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CLEARING THE AIR: LEGISLATION TO PROMOTE

CARBON CAPTURE, UTILIZATION, AND STORAGE

THURSDAY, FEBRUARY 6, 2020

House of Representatives

Subcommittee on Environment and Climate Change

Committee on Energy and Commerce

Washington, D.C.

The subcommittee met, pursuant to call, at 10:00 a.m., in Room 2123 Rayburn House Office Building, Hon. Paul Tonko [chairman of the subcommittee] presiding.

Members present: Representatives Tonko, Peters, Barragan, Blunt Rochester, Soto, DeGette, Schakowsky, Matsui, McNerney, Ruiz, Pallone (ex officio), Shimkus, McMorris Rodgers, McKinley, Johnson, Long, Mullin, Carter, Duncan, and Walden (ex officio).

Staff present: Jeff Carroll, Staff Director; Adam Fischer, Policy Analyst; Jean Fruci, Energy and Environment Policy Advisor; Waverly Gordon, Deputy Chief Counsel; Caitlin Haberman, Professional Staff Member; Rick Kessler, Senior Advisor and Staff

Directory, Energy and Environment; Brendan Larkin, Policy Coordinator; Dustin Maghamfar, Air and Climate Counsel; Nikki Roy, Policy Coordinator; Mike Bloomquist, Minority Staff Director; Peter Kielty, Minority General Counsel; Ryan Long, Minority Deputy Staff Director; Mary Martin, Minority Chief Counsel, Energy & Environment & Climate Change; Brannon Rains, Minority Legislative Clerk; and Peter Spencer, Minority Senior Professional Staff Member, Environment & Climate Change.

Mr. Tonko. Good morning, everyone. The Subcommittee on Environment and Climate Change will now come to order.

I recognize myself for 5 minutes for the purpose of an opening statement but before we get started, I want to announce that Jason Albritton from the Nature Conservancy, who was a scheduled witness, will not be able to join us for today's hearing. We are told that his wife went into labor this morning, and we are wishing them a speedy and safe delivery, and we will include his statement for the record.

[The prepared statement of Mr. Albritton follows:]

**********INSERT 1**********

Mr. Tonko. And let me please have the witnesses come to the table, please.

Okay, we will applaud the new delivery.

Thank you, everyone.

This morning, this subcommittee will examine H.R. 1166, the USE IT Act, which was introduced by Representatives Peters, McKinley, and Veasey last year.

There are a wide range of views on carbon capture on this subcommittee and I ask my colleagues to set aside any feelings you might have about carbon capture in the power sector for the next few hours.

If of you believe, as I do, that we need to achieve net zero emissions in the next 30 years or sooner, that means we need to develop solutions for difficult to decarbonize sectors and processes, along with deploying many more sources of negative emissions.

And if you believe, as I do, that we need major infrastructure investments as part of our climate response, then we will need low emissions in cement, steel, and other industrial products. In some cases, carbon capture is simply the best and most viable option for parts of the industrial sector.

The USE IT Act looks beyond traditional carbon capture. The bill amends the Clean Air Act to authorize a competitive prize for -- of $35 million for direct air capture, or DAC, and $50 million for CO2 utilization R&D.

Title 2 clarifies CO2 pipelines as being eligible covered

projects under the FAST Act. Estimates suggest that 5 and 15 gigatons of CO2 emissions will need to be removed globally every year by 2050 to stay below 1.5 degrees Celsius of warming and we will need to achieve net negative emissions later in this century.

To date, we have offered minimal Federal R&D funding for negative emissions technologies, despite recent recommendations from the National Academies for a large and sustained commitment.

Let's be clear. Carbon removal is not a substitute for major and rapid emissions reductions but technological and natural solutions for carbon removal that stores CO2 in plants, soils, oceans, geological formations, and products will be an important strategy in a comprehensive climate response.

Direct air capture is among the most exciting of these technological solutions. DAC has flexibility in where it can be sited and can even co-locate with a sequestration or utilization site to ensure DAC capacity is available at the scale necessary later in this century.

The Rhodium Group recently estimated that 9 million tons of removal capacity will need to be in operation in year 2030. We are a long way from that target today and there are big hurdles to get this technology to scale. There is a need for low emissions, electrical and thermal energy, and viable storage options. And cost remains the biggest challenge but the experience of the past decade with renewables, lithium-ion batteries, and other technology shows that R&D investments,

coupled with smart deployment policies can drastically reduce these costs. We are on the cusp of major breakthroughs but innovation requires a holistic approach. R&D for technology development is part of the equation but deployment incentives like the 45Q tax credit in California's Low Carbon Fuel Standard are important to monetize negative emissions practices. A Federal carbon pricing program could be structured with this in mind as well. Federal support can also help develop markets for carbon utilization, including fuels, chemicals, cement, and carbon fibers. This is one of the goals of the buy clean proposal in our clean future draft.

While I support many of the concepts in this bill, I believe there are ways to improve it. Mr. Shimkus can attest that I am not usually one to deny new authorities to EPA but, in this case, I believe the Department of Energy is best suited to lead Federal CCUS R&D efforts. That is not to say EPA and other agencies will not have important roles to play, including monitoring and verification of storage sites to ensure carbon is staying permanently sequestered.

I am also interested in how the Federal Government can help standardize and verify the greenhouse gas life cycle assessment for utilization and sequestration practices. This could help foster a common understanding of the net impacts of different technologies and methods.

Finally, the largest current market for CO2 utilization is enhanced oil recovery. This is concerning, as we need to be

moving away from the use of petroleum. This makes it all the more important and urgent that we develop those new markets for alternative uses.

I look forward to today's discussion and I hope we can examine some of these potential issues and work together with the bill's sponsors moving forward.

With that, the chair now recognizes Mr. Shimkus, our ranking member of the Subcommittee on Environment and Climate Change for 5 minutes, please, for his opening statement.

Mr. Shimkus. Thank you, Mr. Chairman. Before I start with my 5 minutes, I would like to ask unanimous consent to brag for a minute on my son.

Mr. Tonko. Yes.

Mr. Shimkus. My son has just left the Peace Corps. He is working his way back to the United States. I had a book made that, when I visited him in Tanzania over Christmas, and I want my colleagues to see and share. I am going to take it home after this week. So if they are looking through a photo album, a real small one, no disrespect to the panel. It is just that I want them to see what my son did and I am very proud of him. So --

Mr. Tonko. Well, proud dad, we wish your son well and safe return. And thank you for sharing that. We appreciate his service.

Mr. Shimkus. And my Democratic friends can see it also, if they would like.

Mr. Tonko. Well, thank you for sharing that in a bipartisan

way.

Mr. Shimkus. In a bipartisan way.

Mr. Tonko. Okay, the chair now recognizes the proud dad for 5 minutes.

Mr. Shimkus. Thank you, Mr. Chairman.

Carbon capture utilization and storage or CCUS has been an important feature of Federal clean energy research and development policy for over 15 years. In fact, the DOE has been researching Decatur, Illinois, an ADM site. At least a decade they have been doing research there.

This support has been driven by a plain fact that fossil energy, coal, oil, and natural gas, is and will remain central to our nation's economy for decades to come. Even accounting for accelerating growth of renewables, fossil energies will continue to fuel the majority of our nation's electricity production, our transportation, and remain absolutely essential in a wide range of industrial processes well into the mid-century and beyond, as last week's annual energy outlook shows.

And fossil energy will remain dominant throughout the developing world, as those nations grow, prosper, and seek the tremendous benefits of affordable energy, and industrial materials, and mobility as we have discussed in previous hearings. Given this fact, policies that seek to reduce greenhouse gas emissions in a way that is economically beneficial must build upon our existing energy supply, infrastructure, and industrial systems. This is where CCUS can serve an essential role.

While there continue to be technical and economic challenges, we are fortunate that innovation and successful demonstrations in large scale industrial capture and advances in the demonstration of power sector carbon capture have shown the viability of these technologies. In addition, given the economic value of carbon dioxide for enhanced oil recovery, there is growing demand for infrastructure in the energy sector, particularly pipeline infrastructure that can take CO2 that has been captured and sequester it, and put it to beneficial use, which brings us to the topic of today's hearing.

H.R. 1166, or the USE IT Act introduced by Mr. Peters and Mr. McKinley, takes useful steps to accelerate development and deployment of CCUS projects, including expressly direct air capture projects, and to help ensure more efficient timely permitting on CO2 pipeline infrastructure.

The bill focuses on EPA's existing nonregulatory authority under the Clean Air Act to develop and support a 10-year program to award funds for direct air capture research and to develop the Federal expertise on this front with a Direct Capture Technology Advisory Board.

The bill also directs EPA to provide, and what will be close collaboration with the Department of Energy, technical and additional financial support for carbon utilization technologies. And consistent with the agency's existing authorities, it directs the agency to report on risks and benefits associated with carbon storage in deep saline formations.

The assistance reporting and Federal collaboration that would grow out of this portion of the bill would help accelerate CCUS technologies but it would be critical to enable the infrastructure for these technologies, which is why permitting provisions of the bill are so important. These provisions clarify current law by making it explicit that CCUS projects, including direct air capture project, which we will hear about today, and carbon dioxide pipelines can be considered, quote, unquote, covered projects under Title 41 of the FAST Act. These provisions enhance coordination of permitting decisions with a goal of more rapid buildout of infrastructure.

Today, we will hear from several witnesses who can speak to climate policy, the innovation, and infrastructure benefits of the USE IT Act.

I would like to welcome the two witnesses, in particular. Jason Burger from -- Begger from Wyoming Infrastructure Authority offers a useful perspective on the energy-rich state that is seeking to develop energy resources and pipeline infrastructure with new cleaner technologies. And that actually, would be very applicable to southern Illinois with our margin oil wells and our coal formations.

And Lee Anderson of the Utility Workers Union of America can help remind us that behind our energy and electricity resources are American workers and their families who can be the first to bear the harsh economic impacts of expensive regulatory policies we would keep in mind, along with the American consumer,

as we develop climate policies.

Mr. Chairman, as you know, this is a thoughtful widely supported bill. It is the kind of bipartisan legislation that we know we can enact in law and make meaningful changes to our climate policies.

And with that, Mr. Chairman, I thank you for the time and I yield back.

Mr. Tonko. The gentleman yields back.

The chair now recognizes Representative Pallone, chairman of the full committee, for 5 minutes for his opening statement, please.

The Chairman. Thank you, Mr. Chairman.

The pictures in that book with your son are beautiful. You took the pictures? Wow, they are really nice.

Mr. Shimkus. Shocking, huh?

The Chairman. No, no, it is really -- it is nice.

I am pleased to be here this morning to discuss H.R. 1166, the Utilizing Significant Emissions with Innovative Technologies Act. This is a bipartisan bill introduced by Representatives Peters, McKinley, and Veasey. It is designed to advance carbon capture storage and utilization, important components of combating the climate crisis, as this committee works to reach a hundred percent clean economy.

In earlier hearings on the climate crisis, we consistently heard that we must develop and deploy technologies to capture and store carbon to prevent it from further elevating greenhouse

gas pollution. And earlier this week, a group of carbon capture experts said that we may need as many as 2,000 carbon capture facilities by 2040 to reach the mid-century goals laid out in the Paris Agreement.

Clearly, we must find ways to remove carbon from waste streams and from the atmosphere and store it permanently and safely. We also need to develop new processes to convert carbon waste streams into durable products. Unfortunately, steel, cement, and other industrial manufacturing activities will likely continue to require fossil fuels and, therefore, for these industries, carbon capture and sequestration are essential. They are needed to achieve the deep greenhouse gas pollution reductions that science says is required.

So there is a lot we must do to achieve these goals. We have to bring the cost of carbon capture down. We have to support research and development of new carbon-based products, and we must gain experience with carbon storage that is verified by monitoring and reporting programs to ensure carbon is being stored permanently and safely. And we also need policies that mandate the control of carbon pollution directly or indirectly.

The bill H.R. 1166 addresses some of these important goals and I commend the bill's sponsors for their efforts. At the same time, I believe the bill could be strengthened to more effectively reduce emissions.

First, I believe that the Department of Energy, which has pursued research, development, and demonstration of carbon

capture and sequestration for many years, should play a larger role.

Second, while enhanced oil recovery is still the most profitable use for captured carbon, we will not make real progress in reducing climate pollution unless there is significant net storage associated with it.

And I am concerned, or I should say third, I am concerned that the bill focuses too heavily on streamlining pipeline construction. I would like to see it provide a lot more direction on medium- to long-term planning for a time when enhanced oil recovery will not be the dominant use of captured carbon.

I also want to work with the sponsors to ensure the bill does more to ensure that captured carbon is safely and permanently sequestered. I have concerns about the EPA track record of enforcing the requirements for companies claiming the sovereign sequestration tax credit. We must also strengthen EPA's underground injection control program to ensure that it protects underground sources of drinking water. This is particularly important as climate change stresses those sources in new ways.

H.R. 1166 makes a significant down payment on crucial innovation in carbon dioxide removal and CCS technologies. And that is important. I also think we must do far more to effectively tackle the climbing prices.

And I commend the bill's sponsors for their leadership on this issue. I hope we can continue to work together to strengthen it and gain additional support from members on both sides.

We have excellent witnesses today. I am looking forward to their testimony but I want to yield my remaining time to Representative Peters, who is the sponsor of the bill.

Mr. Peters. Thank you very much, Mr. Chairman. I am pleased to be here today to talk about the USE IT Act, which we proudly introduced with Representatives McKinley, Veasey, Schweikert, and Bustos, and Senators Whitehouse and Barrasso in the Senate.

Although the global carbon budget projected U.S. emissions to fall 1.7 percent in 2019, we are still running a huge emissions deficit by any accounting standards. And to reach net zero by 2050, scientists tell us that emissions must fall by about eight percent every year over the next decade.

The Democrats on this committee have released draft legislation proposing how to close the emissions gap by investing in clean energy and efficiency, retrofitting buildings, decarbonizing cement, steel, and plastics, increasing public transportation, and even planning -- reducing deforestation, even planting new trees to increase carbon storage.

In the words of Chairman Tonko, our committee has, quote, harvested the low-hanging fruit, energy efficiency, conservation weatherization research, and grid modernization but we have to be more ambitious, as I think the chairman explained.

Experts before this committee have testified that we can't reach net zero by 2050, unless we figure out a way to decarbonize cement, steel, and plastics in the industrial sector, and aviation

and shipping in the transportation sector.

Today we are going to hear why USE IT is as important to a small company like LanzaTech, a bio startup -- a biotech startup figuring out how to scale up technologies that convert CO2 into fuel and other valuable projects, as it is to the State of Wyoming's infrastructure authority, which has been working with DOE for years to develop large scale integrated CCS projects. USE IT is a standalone bill but it is a vital complement to this committee's climate priorities and I look forward to the testimony today. I thank the witnesses and I yield back.

Mr. Tonko. The gentleman yields back. The chair now recognizes Representative Walden, ranking member of the full committee for 5 minutes for his opening statement.

Mr. Walden. Good morning, Mr. Chairman. It is Thursday. It is okay.

H.R. 1166, the USE IT Act, sponsored by Mr. Peters and Mr. McKinley is a practical, it is a widely supported, and it is a bipartisan piece of climate legislation. Versions of this legislation were passed out of the Senate last year. We included it in the Republican 12 and 20 package, 12 bipartisan bills with the USE IT Act at the top we can enact into law. It is a bill that we know can make a meaningful difference for our economy and for addressing climate risks.

The USE IT Act provides the Environmental Protection Agency direction under existing authorities and in coordination with the Department of Energy to foster innovations in carbon capture

technologies and improve scientific understanding of carbon sequestration. The bill addresses permitting delays and it will ensure more timely deployment of these technologies and pipeline infrastructure essential to these innovative technologies to succeed economically.

This important bill is not complicated. It authorizes targeted financial support and it will generate useful information to assess technological deployment. Furthermore, it builds upon the bipartisan work of past Congresses, like reforms to our tax code to encourage more investment in carbon capture and storage.

There will be additional practical and achievable steps the administration and Congress will have to take to clear paths to these innovative technologies to assist with cleaner energy systems but this is exactly how we implement workable climate policies.

And what results can we expect to see from implementing workable climate policies? Well, a recent report from the National Petroleum Council on carbon capture technologies points out that, over the next 2 decades, global GDP is expected to double. With this tremendous growth in prosperity, billions of people will be lifted out of poverty and the increases in prosperity will be enabled by a 25 percent, a 30 percent increase in energy demands. So energy demand is going to go up 25 to 30 percent, as a result of growth in the worldwide economy.

This demand, as we have examined in past hearings, will

depend upon affordable reliable energy and this is a growth that will drive the bulk of future greenhouse gas emissions in the world going forward. So by developing American energy resources, by exploring the fruits of our energy revolution, by developing advanced technologies like CCUS and perfecting their deployment, we can enjoy the economic and environmental benefits of exporting our innovations to these developing nations. Practical policies that promote competitive development of our own resources, not through top-down regulation and taxation but through American ingenuity and innovation is how we can best address global emissions.

Our witnesses this morning will be able to talk about the importance of these bills for expanding our existing resources and infrastructure. It is a good start, Mr. Chairman, and I look forward to continuing to work with you to move this legislation forward.

And let me say I agree with the majority. We need climate action. That is why we cannot let another opportunity slip by. You see we have already missed two opportunities to get the USE IT Act enacted.

There was a three-corners agreement on a version of this legislation in the Defense Authorization Act. We were at the table to negotiate but, unfortunately, the majority pulled the plug.

There was another opportunity in the year-end spending bill. Unfortunately, the majority again said no.

So, let's not let another opportunity slip by and I hope we can look at other practical measures that we can enact into law. There are other bipartisan measures we can and should move.

Just last week, we held an informative hearing on wildfires and I appreciate the committee doing that, the upshot of which was there was wide agreement that implementing active forest management will help reduce risks of fire and increase opportunities for resilient sustainable forests. And by the way, healthy green forests sequester carbon. There is a bill for that and there is a bill to restore burned forests to plant trees to increase carbon sinks and provide for a healthier economy as well.

So there are more bills like this to consider, Mr. Chairman, where I think we can find common ground. I am hopeful we can start working on the measures we agree upon and get them into law. These are the types of concrete legislative steps we can take right now to make progress.

And so, I do look forward to working with your, Mr. Chairman, and I yield back a full minute and 7 seconds.

Mr. Tonko. Thank you very much. The gentleman yields back.

The chair would like to remind members that, pursuant to committee rules, all members written opening statements shall be made part of the record.

We now introduce the witnesses for today's hearing. And again, thank you, one and all, for joining us and sharing your thoughts and solutions with us.

First, we begin with Mr. Sasha Mackler, Director of the

Energy Project Bipartisan Policy Center; next, we have Mr. John Noel, Senior Climate Campaigner with Greenpeace USA; then, Mr. Jason Begger, Executive Director of the Wyoming Infrastructure Authority; then, Dr. Laurel Harmon, Vice President of LanzaTech, Inc.; and finally, Mr. Lee Anderson, Government Affairs Director of the Utility Workers Union of America, AFL-CIO.

Before we begin, I would like to explain the lighting system. In front of you are a series of lights. The light will initially be green. The light will turn yellow when you have 1 minute remaining. Please begin to wrap up your testimony at that point. The light will turn red when your time expires.

At this time, the chair now recognizes Mr. Mackler for 5 minutes, please, to provide your opening statement.

STATEMENTS OF MIKAEL SASHA MACKLER, DIRECTOR OF THE ENERGY PROJECT BIPARTISAN POLICY CENTER; JOHN NOEL, SENIOR CLIMATE CAMPAIGNER WITH GREENPEACE USA; JASON BEGGER, EXECUTIVE DIRECTOR OF THE WYOMING INFRASTRUCTURE AUTHORITY; LAUREL HARMON, VICE PRESIDENT OF LANZATECH, INC.; AND LEE ANDERSON, GOVERNMENT AFFAIRS DIRECTOR OF THE UTILITY WORKERS UNION OF AMERICA, AFL-CIO

STATEMENT OF MIKAEL SASHA MACKLER

Mr. Mackler. Thanks and good morning. As you said, I am Sasha Mackler and I direct the Energy Project at the Bipartisan Policy Center.

I am delighted to be here this morning on behalf of the BPC to express support for the USE IT Act. BPC believes that the only way to confront the climate challenge is to dramatically accelerate the development and deployment of carbon-free energy systems that are cost competitive with traditional options and the USE IT Act is a critical step and a bipartisan step in this direction for carbon capture.

I should also note at the outset that in addition to my work on Energy Policy at the BPC, I spent a number of years recently working in the private sector as a developer of carbon capture projects. Through this experience, I can offer a firsthand account of the challenges facing CCUS development and I can attest to the need for more targeted Federal support, if we are serious about bringing carbon capture into the marketplace in a meaningful timeframe.

BPC is enthusiastic to support the USE IT Act. It focuses on a set of technologies that will be critical to achieving our twin goals of mitigating climate change and keeping America's economy strong for this century and beyond.

My testimony this morning will focus on four main points: first, the importance of innovation; second, the critical role that carbon capture utilization and storage must play in decarbonizing our energy system; third, the unique role that direct air capture, or DAC, could play in managing climate risks; and finally, the significance of utilization in the trajectory of scaling carbon capture systems.

At the outset, I think it is useful to step back and remind ourselves of the role of technology innovation and how it has always played a key role the success of our nation. The Federal Government's willingness to invest in key technologies at key junctures from the space race to the IT revolution has been crucial to navigating past eras of economic transformation. Today, we face another such transformation and it is every bit as challenging as the ones that defined previous eras, the transformation to a net zero economy by mid-century.

And time is not on our side. We need to reduce global emissions to net zero by 2050. That is only 3 short decades from now. To achieve our climate goals, we need more and better tools than we have now and that is where carbon capture comes in.

We need these technologies because we simply don't have non-fossil fuel alternatives for all the energy-using sectors

of our economy, including applications such as long-haul air travel or some industrial processes.

How can carbon capture help? Carbon capture from industrial sources offers a way to capture CO2 from smokestacks and prevent it from going into the atmosphere. Another class of carbon capture technologies, often called direct air capture or DAC, offers a way to remove CO2 from the ambient air.

And DAC is worth focusing on for a minute because it has gotten less attention in the past but that is changing really quickly, as many are increasingly seeing the advantages of adding DAC to our climate toolkit. The key virtue of DAC is that it can be used to remove CO2 already in the atmosphere and if we can make work at reasonable cost, it will give us a tool for reversing past emissions and, in effect, canceling out new emissions that have no practical way to be avoided.

But the only way that DAC will be ready to play a significant role is if the Government helps to jumpstart it. USE IT does this by creating incentives for technology development and by enabling permitting improvements for projects and their supporting infrastructure. So this is the feature of the legislation that we are particularly enthusiastic about.

Another feature of the USE IT Act I want to draw attention to is its focus on CO2 utilization. This is critical because it can help make the economics of DAC or carbon capture work in the near-term. Potential uses for CO2 are actually not too hard to think up. CO2 can be used as a feedstock for cement or

synthetic fuels but the biggest immediate market for large quantities of CO2 today is in the oil industry for enhanced oil recovery.

On balance, we at BPC have concluded that carbon capture with enhanced oil recovery is worth pursuing, both because it offers immediate benefits in terms of reducing the net emissions associated with oil production and because of the synergies it affords in terms of engaging a major industrial partner, accessing potentially large sources of private capital for technology development and infrastructure buildout, and developing the needed regulatory frameworks for carbon storage. And we are not alone in reaching this conclusion. A number of prominent environmentalists also agree.

So in closing, I want to thank the subcommittee again for this opportunity to testify and explain some of the reasons why we at the BPC support the USE IT Act. Technology innovation has always been America's superpower and it remains our best bet today.

Thank you.

[The prepared statement of Mr. Mackler follows:]

**********INSERT 2**********

Mr. Tonko. Thank you very much.

Now, we recognize Mr. Noel. You are recognized for 5 minutes, please.

STATEMENT OF JOHN NOEL

Mr. Noel. Thank you. Chairman Tonko, Ranking Member Shimkus, members of the committee, thank you for inviting me to testify today. It is an honor.

My name is John Noel and I am a senior climate campaigner at Greenpeace USA.

We are not opposed to the provisions in the USE IT Act that support carbon utilization research. And of course, science and technology are going to play a major role in addressing the climate crisis but we do need a vision for carbon removal that is fully decoupled from oil production.

The amount of carbon we have to potentially remove is entirely up to us and what we do right now this decade. The oil and gas growth paradigm makes this difficult and that is what I am here to add context to about today and why we are skeptical of any policy that would strengthen the oil industry in the name of climate action. We see addressing the climate crisis and growing the fossil fuel industry is mutually exclusive.

We cannot escape the fact that absolute demand for and production of fossil fuels must decline rapidly. This necessary decline in oil production calls into question the wisdom of incentivizing enhanced oil recovery. As written, the USE IT Act does not provide any guardrails to ensure that it will not lead to decades of increased oil production. If it is, indeed, an onramp to a broader decarbonization agenda, where is the requisite

offramp for fossil fuels?

Proponents reported that the EOR industry could triple in size by 2030, with 375 million barrels of additional annual production. This would likely only occur under scenarios where the U.S. production continues to expand in the coming decade, rather than declining at a pace consistent with the 1.5 scenario.

Proponents are also clear that the long-term growth for the industry is constrained by a lack of access to consistent sources of CO2 and pipelines are needed to expand. Companies see the future that a subsidized EOR industry could unlock and the resources estimates we are talking about here are breathtaking in the context of an unfolding climate crisis.

Advanced Resources International says there are 284 billion barrels of additional oil that are technically favorable to CO2 injection but the industry intends to step beyond just aging conventional oil fields and apply the technology to unconventional resources, as I talk more about in my written testimony. The expansion into unconventional resources complicates the oil industry's carbon storage narrative, as storage in unconventional resources is not well understood. We also note that CO2 EOR operations are in addition to the rest of the industry's growing production pie. Nowhere in this discussion is there commitment to a managed phaseout of production in line with climate science. It is net expansion.

Part of the justification used for EOR and incentives created by the USE IT Act is that these same productive oil formations

could someday be converted to long-term storage. A 2010 DOE paper determined that it does not make sense as a mitigation tool to construct pipelines to oil fields to expand EOR without first establishing that suitable long-term storage capacity exists. This is not happening, as I talk more about in my written testimony.

IEA goes further and says we need a, quote, paradigm shift in regulations from the way EOR is currently practiced. I do not see the oil industry welcoming a paradigm shift in regulation. At this very moment, oil interests are working to undermine the existing secure geologic storage regulations under Section 45Q. This is a tax credit as part of the system of incentives designed to drive new carbon capture investment.

Senator Menendez recently sent a letter to the IRS Inspector General calling for an investigation into section 45Q, quote: publicly available data suggests that the vast majority of 45Q tax credits claimed have come absent the required the monitoring, reporting, and verification systems that ensure the safe disposal of captured carbon, in clear contravention of current law and guidance. End quote.

This is the type of the regulatory framework and associated tax incentives that this legislation is born into and we think that it ensures that the industry will pocket these subsidies, continue on its current course of full throttle expansion, and fight any additional policies to reduce our dependence on oil. The industry's campaign to undermine true climate solutions in

order to maintain demand is real and well-documented. EOR cannot be siloed off from the rest of a company's portfolio or business strategy. Climate science and carbon math are not complete without an honest analysis of political power.

Thank you for your consideration of these risks.

[The prepared statement of Mr. Noel follows:]

**********INSERT 3**********

Mr. Tonko. Thank you very much, Mr. Noel.

Mr. Begger, you are now recognized for 5 minutes, please.

STATEMENT OF JASON BEGGER

Mr. Begger. Mr. Chairman, Ranking Member, and members of the subcommittee, I appreciate the opportunity to speak with you today.

My name is Jason Begger and I am the Executive Director of the Wyoming Infrastructure Authority. The WIA is tasked with promoting and assisting the development of energy infrastructure in deploying technology. We are focused on solutions.

Our largest current project is the Wyoming Integrated Test Center, which is a public-private partnership between the State of Wyoming, Basin Electric Power Cooperative, Tri-State Transmission and Generation Association, and the National Rural Electric Cooperatives Association. The ITC is a post-combustion research facility located at Basin Electric's Dry Fork Power Station near Gillette, Wyoming. It is the largest facility of its kind in the U.S., providing much-needed scaleup space to learn -- to better learn how to reduce the costs and find new methods of capture in managing CO2 afterwards.

At the top of our utilization efforts is a partnership with the NRG COSIA Carbon XPRIZE, which will award $20 million in prizes to teams that are best able to convert CO2 into other valuable products, such as carbon nanotubes, methanol, building materials, polymers, and plastics. Wyoming is also developing a project with Japan and Columbia University to convert CO2 into calcium carbonate.

While developing high-tech products capture the imagination, the reality is we will require a wide array of options, including enhanced oil recovery and geologic sequestration. EOR is an attractive early option, due to the fact that it produces revenue and can help with the economics until capture costs are reduced in future years.

On the utilization side, the market for carbon nanotubes is small, whereas, concrete is immense but a lower value product. Determining how to best manage carbon is a large puzzle of factors, including geology, markets for products, and pipeline infrastructure. If the U.S. is going to permanently sequester CO2, the country will need a massive expansion of pipelines to carry the carbon from places it is produced to the places it can be used.

For example, there is an extraordinary amount of CO2 produced by Midwestern ethanol facilities. However, they are located hundreds of miles from places with the right geology for permanent storage for EOR and no pipeline exists in the Midwest. The current CO2 pipeline network is about 5,000 miles of fragmented lines, compared to the current natural gas pipeline network, which is 60 times larger, about 300,000 miles. We will need a comparable network of CO2 pipelines to move carbon from sources to sinks.

Further complicating pipeline buildout is many of the places with the best geology have a Federal lands nexus, which triggers National Environmental Policy Act reviews. A typical project

with mixed Federal, State, and privately-owned lands may require upwards of 30 reviews, permits, and approvals from various regulatory bodies. If it crosses multiple states, this number increases accordingly.

NEPA analyses were historically completed in relatively short timeframes. Unfortunately, they have evolved in such a way that they may take upwards of a decade and tens of millions of dollars to complete. The NEPA analysis and permitting for a wind farm in Wyoming and accompanying multi-State transmission line has cost over $200 million and has taken 10 years.

In Wyoming, a right-of-way application for a 200-mile CO2 pipeline project was submitted in February 2013. Six years later, in February of 2019, they finally received the Record-of-Decision from the Bureau of Land Management. Delays such as these affect the economics and viability of projects, not to mention the lost years of carbon reductions.

In an attempt to expedite the development of pipeline infrastructure, Wyoming launched the Wyoming Pipeline Corridor Initiative. This effort has identified the areas best suited to site projects, ideally near existing infrastructure and away from environmentally sensitive areas and critical wildlife habitat. In December 2019, the BLM closed a comment period on the proposal. We hope this initiative can shave years off the permitting process.

Oftentimes, we focus on the various pieces of carbon management and do not consider the entire system and necessary

links to make it a reality. H.R. 1166 is very important to that effort, as it provides both critical funding for the utilization of technologies and a mechanism to accelerate the construction of the CO2 pipeline infrastructure that will be necessary.

I appreciate the opportunity to speak with you today and will gladly answer any questions.

[The prepared statement of Mr. Begger follows:]

**********INSERT 4**********

Mr. Tonko. Thank you, Mr. Begger.

Dr. Harmon, you are now recognized for 5 minutes, please. Your mike, please.

STATEMENT OF LAUREL HARMON

Ms. Harmon. I just wanted to thank you, Chairman, Ranking Member, and members of the committee. On behalf of LanzaTech, for whom I am the Vice President of Government Relations, I am here to share our story of carbon capture and utilization to, I hope, explain to you that this is in fact important, real, and accessible today and, at the same time, share, through our experience, why the research and development provisions in CCU that are in the USE IT Act are so important to advance the technology.

Carbon capture and utilization is an approach which will actually take carbon, which currently looks like an environmental liability, and turns it into an economic opportunity, creating jobs and creating new sustainable products.

LanzaTech was actually founded with the vision that carbon needs to be treated as a resource and that we need to find ways to reuse all carbon that has already served a function and turn it into products which then can supplement, replace those products which we currently rely on from petroleum and other virgin fossil sources. In particular, as we look ahead to a decarbonized world, we will need carbon-dense fuels for aviation. We will continue to need materials from -- that are carbon-based materials.

So we are a biotech company. We are located in Skokie, Illinois, where we have about 130 people in Representative Schakowsky's district. We certainly appreciate the support we

have gotten over the years. We are privately held. We have raised over $340 million of capital from diverse global investors, all of whom see the value of CCU.

And in particular, I would like to emphasize that we are a technology --

Mr. Tonko. Dr. Harmon, I hate to interrupt you. Can you move the mike just a bit --

Ms. Harmon. Certainly.

Mr. Tonko. -- because it is not recording on -- okay. Thank you.

Ms. Harmon. Is that better?

We, as a technology-licensed --

Mr. Shimkus. But you need to mention Schakowsky's name one more time so it really gets out there.

Ms. Harmon. Okay, I will say that very loudly.

So as a technology-licensor, the capital that we have raised has all been for the purposes of technology development and the technology is now being implemented throughout the world.

Our focus is on industrial carbon capture and utilization and our first target is in the steel sector. Our technology uses an ancient biological pathway in which microbes actually consume CO2 instead of sugars in a fermentation that then produces ethanol, produces other chemicals, and we have platforms and partnerships to take our fermentation products and turn them into aviation fuel, into chemicals, and into, ultimately, textiles and other types of durable goods.

An important element, if we are looking at steel emissions, is that the steel sector produces emissions that are very highly concentrated in carbon monoxide. And in fact, carbon monoxide is the primary thing which our fermentation uses as its feedstock. And, therefore, it is very important, when we think about utilization at large and in fact for USE IT, that the utilization provisions extend not only to CO2 but to carbon monoxide, in the form of carbon oxides, as expressed in 45Q.

I would like to share that our technology is gas fermentation technology, which I have written about more in the written testimony, is in fact operating commercially, directly producing ethanol from steel mill emissions. And we have taken the ethanol produced from steel mill emissions and produced jet fuel, which has been used in both a transpacific and a transatlantic flight.

When we think about ethanol as a platform, it is suitable as a pathway to plastics, to the types of fuels that I mentioned but, in addition, technology such as ours can directly produce chemical intermediates that end up on coatings, in plastics, in jackets that people wear, or in yoga pants.

And so in closing, I would like to emphasize that the journey from an idea and a new technology to a commercial plant operating in the real world has taken 14 years and significant investment. And therefore, the investment in R&D represented by USE IT is extremely important to advance this industry.

So thank you, and I appreciate the opportunity, and look forward to any questions.

[The prepared statement of Ms. Harmon follows:]

**********INSERT 5**********

Mr. Tonko. Thank you so much, Dr. Harmon.

And now, Mr. Anderson, you are recognized for 5 minutes, please.

STATEMENT OF LEE ANDERSON

Mr. Anderson. Thank you, Chairman Tonko, Ranking Member Shimkus, and distinguished members of the subcommittee. My name is Lee Anderson and I am the Government Affairs Director for the Utility Workers Union of America.

The Utility Workers Union represents around 50,000 workers in the electric, gas, nuclear, and water utility sectors. It is a truism, at this point, that the manner in which the world generates electricity is evolving rapidly. The Utility Workers recognize that this change is being driven by economics, by the recognition that global climate change is happening, and that it is the result of manmade carbon emissions.

That point is clear. The need to manage carbon emissions at scale globally is urgent. We must decarbonize our economy; however, we must do so in a manner that does not crash local and regional economies. To date, however, change has been occurring randomly, even chaotically, in the absence of a comprehensive plan for how to curb emissions without disrupting our economy.

The closure of a power plant means the loss of many hundreds of jobs for working people directly employed in the operation and maintenance of these large facilities. As these plants are often situated in areas that make them the best source of high-quality employment for many miles around, the challenges these workers often face in seeking new equivalent employment can range from difficult to nearly insurmountable. This is why

we will continue to fight for the survival of all of our facilities, the employment of workers, and the stability of their communities wherever we see hope for the future, particularly through the use of science.

Technology enabling the decarbonization of power plants holds the potential to change the economics of a facility, enabling it to compete with other generation options and the opportunity for these workforces to make their contribution in the fight against global climate change, all while preserving the culture and social fabric of families, communities, and way of life that, once lost, can never be replaced. This is the simple reason why we support the USE IT Act.

Policy choices, or the lack thereof, have very real human consequences. Using public policy to advance research and development on carbon capture technology will make it easier and cheaper to build these systems at scale. Moving the science through successive generations, driving down costs, innovating ever-better approaches to the problem of carbon emissions, all this adds up to a greater ability to operate power plants as cleanly and efficiently as possible and retain them for what they are -- critical infrastructure providing an essential public service, and anchor institutions that underpin the lives of workers, their families, and their communities.

Indeed, the follow-on effects to communities, with the loss of many thousands of jobs indirectly supported by these plants, the shuttering of small businesses dependent on the middle-class

workers in the power sector as their customers, as well as the impact on town and county budgets after the loss of significant portions of their annual tax revenues due to the closer of these large plants, have all too often added up to a landscape of cultural and personal destruction.

For our members, then, the best outcome will always be to keep their families and communities intact but this outcome requires retaining the economic anchors that make that possible. When facilities close, very soon families disperse, towns haul out, and what is left behind are empty desks in the schools, empty pews in the churches, and empty coffers in local government budgets.

Although we also call on policy leaders to develop a system that addresses the needs of workers and communities in the aftermath of plant closures, the reality is that this remains almost entirely in the realm of the hypothetical, one that is meaningless for those who have already lost their jobs, and for those who will continue to do so, unless we can harness technology to retain the assets that make these jobs possible in the first place.

Without this ability, workers with few or no easy alternatives will continue to be left behind. Personal calamity, whether due to divorce, bankruptcy, substance abuse, or simply the diaspora of families and the economic, social, and physical collapse of communities will continue to occur time and again as deindustrialization continues to play out across the U.S.

In summary then, we believe the USE IT Act will promote the use of technology that can create a cleaner environment, create and retain family-supporting and community-supporting jobs, and preserve American communities anchored by the energy industry.

Thank you for the opportunity to be a part of today's proceedings. I look forward to answering your questions.

[The prepared statement of Mr. Anderson follows:]

**********INSERT 6**********

Mr. Tonko. Thank you, Mr. Anderson.

We will now move to member questions.

Before we do that, however, our technical team has asked that our guests move the microphones directly front and center, so that the recording is as crisp as it can be. So, I thank you for that.

I will now start the member questions by recognizing myself for 5 minutes and, Mr. Mackler, let's begin with you.

Last year the Bipartisan Policy Center worked with the Energy Futures Initiative looking at Federal R&D investments in carbon removal. Do you believe getting these innovative new technologies commercialized at scale requires significantly greater Federal support?

Mr. Mackler. I think the short answer to that is yes. I think direct air capture, in terms of a Federal priority for research funding, is only just emerging now as a high-level issue. And for that reason, we actually, at the BPC, launched last year a Direct Air Capture Advisory Council to really help to make the case for a stronger, more ambitious innovation program focused on industrial direct air capture technologies.

Mr. Tonko. Thank you. And EFI also published a report, Clearing the Air, that provides a potential multiagency roadmap for Federal spending. Are you familiar with that report?

Mr. Mackler. I am.

Mr. Tonko. That report makes the case that many agencies should have a role in carbon removal policy, which I agree with,

but EFI has suggested that DOE could play a leading role in carbon removal technology R&D and suggests they should receive the most funding.

Do you believe, based on its previous CCS work, DOE has the technical expertise to lead a negative emissions technologies research agenda?

Mr. Mackler. I do agree with that.

Mr. Tonko. And Dr. Harmon, how has LanzaTech partnered with DOE on R&D projects in the past and have they contributed to your ongoing utilization efforts?

Ms. Harmon. Absolutely. We have worked with the Department of Energy on all aspects of our technology. That includes support from RPE as to develop the technology by which our gas fermentation fundamentally operates, our bioreactor technology.

We have worked with the Department of Energy for development of pathways within our microbes to produce products. We have, through that type of support, demonstrated over 50 direct fermentation products, many of which are direct substitutes then for chemical intermediates.

And a very major piece of work, which has extended since 2012, is the development of the pathway from ethanol to aviation fuel, for which the front end is the ethanol from CCU.

Mr. Tonko. Thank you very much.

And so DOE has existing relationships with many of the stakeholders and technical expertise on CCUS but I don't want

to suggest EPA shouldn't play any role.

Mr. Mackler, I think it was clear from your testimony that BPC cares about achieving emissions reduction goals and that negative emissions be properly recognized. For the credibility and, potentially, compensation of these projects, whether they are technological or natural, how important is it to have an accurate and verified account of how much carbon is removed?

Mr. Mackler. I mean this is central to the rationale for supporting the technologies, in particular, supporting the utilization of CO2 as part of a climate strategy that really needs to be based on sound science, on deep analysis, and on very strong regulatory frameworks that can ensure the CO2 is removed and permanently sequestered.

So this is -- it is a critical piece of the overall rationale.

Mr. Tonko. And I know there are a couple of different methods for nature-based projects, for greenhouse gas life cycle assessments, but should more work be done to standardize the accounting and verify the impacts of negative emissions technologies?

Mr. Mackler. Yes, I think that is right. I mean we need to make a distinction between removal technologies that permanently take CO2 out of the carbon cycle, which is what direct air capture technology would do if you were to remove the CO2 and inject it underground, compared to natural solutions, which really they remove CO2 but they are not permanently removed because they can always -- there is a flux between the biological

carbon cycle and the full carbon cycle.

But the short answer is more analysis is really needed to understand the specifics of the carbon balance of various approaches. But we know, from a general standpoint, that the benefits are there but, if we are going to quantify them, we should probably get a little more precise on how we measure and certify the storage.

Mr. Tonko. Thank you.

Mr. Noel, you suggest safeguards to this bill. Could that include ensuring that carbon removal is validated and storage sites are better monitored and regulated?

Mr. Noel. It should but that is not what is happening right now and there is a lot of work to do to get there.

Mr. Tonko. What types of requirements do you envision from EPA regarding the monitoring of regulation of sequestration?

Mr. Noel. I would say there needs to be an update to the UIC regulations that govern enhanced oil recovery. Right now, companies don't have to report the amount of CO2 that is actually sequestered or come up with a monitoring plan. The companies just report the amount of CO2 they receive.

Mr. Tonko. Thank you.

With that, we will now move to Mr. Shimkus, the subcommittee ranking member, to question for 5 minutes, please.

Mr. Shimkus. Thank you, Mr. Chairman. I am going to change up my order a little bit.

I want to start with Mr. Anderson because your people are

my people. I really appreciate your testimony. I mention those concerns almost every hearing that I have. Sometimes my facilities are operated by the Boilermakers.

So we just had an announced closure, fortunately none in my district, but announced closures of Canton, Coffeen, Havana, Hennepin. Now, those communities don't speak out as to -- they are not a Chicago. They are not a New York. They are not an L.A. So these are the small rural communities that you mentioned.

Can you briefly just talk about what a, in a small community, the loss of 50 employees in a power plant? Again, I think you mentioned wages. You mentioned tax base. You mentioned -- just go over that because it does have real world impact in many of our congressional districts around the country.

Mr. Anderson. Absolutely. Thank you very much for that question, sir.

You really can't overstate the effects. And these are, as you say, the sort of places that are the definition of the kind of places that get overlooked and left behind.

As it happens, our most recent example was in Ohio, two power plants that closed at the same time in one county right along the Ohio River. It is not an overstatement, it is literally the case that the tax revenue from those power plants was 75 percent of the town and county budgets and that paid for schools, fire stations, police. It paid for everything. And this was about 2 years ago and the immediate effect was many of those things started to close, or downsize, or they no longer do that anymore.

The people tried to sell their houses as fast as they can before they lose all of their value. Trying to find other alternatives elsewhere in the country, sometimes they do; sometimes they don't.

But even if individuals are able to sort something out for themselves and find a job in Dayton, or in another State, or whatever, what they leave behind is what I was talking about, an emptied out community that is no longer the same or they won't see their families for more than once or twice a year because now they live hundreds of miles apart.

It seems like a small thing when we are talking about economics but, as a human thing, it is a very big deal.

Mr. Shimkus. Yes, I appreciate that. And just following up, so a lot of us, when we are visited by folks and people talk about jobs and economic development, then there is a multiplication factor of three. You know for every one job here you are going to have the convenience mart. You are going to have the grocery store. You are going to have this.

So I guess what I am hearing is that there is a -- it is not a multiplying, it is a division aspect, where you are going to start losing the convenience store. You are going to start losing the gas station. You are going to start losing the grocery store, and the local theater, and the like.

Is that what you have observed?

Mr. Anderson. Absolutely. When that was happening and we were trying to find options for those power plants at the time,

some of our strongest allies were Chamber of Commerce people, business leaders, people who knew exactly what was going to happen to the business community in those towns because they were completely dependent on the people who lived there and worked there for business.

So politically, our allies were up and down the spectrum because we all saw the same thing coming.

Mr. Shimkus. Yes, thank you for speaking out. I do it. I am a politician, so I am not really trusted all the time but you supporting the men and women -- the working men and women, I do appreciate the testimony and thanks for coming here.

Mr. Begger, you say that enhanced oil recovery, EOR, is an attractive early option for CCUS development. Can you elaborate what you mean by that?

Mr. Begger. Mr. Chair and Mr. Shimkus, it is one of the few, I guess you would call, commercially-deployable revenue streams for carbon management right at this time. You know I think we all are looking for geologic storage, carbon products, those types of things, but technologies get cheaper over time. You know if you look to say, for example, the Petra Nova Plant in Texas, they feel like the lessons learned from just building that first one, they could build the second one 30 percent cheaper and just hope that you will see those incremental cost reductions with every generation and every one that is built.

And so we feel like EOR is currently viable today. And as we do more and more of those things, it will bring the cost down

to make other pathways economic.

Mr. Shimkus. So this helps drive down the economies of scale for deployment --

Mr. Begger. Yes.

Mr. Shimkus. -- because there is a revenue stream that helps offset, whether it is a tax credit or direct Federal funding for these projects.

And Mr. Noel, I don't have time to ask a question but I appreciate your testimony. I appreciate it delivered in the manner in which you did. Hopefully, we can find a method to get this forward.

And I do appreciate the sponsors of this legislation, Mr. Peters and Mr. McKinley, for moving this forward.

And with that, I yield back my time.

Mr. Tonko. The gentleman yields back.

The chair now recognizes Representative Peters for 5 minutes, please.

Mr. Peters. Thank you, Mr. Chairman. Today we have the opportunity to discuss climate legislation with a real shot at becoming law. USE IT passed the Senate Committee on Environment and Public Works by unanimous consent last year. That includes Senators Barrasso, Bernie Sanders, and Ed Markey. So that is a pretty good breadth of support.

And I am sorry that the Nature Conservancy representative couldn't be here. So that is good news/bad news because a baby is a nice event but, clearly, it would have been better if it

was tomorrow but we can't plan that out. That is nature, I guess.

So what the bill does is it provides Federal research support of a suite of CCUS technologies, including $35 million to provide competitive grants for technologies that can cost-effectively remove carbon dioxide out of the air through direct air capture and $50 million to support research and technologies for commercial uses of captured carbon dioxide.

Second, it codifies an existing interpretation that comes from the Obama administration that CO2 pipelines and CCUS infrastructure projects could be considered covered projects under FAST-41, if there also Federal actions under the jurisdiction of Federal agencies. It does not weaken NEPA.

And I think people have discussed a lot of the need for developing these kinds of carbon capture facilities. There are only two commercial direct air capture projects now. The largest is a plant in Alabama that only captures 4,000 tons per year and one active CCUS project capturing CO2 for permanent storage in the saline reservoir and that plan is based in Illinois. We need to accelerate this and this is our opportunity to do that.

I just want to address briefly the EOR issue, the enhanced oil recovery. No one is claiming that linking EOR to captured CO2 is a panacea. Clearly in the long run, we have a lot of techniques we would like to do to phase out the use of fossil fuels. Among those might be pricing carbon and providing incentives.

But I would just note that we have, many of us in this

committee have signed a letter to preserve the CAFE standards, which are intended to ensure that cars, as they come off the production line, are more efficient, they use less gas. But we have implicitly acknowledged by doing that that we are going to have gas cars for a while. Even if today we decided that every car would be electric, it would take about 25 years for the fleet to turn over.

So in the meantime, the capturing of CO2 for EOR in the near-term can reduce the carbon footprint of that oil and gas we will be using. So that is all to the good. It is not a panacea. It is not where we want to end but it is a good place to start.

Now I want to begin by asking Mr. Mackler about this, the concern about streamlined CO2 permitting. And there is a concern that that would lead to an increase in oil production that would derail our climate goals but according to the Clean Air Task Force, if the U.S. EOR expanded to its maximum potential, this was all done with CO2 from direct air capture, the atmospheric benefit would be substantial.

Do you agree with that?

Mr. Mackler. Yes, I do agree that in the limit, if we are talking about in the limit here, if direct air capture were deployed to its full potential to meet demands for EOR, there would very likely be a substantial climate benefit because if direct air capture technologies were married with the best resources for producing oil and storing CO2, you could conceive of a project that was actually producing net carbon neutral oil.

And so if that was your end -- if that was your goal, it could be achieved through direct air capture.

And it is our view at the Bipartisan Policy Center that when it comes to climate risks, the real problem is carbon and CO2, and not necessarily fossil fuels. We need to be looking at the carbon accounting.

Mr. Peters. Right. And so the notion is that in the short-term, at least while we are using fossil fuels, we would like the lowest carbon output as possible, correct?

Mr. Mackler. That is right. There is a net benefit from using captured CO2 to produce the oil. So, we should be doing that as we transition to a lower carbon economy.

Mr. Peters. And in the long run, we are not getting away, necessarily, from transitioning to a lower carbon economy.

Mr. Mackler. Right.

Mr. Peters. But we are also potentially developing technologies that could draw carbon out of the atmosphere and really do what the IPCC said we had to do, the United Nations.

Mr. Mackler. That is exactly right. You are buying down the cost of developing and stealing these technologies and, at the same time, leveraging those economics to build out an infrastructure, CO2 pipelines. Most importantly, that can then be used later just for storage.

Mr. Peters. Okay, thank you so much.

My time has expired. I yield back.

Mr. Tonko. The gentleman yields back.

The chair now recognizes Representative Walden, full committee ranking member, for 5 minutes, please.

Mr. Walden. Well good morning, Mr. Chairman, again, and thanks to our witnesses. You have done a great job educating us on some of these matters.

I wondered -- I have been reading this report out of MIT about engineers there who have designed an ability to remove carbon dioxide from the air using, basically, batteries that attract. Are you familiar with that, Mr. Mackler?

Mr. Mackler. Not in great technical detail but I am aware of the research.

Mr. Walden. And so, as the report goes, they can get down to the 400 parts per million in the atmosphere, move that carbon and requires really no new fuels. It is the effect of the battery charging and discharging, and the air would just flow through, and they can capture the carbon and release it.

And Dr. Harmon, I am curious. Is that the kind of work you are engaged in in your company to remove carbon?

Ms. Harmon. So we are removing carbon directly from industrial emissions. These are emissions that contain a lot of CO, which is toxic and must be combusted. And so, in a sense, you can think of it as a pre-combustion approach.

And our particular technology is biological. So we are using a biological process --

Mr. Walden. Got it.

Ms. Harmon. -- to capture that carbon and transform it

into another output.

Mr. Walden. All right. I --

Ms. Harmon. I would say -- I just was going to say that the products of direct air capture, in whatever technology is representative, also can become feed for our fermentation and we work with partners --

Mr. Walden. Okay.

Ms. Harmon. -- on methods to do that.

Mr. Walden. So I mean my approach to this is innovation is going to be the way out of this. We have to set the right sort of incentive system, and we will have debates about what that is, but our great innovators at MIT and elsewhere are really on the forefront of this. And the consumer can win, the American consumer can win because we can develop this technology here and actually achieve the goals that the IPCC and others say we have to achieve going forward.

A lot of us believe this USE IT legislation, coupled with the 45Q tax credit, provides a nice companionship going forward.

And Mr. Begger, I wanted to ask you about the Department of Treasury. They still have to issue the guidelines, as I understand it, for those applicable applications for the credits but, in the meantime, they are offering a potentially good incentive for private sector investment. Is that right?

Mr. Begger. Mr. Chairman, Mr. Walden, that is correct. We are still waiting on the IRS to issue that guidance.

Mr. Walden. Yes, we have been pushing them, too.

So 45Q is an important reform for the development of the industry. Can you explain how the USE IT Act fits in here, because we think there is a marriage to be had, and what benefits would it supply to the development of CCUS and the related infrastructure?

Mr. Begger. Mr. Chairman, Mr. Walden, you know these first few projects are going to be, I guess the pathway to making them economically viable is going to require sort of layering a number of different benefits, you know whether it is the tax credit, a DOE grant, a State grant, private investment. You know when you look at early technologies, you do need that sort of layering to get the first ones built, to bring those costs down. And then, hopefully at some point, they are just able to stand on their own two feet.

Mr. Walden. I want to make a comment about your comments about NEPA because I, too, am from a -- actually, I am from a western State. I kid my friend from Ohio -- or Wyoming that she is from one of those big rectangular eastern States because Oregon is actually out west. But we face the same sort of issues with public lands. Trying to get anything done there can take a decade and then you litigate. And we know if we are going to actually deal with this crisis at hand, we have got to move faster than a decade or more to be able to build the facilities, build the pipelines, build the power lines to get a grid that works to factor in the renewables and everything else.

And so I am intrigued by that and I am pleased by the

administration's movement forward on NEPA reform, the first major reform since 1978 when the rules were first adopted. I am trying to just streamline the process, go back to the original intent.

I want to also recognize that the study released by the Department of Energy's National Energy Technology Laboratory in September, which found that Russian natural gas exported to Europe has a lifecycle greenhouse gas emission profile that is 41 percent -- 41 percent higher than U.S. gas exported to Europe. And for natural gas sent to China, the Russian gas is 47 percent higher total life cycle.

So do you think it makes sense for the U.S. to send cleaner gas to those areas?

Mr. Begger. Mr. Chairman, Mr. Walden, you are absolutely correct. My organization, we conducted a study about 5 years ago about coal exports to Asia.

Mr. Walden. Cleaner coal?

Mr. Begger. When you look at the tier 2 engines that we use in our mining equipment, the just the cleaner, safer, more productive operations that we have across the fossil energy industry in the United States, there is a lower carbon footprint to export U.S. commodities around the world.

Mr. Walden. All right, thank you, Mr. Chairman. And thanks again to our witnesses. I look forward to continuing to work with all of you.

Thank you, Mr. Chairman.

Mr. Tonko. The gentleman yields back.

The chair now recognizes Representative Soto for 5 minutes, please.

Mr. Soto. Thank you so much.

First of all, I wanted to ask both Mr. Mackler and Mr. Noel about sort of the net reduction that could potentially happen or not happen when we are talking about using direct air capture for advanced oil recovery. Could it lead to a reduction either now or in the near future?

It would be great to hear from both of you.

Mr. Begger. Sure, I would be happy to respond to that.

The short answer is yes. There will be a climate benefit from using captured CO2, particularly atmospheric CO2 for the production of oil. The precise carbon benefit depends on several factors -- what the oil field looks like, for example, how much CO2 is needed to be injected per barrel of oil that is produced. What is the particular direct air capture technology? What kind of energy source does that system use and where is that energy sourced from?

So there is a range of expected benefits, which is why that we are sort of talking in generalities here. So more work needs to be done on how we calculate those life cycle benefits.

But the ability to store that CO2 permanently underground as part of this EOR process is very well-understood and the regulatory frameworks are in place.

Mr. Soto. Okay, Mr. Noel.

Mr. Noel. Yes, I mean it all depends on the assumptions

embedded in those analyses and different players are going to have different motivations to come up with those assumptions.

We do think there is a better way to tackle climate change, rather than sucking carbon pollution out of the ambient atmosphere. The original carbon sequestration is to leave it in the ground.

Mr. Soto. Thanks for that.

And I was intrigued about using the CO2 to develop construction materials, cement, concrete, and other construction materials, where we advanced the Moving Forward Infrastructure package just last week, a $319 billion highway investment that would expand research and innovation. Part of that is innovative materials that last longer and that reduce carbon pollution.

So it would be great to hear from Mr. Anderson and Ms. Harmon on the -- would it be helpful for jobs, Mr. Anderson?

And Dr. Harmon, would it be something feasible to be able to really utilize cement from carbon capture to do a major infrastructure rebuild of America?

We will start with you, Mr. Anderson.

Mr. Anderson. The short answer is yes, absolutely, it would be good for jobs.

I mean in the first place, all of these systems have to be built and my brothers and sisters in the building trades unions love to build things. That is an enormous amount of work that would have to be done.

In the second place, once it is up and running, then there

are other people, like the folks in my union, who will operate and maintain those systems and who will operate and maintain the things on either end of the pipeline, things that are making the CO2 in the places where the sinks are. Those are jobs that we get to keep.

Yes, that will create and retain jobs is literally true.

Mr. Soto. And Dr. Harmon, based upon your manufacturing experience, do you think we could get there, sooner rather than later, to help create cement, concrete, and other construction materials from condensed CO2?

Ms. Harmon. Absolutely. I will say that that is not a part of our particular business.

Mr. Soto. I understand.

Ms. Harmon. But we work with other companies that are very far along in that that are producing materials today. It is an extremely viable and high-volume, high-opportunity pathway and one which, in each instance, will create those manufacturing jobs and in sectors, not just the utilization sector but in manufacturing areas that badly need them.

Mr. Soto. Thank you.

And Mr. Beggar, are you seeing that among Wyoming's infrastructure utilizing CO2 to create building materials just yet; if not, will we see it on the horizon.

Mr. Begger. Mr. Chairman, Congressman, Wyoming right now our focus has really just been on providing the platform to develop these technologies, recognizing that where particular things are

deployed is really dependent on a lot of different factors.

You know, for example, we have great rock quarries out west. So a synthetic material is not going to be probably as economic as the natural one. But for example, our relationship with Japan, that after Fukushima they are doing away with their nuclear, they don't have great land mass and things for renewables, they are doubling down on coal but their western society, their modern society wants low carbon technologies. And so we are working with them on a utilization technology that would use concrete because they have a huge market for that.

Mr. Soto. Thank you and I yield back.

Mr. Tonko. The gentleman yields back.

The chair now recognizes Representative McKinley for 5 minutes, please.

Mr. McKinley. Thank you, Mr. Chairman, and thank you for holding this hearing on our bill.

American innovation in carbon capture technology and utilization will -- the premise I am working under, will lead to reduced carbon emissions, not only in America but, more importantly, around the globe, especially in China and India. Because if you go back to the MIT report, where they say unless growing emissions from the rest of the world are addressed, there still will be global catastrophe. That is why the global carbon capture program is so vital.

For years, our office has led the efforts to advance innovation, increasing fossil fuel research funding, and

implementing 45Q. As the lead co-sponsor of the USE IT Act, I am proud to work for the past 4 years -- 3 years with Scott Peters on this effort.

The USE IT Act had broad support from bipartisan members of the Congress, as well as a host of industry, labor, and environmental stakeholders and the Senate has already advanced it twice in '18 and '19. Consequently, I was disappointed that last year we missed the opportunity sign this bill into law when it was a part of the defense bill. So I am hoping, rather than throw up roadblocks, the majority will continue working with us and pass this bill as a standalone legislation.

Look, let's be honest here with all of this. If America doesn't lead the way on carbon capture technology, who will? Do we really think China, and India, and the rest of the world are going to do that? They have shown no commitment to be able to do that. So for us to maintain our mantle of leadership on energy, this bill will help.

Please direct my question to Mr. Anderson, if I could, please. The primary objective of the USE IT Act is to use R&D funding to spur development and deployment of carbon capture utilization and storage projects. Let's go back over it. I want to make sure that people really hear what will be the impact of that on the jobs and various utility workers.

Mr. Anderson. Well, I can use an example right there in your district, Congressman. We have two coal-fired power plants in your district. The Harrison plant is one example. I am sure

you are very familiar with that facility, and the number of people who work there, and what else is around there, which is not a lot. If a plant like that goes down, the alternative is basically to leave. And good luck finding another opportunity somewhere else, especially if you are a 50-something boiler mechanic.

Mr. McKinley. I know in Pleasants County, it was over 30 percent of the budget for that county, the tax revenue. That is going to affect schools, fire departments, first responders, all of that is going to be. So it is important for us to continue this, continue this effort to try to reduce the emissions and I think we can do this with innovation.

Dr. Harmon, if I could to you, just how big a barrier is the lack of infrastructure in developing carbon capture and storage projects?

Ms. Harmon. So I would say it depends upon the application. As utilization technologies scale, infrastructure will be extremely important to collect large volumes of feedstock and enable large-scale utilization applications, which then drive down costs. Luckily today, we can at least get started with co-located facilities but being able to bring large volumes to sites where either the chemical facilities are available, where hydrogen is available, where renewable power is available, all of that will be extremely valuable in scaling up and promoting utilization.

Mr. McKinley. Let me stay with you on a little bit and try to paint a picture here.

If we do this retrofitting of our power plants, and maybe Mr. Anderson this goes to you as well -- if we retrofit our power plants to remove -- if we implement a carbon capture program, we are already -- we are already capturing and storing the fly ash, the coal ash, residual, we are taking care of that. What is the motivation, then? Why are we so -- if we are on that cusp of being able to accomplish this, what is the cusp then to continue closing down our coal- and gas-fired power plants across America if we are capturing all the emissions and especially given the impact it has on our communities, for our schools, our first responders, and the like? If we do this, wouldn't that address this problem we are trying to focus?

Ms. Harmon. So I am not an expert in capture from power facilities because we specialize in industrial facilities.

What I can say is that, to the extent that we can create value from emissions, such as from the power sector and from the industrial sector, we are not only keeping plants open but we are adding those jobs that are associated with utilization and with infrastructure development and, therefore, there is a multiplicative effect when we look at opportunities to use carbon that is otherwise going to waste.

Mr. McKinley. Thank you.

My time has expired. I yield back.

Mr. Tonko. The gentleman yields back.

The chair now recognizes Representative Schakowsky for 5 minutes, please.

Ms. Schakowsky. Thank you so much.

You know we absolutely all have to have a sense of urgency. The science is so clear that the climate crisis is an existential one for us. And if we are to save our planet for our children and grandchildren, we have to accept that challenge right now.

So to ensure temperatures don't rise above 2 degrees Celsius and to avoid climate change's worst consequences, I think we do need to go beyond reducing emissions. Rapidly transitioning from fossil fuels, building nature-based infrastructures, and I think carbon capture are all necessary. We simply can't afford to pursue one solution at a time. We also can't afford to focus too much on mitigation, while ignoring the real problem of being the world's largest emitters of greenhouse gases, historically.

Still, carbon capture can be part of the solution, I think.

So Mr. Mackler, in your opinion, would the USE IT Act detract from or discourage the use of other strategies like nature-based solutions?

Mr. Mackler. Thanks for that question. I don't think it would detract from nature-based solutions because I think that that is a completely different area when it comes to policy, and when it comes to policy needs, and funding needs.

When we are talking about industrial direct air capture, this is a technological approach that really needs an injection of capital to foster technological innovations in the chemical processes, in the industrial processes needed to capture the CO2.

The nature-based solutions are very important but it is sort of a different arena, I think, from this.

And so both are needed and they are complementary, not competing.

Ms. Schakowsky. So you think it is important to pursue multiple climate solutions alongside carbon capture technology?

Mr. Mackler. Definitely. We are in all of the above, you know low-carbon energy -- we take in all of the above low-carbon energy perspective.

Ms. Schakowsky. Thanks.

And I am glad that companies like LanzaTech, which, as Dr. Harmon said, is in my district. I am very proud of that. And I appreciate your finding innovative solutions to address the climate crisis.

So, Dr. Harmon, how can creative approaches to utilization reduce emissions and repurposing CO2 benefit the ways in which -- in your opinion, how does utilization need to be -- to be limited regarding enhanced oil -- no -- is that right? Do I want those? Yes, okay.

Talk to me about Lanza.

Ms. Harmon. Well, to your first question: How can utilization contribute to our climate objectives at large? As I said earlier, we all understand implicitly that we need carbon in our future. We will need aviation fuel. We will need plastics. And yet, the carbon that is being emitted today that

we see as a liability from a climate perspective is actually the building block that we need.

So utilization in the form of products that substitute for those that we would get from petroleum or from natural gas in fact do a dual value. On the one hand, they are producing new low-carbon alternatives and they are reducing the emissions, the atmospheric emissions. And this is all done in the context of actually creating value and creating money. None of our partners are doing it for charity or to meet regulatory demands. They are doing it because they can make money from emissions.

Ms. Schakowsky. And I appreciate the list of different kinds of products that can be produced that you included.

I wanted to also ask Mr. Noel: Do you think that we can have some guardrails? Do you think we need to limit the use of capturing carbon for enhanced oil recovery?

Mr. Noel. Absolutely. EOR operations, as I said in my testimony, are part of an expansion strategy. It can't be siloed off from the rest of a company's portfolio.

Ms. Schakowsky. So it is not an all or nothing thing. We can put some guardrails, some limitations on the kind of work that we do.

Mr. Noel. The way that carbon capture is currently practiced is all the carbon capture in this country is sold back to the oil companies should not inspire public confidence.

Ms. Schakowsky. I appreciate that.

I yield back.

Mr. Tonko. The gentlewoman yields back.

The chair now recognizes Representative Long for 5 minutes, please.

Mr. Long. Thank you, Mr. Chairman, and thank you all for being here today.

Mr. Begger, do you live in Casper or where do you live?

Mr. Begger. I live in Cheyenne.

Mr. Long. Oh, you do? Good. Good.

Mr. Begger. But I have lived in Casper and I spend a lot of time in Gillette.

Mr. Long. Yes, my wife is from Cheyenne. So that is why I was asking. She grew up there. So, yes.

We have been talking about carbon capture for before there was any functioning facilities. So for years, we have been talking about carbon capture on this committee. And we have people come in all the time from our district and we will have meetings in our office. And when we are in a committee hearing like this, sometimes I will come down here, which just happened to me a few minutes ago. I went out and had a meeting in the side office over here with some folks from our district and they are working on a project trying to get it out of the EPA. And it has been ready to go for 8 or 9 years now, trying to get it out of -- so with that in mind, I have a question about bureaucratic red tape.

Does that stand in the way of innovating new technologies that can expand American energy and manufacturing jobs, while

we do see harmful emissions?

Mr. Begger. Mr. Chairman, I think where this program would best be fitted, you know it is a policy decision for Congress. I do think that the regulators and the EPA have a role to play in making sure that the policies set forth align with the technological reality. And so you know I have great confidence in EPA -- or excuse me -- in Department of Energy, and their team, and what they are able to do but you know I think there is a role for EPA to play as well.

Mr. Long. You think what?

Mr. Begger. There is a role for EPA to play as well in understanding things. But you are right, one of the biggest challenges that we have is bureaucracy and red tape. I mean I spoke about NEPA and some of those processes. And the last thing that we need to do is head down a pathway where we are not able to actually get things built and get things done because of bureaucracy.

Mr. Long. Okay, thank you. Like I said, I just walked out of a meeting behind the TV monitor right there in the next room, where they have been waiting for an answer from EPA. As I say, they have had it ready for 8 or 9 years now.

Mr. Mackler, I am going to go to you next. How important is deploying carbon capture technologies to help promote affordable and reliable energy production, while putting the U.S. on a path towards meeting domestic climate objectives?

Mr. Mackler. Well, we think carbon capture is essential

to decarbonization of the energy system at least cost. And there has been analysis conducted that suggests if carbon capture is not part of the toolkit going forward, the cost of hitting or achieving our climate goals could double.

So it is really important for a variety of reasons. Because we need a big toolkit, we need as many solutions on the table as possible. And frankly, there are not alternatives to some of the energy consuming parts of our economy today, so carbon capture. There are not alternatives to fossil combustion in some of these parts of our economy and carbon capture is really the only pathway forward for some of these places.

Mr. Long. Okay, I am going to stick with you, Mr. Mackler.

Even as coal production in the United States declines, we know that fossil fuel, as being a cheap and reliable source of energy, will continue to be used in the U.S. power sector. Even more developing countries, like China and India, will continue to rely heavily on fossil fuels as they look to grow their economies.

How does the U.S. stand to benefit from being at the forefront of the carbon capture implementation, particularly as it relates to global climate policies?

Mr. Mackler. That is a great question and I think it is important to note that we have seen enormous advances in renewable energy over the last 15 to 20 years. The prices of solar and wind have decreased dramatically and they have deployed very successfully in the U.S. and around the world. It is a great

success story.

But if you look at how that is fitting into the global energy picture, it is mostly a case of those technologies meeting new demand. And so the use of fossil fuels continues to increase, even as we are deploying these other technologies.

So we are going to need carbon capture to start to get at the existing infrastructure and energy chains that we use today. And if the U.S., with all of its innovative commercial expertise, and its innovation systems, and all the companies working on these technologies gets out in front in developing these next generation carbon capture technologies, it is an enormous market for our U.S. companies to export to globally.

Mr. Long. Okay, thank you.

And Mr. Anderson, how would the increased use of carbon capture technology, both here and around the world, impact jobs here in America?

Mr. Anderson. Well I think there is really three pieces to it. One, to start with, is the manufacturing. It all has to be made. It would be wonderful to make all of that equipment here in America. The second thing is that it all has to be built. It all has to be constructed by somebody. And the third thing is that then it has to be operated and maintained.

That whole chain is thousands upon thousands of jobs that we could have all over the country.

Mr. Long. Okay, thank you.

And Mr. Begger, just to wrap up my earlier comment -- I don't

know how long you have lived in Cheyenne but my wife and I -- everybody wants to know how I met someone from Cheyenne. But we met at the Tollerton School of Ballet in Cheyenne, Wyoming.

I yield back.

Mr. Tonko. Well, we thank you for that information.

The gentleman yields back.

And now the chair recognizes Representative Matsui for 5 minutes, please.

Ms. Matsui. Thank you very much, Mr. Chairman, and I thank the witnesses for being here today.

As we look at the technologies and the solutions currently available to us, it has become quite clear that carbon reduction strategies are not enough. It is critical that we begin laying the groundwork for robust deployment negative emission technologies to remove carbon dioxide from the air and sequester it. This is likely the only way we can possibly hope to achieve the emissions reductions needed to prevent catastrophic climate change.

We know there are natural sequestration efforts like afforestation and reforestation uptake, and storage by agricultural soils, and biomass energy with carbon capture and storage.

Mr. Mackler, are these natural sequestration efforts sufficient to keep limit warming of our planet at 1.5 degrees Celsius? And a yes or no is all I need here.

Mr. Mackler. They are not sufficient. They are important

but not sufficient.

Ms. Matsui. All right. Do you think that there is currently an adequate investment at the Federal level for carbon capture research and development? Yes or no?

Mr. Mackler. No.

Ms. Matsui. What kinds of improvements in CCUS technology can we expect from the improvements -- from investments made under H.R. 1166?

Mr. Mackler. I think we can expect to see improvements in the technologies around direct air capture. That would probably be the primary benefit.

Ms. Matsui. Okay, thank you.

Some of my colleagues and one of the witnesses on the panel had raised concerns about the potential support that this bill provides for increased investments in oil development. At a time when we are doing everything we can to ramp up investments in renewable and clean energy technologies and transition away from fossil energy, we should not be subsidizing or supporting new investments in construction of fossil fuel development.

I would like to ask each of the witnesses: Do you believe that, in its current form, H.R. 1166 could lead to increased investments in oil development? Just a yes or no, starting with Mr. Mackler.

Mr. Mackler. I do believe it could lead to increased investments in oil and gas development, yes.

Ms. Matsui. Mr. Noel?

Mr. Noel. Yes.

Ms. Matsui. Mr. Begger?

Mr. Begger. Yes.

Ms. Matsui. Dr. Harmon?

Ms. Harmon. Yes.

Ms. Matsui. Mr. Anderson?

Mr. Anderson. Yes.

Ms. Matsui. Mr. Noel, you referenced a 2010 DOE study that states that CO2 pipeline to oil fields looking to expand EOR operations should not be constructed without establishing that large, additional, suitable storage capacity exists in the area that can handle storage over the long-term.

Does H.R. 1166 contain any provisions that would ensure this? Yes or no?

Mr. Noel. No.

Ms. Matsui. Are there ways this bill can be improved and strengthened to ensure that sequestration is done safely and at significant scale, while minimizing other environmental risk?

Mr. Noel. There are ways on multiple fronts to strengthen this bill.

Ms. Matsui. Can you please provide an example of potential improvements?

Mr. Noel. Sure. Explicitly exclude enhanced oil recovery from the research provisions. Also, explicitly state that the pipelines should not be sent to EOR regions to produce oil --

Ms. Matsui. Okay.

Mr. Noel. -- among other things, which I can submit for the record.

Ms. Matsui. Okay, thank you.

As you probably are aware, in 2018, the State of California amended its Low Carbon Fuel Standard to enable CCS projects that reduce emissions associated with a production of transport fuels sold in California and projects that directly capture carbon dioxide to generate LCFS credits. This qualification for credits came with a few stipulations, including a requirement that operators of CCS projects monitor the site for at least 100 years post-injection.

Mr. Mackler or Mr. Noel, do you think a monitoring requirement like this would strengthen the integrity of carbon capture projects?

Mr. Mackler. Yes, I do.

Ms. Matsui. Mr. Noel?

Mr. Noel. Sure.

Ms. Matsui. So do you think the 100-year timeline is appropriate? Either -- Mr. Mackler.

Mr. Mackler. Well, I think it is very rigorous. You know whether or not it is the right number I think is an open question but it is certainly a very rigorous approach.

Ms. Matsui. Okay. Mr. Noel?

Mr. Noel. Agreed. And what happens on the 101st year?

Ms. Matsui. Okay. I don't have much time but there seems to be a broad agreement in this room that CCUS has an important

part to play in achieving our carbon reduction goals but some here are more supportive of EOR than others. I believe we should be focused on other means of sequestration, such as long-term geologic storage.

Mr. Mackler, in what ways has the U.S. demonstrated or deployed carbon dioxide sequestration and utilization, other than EOR? And I realize I am going over time but quickly, can you?

Mr. Mackler. Well, we share your view that, in the long-term, geologic saline storage should be the priority for most of the CO2 that we capture. The U.S. Department of Energy has had a very sweeping research program on saline for many years now and so we have demonstrated global leadership there.

Ms. Matsui. Thank you very much. I am signaled that I have run out of time.

I yield back. Thank you very much.

Mr. Tonko. The gentlelady yields back.

The chair now recognizes Representative Carter for 5 minutes, please.

Mr. Carter. Thank you, Mr. Chairman, and thank all of you for being here. Obviously, it is extremely important.

I continue to say that innovation is going to be the key for us. And when you say innovation, a lot of people think, when you are talking about the climate, that we are talking about renewable fuels, and we are, but this is also innovation. This is extremely, extremely important.

I want to start with you, Dr. Harmon. LanzaTech has a plant

near my district in Soperton, Georgia, right outside my district. And whereas I have not had the opportunity to visit it yet, I do plan on doing that and want to go by and see exactly what you are doing. And from what I understand, it is a very large operation and we appreciate your investment in our area.

Tell me -- obviously, it looks like you see a viable opportunity here to create these products from waste gases. What kinds of industrial gases and waste submissions are you utilizing here?

Ms. Harmon. So our first commercial plant is directly converting steel mill emissions into ethanol. We have projects in development around the world, actually, which use refinery gasses, ferroalloy gases, which are similar to steel-making gases. These are gasses that are rich in carbon monoxide, carbon dioxide, and hydrogen, depending upon the source.

Mr. Carter. Do you know, do you see other kinds of gasses like this being able to be utilized?

Ms. Harmon. There are other industrial sectors for which the technology is also applicable. Calcium carbide would be one. There are emissions in the chemical sector as well. It is quite -- it is a very broad opportunity.

Mr. Carter. You mention in you testimony about gas fermentation and the use of carbon dioxide to develop beneficial products such as this. What do you see as the future of that?

Ms. Harmon. So just to be clear, the gas fermentation relies not just on carbon dioxide but on carbon monoxide. We see this

as very broadly deployable, even in the U.S. Taking strictly the gases from industry that area accessible to us today, we could build 33 plants, based just on 60 percent of that gas.

Mr. Carter. Wow.

Ms. Harmon. And each of those plants would create probably a thousand jobs during construction, maybe 240 during operation, and that takes into account the multipliers that were referenced earlier.

But these are substantial operations in areas that need that kind of --

Mr. Carter. And see, this is the point I try to make. I look at this as being a tremendous opportunity for us. You are talking about creating jobs right here. A tremendous opportunity.

One last thing, Dr. Harmon. You mentioned how Federal research had actually assisted and help kickstart this type of technology. Could you just expound upon that for just a second?

Ms. Harmon. Certainly. If we talk about our site in Georgia, for example, there we have, in fact, a pilot operation that is demonstrating our next generation bioreactor technology and that technology originated at small scale, with support from RPE. And with support from RPE, we were then able to scale that up to a larger what we call a field pilot.

At the very moment, sticking with Georgia, we are in fact designing a 10 million gallon per year facility to produce jet and diesel fuel from ethanol that is brought from all parts of

the U.S. And that is, it is a pre-commercial demonstration but, in fact, it will be commercially viable.

And if you are aware of the scale of some of the renewable fuel and sustainable aviation fuel initiatives, this is a substantial opportunity that can be replicated everywhere, and that technology was developed and scaled up with support from Department of Energy's Bioenergy Technologies Office.

Mr. Carter. So Government created the environment for you to succeed in. That is the point we have been trying to make. Thank you for verifying that.

Very quickly, Mr. Begger, I wanted to ask you. You mentioned the XPRIZE Foundation. Can you just tell me about that, explain that to me?

Mr. Begger. Sure. Mr. Chairman, Representative, XPRIZE Foundation is sort of a philanthropical foundation that has offered a lot of engineering competition prizes over about the last 20 years. Probably the one that they are most well-known for is SpaceX; that started out of an XPRIZE competition.

And so they have done a lot around public health, and water, these sorts of things, but they have one now that is really focused on carbon utilization. So 3 or 4 years ago, I think there was 47 teams from seven or eight different countries that put forth proposals to best pull CO2 out of a power plant stream and convert it into some other marketable product.

Mr. Carter. Right. Right. Just another example of how the private sector is helping us in this goal that we all share

in.

So thank you, Mr. Chairman. I yield back.

Mr. Tonko. The gentleman yields back.

The chair now recognizes Representative McNerney for 5 minutes, please.

Mr. McNerney. I thank the chairman. I thank the witnesses for your testimony; it was informative and useful. I appreciate it.

Especially, Mr. Anderson, I agree with your testimony and I wholeheartedly agree that we need to find a way to positively utilize the human resources and capital currently employed in the fossil fuel industry. Hopefully, Federal regulation will help in that regard, including the USE IT Act.

Mr. Mackler, is there an accurate cost model for direct air capture, say in dollars per ton, or something like that?

Mr. Mackler. Well because this is such a nascent field, with many different technology strands and sort of pathways being developed in real time, some of them privately developed so it is hard to look under the hood and see what they cost, we don't have great insight into what the costs are.

There have been some studies that have been put out that suggest costs could be as high as $600 per ton, but that is really seen as very much on the high end, and as low as potentially $100 to $200 per ton within sight, and potentially less than that at some point in the future.

Mr. McNerney. Where do we need to be, dollars per ton?

Mr. Mackler. Well, it depends on the business model, and it depends on you know what the climate goals are, but I think if we are in the range of $100 per ton, we are going to see significant deployment of direct air capture.

Mr. McNerney. Thank you.

Ms. Harmon, a similar question in terms of carbon usage: How far are we from competitive uses of carbon usage and what are the biggest cost production obstacles?

Ms. Harmon. So the distinction in this case is that we are, in fact, producing a product that goes into the market. So the ethanol that is being produced from steel mill emissions is being sold as a gasoline blending component and that is a profitable operation.

There are high-value products in the chemical sector that create really significant value but in any and every instance, those partners, industrial partners that we work with, are motivated by actually a positive economic return. They evaluate these investments in the same way that they would evaluate any other.

Mr. McNerney. We need large-scale commercial applications.

Ms. Harmon. We need to move to large-scale. As I mentioned, it took us 14 years to get to this point. Any of the new technologies, and there is a whole portfolio that are emerging across the innovation world, they will all need to move to scale. They need that type of support.

Mr. McNerney. Right.

Well, Mr. Mackler, what additional forms of policy do you see -- this was already asked of Mr. Noel -- do you see needed in addition to the USE IT Act?

Mr. Noel. For carbon capture in particular?

Mr. McNerney. Carbon capture.

Mr. Noel. Well I think the USE IT Act does some very important things in terms of investing in direct air capture and in helping to facilitate the construction of infrastructure.

The most important policy for driving large-scale carbon capture and direct air capture into the marketplace would be a market for low-carbon energy, whether that takes the form of a clean energy standard, of a carbon price, or procurement policies that could actually provide the developers of the technologies and the projects a means to recoup their investment, that is the most important policy.

Mr. McNerney. Thank you.

Mr. Begger, while enhanced oil recovery is currently one of the primary applications for utilizing captured carbon dioxide, its usefulness is expected to diminish as we transition away from reliance on fossil fuels.

In your testimony, you noted the role of carbon control technologies beyond EOR. Please describe some of the more interesting projects that your State is funding for utilizing captured carbon beyond EOR.

Mr. Begger. Mr. Chairman, Congressman, there really is a suite of different technologies. Sometimes I think we tend to

gravitate towards the carbon fibers and these high-tech sort of things and there certainly are opportunities there because, at the end of the day, this is just chemistry. We are taking CO2, you know one atom of carbon, two atoms of oxygen, and converting it into something else.

Mr. McNerney. We have to do it economically, right? I mean --

Mr. Begger. We have to do it economically and so you know it is a very strong chemical bond that needs to be broken. And so what are the economics to take that energy and put -- and convert it into something else?

I think sometimes, too, we try to demonize the particular carbon source when, in reality, we need to be focused on carbon itself. It shouldn't matter if it comes from EOR, or coal, or natural gas, or ethanol. It is what are doing? Are we capturing the carbon and utilizing it or permanently sequestering it in a place where we can't use it?

So you know there are things like cryogenic carbon capture that could be used. There are things -- membrane, solvents, absorbents. You know while we can't forget about the carbon capture piece -- you have to capture it first -- and then you know what you do with it. There is far more carbon out there than just EOR can support, or products, or geologic sequestration. So it is going to have -- it is fitting those puzzle pieces together.

Mr. McNerney. Thanks.

Mr. Chairman, thanks for your indulgence. I yield back.

Mr. Tonko. You are welcome. The gentleman yields back.

The chair now recognizes Representative Johnson for 5 minutes, please.

Mr. Johnson. Well thank you, Chairman Tonko, and Ranking Member Shimkus for this hearing today because I think it is an important one. I want to thank our witnesses for being with us talk about a path forward on carbon capture technology.

You know whatever your opinion is on carbon emissions, it is good to see a number of us on both sides of the aisle taking a look at this thing and saying hey, how do we get some use out of it you know. We don't all have the same scientific background but we have been working on it now for a number of years and I am looking forward to seeing, through this legislation that we are look at, how we can make this work.

I want to start out by mentioning and springing off of something my colleague, Mr. Carter from Georgia, said. You know what is going to really address the climate concerns across the globe is innovation. That is what is going to solve the problem -- market-driven solutions and discoveries like carbon capture and others. Yes, there is a place for alternative fuels, and biofuels, and wind, and solar, and absolutely we should let the market drive innovation on those and use them as they fit into our energy profile but we are not going to solve the climate concerns with government mandates. We are just not going to do that. It is going to be smart folks like you guys and others

that come up with solutions that solve the problem.

So let me start with Mr. Mackler, if I could, and Mr. Begger, you can chime in here, too. Last Congress, I co-sponsored, along with several of my colleagues, the legislation to reform the 45Q tax credit enacted as a part of the 2018 Omnibus, which was intended to incentivize the acceleration of new technologies to capture and store carbon for practical use.

While I understand that a number of carbon capture projects have been announced since those changes, I am told the IRS is sort of slow-walking, taking their time on making a number of clarifications for credits -- or for companies wishing to claim this tax credit.

So first, I would like to ask: How important has the Section 45Q tax credit been in some of the recent project announcements across the country, Mr. Mackler and Mr. Begger, if you would?

Mr. Mackler. It has been central. It is the most important policy we have in place today for carbon capture.

Mr. Johnson. Okay. Mr. Beggar.

Mr. Begger. I agree. You know there have been a lot of people who are using I guess those dollar figures for that tax credit to at least do some early back-of-the-envelope calculations on what projects would look but, ultimately, until they receive final guidance, you won't be able to pull together a project.

Mr. Johnson. Right. Okay. So here is a case where Government policy of incentivizing innovation is producing

results, rather than mandating a solution, giving the innovators an opportunity to work the problem.

And so if we can get some certainty with the IRS and guidance, which we know would minimize some ambiguity for businesses looking to invest in carbon capture technology, what effect would that have going forward, Mr. Mackler and Mr. Begger, again?

Mr. Mackler. I think it would kickstart the commercial industry in a way we haven't seen yet. So it would be very catalytic. Of course, you know some of it depends on the details around what the IRS specifies in terms of how to implement the tax credit. So, that needs to come out quickly so we can take advantage of the credit because the window of opportunity is closing because there is a sunset on the tax credit and so we are losing time. But if enough time remains or if the credit is extended, it could be very catalytic.

Mr. Johnson. Okay. Mr. Begger, do you agree?

Mr. Begger. I agree. I think the carrot of a tax credit has done far more to advance commercialization than any regulation, or threat of a carbon tax, or anything has ever done.

Mr. Johnson. I like your term, Mr. Mackler, it would kickstart it. You know it wasn't until the Wright brothers solved the problem with powered flight that it kicked into high gear the aviation industry. You know I mean we have got many, many examples like that and this is just another one.

We need to give the innovators an opportunity to innovate. That is what we need to be doing.

Mr. Chairman, I yield back.

Mr. Tonko. Thank you. The gentleman yields back.

The chair now recognizes Representative Blunt Rochester for 5 minutes, please.

Ms. Blunt Rochester. Thank you, Mr. Chairman and Ranking Member Shimkus. Thank you also the panelists.

We are in a climate emergency. We are seeing the impacts from climate change in our communities every day. We are getting grave warnings from scientists and economists about our future, if we fail to address climate change. So, we must act.

Not only do our children and grandchildren depend on it for their futures, we all depend on it right now. That means that we must use every tool available to us to try to avoid the worst impacts from climate change. Numerous witnesses have testified that carbon capture and sequestration will be an important and even required tool, as we work to drastically reduce emissions.

I agree that carbon capture has a critical role to play in developing climate solutions, which is why I look forward to working with my colleagues on this legislation, but we must ensure that we get this policy right so that we can deploy this technology while also protecting our communities and our health.

Mr. Noel, in your testimony, you mentioned that, following enhanced oil recovery, carbon dioxide is stored underground. Are there environmental impacts to injecting carbon dioxide into the ground and, specifically, does it pose risks to drinking water sources?

Mr. Noel. Sure, there are a whole unique set of risks that injecting continuous CO2 under the ground at high pressures present to underground sources of drinking water. And we do not think the regulations on EOR, as currently practiced, are anywhere near where they need to be.

Ms. Blunt Rochester. Thank you.

And Mr. Mackler, as you know, throughout this Congress, this subcommittee has held a series of hearings on the challenges stemming from the climate crisis, as well as the solutions needed to address it. In your testimony, you discussed the need to bring a diverse set of solutions that will work comprehensively across economic sectors.

Can you elaborate on this and how this legislation will add to the suite of policy options to tackle the climate crisis?

Mr. Mackler. Sure, I would be happy to.

Yes, so we have reviewed the analysis that has been done on how we can most cost effectively decarbonize the U.S. and the global energy system. And it is very clear that the broader the toolkit of solutions, the more likelihood that we are going to actually achieve our climate goals, and especially achieve them at the lowest cost.

And so historically here in the United States, we have invested an enormous amount of resources quite successfully in bringing down the cost of wind and solar. And that is a major success story. We need to now do the similar thing for other energy technologies to ensure we are positioning ourselves for

success. And the USE IT Act can be a part of a strategy for bringing forward carbon capture.

Ms. Blunt Rochester. Mr. Mackler, do you believe that this bill can be improved in ways that bolster public health protections, while maintaining its fundamental purpose to support CCUS deployment?

Mr. Mackler. Yes, it could probably be improved in some ways.

Ms. Blunt Rochester. Do you have any suggestions?

Mr. Mackler. Well, I haven't given a lot of thought to that part of this bill but I am sure there are ways that this could be done. I would be happy to submit that for the record later.

Ms. Blunt Rochester. That would be awesome.

Do you believe that these priorities -- those priorities are compatible or are they mutually exclusive?

Mr. Mackler. They are very compatible. I mean we have been injecting CO2 into the subsurface through the enhanced oil recovery industry for more than 50 years. And so we can go and look, and see what impact that has had on the local environment, and I think we can demonstrate very clearly it has been minimal.

And so those parts of the challenges, to the extent that they remain, can be managed.

Ms. Blunt Rochester. And Mr. Anderson, in your testimony, you discussed how deploying carbon capture technology can impact your workers and communities.

Can you elaborate on how this legislation would create jobs?

Mr. Anderson. Well, as I mentioned earlier, there are three main components to it. All of the technology has to be made somewhere. It has to be manufactured. I think, personally, that we should make that domestically in America and export it abroad, as well as here.

Second of all, it all has to be constructed. Whatever the CO2 source, there is no need to, as my colleague said, demonize any particular CO2 source. They all need it and all of these systems would to be built for that. That is thousands of jobs.

And then once they are in place, they have to be maintained, repaired, operated. That never ends. That is an unending source of jobs, literally.

Ms. Blunt Rochester. Thank you. I want to just close out by saying I believe it is not an all or nothing, and that we can't just do something today and not do something for tomorrow, or not do something for tomorrow and not do something right now, and that is why this legislation is important. But we also have to take into account the health outcomes as well. And so we look forward to working with you, Mr. Peters and Mr. McKinley, thank you, on this legislation.

Thank you so much and I yield back.

Mr. Tonko. The gentlewoman yields back.

The chair now recognizes Representative Barragan for 5 minutes, please.

Ms. Barragan. Thank you. Thank you for having this conversation. The climate crisis does require urgent action and

we need to consider all options.

I think that there are merits to carbon capture technology for preventing greenhouse gas emissions. I am a little concerned about some of the unintended consequences that can arise from it.

Mr. Noel, one of the most significant reasons for environmental injustice in low-income communities and communities of color is their close proximity to fossil-fueled power plants and industrial facilities, such as coal.

In a carbon-constrained future, could carbon capture and storage keep a facility open longer in a disadvantaged community and would there still be the emission of pollutants, such as sulfur dioxide particulate matter and mercury, into the community?

Mr. Noel. Yes, and it is one of the reasons Greenpeace does not support carbon capture in fossil fuel plants. Existing fossil fuel plants should be phased out.

And I also say that there is no consensus, in our view, on these technologies without representation of communities who live on the front line, who have to live next to extraction projects that would be prolonged as a result of deploying these technologies.

Ms. Barragan. So it would take us longer to get away from the reliance on fossil fuels. Would that be accurate in what you are saying?

Mr. Noel. Yes.

Ms. Barragan. Mr. Mackler, one of the main uses for captured

CO2 is enhanced oil recovery, which makes it easier to extract oil from oil wells. My district has a lot of urban oil drilling. You can drive around my district and you can actually see it right in people's backyards, right next to where kids play on soccer fields, and you can also see our kids walk around with inhalers around their necks.

So I have been fighting for closure of some urban oil wells, not understanding why we need them in people's backyards and next to parks where our kids play.

Could the oil industry use this enhanced oil recovery to extend the life of these wells?

Mr. Mackler. Well that is a very good question. And the one thing to keep in mind when it comes to CO2 injection for enhanced oil recovery is it can't be used in every reservoir. There are only certain reservoirs that are amenable to CO2 injection for enhanced oil recovery. So I can't speak specifically, for example, around the production that is happening in your district and to whether or not they would be extended in their life by the injection of CO2.

Ms. Barragan. What about urban drilling, in general?

Mr. Mackler. I don't think that carbon capture or EOR would have any special impact on urban drilling, in general.

Ms. Barragan. And so following up on that question, does the streamlined permitting in the bill reduce the level of public input and environmental protections for establishing carbon capture in enhanced oil recovery?

Mr. Mackler. Well it is really, you know those provisions that help to streamline the permitting of infrastructure do not -- are not designed to circumvent the environmental review process. They are really designed to help accelerate and better coordinate environmental review and permitting of certain projects.

So I think that, in general, you know one should not look at that provision as sort of a workaround of environmental permitting.

Ms. Barragan. Mr. Noel, do you have anything you want to add?

Mr. Noel. Yes, I would say the whole point of EOR is to extend the life of oil fields. It is right on DOE's website. It is in all the oil industry's literature.

I was at a briefing yesterday with an oil company who said you could almost apply EOR to every oil reservoir in the world, if they perfect this technology.

So if they get -- continue to get Federal, State support and incentives, we are talking an insane amount of oil on deck.

Ms. Barragan. Thank you.

Mr. Noel, how does the current cost of carbon capture and storage, as a climate solution, compare to the cost to reduce emissions through other means, like solar, wind, geothermal, and energy efficiency investments?

Mr. Noel. It is probably the most expensive way to do it

right now in the near-term. Energy efficiency seems to be the cheapest.

Ms. Barragan. Right. Thank you to our panelists.

I yield back.

Mr. Tonko. The gentlewoman yields back.

I believe that completes the list of members choosing to ask questions of our panelists and we thank you all for appearing here today and for your help, too, in bringing us together.

So I do have a request for unanimous consent to enter the following into the record: a letter from Clean Water Action; a letter from the Portland Cement Association; a letter from Sfonte (phonetic); a letter from the Western Governors Association; a letter from Our Children's Trust; a report from World Resources Institute entitled CarbonShot: Federal Policy Options for Carbon Removal in the United States; a memo from the Congressional Research Service regarding CCUS projects and CO2 pipelines as covered projects under FAST 41 guidance; and then finally six letters of support from various groups that were sent to the Senate in 2019.

Without objection, so ordered.

[The information follows:]

**********COMMITTEE INSERT**********

Mr. Tonko. And I again thank all of our witnesses for joining us for today's hearing.

Mr. Anderson, thank you. I know you did some reach out with the subcommittee and thank you for that.

Mr. Anderson. Thank you.

Mr. Tonko. And I remind members that, pursuant to committee rules, they have 10 business days by which to submit additional questions for the record to be answered by our witnesses. I would only ask that each witness respond promptly to any such questions that you may receive.

And at this time, this subcommittee is adjourned.

[Whereupon, at 12:09 p.m., the subcommittee was adjourned.]