even though we previously had fully comprehensive rules, including pore space ownership, unitization provisions, et cetera.

Senator CRAMER. How long does the permitting process take?

Mr. HARJU. In the State of North Dakota, the average thus far for each of those permits has been 7 months. My recollection of the one Federal permit was on the order of 5 or 6 years in the State of Illinois.

Senator CRAMER. Can you, in the remaining seconds, explain how EOR actually functionally works, the amount of carbon storage compared to the downstream emissions from oil produced? Because that is part of the program that is most controversial.

Mr. HARJU. Absolutely. Denbury has done a fairly extensive analysis of their own operations. They estimate that roughly a quarter of their operations, especially those that are industrially sourced or anthropogenic CO_2, that each of those is a net carbon negative oil production operation.

So our own research at the Bell Creek Field in southeastern Montana further verifies that long term secure geologic storage. Our average stored volumes over the course of a project suggests that it is going to be on the order of approximately one-half ton of CO_2 stored for each barrel of oil produced.

Senator CRAMER. Thank you.

Thank you, Mr. Chairman.

Senator CARPER. Thank you.

We have been joined by Senator Kelly, and I am going to recognize Senator Kelly, and then we will come right to you, Senator Lummis, OK?

Senator Kelly, welcome.

Senator KELLY. Thank you, Mr. Chairman.

I ask for unanimous consent to change the temperature in this room through the thermostat.

[Laughter.]

Senator CARPER. I object.

Senator KELLY. I have heard of these things, and they work pretty well.

Thank you.

Mr. Albritton, good morning, and thank you, all of you, for testifying today. This question is for Mr. Albritton and Mr. Lanclos.

I want to begin with the two of you.

As many of you know, I supported efforts to permanently reauthorize the FAST 41 permitting process, which I believe is a critical tool that helps large projects navigate the Federal permitting process, which can be rather complex. It is especially critical that the Federal permitting process doesn't needlessly delay projects that can help us fight climate change, which is why I am glad that the USE IT Act clarifies that carbon capture, utilization, and storage, or CCUS, projects are eligible for the FAST 41 process.

Mr. Albritton and Mr. Lanclos, can each of you speak to the potential benefits associated with allowing carbon capture projects to utilize the FAST 41 process?

Mr. ALBRITTON. Sure. I think the FAST 41 process offers a lot of opportunity for these types of projects. It was actually legislation that I was deeply involved in when I was a staffer on this Committee, and I see the value of what it can do, because it encourages agencies to get together early and to coordinate permitting instead of doing it sequentially.

I think that type of coordination, as I highlighted in my testimony, can really help project approvals be much more efficient so that we don't go agency by agency by agency, but we kind of get together up front, figure out what the requirements are, and then try to do that in the most efficient and coordinated way possible.

Mr. LANCLOS. Senator Kelly, thank you so much for your question. I think that Mr. Harju really articulated the point very well, that there haven't been many Class 6 permits that have been filed in the United States thus far, so the numbers are very, very small. If we proceed with what we are doing in Louisiana, we think that that number could be in the neighborhood of 25 to 30 permits in the next 2 to 3 years, so rapidly changing how quickly we need to assess these permits.

Our big area of emphasis thus far has been, obviously, to try to get regulatory primacy, because we feel like we have an extensive staff who can really look at the geology and try to make these decisions more quickly. In addition, we also have the opportunity to get outside help to come in and bring this.

What FAST 41 brings to the table for us is exactly what was articulated by Mr. Albritton; the Federal coordination and agencies working together early and consulting with us and working through these projects would help tremendously. Because the workload is obviously going to change based on the level of interest.

We really feel, to be able to make an impact and to get these projects out of the door, developers and folks who are doing these projects, they are very capitally intensive, and we have to make sure that they have clarity in terms of how quickly these permits can be turned around. We cannot afford to review them in 5 and a half to 6 years. So focusing on resources and making sure that folks are coordinating needs to be first and foremost in this process.

Senator KELLY. Do you think OMB and the Council of Environmental Quality have done enough to allow projects to take advantage of this process?

Mr. ALBRITTON. To my knowledge, I don't think a carbon capture project has yet stepped forward to take advantage of the FAST 41 process, and it is really on the project developers to come forward and request to be part of that, so I think that is something that is needed.

I do think the actions taken in response to the USE IT Act by the Council on Environmental Quality, to issue guidance to agencies to how to think about this is an important step forward. Obviously, there is always more that can be done, but that is a good start on this topic.

Mr. LANCLOS. I think, in addition, I have heard that the two task forces that they are talking about, in terms of looking at offshore

and onshore storage, I think that there is going to be a lot of interest in terms of moving both of those forward very quickly. I think that CEQ just leading that effort and making sure that the right partners are in place, land rights and pore space continues to be first and foremost when we are looking at siting projects.

So obviously, we have a lot of State lands, but obviously, when we start to look at offshore, we need to make sure that resources are in place and we have a very clear understanding of what the Federal process is for injecting carbon dioxide in offshore waters.

Senator KELLY. Thank you. I appreciate that, and thanks again for being here.

Mr. Chairman, I yield back the remaining 14 seconds.

Senator CARPER. We are happy to have them back.

Senator Lummis.

Senator LUMMIS. Thank you, Mr. Chairman, and thank you, Ranking Member Capito for hosting this hearing.

Senator Cramer and I have been sitting here, proud of our two States and their leadership in carbon capture, utilization, and storage. There has been a lot of forward thinking in your State, mine, from policy leaders. The University of Wyoming School of Energy Resources, the Wyoming Energy Authority have been involved with you all in North Dakota, and you are making real, genuine progress. Substantive goals are being met. Thank you for that.

My first question is for Mr. Harju. Thank you for your testimony. I understand, from Dr. Holly Krutka at the University of Wyoming, that in a few days, we will be calling you Dr. Harju. So congratulations on that.

I want to focus on one aspect of CCUS with my questions, and that is geological storage. Mr. Harju, you mentioned in your testimony one of the challenges to expanding geological storage is the complicated legal and regulatory regime around pore space ownership and long term stewardship. So can you talk a little more about what North Dakota and Wyoming have done to address these challenges, particularly around long term stewardship?

Mr. HARJU. Thank you for the question, Senator Lummis. Yes, North Dakota and Wyoming have had a wonderful working relationship for a long period of time. I am delighted to call Dr. Krutka a friend and colleague. And our States have shared our experiences over time, and copied one another's successes and avoided one another's misses. Anyway, it has always been a pleasure.

With respect to long term liability, North Dakota established a long term liability trust fund because of concerns that companies may not be around in perpetuity, and the fact that a trust fund would be a reasonable way to manage any long term stewardship associated with CCUS projects.

The way that this works in the State of North Dakota is companies pay into this trust fund over the life of their project. The fee is set administratively and based on, essentially, you could almost contemplate it like a State run insurance fund is the way I would look at it.

In North Dakota, after a 10 year post-closure monitoring period where the site is carefully monitored at the expense of the project developer and operator, the State is authorized to take title to that

injected CO_2. I believe the similar program in Wyoming has chosen a post-closure monitoring period of 20 years as the default.

Senator LUMMIS. Thank for your explanation. I think this is part of the example of the forward thinking that is going on in expanding geologic storage, so good on you. Good on our States, and I am proud of the work you are doing.

My next question is for all witnesses. Should the CEQ support expediting CCUS permitting as a way to encourage and support carbon capture?

Mr. ALBRITTON. I think there are always opportunities to be more efficient in permitting, and I think CEQ in its guidance laid out some opportunities on how we can do that, by regional approaches and other tools that they have. I think that has to also be balanced with making sure we are doing thorough reviews and getting strong community engagement in those reviews so that we get good outcomes at the end of the process.

So I think we can achieve both, and I think that is the right direction to go.

Mr. LANCLOS. I agree very much with Mr. Albritton's comments. I think that, again, that coordination and communication both from all Federal agencies with the States is absolutely essential to moving these projects forward. These permits are extremely labor intensive. We understand that the modeling and the geophysical aspects for a Class 6 is some of the most extensive that is out there right now. So having folks at the table working together is absolutely essential, so yes, thank you very much.

Mr. HARJU. I would concur. I would especially urge the Federal Government to work toward a responsible means of permitting and accessing Federal pore space. It is a really big issue as you get to the west.

For instance, in Senator Lummis's State, roughly half of the State is under Federal pore space ownership. Right now, I do not see a means of accessing Federal pore space to do these kinds of projects. So when we see Federal pore space on the map in North Dakota, as we contemplate projects, we step away from it, because we see it as more of a risk factor than an opportunity.

Senator LUMMIS. Yes. Great point. Thank you all for your testimony.

Yes, sir.

Mr. TOWNSEND. If I may, sorry. Just sort of chiming in here remotely. I think, just to underscore, I think this is an area of real agreement. It is also certainly true that, in order to meet climate goals and grow the economy, we have to be able to build a wide range of clean energy and zero carbon infrastructure, including CCUS infrastructure for transmission, et cetera.

It is also true, I think, that a growing number of organizations on both sides of the political spectrum acknowledge that the system we have in place is not currently working. And so the good work being done by folks, for example, at the Federal Permitting Improvement Steering Council to promote transparency and coordination in partnership with CEQ is going to be really critical.

And it is our view that there are certainly opportunities to improve the current system in ways that still protect the vital community and environmental interests while also allowing the coun-

try to build the infrastructure we need for the net zero transition. Thank you.

Senator LUMMIS. Thank you, gentlemen. I appreciate your testimony.

I yield back.

Senator CARPER. Thank you, Senator Lummis.

We have been joined by Senator Ernst.

Great to see you again, second time today. Welcome. You are a great, faithful attender of these hearings. We are grateful for that.

Senator ERNST. Thank you, Mr. Chair. I really appreciate it.

Thank you to our witnesses for being here today, as well.

Mr. Harju, biofuels have really enabled the U.S. to cut emissions from the transportation sector for over a decade. Between 2008 and 2020, the RFS saved nearly 1 billion metric tons of carbon dioxide equivalent greenhouse gas emissions, and it is only getting cleaner at this point.

Biofuel can further reduce greenhouse gas emissions with carbon capture and sequestration technologies and on farm conservation practices, which many of our Iowa farmers are actively engaged in.

Mr. Harju, in your testimony, you mentioned a need for an energy strategy to recognize the importance of the environment through lowering carbon intensity, as well as our economic and national security. Can you talk more about why CCUS is such a key part to that all of the above energy strategy?

Mr. HARJU. Absolutely. Thank you for the question, Senator Ernst.

In fact, I will offer a quote from our Governor, Governor Burgum. We can reach carbon neutrality in the State of North Dakota by 2030 without a single mandate, without any additional regulation, and we can get there through innovation and the geology that we have. This has been a fundamental tenet of how North Dakota will be a carbon manager.

Ironically, some of that carbon dioxide that we intend to manage would actually be born in the State of Iowa, so one of the project proponents and a client of my team is looking to gather carbon dioxide from 30 different ethanol plants, many of which are in your State, and move them up into the State of North Dakota, picking up CO_2 in South Dakota and the State of Minnesota as well. So that really goes to that importance of a pipeline system that would take carbon dioxide from places that did not have geology that is favorable for direct storage of CO_2 to places that are.

Senator ERNST. I appreciate that. I am a farm kid, too, and I am very familiar with the crossover between our energy and our agricultural sector.

What is really exciting to me about the CCUS technology is the ability to intertwine that carbon in that relationship. As you stated, in your home State of Louisiana, Governor Edwards has made carbon capture a priority for his administration.

Maybe describe a little more of that to me, if you would, please, but how has Louisiana really been working with those landowners to ensure them the support of those CO_2, and yes, this is for you, Mr. Lanclos, to ensure that broad support for CO_2 pipelines and avoid using eminent domain? Because right now, that is an issue.

I know that through some of our farmland, our ag land, we have experienced those that are using eminent domain, those that are trying not to use eminent domain. So, if you could just address that, that would be good. Thank you.

Mr. LANCLOS. Absolutely, thank you so much, Senator Ernst, for your question. About 3 years ago when we started with this process, early engagement is absolutely critical. So, we have a couple of associations, one, the Louisiana Landowners Association, where we did a series of presentations. Our executive council actually created a committee which brought in landowners and folks who are actually using pipelines or potentially were looking at permitting pipelines to really look at ownership issues and look at siting.

So I think that that committee was instrumental in really educating folks in terms of what these projects look like in terms of what we would need. We are fortunate that we already have a number of CO_2 pipelines that traverse the State. But obviously, there will be a need, as we move forward, for more.

I think that early and often engagement is absolutely essential in working with landowners so that they understand that these projects are critical and what their overall intent is doing in our State. We have continued to do that, and I think that the committee has been very successful in really educating folks about it.

Senator ERNST. I appreciate that. I think education is key to everything and making sure that the folks engaging in the project are well advised on how it will impact them, and of course, our future with the new technologies that are coming out.

I really appreciate the hearing today. Thank you to our witnesses. Thank you so much. I really appreciate the input.

Thank you, Mr. Chair.

Senator CARPER. Senator Ernst, thank you so much.

I think everyone else has had a chance now to ask at least one round of questions. I have several questions of my own, and then I am going to yield to Senator Capito, and see if anyone else shows up to join us.

This has been a wonderful hearing so far. I knew it would be, and you haven't disappointed. You haven't disappointed at all.

The newest climate assessment report issued earlier this year by the United Nations International Panel on Climate Change is clear. Carbon capture, utilization, and storage technologies are not the only answer to climate change, but it must be part of the climate solutions. I am going to say it again. Carbon capture, utilization, and storage technologies are not the only answer to climate change, but must be part of the climate solutions.

More specifically, the report suggests that to limit global warming to 1.5 degrees Celsius by the end of this century, we need global usage of carbon removal technologies like direct air capture.

This will be a question, I think, I will ask for Mr. Albritton, Mr. Townsend, and Mr. Lanclos. Your testimonies identified the importance of CCUS in our battle against climate change. Would each of the three of you please take a moment and speak to the need for additional large Federal investments in CCUS and other zero emitting technologies so that these technologies are able to be deployed quickly into our economy?

In your answers, please discuss the cost to every American and to U.S. businesses if we fail to make significant investments in climate solutions this year.

Mr. Albritton, do you want to lead us off on that question, please? Thank you.

Mr. ALBRITTON. Sure, happy to. I think, as I highlighted in my testimony, we have had a lot of progress, so that Infrastructure Investment and Jobs Act invested 12 billion in carbon management technologies. That is a strong foundation, but we definitely need more. The 45Q tax credit, for example, is an important additional policy to continue to drive investment, and we need long term extension of that.

There are a range of other clean energy technologies, from renewable energy to hydrogen that was discussed, that also need that same type of Federal investment if we are going to see it scale up, and we are going to have this transition happen in a quick way.

I think there are clear economic benefits of doing that. There is the economic costs that are avoided if we avoid those impacts of climate change. You highlighted a number of them in your opening statement, Senator Carper, that cost to communities, to taxpayers, whether it is floods or wildfires, that is a cost savings if we avoid this.

But these investments can create jobs and create jobs for communities, and so I think it is important to realize that there is an economic benefit of these types of investments that we can realize, and if we don't make those investments, we are leaving all of that on the table.

Senator CARPER. All right, thank you.

Mr. Townsend.

Mr. TOWNSEND. Thank you for the question, Chairman Carper. I think, as Jason pointed out, the investments made as part of the Bipartisan Infrastructure Law are a really crucial down payment on the future of CCUS and carbon removal technologies. There is more that we could be doing, in terms of RD&D, including things like increasing the efficiency of separation technologies, regeneration and reuse of materials used to capture carbon dioxide, the potential of hybrid separation systems. Utilization is going to be a really critical opportunity on the research side to really expand markets for these products.

I also want to pick up on the second part of your question, which Jason also touched on, which is about the need for broader investments in these technologies. There is a lot more that we could be doing on the hydrogen front and more broadly, as well.

You mentioned during your opening remarks some of the work the NOAA has done on weather and extreme weather and climate related events. We have already had more than nine events with losses exceeding $1 billion this year in the United States, which is greater than the average between the years 1980 and 2021. So we are already seeing the impacts of climate change. These investments do pay a dividend in terms of reducing those long term costs and impacts to communities.

But also there is the low carbon economic opportunity that could be as great as $26 trillion, globally, by 2030. If we want to take advantage of that opportunity and reduce the cost of extreme

weather, this is really the moment for policymakers to take significant steps to invest in that future.

Senator CARPER. Thank you, sir.

Mr. Lanclos.

Mr. LANCLOS. Yes, sir. Chairman Carper, fantastic question, because I think what we are seeing as well in working with DOE and some of our other Federal partners, they are estimating that we need in the trillions of dollars for decarbonization. So every program that we put forward, we are going to develop efficiencies. We are going to develop economies of scale. Manufacturing is going to get better. We are going to get better at producing hydrogen. We are going to become more efficient.

But with CCUS, it is absolutely critical that we get the cost down. I think that for us, we have done a lot of economic analyses and understood that there are some challenges to get there. The $50 per ton is fantastic, but a lot of industries that are hard to decarbonize will need more funding to be able to get those costs to where they are in a manner where they can rapidly deploy this technology.

In Louisiana, where we have so many industrial emissions, getting those costs down is going to be absolutely essential because we want to make sure that these projects can be beneficial in the long term, but also be financially viable.

Senator CARPER. Thank you. I am going to hold my questioning there and hand it back over to Senator Capito. I have some more questions, but Senator Capito, please.

Senator CAPITO. Thank you, Mr. Chairman.

I would like, Mr. Lanclos, to follow up from where you left there. To make the 45Q tax credit more beneficial and to be able to deploy these technologies faster and make the projects go faster, there has been some discussions of direct pay of the tax credit. Do you think that that is something that we should seriously look at? Do you have an opinion on that?

Mr. LANCLOS. Thank you, Senator Capito. As I mentioned in the earlier testimony, in terms of economic analyses, as we were going through the process of looking at the cost per ton, the 50 versus 85 when that was still in play, one of the analyses that we saw showed that if we got to even $85 to $90 per ton, that potentially almost 90 percent of the industry in the State of Louisiana could potentially utilize carbon capture, utilization, and storage to where the economics would make sense.

I think that for us, $50 is a tremendous start. It looks at, probably, and brings about 48 percent of industry to the table. But in addition, what gets left behind, I think, in the conversation sometimes is some of the smaller operators and the smaller industries that don't have a lot of tax liability and don't potentially have as much use for tax liability, where direct pay would be a lot more beneficial.

So I think that, for us, many of the companies that we have spoken to have said that that could be an absolute game changer in terms of if it is still $50 a ton, direct pay would be tremendously beneficial to them getting deployment of CCUS projects earlier rather than later.

Senator CAPITO. Thank you. Let me ask a question about, there was some initial discussion, I think, in several of your statements about communities that have been heavily impacted by emissions. There has been some discussion in this Committee as well as to how to help those communities.

In my view, I think that industrial use of carbon capture is a tremendous way to help those communities, obviously, from CO_2 emissions. But isn't it also a way to, if carbon capture is occurring at an industrial site, say, a refinery is next door to a disadvantaged community who has been living there forever, are there other pollutants that are removed as you are cleaning up the carbon, are you cleaning up other things as well? Is that the case?

Mr. Lanclos, I will go back to you.

Mr. LANCLOS. Sure. So, Senator Capito, I have seen some preliminary analysis that shows that carbon capture, even amine based carbon capture, potentially significantly reduces criteria pollutants, in addition to particulates. So we are hoping that in the next several months that the funding associated with these studies continues that really illustrates that data, because at the end of the day, I think that there are often associated things about carbon capture meaning that they think that facilities will rapidly expand and that the footprint and the operations will get larger.

I think that, for us, it is imperative that community engagement includes that this actually just includes a pipeline and an injection well that is taking carbon out of these facilities and putting it into storage in geological formations.

So I think that your point is very well received. The data that we have seen is very encouraging, and we are really hoping that these studies can really move forward that shows that these community impacts can be positive if CCUS is employed in these areas.

Senator CAPITO. Does anybody else have a comment on that, from the panel?

Mr. Albritton.

Mr. ALBRITTON. I would just say, it is important, I think the criteria pollutant issue is a really important one to look at. I don't think there is enough data out there right now, but I think it is primary for research because, and I think that is one of the key issues. Removing the carbon is great, and that has a huge environmental benefit. We shouldn't discount that.

But many of these facilities have ongoing issues with other air pollutants, and that just has to be part of the equation. I think, if we make that part of the conversation about where we deploy this technology, and importantly, get input from those communities that live there as part of the process and understand what their concerns are, I think that is also an important part of this, to make sure we are addressing these concerns.

Senator CAPITO. Thank you.

Senator CARPER. The Council on Environmental Quality recently issued CCUS guidance as directed by the USE IT Act recognizing the climate change benefits from CCUS deployment, as well as a possible public health and environmental impact, especially for frontline communities. Some of our colleagues have stated that CEQ's guidance does not adequately expedite the deployment of CCUS projects and has suggested that additional reforms are need-

ed at a time when Federal agencies are still developing best practices within existing permitting processes to support the deployment of CCUS.

Mr. Albritton, how do you think the implementation of the USE IT Act is going? Do you share CEQ's view that early public engagement and the CCUS permitting process is likely to lead to a more efficient approval process?

Mr. ALBRITTON. I think important progress has been made on implementation of the USE IT Act. We talked about a number of the provisions there, that we are seeing progress, including the guidance as well as the announcement this morning of nominations for the task forces.

I do think that, and this was in my answer to Senator Capito as well, that early engagement is really important in making sure that impacted communities are at the table early in the process. I think that is critical. I think the CEQ guidance recognizes that. That is an important part, because if we don't engage those communities early, that concern and the opposition to these projects will build, and that will ultimately delay deployment. And that doesn't serve any of our interests, so I think that is a critical piece that we really have to focus on.

Senator CARPER. Thank you. Just as a follow up, would more resources for the Federal as well as State agencies to review and to approve carbon management projects help expedite the permitting process, and if so, why?

Mr. ALBRITTON. Absolutely. Doing robust permitting, doing good community engagement, it takes resources, and we have to invest in that. I think we often think about investing in the technology or investing in other aspects, but discount this piece. But it is an important piece, and if we all share the goal of rapid deployment of these technologies, this is one of those places we have to put more funding into, and I think it often is not in the same discussion. We have to make it.

The Princeton Net Zero America Analysis that was released recently looked at carbon capture deployment, and they estimated that by 2035, we need to invest nearly $13 billion in stakeholder engagement, permitting, site assessment if we are going to deploy these technologies at the scale that we need. So I think that is a good indicator of why this is such an important issue and why we need significant investment in this.

Senator CARPER. All right. Thanks for that.

Mr. Townsend, if I could, I would like to address another question to you. Direct air capture is one type of CCUS technology that can remove existing CO_2 from the atmosphere, as we know. Direct air capture technology offers virtually unlimited carbon dioxide removal potential, if cost and other barriers can be overcome. This technology also has important advantages in terms of siting flexibility and scalability.

Mr. Townsend, would you take a moment, please, and describe for us some of the benefits of direct air capture technology in comparison to other carbon removal approaches? And what is maybe the most important thing that Congress can do, that we in this body could do in the near term to help direct air capture technologies be quickly deployed and commercialized to scale?

Mr. TOWNSEND. Thank you very much for the question, Senator Carper. I think there are really two chief advantages of direct air capture, and you touched on them, scalability and siting flexibility. Not only is this technology deployable at really significant scale, it can also be co-located in places where there is either excess renewable power or even excess nuclear capacity, as well.

I think the chief thing, the principal thing that Congress could be doing at this point was already a part of the conversation around the extension and expansion of the 45Q tax credit, which would be adding the $180 per ton credit via 45Q, which would really go a long way toward facilitating projects.

Additionally, some of the work that has been done around hubs that works to capitalize on shared infrastructure are also key. But really, the extension and expansion of 45Q, I think, would be the most significant priority.

Senator CARPER. OK.

Senator Capito, please, and then I have a couple more questions as well.

Senator CAPITO. I don't have any further questions, Mr. Chairman, but I do want to express my gratitude to you and to the staff of the Committee for putting this together. I think it is really refreshing to have a goal of cleaning the environment and decarbonizing where we can both, from each side of our aisles, because sometimes it would be very sensitive subjects, we can work to find solutions, and I think that is what we have heard today.

We have got some really good suggestions on ways that we can improve this. And I am very excited about the future of this. Thank you.

Senator CARPER. I am excited, too. My colleagues, certainly Senator Capito, has heard me quote Albert Einstein too many times, but among the things he said was, in adversity, lies opportunity. In adversity, lies opportunity.

People, my wife thinks I am too much of an optimist. I am an optimist, and I have always been an optimist. But I think there is a reason, as we face all this terrible climate crisis going on around the world, there is a real opportunity here. There is a real opportunity to take some of these ideas that we are discussing today and prove them and go to work on it.

Not only address the climate crisis, but also provide for economic opportunity, job creation, which for me is like, the golden, not the golden rule, but it is exactly where I want us to go.

OK. A couple more questions, if I can, and then we will wrap it up.

Maybe I can move to a question for the entire panel. I appreciate the perspectives the entire panel has shared with us. We appreciate the perspectives that you all have shared with us and the opportunities and some of the challenges for carbon capture utilization and storage. I hope that this dialogue can help inform thoughtful action to support the future deployment of CCUS innovation and deployment.

I would just like each of you to take a minute or two and tell us where you believe there is common ground among all of you on this panel. Senator Capito and I always try to come back to, where do we agree. There are plenty of areas where we can disagree, but

I always look for consensus among the panels, especially one as good as this one.

If you all would just give us your thoughts, where do we agree? Let us start on my left. Go ahead, please.

Mr. ALBRITTON. Sure. I think we have heard tons of agreement on this panel, which is encouraging. I think a couple of different areas that I have heard, one, I think the continued Federal support and investment in these technologies, whether it is the 45Q or other means, I think that is a pretty shared perspective, because it will be vital to continue to scale up these technologies in the years to come.

I also think that that idea of how do we better coordinate as we try to deliver this, so that we are getting all of the folks around the table, whether it is the State agencies, the Federal agencies, or the outside stakeholders. I think that is another shared priority, and I think we can do much more in that space. That is an opportunity.

Mr. LANCLOS. Chairman Carper, I think that at the end of the day, for us and as the panel has expressed, there is hope that we have solutions. I think that, for us, that is what is most exciting. I think that, for a State like Louisiana, we have gotten to the point where we have seen four and five record storms that have happened per year in the last several years. This gives folks an opportunity to say that, look, we are working toward solutions. We are working together. Folks are coming together to employ the best available technologies. We are looking at things from a very comprehensive lens, and we are thinking about our communities and making sure that they remain a priority and that folks understand why we have to make these investments.

I really appreciate your support and all your Committee staff's support to really put this dynamic legislation together to put 45Q in a position to really make an impactful change.

Senator CARPER. All right, thank you.

Mr. HARJU. Certainly, I can echo those comments. I would say growing the 45Q values at least commensurate with the kind of inflation we have seen. I know on capture projects that we have on the cusp of implementation, we have seen prices of steel up considerably. Total installed capital costs on one of the projects we have been working on has gone from right around $1 billion to almost $1.6 billion. So you see the effects of the monumental inflation we are experiencing, and it would be really nice to see that in the credit values as well.

I would urge anyone who can be helpful to help grow that primacy club and extend it to our colleagues in Louisiana and those other States who are eager to move forward with these kinds of projects.

Finally, I would just implore everyone, let us focus on emissions and carbon reductions, as opposed to on fuels themselves. I see a lot of discriminatory action regarding the sources of emissions as opposed to the things that we can do to mitigate emissions.

Senator CARPER. All right, one more. We have one more witness. Please.

Mr. TOWNSEND. Yes. Thank you, Chairman Carper. Thanks again, also, to you and to Senator Capito and your teams for hold-

ing this hearing. It is incredibly important in this moment. I would echo, among the panel there certainly seems to be a lot of agreement, and that is a very encouraging thing to see.

I think a few things stand out to me where there has been some pretty clear consensus, including the fact that CCUS and carbon removal technologies just have to be part of the solution to address long term climate mitigation. Second, that there are significant opportunities, economic opportunities to deploy these technologies and benefits both domestically and globally, presuming that there is early and continuous public engagement in working with communities.

The last area where I heard a lot of agreement, I think, which Mr. Harju just touched on, is policy is going to be really important to help not just drive these technologies, but really to attract the private sector investment that is going to be necessary to deploy them at the scale and speed that is needed. Thank you very much.

Senator CARPER. Thank you, thank you very much.

We have a little time here. I want to say, if you prepare for these hearings, and you prepare for probably much of your life, actually, and the work that you do is just so important.

We have asked some questions, and my colleagues have asked some very thoughtful questions, and you have provided thoughtful responses. Each one of you, starting off with maybe Mr. Albritton, is there a question that maybe you think could have been asked, should have been asked, that you would like to say, well, maybe you should have asked this one too, and here are my thoughts?

Mr. Albritton, why don't you go first? I don't believe we have asked every good question, so maybe you have another one.

Mr. ALBRITTON. It is always tough to go first on this one. I think we have covered a lot of the important issues around this technology and the deployment.

I think one issue we haven't focused on as much, because this hearing is about carbon capture, is how does carbon capture fit in with all of the other solutions that we have to deploy to address climate change. Clearly, it is an important tool, but I think that is an important question moving forward, and we have to look at this and a lot of different solutions if we are going to really address this problem.

Senator CARPER. Thank you.

Mr. Townsend, maybe one question you think we didn't ask that we should have asked?

Mr. TOWNSEND. Thank you. I think that I would be keenly interested in further discussion around the work force needs, in terms of the skills that are developed that has been touched on, the fungibility of skills in traditional fossil, oil and gas, and other sectors. I think really sort of building out a deeper set of knowledge about what it is going to take to facilitate and build the work force that we need to deploy these technologies would be an interesting area of discussion.

Senator CARPER. Good, thank you.

Mr. Lanclos.

Mr. LANCLOS. Yes, sir. At the end of the day, I think for us, one question would be as a State, we are advanced in our primacy application. But I think it is important for States that are considering

it to understand what resources and what is ahead of them in terms of how they can be successful in getting primacy and deploying CCUS in their States.

We have been trying very hard to work with other States to provide resources. I know Mr. Harju and his team have really been a great resource for us, as well as Wyoming. They have come to us and helped us with training. So I think that just making sure that States understand the process and have all of the associated resources for community engagement and also for staff.

Because again, if we are successful in deploying CCUS and we do get to a point where we have a multitude of permits that get filed, that last thing that we want to have happen at the end of the day is that there is a tremendous backlog. So making sure that resources are in place and that we have a plan to be able to move these projects forward and move these permits forward is absolutely essential.

Senator CARPER. Thank you.

Last, Mr. Harju, a question maybe we could have asked, should have asked, that you would like to share with us?

Mr. HARJU. Yes, I guess the one that I would think of is regarding the linkage between energy security and carbon management. In my opinion, you hear a lot about a carbon constrained future.

We like to think about a carbon managed future. As you look at the part of the world where we are from, economic activity and carbon utilization and in turn, emissions, are inextricably linked. Being able to effectively manage that carbon, I think, is our real challenge and our real opportunity. I guess that would be the one that I would focus on.

Senator CARPER. OK, good.

Senator Capito, any last thoughts?

All right. One of the questions I like to ask people, I am not going to ask you all, but one of the questions I ask people is, what gives them joy in their work or in their life? You know, more often than not, what people say is, I like helping people; that gives me joy in my life. One of the best ways we can help the people of this planet is to make sure we have a planet in the years to come.

The people of this country want us very much to find ways to work together to get stuff done, and this is about as important as anything that we are working on. There is a great opportunity for us to make real progress. I think it is an encouraging time that we spent together.

I just really want to thank Senator Capito. This is a great idea. I am so pleased that we were smart enough to say yes, that is a good idea.

I want to thank your staff, I want to thank our staff on the majority side, and everyone who has participated today.

It is clear that while we cannot meet our climate goals or decarbonize certain sectors of our economy without carbon capture, utilization, and storage technology, Congress must be ready. We must be ready to support rapid and responsible deployment and promote solutions that we just discussed here today for the last couple of hours.

We have been here for a few hours now, and in the last, Mr. Lanclos, in the last 2 hours, Louisiana has lost two more football

fields. I know it is a big State compared to mine, but eventually you run out of football fields. We have got to impart a sense of urgency for all of us.

Before we adjourn, a little bit of housekeeping. Senators will be allowed to submit written questions for the record through the close of business on Wednesday, August the 10th. We will compile those questions and send them out to all of you. We would ask that you try to reply to us by Wednesday, August 24th.

With that, with a deep sense of gratitude, this hearing is adjourned. Thank you so much.

[Whereupon, at 11:52 a.m., the hearing was adjourned.]

[Additional material submitted for the record follows:]

United States Senate
WASHINGTON, DC 20510

April 29, 2022

The Honorable Brenda Mallory
Chair, Council on Environmental Quality
The White House
1600 Pennsylvania Avenue Northwest
Washington, D.C. 20500

Dear Chair Mallory:

Thank you for prioritizing the development and release of the Carbon Capture, Utilization, and Sequestration Guidance, which was mandated under the Utilizing Significant Emissions with Innovative Technologies (USE IT) Act and passed as part of the Consolidated Appropriations Act of 2021 (P.L. 116-260). The USE IT Act demonstrates a bipartisan recognition that deploying carbon capture, utilization, and sequestration (CCUS) projects will be important domestically to support jobs and to reduce carbon dioxide emissions. We agree with the Council on Environmental Quality (CEQ) that "successful widespread deployment of responsible CCUS will require strong and effective permitting, efficient regulatory regimes, meaningful public engagement early in the review and deployment process, and measures to safeguard public health and the environment." Achieving these goals requires that CEQ's final guidance serve to "*expedite* the CCUS permitting process,"[1] as stated in the Committee report for the USE IT Act.

To do so, the final guidance must explicitly identify applicable requirements under the various federal statutes that apply to potential CCUS projects, address any duplication or ambiguity in how relevant statutes may apply to these projects—particularly carbon dioxide pipelines—and ensure a coordinated process for projects that could be operational in an efficient time frame. Further, CEQ should ensure that the requirements suggested in the guidance—such as enhanced emissions reporting and additional guidance for considering air quality impacts[2]—are designed carefully so as to weigh potential environmental impacts while also allowing for project decisions in a timely manner. We encourage CEQ to consult stakeholders and swiftly convene the task forces that are established by the USE IT Act to ensure the goal of expedited review.[3]

Additionally, the language in the USE IT Act states that the guidance "*shall include* direction to States and other parties for the development of programmatic environmental reviews."[4] Instead, the draft guidance states that "agencies should consider developing programmatic environmental reviews" without providing the specific direction required by the statute.[5] Before the guidance is

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[1] S. Rep. No. 116-38, at 5 (2019), https://www.congress.gov/116/crpt/srpt38/CRPT-116srpt38.pdf (emphasis added).
[2] Carbon Capture, Utilization, and Sequestration Guidance, 87 Fed. Reg. 8808 (Feb. 16, 2022), https://www.govinfo.gov/content/pkg/FR-2022-02-16/pdf/2022-03205.pdf.
[3] Utilizing Significant Emissions with Innovative Technologies (USE IT) Act, Public Law 116–260, div. S, §102(d)(2)(D), 134 Stat. 1182, 2243 (2020).
[4] *See id.* at §102(d)(2)(C)(ii)(II) (emphasis added).
[5] *Supra* note 2, at 8809.

finalized, we respectfully request CEQ provide direction on development of programmatic environmental reviews that is required by the law.

We appreciate your consideration of our comments on the Carbon Capture, Utilization, and Sequestration Guidance. Thank you for the Administration's continued interest in reducing emissions, supporting domestic jobs, and positioning our country to lead the way on CCUS development and deployment.

Sincerely,

Shelley Moore Capito
United States Senator

Sheldon Whitehouse
United States Senator

John Barrasso, M.D.
United States Senator

Joe Manchin III
United States Senator

Steve Daines
United States Senator

Tina Smith
United States Senator

Kevin Cramer
United States Senator

Mike Braun
United States Senator

EXECUTIVE OFFICE OF THE PRESIDENT
COUNCIL ON ENVIRONMENTAL QUALITY
WASHINGTON, D.C. 20503

The Honorable Shelley Moore Capito
Senator
United States Senate
172 Russell Senate Office Building
Washington, DC 20510

July 6, 2022

Dear Senator Capito,

Thank you for your letter regarding the Council on Environmental Quality's (CEQ) implementation of the USE It Act. As a result of this law CEQ has published a report on CCUS permitting and issued interim guidance for Federal agencies to help ensure that the development and permitting of Carbon Capture, Utilization and Sequestration (CCUS) projects, including carbon dioxide (CO_2) pipelines, is done in a responsible manner that includes community input and reflects the best available science. We have endeavored to do this in a timely, thorough way and I appreciate your feedback on our progress to date.

Your letter identified two key areas that will be important to ensuring CCUS projects can be responsibly built: The first is regarding what federal statutes projects can be expected to comply with to help enable a coordinated, efficient process. I hope you will be happy to know that Appendix A of our June 2021 report provides an inventory of Federal permits and reviews potentially relevant to CCUS. The report also describes how permitting a CCUS project is similar to the process for permitting any other industrial activity. The pathway for regulating CCUS projects, and the precise mix of permits and reviews needed, will be determined by the specific details of the project. For example, a project on Federal lands will need to comply with the National Environmental Policy Act (NEPA), the Endangered Species Act, Federal land management statutes, and other safety, environmental, and ecological regulations. The report also provided the relevant points of interaction with Federal agencies, clarified the permitting responsibilities and authorities among Federal agencies, and provided information regarding best practices for permitting CCUS in an efficient, orderly and responsible manner.

As indicated in interim guidance issued in February 2022, we are also currently working with the Federal Permitting Improvement Steering Council on establishing appropriate facilitating agencies and recommended performance schedules for general CCUS project categories.

You also raised the importance of Programmatic Environmental Impact Statements (EIS) under NEPA. As you may be aware, CEQ does not administer the NEPA process for agencies. However, we are taking steps to provide direction and coordination where appropriate. Our interim guidance makes clear our recommendation that agencies consider developing programmatic environmental reviews and provides specific examples of how programmatic EISs have facilitated more efficient and effective environmental reviews of multiple projects. This

process can provide assessment regarding environmental issues common to CCUS projects and facilitate the efficient preparation of environmental assessments for individual CCUS projects or components of such projects.

CEQ will continue to collaborate with agencies and monitor progress on activities and regulations related to CCUS. To that end, CEQ has been convening relevant agencies on a monthly basis to discuss progress and facilitate interagency cooperation and action regarding the efficient, orderly and responsible deployment of CCUS in the United States at increased scale.

President Biden has been committed to making CCUS a widely available, cost-effective, and rapidly scalable solution to reduce carbon emissions. He also firmly believes that responsible CCUS projects should engage communities and Tribes in co-development of projects and approaches; protect communities from pollution; and incorporate environmental justice and equity considerations, especially in communities that are already exposed to multiple pollution sources.

As Chair of CEQ, I appreciate your feedback on where we should seek further clarity on our approach to these issues, and have instructed staff to ensure we are providing technical assistance and expertise to the project developers and agencies on the front-lines of these projects.

Best regards,

Brenda Mallory
Chair
White House Council on Environmental Quality

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America's Cement Manufacturers™

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July 27, 2022

The Honorable Thomas Carper
Chairman
Environment and Public Works Committee
410 Dirksen Senate Office Building
Washington, D.C. 20510

The Honorable Shelley Moore Capito
Ranking Member
Environment and Public Works Committee
456 Dirksen Senate Office Building
Washington, D.C. 20510

Dear Chairman Carper and Ranking Member Capito:

The Portland Cement Association (PCA)[1] appreciates you holding the hearing titled Examining the Development of Projects and Implementation of Policies that Support Carbon Capture, Utilization, and Storage (CCUS) Technologies. 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 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

[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

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.

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, 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.

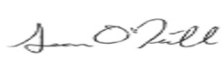
Given the challenges in decarbonizing the entire cement and concrete value chain, the cement industry will be unable to reach its carbon neutrality goal by 2050 alone. We can only achieve this goal with significant policy support from the federal government to assist with eliminating regulatory hurdles 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.

Further, cement manufacturers face the challenge of determining where captured carbon can be sequestered or how it will be utilized. Beyond the high cost of implementing carbon technologies at scale, necessary pipeline and energy grid infrastructure must be implemented to ensure that CCUS technologies can be employed. Implementing CCUS will require a national network of CO2 pipelines and electricity grids that can handle the loads required to operate CCUS units and, or hydrogen fuel and infrastructure to transport the hydrogen from the manufacturer to the cement plant must be in place. All these activities are 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 reform and investments toward 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

CARBON CAPTURE COALITION

Carbon Capture Coalition Statement for the Record

United States Senate Environment and Public Works Committee Hearing on "Examining the Development of Projects and Implementation of Polices that Support Carbon Capture, Utilization, and Storage (CCUS) Technologies"

July 27, 2022

The Carbon Capture Coalition appreciates the opportunity to submit this statement for the record for the Senate Environment and Public Works Committee's hearing on carbon capture, utilization and storage. Carbon management technologies are essential tools to achieving midcentury climate goals, while preserving and creating middle class jobs that pay family-sustaining wages, providing environment and other benefits to communities, and supporting regional economies across the country.

The Carbon Capture Coalition is a nonpartisan collaboration of more than 100 companies, unions, conservation and environmental policy organizations, dedicated to building federal policy support to enable economywide, commercial scale deployment of the full suite of carbon management technologies, which includes carbon capture, removal, transport, utilization, and storage. Widespread adoption of carbon capture at existing industrial facilities, power plants and future direct air capture facilities is 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**.

This statement outlines the current opportunities and challenges to realizing the full potential of carbon management technologies in relation to midcentury climate targets, domestic energy production, and high-wage job growth. This includes the need for robust federal policy support to enhance the foundational economic incentive provided by the federal Section 45Q tax credit, the key role Class VI wells permitting and primacy play in achieving economies of scale, and critically, the inherent need to implement key carbon management policies the 2020-enacted bipartisan Utilizing Significant Emissions with Innovative Technologies Act (USE IT Act).

Carbon capture, transport and storage technologies have been proven at commercial scale in the United States for decades and industry has more than 50 years' experience safely transporting and permanently storing CO_2. Economywide deployment of the full value chain of these technologies (carbon capture, direct air capture, utilization, transport and storage) and associated infrastructure is essential to reach an economy of scale by 2030. Doing so will establish new benchmarks in technical maturity, ease of construction, affordability, and effective and timely permitting processes. Meeting these benchmarks will enable the industrial, power, and CO_2 transport and storage sectors to make the massive carbon capture investments necessary for achieving net-zero emissions by 2050.

Increased interest in the U.S. among members of Congress, both the current and recent administrations as well as key stakeholders to scale deployment of carbon management technologies paired with recent federal investments in carbon management and industrial decarbonization through the Infrastructure Investment and Jobs Act (IIJA), have provided a near-term opportunity to scale commercial carbon capture, direct air capture, associated infrastructure, and geologic storage. These investments put us on a path to deploy the technology at the rate necessary to play an integral role in enabling a clean energy economy,

however, more must be done. If we fail to commit to a broader portfolio of complimentary federal policies to enable significant carbon management project deployment by 2030 today, the U.S. and other countries risk being left without essential options needed to avoid the worst impacts of climate change.

Enhancements to the federal Section 45Q tax credit are critical to leveraging private investment and deploying projects at climate scale. The 45Q tax credit is the cornerstone federal policy for enabling economywide deployment of carbon management technologies. Further enhancing the 45Q tax credit is crucial to providing investment certainty, additional incentive value and the flexibility needed to drive greater private investment in carbon management projects.

- **Providing a direct pay option for the federal Section 45Q tax credit**: This is the most important next step Congress can take to realize the full emissions reduction and job creation benefits of the credit. Direct pay would address the current significant loss of tax credit value to burdensome, costly and inefficient tax equity transactions, creating an urgently needed alternative for most project developers, who otherwise lack sufficient taxable income to fully utilize the credits, or who are exempt from federal tax liability altogether.
- **Extending the commence construction window for the 45Q credit**: Extending the commence construction window to qualify for 45Q by an additional ten years, to the end of 2035, would establish a critically needed investment horizon to give carbon management projects the time required to scale up between now and midcentury.
- **Enhancing 45Q credit values for industrial and power plant carbon capture and direct air capture:** Recent analyses and commercial experience underscore that current 45Q credit values are insufficient to drive the early deployment needed in industry, electric power generation and direct air capture to bring costs down and reduce commercial risk. For industrial and power generation projects, credit values should be increased to $85 per metric ton for CO_2 captured and stored in saline geologic formations, $85 per ton for utilization of captured CO_2 and its precursor carbon monoxide to produce low and zero-carbon fuels, chemicals, building materials and other products, and $60 per ton for storage in oil and gas fields. For direct air capture projects, credit values should rise to $180 per ton for saline storage, $130 for oil and gas field storage, and $130 for carbon utilization. Boosting 45Q credit values would aid in safeguarding domestic production and high-wage, blue collar jobs and in maintaining U.S. technology leadership in this arena.
- **Eliminating annual carbon capture thresholds**: Current thresholds in the 45Q program are arbitrary, serve no policy purpose and reduce the overall technology innovation and emissions reduction potential of the incentive. Based on 2019 U.S. Environmental Protection Agency (EPA) data, approximately 54 percent of power plants and 75 percent of industrial facilities fall below eligibility thresholds, and many direct air capture and carbon utilization projects deploying emerging technologies simply lack the scale to meet these requirements.

Commercial interest in carbon management technologies and projects is growing rapidly, with nearly 120 publicly announced projects in various stages of development throughout the United States. More than 70 percent of these announced projects intend to store captured CO_2 deep

underground safely and permanently in saline geologic formations. The potential for saline geologic storage is enormous and represents a long-term, scalable climate solution. While carbon capture and storage is only one piece of the climate solution, estimates of domestic saline storage capacity represent over 1,000 years' worth of U.S. CO_2 emissions.

Safe and permanent injection and storage of CO_2 in deep geologic formations represent a well-understood and commercial practice in the U.S. and worldwide. In the U.S., EPA regulates and permits geologic storage projects using the Underground Injection Control Programs' Class II and Class VI wells. 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. To that end, 45Q remains the only energy technology which must demonstrate that the captured carbon oxide (CO_2 or it's precursor, CO) is permanently stored or utilized to receive a tax credit – wind, solar and other energy technologies receive federal tax credits based on production – regardless of total CO_2 emissions reduced.

With more than 60 of the publicly announced carbon management projects declaring their intent to store CO_2 through dedicated saline storage, ensuring that EPA's Class VI permitting program, which provides specific regulations for dedicated geologic storage of CO_2, has adequate resources to permit projects properly and expeditiously is increasingly important. The anticipated increase in project applications to the Class VI Well program (DOE estimates that EPA will receive more than 100 applications from project developers by 2030) highlights the importance of federal and state efforts to provide key support for project development to meet midcentury climate goals. EPA has permitted two Class VI wells to date, with well permit applications for an additional 19 wells listed as pending, as of July 26, 2022.

Recent federal investments in carbon management and industrial decarbonization through the bipartisan IIJA provide a very near-term opportunity to scale commercial projects, associated infrastructure, and geologic storage. Among other critical policy mechanisms, the IIJA featured foundational investments in the buildout of regional CO_2 transport and storage infrastructure with the inclusion of the bipartisan Storing CO_2 and Lowering Emissions (SCALE) Act in its entirety. The SCALE Act provisions included funding for the EPA's geologic storage permitting program at $25 million during fiscal year (FY) 22-26 and $50 million during FY22-26 for state permitting program grants. Effective implementation of these modest, but vital, permitting resources will be transformative.

While industry has decades of commercial experience safely storing CO_2 geologically at large scale, increasing the pace of project development and permitting of secure geologic storage at gigaton scale is essential to getting industries on track to be able to reach both net-zero emissions targets and midcentury climate goals. Domestically, the Great Plains Institute estimates that there is the potential to capture and store more than 300 million metric tons of CO_2 emissions per year from existing industry and power sources in the mid-continent by 2035. Though only one dedicated saline geologic storage project exists in the U.S. today (the Illinois Industrial Carbon Capture and Storage Facility), the project stores approximately 1.1 million tons of CO_2 per year from ADM's corn processing facility in Decatur, IL, alone.

Currently, securing an EPA Class VI permit for saline geologic storage can take several years, yet to meet midcentury climate goals, we will need to remove and safely store billions of tons of CO_2 in appropriate saline formations that are captured from industry, power generation and

directly from the atmosphere through direct air capture. Even with the two-year extension of 45Q, thanks to the FY2021 Omnibus, bringing the commence construction window to the end of 2025, the timeframes required for saline geologic storage permitting may put carbon capture projects at greater risk of missing the deadline to qualify for 45Q, especially when considering the additional time required to undertake planning, complete engineering, secure financing and accomplish other necessary components of project development. Therefore, it is critical that EPA reaffirm its commitment to reviewing applications and announcing decisions in a timely and effective manner, including publishing an annual Class VI report Included in legislation passed by the House of Representatives to fund the federal government in FY23.

In addition to current efforts in Congress and federal agency regulations, the USE IT Act, enacted as part of the FY2021 Omnibus, required the Council on Environmental Quality (CEQ) to establish two regional task forces within 18 months of enactment to improve the performance of the permitting process for carbon management projects. We are pleased to see the recent announcement that CEQ is establishing these two task forces, and getting them up and running in short order will help to ensure the regulatory framework enables efficient, orderly, and responsible deployment of carbon management projects and infrastructure.

An area of particular focus for the task forces should be CO_2 transport infrastructure. Multiple analyses have found that to achieve net-zero emissions, a substantial buildout of CO_2 pipeline infrastructure will be needed to transport large quantities of CO_2 from industrial facilities, power plants and direct air capture facilities to points of utilization and/or permanent storage. CO_2 pipelines have operated in the United States for over 50 years and have a strong safety record. However, in anticipation of an expanding CO_2 pipeline network, we must be sure that the regulatory framework enables efficient permitting while also ensuring CO_2 pipelines are designed, constructed, managed and maintained at standards delivering the highest levels of reliability and safety. To achieve the necessary deployment of carbon management technologies in the timeframe needed to meet climate goals, it is imperative that the public has confidence in the safety of CO_2 pipelines and that diverse stakeholders have a chance to consider the current and any potential changes needed to ensure the regulatory framework enables both the efficient and responsible deployment of carbon management technologies. The task forces provide a timely opportunity to address this need.

Together, these resources will be critical to ensure adequate federal and state permitting capacity required for economywide deployment of carbon management projects at climate scale. Robust and efficient permitting of CO_2 storage is central to ensuring that the significant federal investments in these technologies contained in the infrastructure bill and the 2018 bipartisan reform and expansion of the federal 45Q tax credit achieve their full climate potential. However, while these incremental gains remain important to realizing economies of scale, Congress now must deliver the broad portfolio of federal policy support for carbon management in forthcoming budget reconciliation legislation, including direct pay and multi-year extension of the 45Q tax credit, increased credit values for industry, power and direct air capture, and dramatically reduced annual capture thresholds. Combined with the investments made in the infrastructure law, these enhancements to the 45Q tax credit would result in an estimated 13-fold increase in carbon management capacity and annual CO_2 emissions reductions of 210-250 million metric tons by 2035 as well as creating hundreds of thousands of jobs in the carbon capture and direct air capture industries.

Conclusion

Carbon capture, removal, utilization, transport and storage technologies are essential tools to decarbonize the hardest-to-abate sectors, increase domestic energy production, protect and grow a high-wage jobs base, and fulfil our climate obligations. The groundbreaking provisions to scale deployment of associated CO_2 transport and storage infrastructure enacted as part of the bipartisan infrastructure law 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 industries that provide millions of existing high-wage jobs, which represent the lifeblood of American workers, their families and communities, and regional economies. Analyses by the Rhodium Group reveals the potential for creating tens of thousands and hundreds of thousands of jobs and generating hundreds of billions in investment from carbon capture and direct air capture deployment, respectively, if these technologies are deployed at levels needed to meet net-zero targets.

The Carbon Capture Coalition appreciates the opportunity to comment on the important topics of today's hearing and the Committee's support in advancing federal policies to enable greater deployment of carbon management technologies and infrastructure to meet midcentury climate goals. We look forward to working with the Committee in a bipartisan manner to ensure carbon management technologies fulfill their emissions reduction potential. Should you have any questions about anything outlined in this statement, please contact Madelyn Morrison, External Affairs Manager, Carbon Capture Coalition at mmorrison@carboncapturecoalition.org.

