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Committee on Environment
and Public Works Washington, D.C.

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HEARING TO EXAMINE S. 383, THE UTILIZING SIGNIFICANT EMISSIONS
WITH INNOVATIVE TECHNOLOGIES AT, AND THE STATE OF CURRENT
TECHNOLOGIES THAT REDUCE, CAPTURE, AND USE CARBON DIOXIDE

WEDNESDAY, FEBRUARY 27, 2019

U.S. SENATE

Committee on Environment and Public Works

Washington, D.C.

The committee met, pursuant to notice, at 10:05 a.m. in
room 406, Dirksen Senate Building, the Honorable John Barrasso
[chairman of the committee] presiding.

Present: Senators Barrasso, Carper, Inhofe, Capito, Braun,
Rounds, Sullivan, Ernst, Cardin, Whitehouse, Merkley,
Gillibrand, Booker, Markey, Duckworth, Van Hollen.

STATEMENT OF THE HONORABLE JOHN BARRASSO, A UNITED STATES
SENATOR FROM THE STATE OF WYOMING

Senator Barrasso. Good morning. The committee will come to order.

Today we are here to discuss Utilizing Significant Emissions with Innovative Technologies Act, or simply, the USEIT Act. The USEIT Act would encourage the commercial use of man-made carbon dioxide emissions.

The bill supports the use of carbon capture technology, including direct air capture. The legislation also expedites permitting for carbon dioxide pipelines in order to move the carbon dioxide from where it is captured to where it is stored or used.

For those of you who are not familiar with the USEIT Act, it is a practical, common-sense piece of legislation to turn carbon dioxide emissions into valuable products. We can use carbon dioxide to extra oil from wells that wouldn't otherwise be profitable through a process called enhanced oil recovery. We can capture carbon dioxide and use it to make building materials and carbon fiber. Captured carbon even can be used for medical purposes.

Today we are going to hear testimony about other new and exciting developments in the area of carbon capture technologies. When we introduced the USEIT Act last year, we

had a group of four Senators in support, including members of this committee, Senators Whitehouse and Senators Capito. And I would like to introduce into the record an article published in the National Journal last week entitled The Senate's Quite Climate Policy Deal Maker. You look great in that picture, Sheldon.

[Laughter.]

Senator Barrasso. The article praises Senator Whitehouse for "finding incremental successes working with Republican colleagues." And I hope there is no objection to introducing this.

Senator Whitehouse. I don't know. Does Senator Cardin have any objection?

[Laughter.]

Senator Whitehouse. Well, thank you, Chairman, that is kind of you.

Senator Barrasso. The praise is well-deserved.

This Congress, I want to again thank Senator Whitehouse and Senator Capito for their continued partnership as we work to get the USEIT Act to the President's desk. Support for the USEIT Act has now grown from an initial bipartisan group of four Senators to a larger group of twelve Senators, including seven of my colleagues on this committee. Along with Senators Whitehouse and Capito, I am pleased, this Congress, to have

Ranking Member Carper, Senator Cramer, Senator Duckworth, Senator Rounds and Senator Inhofe as cosponsors of the USEIT Act.

In addition, a bipartisan companion bill has been introduced in the House of Representatives.

When we had a hearing on the USEIT Act last year, we heard testimony about the many ways carbon dioxide can be transformed from a useless by-product into a valuable commercial good. Interest in the USEIT Act has continued to grow since last year. This is in large part due to the bipartisan success we had with the FUTURE Act, which was signed into law a year ago. Senators Whitehouse, Capito and I led that legislative effort as well. The FUTURE Act extended and expanded the tax credit for using and storing carbon dioxide.

The Clean Air Task Force called the FUTURE Act one of the most important bills for reducing global warming pollution in the last two decades. The extension and expansion of the so-called 45Q tax credit to the FUTURE Act has expended public interest about how we capture and use carbon dioxide.

This Congress, I have continued to focus on ways to expedite and expand the use of carbon capture. That begins with the USEIT Act. Last Congress, we unanimously supported the legislation out of committee by a voice vote. This Congress, we want it signed into law. America should reduce emissions

through innovation, not punishing government regulations. The USEIT Act advances that goal.

This is also the approach we took with the bipartisan Nuclear Energy Innovation and Modernization Act. The bill will make sure America remains a leader in nuclear energy innovation. Nuclear power creates jobs and is critical if we are going to reduce our carbon dioxide emissions. President Trump signed the legislation into law earlier this year.

Passage of the Nuclear Energy Innovation and Modernization Act was an important step forward. I look forward to continuing to work with members of this committee on both sides of the aisle to make additional progress in promoting nuclear energy technology, including exploring solutions to nuclear waste disposal issues.

This committee has and should continue to lead on bipartisan and on common-sense solutions. Such solutions do not include, in my opinion, the Green New Deal, which I believe is unworkable and according to Doug Holtz-Eakin, the former director of the Congressional Budget Office, would cost between \$51 trillion and \$93 trillion dollars.

My ideas do include the USEIT Act, as Axios recently reported, although the USEIT Act is not as high-profile or sweeping as the Green New Deal resolution, also unveiled on the same day. The bill takes a more direct, concrete aim at the

root of climate change, emissions themselves. So when we work together, we have shown we can promote American leadership, grow our economy and lower our emissions.

I would now like to recognize Ranking Member Carper, a cosponsor of the USEIT Act, for his opening statement.

[The prepared statement of Senator Barrasso follows:]

STATEMENT OF THE HONORABLE THOMAS R. CARPER, A UNITED STATES
SENATOR FROM THE STATE OF DELAWARE

Senator Carper. Thanks, Mr. Chairman.

Sheldon, I just note, that looking over your shoulder, in this article, that the headline says, the Senate's Quiet Climate Policy deal maker, Bernie, is looking over your shoulder. So for what it's worth.

[Laughter.]

Senator Carper. Mr. Chairman, thank you for convening this hearing today and for your leadership as we begin to examine one of the many ways we can work together to find solutions that we need to, and then craft legislation to support what I call win-win policies that address climate change while addressing job creation and fostering economic growth.

In today's hearing, we are going to be focusing on technologies that reduce, capture, and use carbon dioxide as well as bipartisan legislation that supports them. Utilizing these significant innovations with innovative technology or USEIT is sponsored, as we know, by the Chairman, cosponsored by a bunch of us, including me. And let's start with the primary reason I believe we need to act, and that is, to address carbon dioxide emissions and climate change.

The science behind climate change is settled, from our warming oceans to heat traps in our atmosphere. Climate change

is real. It is happening, and human activities, such as burning fossil fuels, are greatly contributing to the problem. Scientists have also found direct links between climate change and recent extreme weather events such as the rash of devastating category 5 hurricanes that our Country has experienced, wildfires in the west, they are as big as my State of Delaware. Again, the science is clear from these extreme weather events, they are only going to get worse if we do nothing.

It doesn't matter if you are from a coastal State or from a landlocked State. I have lived in both. If you care about public health or the environment, if you care about our economy and our national security, the reality of climate change is that every person living in our Country will eventually see or experience it. Most are already affected by it today. God knows that we are in Delaware.

As I see it, we have a couple of options. We can take up this fight and get serious about addressing and adopting and adapting to climate change, or we can stick our heads in the sand and do nothing. Doing so I think threatens the future of our children and our grandchildren. I say we fight and we fight together, not with one another. Senator Barrasso's colleague, his wing man from Wyoming is Mike Enzi, who is a great guy. He is the author of the 80-20 rule that I oftentimes cite. I used

to explain why Mike Enzi, a very conservative Republican, got so much accomplished by working with Ted Kennedy, the most liberal Democrat we had at the time. And Mike said that, "Ted and I work on the 80-20 rule." I said, what is that, and he said, "We agree on 80 percent of the stuff, we disagree on 20 percent of the stuff, we focus on the 80 percent where we agree, and we'll turn to the other 20 percent some other time." I think the USEIT Act is just a great example of the 80-20 rule. So we appreciate his wisdom.

The fight, however, can also do some real good, can unleash American innovation and job opportunities, while putting the U.S. in the driver's seat of a global clean energy economy that would include this kind of technology. That won't be easy. We still need a comprehensive approach, every tool in our tool box to address this issue.

To make that major shift toward a cleaner energy economy, R&D and our other federal investments, tax incentives from our regulations and all our other policies that harness market forces are going to be on the table, too. Fortunately, we are not starting this fight from square one. Smart investments and regulations made by the Obama Administration, and we can go back even as far as the George Herbert Walker Bush Administration, results in dramatic increases in the deployment of energy efficiency, clean energy technology at a cheaper cost.

As a result of these smart policies, more than 3 million people went to work today in clean energy energy jobs, while consumers pay less, not more, in energy costs now than they did a decade ago. Which proves yet again we can have a cleaner environment, better climate, and stronger economy.

Despite these successes, much more is needed to stem the tide of climate change. We are going to hear today from our witnesses that major investments in carbon capture utilization and sequestration technologies are in demand. The USEIT Act helps make these investments through R&D and by lowering other barriers preventing the widespread development and deployment of CCUS. I am especially pleased to see that this year's version of the bill makes additional investments in direct air capture of carbon pollution. With the changes we have made, and again, I am happy to join our Chairman and colleagues and Sheldon in cosponsoring this USEIT Act.

We want to assure the broad deployment of CCUS and other clean energy technologies. However, the U.S. must make bolder, bigger actions than the USEIT Act. And we must embrace broad climate policies, such as a price on carbon eventually to really move the needle on our climate change policies.

With that said, this hearing is not the end. It is just the beginning. I look forward to working with the Chairman and all of our colleagues here to make sure that our Country is more

secure, both economically and with respect to the threat of climate change. My hope is that we can do so in this Congress. This is a good place to start. Thanks so much.

[The prepared statement of Senator Carper follows:]

Senator Barrasso. Thank you, Senator Carper.

I would like to give my two colleagues who have supported the USEIT Act since its initial introduction last year an opportunity to provide some remarks. Senator Whitehouse, would you like to say a few words?

STATEMENT OF THE HONORABLE SHELDON WHITEHOUSE, A UNITED STATES
SENATOR FROM THE STATE OF RHODE ISLAND

Senator Whitehouse. I would be delighted to, Chairman.
Thank you very much for your kind words and for your leadership
on this.

If we can get this bill passed, it will build on the
success of the FUTURE Act, the 45Q Act, which we successfully
got into the 2018 budget deal. And I want to thank our
chairman, Senator Barrasso, and Senator Capito, for their
leadership on the FUTURE Act. Pulling everybody together was a
broad and unlikely coalition, but it worked, and the bill is in
place.

It will help solve the market failure of there being no
revenue proposition for captured carbon. We gave it a revenue
proposition, and the market has responded. Occidental Energy
and Hoyt Energy have announced that they will pursue a project
to capture CO2 from two ethanol plants supported by the 45Q
Rule. Net Power, a novel natural gas electricity-generation
technology that inherently captures all its CO2 emissions, has
said it will use the credit to build its first commercial scale
plant.

So things are already moving. But nobody likes highways
and roads more than Senator Inhofe, and this USEIT Act will
basically allow for highways and roads for the CO2 to get from

the place where it is captured to the place where it can be either used or sequestered. At the moment, you can do things like they are doing up in Saskatchewan and you can capture carbon from the plants emissions and run it to, as the Chairman pointed out, enhanced oil recovery sites. But that limits the reach of this technology. And we need to expand it. The USEIT Act will help expand it.

I want to thank Chairman Barrasso for his leadership on both of these bills. I appreciate it very much. I want to thank our ranking member, Senator Carper, for his very helpful contributions to this bill and his support of it. Senator Capito is again a key, lead player in this, and I appreciate and thank her. Senators Duckworth, Rounds and Cramer were in my notes to thank. But Chairman Barrasso mentioned that Senator Inhofe is a cosponsor as well. So I want to express my appreciation to him.

We have had very good luck when we work with Senator Inhofe on pieces of legislation. We have a plastics bill that passed by unanimous consent with Senator Inhofe's support. We have the TSCA bill that passed Congress and has been a very strong, bipartisan environmental achievement, with not just Senator Inhofe's support, but his leadership. And Senator Inhofe is very often very active in making sure that infrastructure bills get done. We have had a few occasions where we have worked

together to break various logjams in the Senate to keep infrastructure bills moving.

I think that our colleagues look at a bill that has both Senator Whitehouse and Senator Inhofe cosponsoring it and think, well, there is probably room for me in that bill.

[Laughter.]

Senator Whitehouse. And that, combined with Senator Inhofe's immense legislative skills at getting things done, I think I would give him a particular welcome to this bill.

So we have a big opportunity here. I do think that we have shown that pricing carbon works, that the market does need to accept that there is a real difference between carbon-intensive power and carbon-free power. And the quicker we can reflect that, the better we will respond to the climate crisis that is looming over us.

So it is great to have this bipartisan opportunity. I have companies like AgCorp and BioProcessH2O and my home State of Rhode Island that are excited by these prospects.

I will close by saying that some years ago, I won the very prestigious award of being the algae advocate of the year. I know you are all deeply jealous of that accomplishment by me. But one of the reasons I was the algae advocate of the year was because algae actually can get into the exhaust stream once CO2 gets captured, and it can be turned into a variety of products,

from feed to makeup to human food products and so forth. So when we added carbon capture utilization and sequestration, a kind word to the algae folks.

Thank you very much, Mr. Chairman.

[The prepared statement of Senator Whitehouse follows:]

Senator Barrasso. Thank you, Senator Whitehouse.

Senator Capito, over to you.

STATEMENT OF THE HONORABLE SHELLEY MOORE CAPITO, A UNITED STATES
SENATOR FROM THE STATE OF WEST VIRGINIA

Senator Capito. Thank you, Mr. Chairman. That is going to be a hard act to follow Captain Algae over there.

[Laughter.]

Senator Capito. But I am going to try. I do appreciate, certainly, Senator Whitehouse's leadership on this, when we introduced it last year, when we did 45Q, the FUTURE Act. It was amazing to see the different stakeholders in the room. And I want to thank the chairman and the ranking member for being here, and Senator Inhofe for joining on to our second try here.

I want to thank the chairman, too, for prioritizing this bill early in our session. I really appreciate this. We did learn some things last year when we tried to move the bill forward. And this year, I am happy to say that one of my counterparts from West Virginia, David McKinley, has already introduced a counterpart for this in the House.

So I think timely enactment of the USEIT Act is of essence. Because last year we did pass the FUTURE Act, as Senator Whitehouse said. The FUTURE Act expanded and improved the 45Q tax credit for the utilization, carbon capture and storage. I think it was a very substantive step.

But we have had some headwinds with that that prevent that bipartisan achievement from having its full effect. First of

all, the IRS has yet to provide revised guidance, helping us to utilize the credit. And just recently, Senators Whitehouse and Barrasso and I sent a letter earlier to the IRS leadership requesting that they expedite that guidance.

The January 1, 2024, deadline for projects to begin construction is looming ever larger. And we know, and you all know certainly, and I know our panel will tell us, these are not inexpensive projects as you are moving forward. You are making enormous capital commitments along with a longevity. Predictability is absolutely critical.

Secondly, there remains the lack of regulatory certainty from our federal permitting agencies. That is where we know that this bill comes in, providing a clear playbook for securing the necessary permits. Senator Whitehouse talked about sort of the belts and suspenders aspect of this bill, and the associated infrastructure, like CO2 pipelines, will help sponsors know what they are getting into. And it will provide assurance that as they seek private investment that a project won't get lost in approval purgatory.

This committee has heard substantive testimony about the cost overruns and delays that can result when project sponsors in any arena, and even the agencies themselves, don't know what the approval process actually looks like. So that is why timely enactment of the USEIT Act is so vital for making broad-based

deployment of carbon capture utilization and storage technologies reality.

As I am sure we will hear from our witnesses today, if the United States and the world are to bend the curve on atmospheric carbon dioxide, CCUS has to be a part of a policy and technological win and mix. CCUS will also serve to preserve employment in industries like coal and construction and manufacturing, and in the process, it will prevent major market disruptions that could kill jobs and significantly raise costs for energy and goods across our Nation.

So I look forward to hearing from the panel. Again, thank you for bringing this bill up so quickly. It is an important policy and it has a lot of good, bipartisan cosponsors and interests. Thank you.

[The prepared statement of Senator Capito follows:]

Senator Barrasso. Thank you, Senator Capito. Senator Carper?

Senator Carper. I was counting the number of times I heard the word bipartisan. I stopped counting at 20. And normally, you would hear a lot about fighting, how we don't get along, we don't work on anything together. And normally, at this part of our hearings, we stop and we join hands and sing Kum By Yah.

[Laughter.]

Senator Carper. And this might be one of those moments, if not right away, then maybe at the end of the hearing. But we are glad you are here to add to the spirit. Thank you.

Senator Barrasso. Thank you, Senator Carper.

I am pleased now to introduce our three witnesses, Paul Sukut, who is CEO and General Manager of Basin Electric Power Cooperative. Basin provides power to residents of nine States, including my home State of Wyoming. We are happy for your willingness to testify.

We also have with us Mr. Steve Oldham, who is the CEO of Carbon Engineering, and Mr. Kurt Waltzer, who is the Managing Director of the Clean Air Task Force.

So welcome. I invite all of you to testify. I want to remind the witnesses that your full written testimony will be included and made part of the official hearing record today. We ask that you try to keep your statement to within five minutes,

so we will have some time for questions. I look forward to hearing from each of you. Would you like to begin, Mr. Sukut?

STATEMENT OF PAUL SUKUT, GENERAL MANAGER AND CEO, BASIN ELECTRIC
POWER COOPERATIVE

Mr. Sukut. Thank you, and good morning, Chairman Barrasso, Ranking Member Carper and members of the committee.

As the Senator said, my name is Paul Sukut. I am the CEO and General Manager of Basin Electric Power Cooperative. We are headquartered in Bismarck, North Dakota. I have worked in the energy industry about 40 years, about 36 with Basin Electric, and really, I have served as CEO since 2014.

I would like to thank you for the invitation to speak this morning about innovation in the utility industry and other efforts to reduce emissions, particularly carbon. Basin Electric is a generation and transmission cooperative that provides wholesale electricity to 141 rural electric cooperatives that serve 3 million customers across 9 States.

We have a diverse generation portfolio, consisting of over 6,000 megawatts of coal, natural gas, wind, recovered energy, nuclear and market purchase agreements. Our generation resources participate both in the MISO and SPP regional transmission organizations.

Basin electric and its members have invested billions of dollars in capital in recent years to secure its fossil-based generation. I would refer the committee to my written testimony for additional details on our facilities. Basin Electric is

actively engaged in assuring that these assets can continue to operate in a carbon-constrained future, and we strongly support common-sense carbon management regulation that recognizes improvements already made to existing plants, and sets a standard that is achievable with cost-effective technologies that can be applied to the facility itself and allows flexibility.

As utilities make decades-long planning decisions, it is imperative to have certainty with respect to how regulations impact our facilities, and the associated costs just to run them. Looking further into the future, Basin Electric remains interested in developing solutions to innovate with respect to cost-effective clean coal technologies that capture, utilize and sequester CO₂.

Basin Electric is the host site for the Integrated Test Center located at our Dry Fork Station near Gillette, Wyoming. This test facility will provide space for researchers to turn CO₂ into a marketable commodity.

In addition to the Integrated Test Center, Basin has been involved with exploring the potential for near-zero emission Allam Cycle technology as an option for future power generation. Again, I would refer the committee members to my written testimony for details on this technology, our partners and its status.

I would like to highlight for the committee a subsidiary of Basin Electric, the Dakota Gasification Company, which operates the Great Plains Synfuels Plant near Beulah, North Dakota. This one of a kind facility produces synthetic natural gas from lignite coal, and several fertilizer and chemical coal products. Notably, the facility is also one of the largest CO2 sequestration projects in the world, utilizing CO2 separated during the coal gasification process for enhanced oil recovery in Saskatchewan, Canada.

I believe that the plant and the development of its products continue to demonstrate what a resource we have in our coal reserves, and what can happen with smart innovation. I hope this is the kind of progress that we will continue to see from the ITC and through other initiatives for value-added coal use and CO2 capture at the federal and State levels.

Finally, a lot of discussion on carbon capture tends to focus on the technological challenges of economically capturing CO2. But the other side of this equation is what you do with CO2 once it is captured. Recently, Basin Electric has participated with the Plains CO2 Reduction Partnership in the Department of Energy's CarbonSAFE program, to investigate the geology in both North Dakota and Wyoming and ultimately develop a large-scale injection test well for CO2 sequestration. Developing a solution for captured CO2 will inevitably require

additional build-out of pipeline infrastructure in order to come to fruition.

For this reason, we support the Utilizing Significant Emissions with Innovative Technologies Act and its provisions to expedite guidance, permitting and construction of CO2 infrastructure. As a not-for-profit electric cooperative, Basin Electric has a fiduciary responsibility to its members to provide electric generation at the lowest possible cost.

The question of carbon capture is not only one of a technology barrier, but an economic one as well. Many factors impacting the utility industry today make capital investments, such as new coal construction, cost prohibitive if not impossible.

To this end, we appreciate the bipartisan support from the members of this committee for legislation such as the 45Q capture tax credit that was expanded last year, as well as the USEIT Act that provide further assistance to relieve the regulatory and financial barriers to carbon capture utilization and sequestration, as well as other novel technologies.

In closing, Basin Electric has undergone a number of changes as the electric industry has evolved. But I believe we have a good story to tell with respect to CO2 reduction, and are well-positioned to serve our members now and well into the future.

Again, thank you for the opportunity to share my thoughts.
I would be happy to answer any questions that the committee may
have.

[The prepared statement of Mr. Sukut follows:]

Senator Barrasso. Thank you very much, Mr. Sukut.

Mr. Oldham, welcome to the committee.

STATEMENT OF STEVE OLDHAM, CEO, CARBON ENGINEERING

Mr. Oldham. Thank you. Mr. Chairman, Ranking Member Carper, thank you very much for the opportunity to meet, and the other distinguished members of the committee, too. Thank you for your attention to this matter.

Senator Carper. Mr. Chairman, could we have a translator, please?

[Laughter.]

Mr. Oldham. Is it my British accent? I will talk slowly.

[Laughter.]

Mr. Oldham. I am CEO of a company called Carbon Engineering. We are actually based in British Columbia, Canada. We are an innovative company. We are privately-funded. And we have been focused on developing technologies that will allow the large-scale capture of atmospheric CO₂.

Why atmospheric CO₂? Why do we focus on capturing that? I am a simple guy, I would like to do a simple metaphor to help you and everybody else understand. Think of your kid in the bathtub. Think of the bathtub as the atmosphere, and we fill the bath with water. We all know there is a safe level of water that you can put in there before your kid is under any threat whatsoever.

Now put the taps on, and leave the taps running. So the taps running is the equivalent of CO₂ emissions. We keep

building more and more water in that bathtub. Eventually, it becomes a threat for the child and the bathtub. Eventually, it runs over the side of the bathtub and wrecks the whole house.

So what do we do about that? The first and most obvious thing we do is we turn down the tap. And that is CO2 emission control. It is absolutely essential that we turn down the tap.

But every one of us knows that even if you turn the tap down so it is just dripping, it is just a matter of time before the bathtub fills and it overflows and it wrecks the house. So the other solution is to pull out the plug. And the plug allows you to rapidly drain the bathtub, and you can put the plug back in when it gets back to a safe level.

That is negative emissions. That is direct air capture and that is what we do.

Senator Carper. Could you explain that to me one more time, please?

[Laughter.]

Senator Carper. That was a great example. That is terrific.

Mr. Oldham. Thank you.

So our focus as a company has been to develop the tools that allow very large-scale capture of CO2 directly from the atmosphere. We have developed and demonstrated that technology, it has been working in British Columbia since 2015.

We are now moving ahead with a plan to bring that technology into the United States with a variety of different partners. We have had inquiries from 38 U.S. States that would like to set up a facility within their State. And of course, we have recently received investment from some significant companies here in the United States, Occidental Petroleum and Chevron have become both shareholders and partners with Carbon Engineering in bringing our technology to market.

The process is extremely safe. This is an example of a part of our process. When we capture the CO₂ from the atmosphere, we make calcium carbonate. Calcium carbonate is what you guys would know as seashells. So just as our kids play safely on beaches with seashells all around them, this calcium carbonate here, which is made out of atmospheric CO₂, this is negative emissions right here in my hand, is part of our process.

Moving forward, our company is now ready to start building commercial-scale activities. It is critical that we have large scale here. The CO₂ problem in the atmosphere is significant, and it has to be addressed at scale. So the interest of Occidental, the interest of Chevron, why are they interested? They like negative emissions, they want to focus on decarbonization. The use of CO₂ enhanced oil recovery is a very valuable opportunity. If you capture CO₂ from the atmosphere

and you put that CO2 underground in the process of EOR, you are putting more carbon underground than is contained in the crude that comes back up.

So now you have a win-win. We have a continued source of jobs and prosperity associated with that crude. But you also have a negative emission.

Thirdly, what if you take that CO2 from the atmosphere, you combine it with hydrogen and you make a synthetic fuel? Now that synthetic fuel uses the CO2 that was burned in the atmosphere already, you put it in your car, your vehicle, you drive that vehicle, the CO2 is put back into the atmosphere, we collect it again and we make more fuel. So the opportunity to create a sustainable, low-carbon fuel which is compatible with every vehicle, every truck, every plane that exists today, is enabled by large-scale capture of atmospheric CO2.

That is the reason why our friends at Chevron are interested in our business. They would like to de-carbonize their fuel by blending our fuel with their fossil fuel. It makes the fossil fuel more sustainable while achieving de-carbonization at the same time.

Moving ahead as a company, the building of our plants is a critical activity, as the Senator pointed out earlier on. These are large capital projects, and investors in those projects look at the market, they look at the legislation that is on the books

right now. 45Q has been an essential part of the economics of our plants, so thank you for your work and your leadership in bringing that in.

The USEIT Act is also important. When we have the IPCC, we have the National Academy, we have the Royal Academy, the United Nations, all saying that negative emissions, capturing atmospheric CO2 is essential, it scares me that there are less than 200 people in the world today working on direct air capture. We need more people. We need more brilliant minds onto this. And the USEIT Act will enable that by providing funding for R&D.

Here at Carbon Engineer, we need more competitors. We need more partners, we need more innovation. We hope your Act brings more people to the table, and we thank you for your leadership. Thank you.

[The prepared statement of Mr. Oldham follows:]

Senator Barrasso. Thank you very much for your testimony.

Very, very interesting.

Mr. Waltzer, please.

STATEMENT OF KURT WALTZER, MANAGING DIRECTOR, CLEAN AIR TASK
FORCE

Mr. Waltzer. Senator Barrasso, Ranking Member Carper, members of the committee, I am here on behalf of Clean Air Task Force to express our support for the USEIT Act and urge its prompt enactment.

The kinds of solutions proposed in this legislation is urgent. Supporting innovation and infrastructure development for carbon capture utilization and direct air capture as well as other types of technologies and policies is crucial, given the enormous challenges we are facing in addressing climate change. To address this Herculean challenge will require nothing less than fully de-carbonizing a \$25 trillion global energy system at the same time that we expect a 40 percent increase in the world's energy demand.

To accomplish this task, we need a portfolio of low-carbon technologies that are widely commercially available. Solar and wind will certainly play an important role in de-carbonization, but relying wholly on those technologies would be risky. In part, this is because generating 100 percent of electricity from just those sources will be significantly more expensive than a more balanced portfolio of low-carbon solutions, including nuclear and CCUS.

But more broadly, our complex energy system has some

sectors that are really not easily addressed or electrified. These include aircraft, other certain types of industrial processes. So in short, we really need multiple technology shots on goal.

This is underscored in the de-carbonization scenarios studied by the Intergovernmental Panel on Climate Change where the vast majority of those scenarios included a substantial amount of CCUS, as well as direct air capture. We are also going to need a portfolio of policies, which includes policies that provide certainty to inventors and investors by setting clear targets through technology portfolio standards or emission limits.

At the same time we need to also drive forward technology innovation policies, including research and development, support for commercial demonstrations, deployment incentives and support for infrastructure. We need all these tools in the tool kit if we are going to address this massive challenge.

For CCUS and direct air capture, the 45Q incentive was an important bipartisan success supported by a broad range of stakeholders from environmental organizations, labor unions and industry. The USEIT Act is an important successor bill to that effort.

If adopted, it will provide important, targeted support for early stage R&D for demonstrations in CO2 pipeline

infrastructure development. The proposed direct air capture prize is an important addition to our current RD&D tool kit, and is based on a proven approach for leveraging private capital in service to technology problems.

Supporting R&D for new products that utilize and efficiently store carbon will provide an important catalyst to an area that is already attracting early stage private investment and early commercialization in niche markets. Clarifying the eligibility of CO2 pipelines under the FAST Act, and developing regional task forces to promote local, State and federal coordination will help move projects while preserving environmental protections needed to ensure responsible development.

Again, these policies by themselves are not going to be sufficient to get us where we need to be. But they are necessary.

We appreciate your leadership, Mr. Chairman, as well as that of the bill's cosponsors on championing these policies and on the bipartisan approach you have all taken in introducing this legislation as well as your commitment to maintaining that approach and addressing any future amendments. I appreciate the opportunity to testify and look forward to answering your questions.

[The prepared statement of Mr. Waltzer follows:]

Senator Barrasso. Thank you very much. We are going to proceed to a series of questions. I will start, Mr. Sukut, I would like to start with you.

Basin Electric's leadership in carbon capture and utilization and sequestration is impressive. I think you are really to be commended for what you have been doing. Through initiatives like the Integrated Test Center in Gillette and Basin's Dry Fork Station, we are really proud to see Wyoming has already established itself as an innovation hub. Can you discuss why Wyoming and surrounding States are ideal, like yours, are ideal places to do carbon capture utilization and sequestration work?

Mr. Sukut. I think we should point out the first thing is States like Wyoming, and of course North Dakota, have abundant oil, gas and coal resources, natural resources. And these resources are going to be a part of the energy future for this Country for a long time.

But I think the most important thing to point out, and the most relevant thing this morning to talk a little bit about is actually the geology. Through the CarbonSAFE program, we have got some wells drilled, one of them only less than a quarter mile from Dry Fork Station. The geology looks very promising to infuse carbon. We have two sites in North Dakota that are virtually under some of our resources, our coal-based resources.

So from that standpoint, I think we have an opportunity here, a great opportunity here to infuse and demonstrate that once we capture the carbon, we will be able to infuse it and store it in the ground. But I think one of the most important things, and I am so encouraged by sitting in front of you all for all the leadership that you have taken in trying to get us the legislation. I thank you for all that. Because the leadership really does make a difference for us.

Senator Barrasso. Mr. Oldham, you can follow up on that. But I really have been interested for a long time in direct air capture. I am pleased to see that public interest is now coming into the fore. This is something I read about years ago in *The Economist*, talking about the ways that they can be doing it and trying to make it more cost-effective. Clearly, the technology is there.

Why do you think we are seeing an increased interest in direct air capture? Do you think the USEIT Act can actually help drive public sector interest in direct air capture?

Mr. Oldham. Thank you. I see we even made a Dilbert cartoon in the last couple of weeks. So I guess direct air capture is really public domain now.

[Laughter.]

Mr. Oldham. So that is very good.

I will answer the question two ways. First, I think in

public conscience, the recent reports from the various scientific committees worldwide have raised awareness of the issue. So there is increasing recognition of need and equally, at the same time, the recognition that there are solutions out there like ours. We are not the only one. Having a need and a solution really drives interest.

Economically, for sure, 45Q has made a big difference. It sent a very clear signal from this house that there is a desire to see innovation in this area. It helped close the economics for business cases that didn't close otherwise.

For businesses like ours, the challenge is always the first couple of projects. There, the cost is higher, the schedule is longer, the perceived risk is higher. So having some support for those initial projects is just essential.

So to my mind, that is a large part of it, helping us over the hump at the first few projects.

Senator Barrasso. Good. And Mr. Waltzer, in terms of this 45Q, and I am so pleased to see the Clean Air Task Force's recent report about the real impact that the 45Q tax credit could have on reducing emissions. We have worked hard to extend and expand that tax credit to support carbon capture efforts. So we want to make sure that that tax credit is used.

If carbon capture projects are developed on a scale that you predict, is there a real need for supporting infrastructure,

and how can the Federal Government support and expedite the development of that infrastructure that you talk of?

Mr. Waltzer. Mr. Chairman, in short, the answer is yes, that is needed. What our study really showed was the economic potential of 45Q. But 45Q by itself perhaps will not get us there. In fact, we think more is needed.

We think that just because of the way commercial contracts are set up today for developing pipelines, you can set up a contract between point A and point B with the amount of CO2 that is going to flow through, but you are not going to necessarily set up the interstate pipelines that are necessary to connect all the little sources together to get them to where the markets are. Right now, the most developed market is enhanced oil recovery activity.

So we are going to need the sort of support to develop that infrastructure and develop our national CO2 pipelines. But we are also going to need the kind of solutions that are proposed in the USEIT Act that make the process of setting those pipelines efficient and effective, while maintaining our current environmental protection standards.

Senator Barrasso. Thanks so very much. Senator Carper?

Senator Carper. Thank you all for your testimony. I was especially interested in your example of the infant in the tub. I thought that was a great example. I wrote it down. I will

use it often, never attribute it to you.

[Laughter.]

Senator Carper. Oh, I will, I will. Thank you, that was great.

I have a couple of questions for the whole panel.

Senator Barrasso. We don't need to start the clock. So we had a former member of this committee, Senator Joe Lieberman.

Senator Carper. I remember, he just had his birthday last week.

Senator Barrasso. And he said, well, here is something really smart. The first time he repeats it, he says, and I have heard Mr. Oldham say, dah, dah, dah, dah, dah. The next time he would say, I heard a wise man once say, dah, dah, dah, dah.

[Laughter.]

Senator Barrasso. And then the third time, he says, As I have said time and time again.

[Laughter.]

Senator Carper. We do this all the time.

[Laughter.]

Senator Carper. I am surprised there are not more cameras here.

This is one for Mr. Waltzer. Again, thank you all for your testimony. Like you, Mr. Waltzer, I want to ensure that this legislation doesn't lead to other efforts to weaken the Clean

Air Act. I also appreciate the Chairman's commitment about not using this bill as a vehicle to weaken the Clean Air Act, and want to thank him for accepting a number of changes that we recommended to last year's legislation, which we think makes this version better.

My question, if I could, Mr. Waltzer, in your opinion is the Clean Air Act inhibiting progress in CCUS technology development or deployment?

Mr. Waltzer. Mr. Chairman, Senator Carper, I want to make sure I understand your question. You are asking if the Clean Air Act is, can play a role in moving CCUS technology forward?

Senator Carper. I will repeat the question. In your opinion, is the Clean Air Act inhibiting progress in its current form in CCUS technology development or deployment? Is it impeding work in this area?

Mr. Waltzer. We have looked at this question from a legal and technical perspective, and in our view, we don't see any impediment. By the way, programs such as New Source Review would be applied when carbon capture equipment is installed on the power sector. So from our assessment, no, we don't see an impediment.

Senator Carper. All right, good. As a follow-up, in 2009, Congress was debating a climate bill that amended the Clean Air Act. In the Senate climate bill, I worked with the late Senator

Robert Byrd and other coal-State Senators to provide incentives for the deployment of CCUS. At the time, there were several CCUS projects in the works nationwide. Once the climate bill died, so did most of those projects.

My question is, could the Clean Air Act and broader climate regulatory actions be helpful, maybe even critical, for the success of CCUS?

Mr. Waltzer. Mr. Chairman, Senator Carper, in our view, having that kind of long-term certainty associated with planning horizons is absolutely crucial for power companies, for example, to plan to include and develop carbon capture and storage in their portfolios.

As many of us have witnessed, more and more power companies are making commitments or laying out plans for de-carbonizing their systems. We don't see those plans coming to fruition unless there is a strong signal that is sent to allow that kind of investment to occur. What we will see in the interim is more investment in incremental resources that may reduce emissions. But we are not going to see the kind of large-scale energy system change that we think is needed, absent that kind of direction.

Senator Carper. My next question, and I am going to ask it initially of Mr. Waltzer, then I will ask our other panelists to respond as well. That question is, would you take a couple of

moments to talk further about why the development of today's carbon capture and sequestration technology is critical to help us meet our climate goals and also help us get closer to having direct air capture become a reality?

Mr. Waltzer. Senator, I think today's legislation, as I noted, is an important component. We need all of the tools in the tool kit. We need the kind of innovative prize tools that are being proposed in this legislation to bring new commercial pilot scale projects to market. We need to be developing utilization technologies that create new uses.

While those markets may not necessarily be large by themselves, they can have important catalytic effects. We have seen one company develop its first pilot project in India making baking soda, and based on that, they are developing their next generation of solvents for carbon capture. We think that moving this kind of legislation forward on a bipartisan basis also more broadly sends an important signal that technology innovation is increasingly being taken seriously, and that does have, as soft as it is, that has an actual impact on driving more interest in investment.

Senator Carper. Good. Thanks for that. Mr. Oldham, any brief comments, please?

Mr. Oldham. Yes. I think a recognition of the problem of increased carbon levels is critical. This house's recognition

of that problem is critical. The funding that you put aside will, as I said earlier on, bring more brilliant minds into this business. I think that is essential.

For me, it is about developing the tools. If we have the tools that allow us the flexibility to make choices, we now are able to make choices to address decarbonization. So any innovation that drives that, any funding mechanisms that drive an innovation will make a big difference.

Senator Carper. Thanks. Mr. Sukut?

Mr. Sukut. I basically agree with both the other two panelists, maybe in a different way. When I look at our facilities and how we get there. When we put iron in the ground, we put it in for 30 or 40 years. My sense is that sol, the USEIT Act gives us sort of the road map to get there, 45Q gives us the financial incentives to get there. That is so important.

I mean, we recognize we are past the science now. We recognize the fact that we are in a carbon-constrained world, and how do we get there. So we need time, and we need some flexibility. I think Kurt mentioned the time element of this. From our perspective, those are kind of the two aspects of how we look at it, as I would look at it as a CEO of a utility.

Senator Carper. Thank you all. Thanks.

Senator Barrasso. Senator Inhofe.

Senator Inhofe. Thank you, Mr. Chairman.

None of the three of you will appreciate this statement, but it is so refreshing to me that we can talk about climate without the normal, hysterical Hollywood references that are being made, that the world is coming to an end and such as that. Our world is not coming to an end, and climate has always changed and always will change. I don't think anyone will disagree with that.

All right. Let me just mention a couple of things. First of all, the comments that were made by Senator Whitehouse. That is significant, because those three pieces of legislation that he mentioned, with the exception of the Defense Authorization Act, were the three biggest, most significant things passed that year. And it was a great partnership that did it, and it surprised a lot of people.

Quite frankly, I didn't get on this bill until today, because I didn't want my appearance on this bill to chase off any of the others that were on this thing.

[Laughter.]

Senator Inhofe. So that is where I am. Now, I am the first to admit, my State of Oklahoma is an oil State. We have 150,000 jobs with an average salary of \$104,000. We contribute \$24 billion to the gross State product. It is nearly a quarter of the State's budget, that is spent in the oil and gas

industry.

Now, you think that is the reason I would be supportive of this. It is not. Those are good things. But when you look at the fact that, I have 20 kids and grandkids, and they are going to be around here a lot longer than I am. And we have to run this machine called America. And you can't do it without the use of fossil fuels. I think we now, this is kind of a recognition that that is a fact.

Let me ask a question of you first, Mr. Oldham. In your testimony, you talk about the existing supply of CO2 are primarily from geological sources and they are not enough. I would like to have you speak on the demand side of this.

Mr. Oldham. Yes, sure. So today, I believe the figure is about 18 megatons of CO2 are used globally around the planet, of which my understanding is about 50 megatons are used for enhanced oil recovery. So enhanced oil recovery is actually the largest use of CO2 around the world today.

Speculation and the market reports estimate that increasing the amount of CO2 up to even as high as 140 megatons per year is justified and can be used for EOR. So this is part of the reason why we have had some energy companies invest into our company and start working in partnership with us.

Remember also, when you capture CO2 directly from the air, you have split the dependence on location. So we can build our

plant just about anywhere. We no longer have to build a CO2 collection plant where the ethanol plant has to be, and then move the CO2 through a pipeline. By being able to do it by pulling CO2 directly from the air, you can do EOR and capture your CO2 locally, and then use that CO2 for EOR and get negative emissions at the same time.

Senator Inhofe. That is great. That offsets so many of the people who are trying to use this issue for political purposes, and they say you just have to do away with fossil fuels altogether. You do that, you can't do that we are talking about doing.

I want to have one short question there to Mr. Sukut. I know this is addressed in the opening statement by our chairman. But in your testimony, you mentioned that your cooperative supports reform to other parts of the Clean Air Act, specifically the New Source Review. I would like to have you elaborate a little bit more, if you have more to say about that, the fact that we are looking at it.

Mr. Sukut. I would be happy to, Senator. We, I think, more than anything, encourage the enactment or, it isn't that we don't, are not compliant with the New Source Review. I think the biggest problem that we have had in the past, we have had situations where, and I will use, actually I will give you a real-life situation, where we had one of our coal plants in

North Dakota was going to put in some equipment to actually make it more efficient. And then at the same time, it would have generated 22 megawatts more of electricity. But we were impacted and not able to do it because of the NSR rules.

Actually, if you had thought about it, it was going to reduce the amount of coal burned, we were going to increase the amount of electricity. But the rules were written such that we couldn't get that done. I think we just need more clarity, Senator, in terms of with the NSR rules. We need more clarity in terms of what we can and can't do.

If we get a road map, we are going to be compliant and we are going to do it. But we just need clarity, because it really stopped us from, a, we could have generated more electricity, two, we could have burned less coal and we would have had less emissions. So it is kind of a double-edged sword. But if you will, that is sort of my comment in terms of the NSR rules.

Senator Inhofe. That is good. I appreciate that.

Mr. Waltzer, I do have a question for you, but it will have to be in the record, because I will not have time to get to it now. But I do want to ask Mr. Oldham, you heard me describe my State of Oklahoma, the number of jobs, the reliance we have, how important the fossil fuels are to our State of Oklahoma. I would like to ask you, what specifically, for a State like Oklahoma, what does carbon capture utilization sequester, CCUS,

mean for my State of Oklahoma and how do these technologies help?

Mr. Oldham. Sure. So that is probably a several-point answer, but I will try and be brief. I think the first thing is the ability to do further enhanced oil recovery, but in an environmentally safe way. Negative emissions and EOR combined is really a win-win. So that is number one. And of course, Wyoming has a good amount of EOR already.

Secondly, I think it offers an opportunity for new industry. There are many, the Department of Energy publishes an atlas of sequestration sites across the United States. Wyoming has a lot of potential sequestration sites, saline aquifers, geological formations. So the opportunity to store CO₂ underground in a State like Wyoming and many other States is a very real opportunity.

The third thing is the synthetic fuel. So by reducing the carbon intensity of fuel through blending, which of course the biofuel industry, the ethanol industry does today, it is a great way of helping de-carbonize the fossil fuels while continuing to enable the economy that is so essential. So I think those are the three main areas where I think we can benefit. What I have said to you here, sir, is also applicable for many other States across the United States.

Senator Inhofe. Okay. I appreciate that very much,

appreciate the testimony very much. Thank you.

Senator Barrasso. Thank you, Senator Inhofe. Senator Whitehouse?

Senator Whitehouse. Thank you, Chairman. Let me just take a minute to ask unanimous consent that letters of support from The Nature Conservancy, the Audubon Society, a list of our many, many, many USEIT Act supporters, running from the AFL-CIO to the Wyoming Outdoor Council, alphabetically, and a series of statements from some of our supporters be put into the record.

Senator Barrasso. What was the first one?

Senator Whitehouse. AFL-CIO. A to W.

Senator Barrasso. Okay. I was looking where the Algae Association would fit in there.

[The referenced information follows:]

Senator Whitehouse. After AFL-CIO.

[Laughter.]

Senator Barrasso. Do you have the Algae Association?

Senator Whitehouse. No, I have got to get them on that.

[Laughter.]

Senator Whitehouse. First of all, very basic question. Do any of you doubt that climate change is a serious matter requiring urgent attention by Congress?

Mr. Waltzer. No.

Mr. Sukut. No. I mean, I think we are past the science. I think we are to a point as a utility that we want to find ways to capture and sequester carbon.

Mr. Oldham. No.

Senator Whitehouse. And how important do you feel carbon pricing is as one of the solutions to the problem? In the top ten, in the top two, top one?

Mr. Sukut. So maybe I will start with a comment and then you can follow up with a question based on my comment. I think as a utility, we are really challenged or pressed to operate at the lowest possible cost that we can. I think technologically there are probably some solutions that might be a little bit, if you are referring to a carbon tax in its essence is maybe something a little bit cheaper than a carbon tax as far as being onerous to our end consumers.

So I would encourage, as a utility, I would encourage the technological advances that we can make to capture carbon, because I think there are ways we can even do it cheaper there than through the carbon tax.

Senator Whitehouse. Mr. Oldham?

Mr. Oldham. Let me first apologize to Senator Inhofe. I got your State wrong. Please chalk that down to an ignorant foreigner.

[Laughter.]

Senator Barrasso. The Chairman loved your answers.

[Laughter.]

Mr. Oldham. Again, my apologies. So I think the question is, how do you incentivize the public to recognize a better product, and a better product in terms of de-carbonization is a product that has a lower carbon footprint.

Often the way that works is a combination of public sentiment, but also government direction and regulation. So the mechanism of government direction I am not the expert on. I can't speak as to whether a carbon tax is the right answer or tax credits or positive incentive or a negative incentive. It is just not my area of expertise. But I think the signal is essential.

Senator Whitehouse. The signal is essential.

Mr. Oldham. Yes.

Senator Whitehouse. Mr. Waltzer?

Mr. Waltzer. I think there is ample evidence that a combination of a pull policy, something that has a clear signal that companies know they need to invest in order to meet a technology goal, an emissions reduction goal, or a carbon price, combined with innovation, has been a winning combination. We have seen that with deployment of sulfur dioxide scrubbers, there was a lot of R&D that went into that.

And obviously a lot of tools in the Clean Air Act that pulled that technology forward. We have seen that with solar, for example, significant price drop between the early 1980s to say, 2010, almost 95 percent, driven by a combination of R&D, the kind of deployment incentives that we have now with 45Q and the renewable portfolio standards. These policies, given how short our time frame is, given the need to develop technologies that are here, not just here but globally, we have to have both of those options on the table and move forward with them quickly.

Senator Whitehouse. Let me ask a question specific to this technology. And it would be, what do you think the best case scenario is for the carbon capture industry, say by 2040? What could we expect in terms of potential carbon removal? And what in the way of getting there, to you, are the most exciting technical or other opportunities? What do you see as the great

things that might open up? Let's go the other way this time, we will start with Waltzer, Oldham and Sukut.

Mr. Waltzer. So by 2040, what we hope to see and what we think is possible is significant deployment of carbon capture utilization storage, not just in the U.S., but around the world. We think, as we have seen with technologies like Net Power, there can be substantial cost reductions on CO₂, carbon capture at industrial facilities and power facilities. They are targeting \$10 a ton if that happens, if you have a natural gas plant, if they can capture \$10 a ton, that is a game changer.

We also are really interested in the concept of zero carbon fuels, and carbon capture and storage can play an important role there. Hydrogen and ammonia, basically taking natural gas or forming it, sequestering it.

Senator Whitehouse. I am down to 30 seconds and I have two more witnesses. So let me jump to Mr. Oldham. Sorry, Mr. Waltzer.

Mr. Waltzer. No problem.

Mr. Oldham. I would like to see a combination of successes. The first would be the continued prevalence of emission control through the types of activities that you have heard discussed here. The second would be a recognition that there are some industries that it is extremely challenging to de-carbonize, and instead, you set up a carbon offset program by

doing something like direct air capture to reduce CO2.

Senator Whitehouse. How big could this be?

Mr. Oldham. How big?

Senator Whitehouse. Yes. There are only 200 people working in this area right now. Could that be 200,000? Could that be 20,000?

Mr. Oldham. So each of our plants does about a megaton of CO2 capture per year. So a large number of plants is required to make a dent in this problem. I believe there is no reason why you can't roll out these plants worldwide. Our business model is to license our technology to any partner who is interested. So we would like to see literally hundreds of our plants put worldwide, because this is a global problem, it is everybody's problem.

Senator Whitehouse. Well, my time is expired, so let me just leave a question for the record. Because I have truncated your answer and we ran out of time before you could have a chance, Mr. Sukut. So if you could, again, what are the coolest things that you think are out there in this industry? And what do you think the prospects are, and how can we help you achieve those best case prospects?

Senator Barrasso. You would like written response to that?

Senator Whitehouse. Yes. I think response to the record makes sense. We can go on with other colleagues who are

waiting.

Senator Barrasso. All right. Before heading to Senator Capito, I have a list of letters supporting this as well in alphabetical order, from the Carbon Utilization Research Council to the Western Governors Association. And without objection, we will submit these as well.

[The referenced information follows:]

Senator Barrasso. Senator Capito.

Senator Capito. Thank you, Mr. Chairman.

Mr. Sukut, you mentioned in your statements about research and development. We have talked about enhanced oil recovery as a use. Mr. Oldham talked about a new synthetic fuel that could be used with the recycling of the carbon. Is it your intention or is the intention -- how advanced would you say the research is in this area in terms of other kinds of uses of carbon, and where do you see this in the next 10 to 15 years?

Mr. Sukut. So just let me start by saying, I think we are probably, in the technology curve, we are probably back here a little bit. But let me say this. In taking a look at the Integrated Test Center in Wyoming that we have, we have the six participants now. I see a lot of excitement in some of the things they think they can do to extract and turn it into useable product, like a cement enhancer, ethanol. I think it could be limitless, especially with the time frame that we have here in terms of years, saying to 2035 or 2040.

Look what this Country did with sulfur. Thirty-five year ago, we were struggling with removing SO₂ from the air. Today it is not tough at all to get to over 99 percent. All of our plants are able to do it, and they do it very routinely. So I think with a timeline like that, this Country has been able to do it before, and I think we can do it again with CO₂.

So I think it is limitless. I know I am not giving you as direct an answer as you want, but I really feel that.

Senator Capito. Mr. Oldham, do you have any comments on that?

Mr. Oldham. I think this technology is at different phases of implementation. Our technology is ready to go to market now.

Senator Capito. Is this for the synthetic fuel?

Mr. Oldham. No, well, for both. We have done it to capture CO₂, and then you can make the synthetic fuel.

Senator Capito. Right.

Mr. Oldham. So it is ready to go to market now, because we use pieces of equipment from things like the clean power industry, the water treatment industry, the I&R industry. So in our case, we think, well, we know we are ready to go to market now, and the large energy companies that are working with us agree.

But you can always improve the process. The sulfur example is a great example. It is an iterative process to make it better and better. But it is a spectrum. There are some technologies that are absolutely fully ready for implementation now.

Senator Capito. So let me ask Mr. Sukut again, on the regulatory thing, do you agree that interstate CO₂ pipelines would be more challenging than international pipelines?

Apparently, we have had some issues in Wyoming and other places where we can't do interstate carbon pipelines.

Mr. Sukut. I think there are some challenges. We have seen some challenges with pipelines via some of the landowners and some of the other things that have happened in this Country. I think all you have to do is look at the natural gas market and see, there are pockets there where natural gas can go to eight bucks where Nymex is trading at two, just because of its infrastructure. There is a lot of natural gas out there.

Senator Capito. Right.

Mr. Sukut. So yes, I think that there are some issues. I think we could use some help with it. I think the USEIT Act is a huge step in that direction, I really do, and I applaud you, all of you, for taking that step, to be honest with you.

Senator Capito. There has been a lot of pushback on pipelines. We are experiencing that in West Virginia right now, with the natural gas pipelines.

In terms of, this is a little offshoot question, but in terms of the general public's perception of a carbon CO2 pipeline, does that present any other inherent dangers, besides a regular ethane, methane pipeline?

Mr. Sukut. No, it doesn't at all. In fact, we have a CO2 pipeline in service. We have had it in service for 20 years.

Senator Capito. Right.

Mr. Sukut. We send CO2 every day to the Canadian oil fields. We add a sort of an odor, it is called mercaptan, it is added to natural gas.

Senator Capito. To protect it. Yes.

Mr. Sukut. Absolutely not, doesn't pose any kind of greater threat.

Senator Capito. So I also have a large coal industry, as you all probably know, being from West Virginia. My interest here is obviously on the economic front, but on the environmental front as well. Globally, we know that a lot more countries are using coal in other areas to pull people out of poverty and bring up the economic viabilities.

Are you finding globally that this technology is something that is -- you mentioned you wanted to have plants all over the world. For the heavy coal-intense areas now, where are you seeing this acceptability?

Mr. Oldham. It is a great question. So why people are interested in our technology is because we can offset the hard to de-carbonize industries that are essential for economy or essential for any other reasons, for jobs and so on. So our technology, because it sounds independent and does negative emissions in parallel with other industries, airline industry is another great example, really hard to de-carbonize, the coal industry, hard to de-carbonize.

So by doing things like a negative emissions plant which can be located at any location, you can put them anywhere, you have another industry, but you allow that first industry to keep going, but you are still de-carbonizing it.

Senator Capito. Thank you.

Senator Barrasso. Thank you, Senator Capito. Senator Cardin? Oh, Senator Whitehouse, yes.

Senator Whitehouse. When I gave my thank-yous to my cosponsors on this bill, Senator Duckworth was not in the room. She is now in the room, so I just want to add my gratitude personally to her for her support. Thank you.

Senator Barrasso. Senator Cardin.

Senator Cardin. Thank you, Mr. Chairman. I want to thank you and I want to thank Senator Whitehouse for working together to deal with a practical, bipartisan way to reduce carbon through carbon capture. To me, this is how we should be working to try to make progress wherever we can make progress. I thank you. It is science-driven decision making.

In my State of Maryland, the geological survey has been working on carbon capture and sequestration for many, many years. They are targeting entities such as unused gas wells, geologic rift zones and deep saline aquifers. So we are very much engaged in this process, because we think there is a major return.

But I would also point out there is no one answer to dealing with the carbon issue. Senator Van Hollen and Senator Carper and I, and also Senator Gillibrand, represent the Chesapeake Bay watershed. So we understand, and Senator Capito who was here, is also part of that region.

We recognize the challenge that we have in the Chesapeake Bay. So we look at carbon capture as one way of helping deal with the issue. We also look at our energy policy as an important point on dealing with carbon emissions. We look at farming practices, we look at shoreline development and dealing with storm runoff issues. All these are important.

One area where we have been able to get bipartisan support is to restore wetlands. Wetlands are a natural way of capturing carbon. So as we lose wetlands, and we lose wetlands every year, we are making the carbon issue more severe in this Country.

So when we got to the nutria eradication issue, which was a bipartisan effort, this committee was very much engaged in it, we were able, effectively, to eliminate the nutria population on the eastern shore, which has saved, literally, a large portion of Blackwater National Wildlife Refuge, it is saved today with wetlands because we got rid of the nutria population. That is helping on our carbon emissions.

So my question to Mr. Waltzer is, do you agree that carbon

capture is important, but we need to have a coordinated effort on so many different directions if we are going to make a consequential difference on the carbon emissions that are occurring today? What would your priorities be?

Mr. Waltzer. Senator Cardin, I think there is no question that we have to have a broad set of technology tools available to us to de-carbonize our planet. Our priorities are pretty simple. We need to have a set of policies that drive innovation across renewables, carbon capture and nuclear.

We need to make sure that those technologies get to the point where they are widely commercially available, to be not just used here in the U.S., but around the world. And that tool kit is going to be a combination of certainty that comes from technology portfolio standards or emission limits or carbon pricing combined with a robust set of innovation policies, like we are talking about today with the USEIT Act.

It seems like a pretty simple formula. But it is a profound formula, and one that we need to move on on all fronts quickly if we are going to address this in a time frame that matters.

Senator Cardin. Another area that we were able to work in a bipartisan manner dealt with certain tax incentives for renewable energy sources. That also has a dramatic impact on reducing carbon emissions. I just mention the different areas

that we need to work on in a coordinated way to deal with the realities of carbon pollution and what it is doing to our atmosphere and what it is doing to our environment.

So on a scale of where we need to put our attention, where should we be placing our attentions?

Mr. Waltzer. I think our priorities need to be focused on insuring that renewable energy continues to develop as a solution. Right now it is only providing less than 1 percent of the world's primary energy production. That is not enough. We can do much more. But we are currently getting over 80 percent of our primary energy production from fossil fuels. That is not likely to go away by mid-century. So we are going to need a robust application of carbon capture utilization and storage.

And we get about 5 percent globally from nuclear power. We are beginning to see some evidence that that can get back to a place where it can play an important role in providing those solutions. And we need all of those tools in the tool kit. So I think we have to be ambitious and move forward on all fronts.

Senator Cardin. Thank you. Thank you, Mr. Chairman.

Senator Barrasso. Thank you so much. Senator Braun?

Senator Braun. Thank you. Indiana is a State among others that is disproportionately dependent on coal, and most of our fossil fuel reserves are in coal. My opinion is, in the long run, the cleanest, least expensive fuel is going to win out in

the marketplace. We are slowly transitioning.

I want to direct these questions at Mr. Sukut, if you could start off. Is there anything on the horizon that can take coal and have it emit more cleanly? I would also like a comment about recapture on fossil fuels once you burn them. Is that basically the same? And does one have an advantage over the other?

But we are closing coal plants down, probably starting out any new regeneration with natural gas. But just curious if there is anything on the horizon for a State like Indiana that is so dependent on coal, to fix it in the short run and then maybe lengthen the life of these plants in a clean way.

Mr. Sukut. Thank you for the question, Senator. Yes, I think there is. I think there are some promising technologies out there that work. For example, Amine, and I am not a scientist, I am a finance CPA, so don't ask me any scientific questions here, because I can't answer them.

But I do know this: the Amine process works, it does. I think the most important thing is, we really do kind of need an all of the above energy resources, inclusive of coal. If we can clean coal up, if we can take the CO2 out, we already know we can take sulfur, mercury, NOX out, it would operate a lot just like wind. You would have a clean source.

Now, as time goes along, for example, in North Dakota, wind

works very well for us. In fact, this year over 25 percent of the energy produced at Basin Electric is going to come from wind. Because wind works up in North Dakota, it really does. And as time goes along, new coal, as you know, Senator, has not come online for about ten years. Dry Fork Station is one of the last ones that came on, and that was 2010.

So if you think about it, the older coal plants, they will retire, and as they retire, you are going to see less and less coal. But I think what we do need to do is the newer plants continue to work on, for example, the Amine technology is one I can think of right off hand, to capture carbon and infuse it. Because we know we have ways to do that, and we have caverns that we know we can store it at.

So from that standpoint, I would encourage that we continue to re-use that natural resource to the extent we can utilize those kinds of technologies.

Senator Braun. Anything other than Amine that you can think of?

Mr. Sukut. The science guys would be better at talking about this than I would.

Senator Braun. Go ahead.

Mr. Waltzer. I think it is important to note a couple of things with coal and CCUS. The first commercial demonstration of applying CCUS was done on a coal plant, the Petra Nova

project, outside Houston. It is worth to note that project came in on time and on budget. It is very well managed, operating very well.

More broadly, when we step back, we think about this issue as global. And we see a thousand gigawatts of coal plants in China, most are new and are going to be emitting for the next 50 years. It is absolutely crucial to develop this technology so it can be applied, not just in the U.S., but around the world.

The third point is, we have talked with power companies that have expressed an interest in using 45Q to move forward on projects. I think as Senator Capito alluded to, we are waiting for the starting gun to happen, when the Treasury will put out its guidance, and that can't happen too soon. We have that short window of commenced construction, which can be a challenge for power plants. But we do think that utilizing CCUS with coal plants is an important tool.

Senator Braun. Thank you. Mr. Oldham?

Mr. Oldham. Yes, thank you. One of the beauties of the technology that we have developed is the fact that it allows you to do purely negative emissions. Capture CO2 from the atmosphere, bury it under the ground permanently, at a location that makes sense. And there are many, many locations across the United States.

What that allows you to do is make a choice. You can

continue to operate a coal plant and it can continue to have emissions. But at the same time you build one of our plants or a similar technology, to completely offset those emissions. So you have immediately gone carbon-neutral. But you haven't affected the economics of that plant and the industries that depend on it.

So in my view, that is one of the critical reasons why direct air capture technology should be increased in funding. It gives you choices. You can continue with the airline industry, you can continue with the coal industry, but doing so in a carbon-neutral or even carbon-negative way.

Mr. Sukut. One last technology that we have participated with, Allete, it is a Minnesota-based investor-owned, is the Allam cycle. And I referred to it in my written testimony. Actually, that is a coal-based, but is zero-emissions. The byproduct of that, it uses compressed CO₂ to run a turbine. And really, the byproduct of that is water, so it is completely clean. But yet another technology that is on the horizon, and it is down the road a little way. We are trying to get to the demonstration stage with it.

Senator Braun. Thank you.

Senator Barrasso. Thank you, Senator Braun. Appreciate it.

Senator Duckworth?

Senator Duckworth. Thank you, Mr. Chairman. Gentlemen, welcome, and Mr. Sukut, a special welcome to you. Your daughter is one of my wonderful staff members, and I exploit her labor on a daily basis. She is quite wonderful, I am glad to have her on staff.

Mr. Sukut. Thank you, Senator. We are very proud and thank you to, for employing her gainfully. We appreciate that.

[Laughter.]

Senator Duckworth. You are most welcome.

Across Illinois and our Country, we are already experiencing the harmful effects of climate change. Growing seasons are changing, heat waves are increasing, extreme floods are becoming more frequent and severe. This all that we are talking about today.

Simply put, climate change is no longer a threat. It is here, the climate has changed. I believe that we must seek solutions to cutting carbon pollution that strengthen our economy and advance new industries and create quality American jobs. The bipartisan USEIT Act, combined with the action Congress took last year that extended and reformed the 45Q tax credit, will help to make sure we accomplish these goals. Senator Whitehouse mentioned this. I look forward to working with my colleagues on this committee to advance and further improve this promising legislation.

Mr. Waltzer, Illinois has some of the best saline storage locations in the Country. Last Congress, Chairman Barrasso and Senator Whitehouse worked with me on adding language to the USEIT Act that requires the Department of Energy to author a report to make recommendations to project developers on how best to use saline formation for carbon sequestration. Can you share why this report would be important to the future of permanent carbon sequestration?

Mr. Waltzer. Absolutely, Senator Duckworth, for three reasons. First, given the scale of what we need to do in terms of eliminating carbon emissions on the planet, saline is going to be our biggest target. There is really no substitute. We need to move forward on enhanced oil recovery and utilization. But if we are really going to make the cuts we need to make, that is where we are going to store the carbon.

Second, there are innovations that are occurring, for example, being able to produce water, particularly in arid areas. So it is not just a storage space, it is potentially a place where we can also develop useful products.

And third, it is the resource that is most abundant. That is why ADM is doing that project in Illinois in saline, because there is some EOR potential, but it is completely dwarfed by the availability of saline resources. We have more saline resources in North America than we have EOR or any other target. So if we

are not developing this resource and we are not being thoughtful, then we are putting ourselves at a significant disadvantage.

Senator Duckworth. Thank you. So you mentioned ADM. They are one of the world's largest food processors, and this is a one of a kind project in Decatur, Illinois. It captures carbon dioxide, which is created as a by-product at a corn processing facility, and stores it safely almost a mile and a half underground in the Mount Simon Sandstone. A lot of attention is spent discussing on how CCUS can be applied to the power sector. I believe the USEIT Act will help spur industrial capture projects like the one in my back yard.

Mr. Waltzer, you mentioned ADM's project. Can you talk a little bit about how decarbonizing projects like ADM can teach us lessons about how we can decarbonize the industrial sector?

Mr. Waltzer. Absolutely. It is a very important project. It is a first of a kind. Industry is one of those hard to reach places in terms of decarbonizing. CCUS is almost certainly going to be necessary to decarbonize the industrial sector.

Fortunately, there are plants like the ADM plant that are ready-made, in a sense. They have a low-cost CO2 supply, they have pure CO2 streams, and there are many of these types of facilities, from ethanol, from hydrogen or ammonia production, other sources that we can quickly move forward on. And we

expect 45Q to really move first in those areas.

So we think it is both absolutely necessary and an area that we expect to see a fair amount of activity on in terms of utilizing incentives like 45Q and the USEIT Act.

Senator Duckworth. Thank you.

Mr. Sukut, I know you said that you are a finance guy and not a scientist, but I would think that a report that would come out of something like the USEIT Act, that would make recommendations to project developers on how best to use information for carbon sequestration would be something useful. Can you talk a little bit to that? In Illinois, for example, wind power has created 100,000 jobs in ten years. I see that there is potential on the economic front for some great benefits here as well.

Mr. Sukut. Absolutely, Senator. I think when we put iron in the ground, we put it in, as I said, for 30 or 40 years. To the extent that we can get more information and we can use it in terms of making sure that it is critical and can be used, and the fact that it gives us the information that we can go forward with, that is one of the most critical things in the utility industry, quite frankly.

So I would think it is absolutely critical that we have information like this in the USEIT Act. So I would very strongly encourage it to be part of the Act.

Senator Duckworth. Thank you. Mr. Oldham, I just have a minute left. Did you want to add anything to the discussion so far?

Mr. Oldham. I think one of the things, you are absolutely correct, that renewable energy and the driver, that is a critical part of developing jobs. One of the key things to remember is the importance of not just reducing emissions but also reducing the CO2 already in the atmosphere. Senator Carper has an excellent bathtub analogy that I think he uses.

[Laughter.]

Senator Carper. I have been using it for years.

Mr. Oldham. Continued focus on CO2 removal, and you are quite correct, saline aquifers are a fantastic place to store CO2, and Illinois a great place to do so.

Senator Duckworth. Thank you. I yield back, Mr. Chairman.

Senator Barrasso. Thank you so much. Senator Sullivan?

Senator Sullivan. Thank you, Mr. Chairman. You learn a lot in these hearings. I am not sure I was expecting to hear the exploitation of labor happening -- I am just kidding.

[Laughter.]

Senator Sullivan. That is just a joke.

But let me ask really all of you gentlemen, one of the issues, when we are all looking at the issue of bringing on new technologies in the energy space is our regulatory and

permitting processes at the federal level. One of the things that I have been very concerned about is the time it takes to deploy just basic infrastructure in our Country, whether it is roads or bridges or pipelines. And as all of you know, it takes forever, about eight years on average, to permit a bridge in America, if you can believe that. Same with a pipeline. Highways, it is well over a decade.

This is a problem that I say cuts across partisan issues. I had a bill last year we are going to reintroduce called the Rebuild America Now Act, which is looking at reforming the NEPA process, not to cut corners. But I don't think anyone thinks nine to ten years to permit a pipeline is a good idea for our Country.

What are the big areas of permitting roadblocks that you have seen in your experience, and how can we address it here in the Congress? I will open that up to any and all.

Mr. Sukut. I can start, because this is sort of one of my things, too, quite frankly. So in some of the things with NEPA, one of the areas that we see a lot of roadblocks is the EA, or the environmental assessment or the EIA. Those things take months and months and months.

Really, if we had some more certainty when we headed into them, and the rules that we could get over the hump. Because a lot of times, the actual work doesn't really take that long.

But there is just so many regulations. And really, we are not trying to bypass the environmental assessment at all.

Senator Sullivan. No.

Mr. Sukut. That is not what we are trying to do. Please don't get that impression. But it takes so much time to get some of this done.

So I will give you one example. We are not an RUS borrower any more. We used to be. We were putting in a 200-megawatt wind farm. We had to go through an environmental assessment. We finally went to outside financing, just because we couldn't get all of the work done because we had to do an EIS instead of an EA. It took us so long to get it done, I think the thing was fully depreciated by the time we got the go-ahead from RUS.

Senator Sullivan. How many years did it take?

Mr. Sukut. Well, we ran two and a half years. The wind farm was completed and we had run it two and a half years before we finally got the go-ahead, oh, you can go get the RUS money now. Well, too late, we had to do conventional financing.

So yes, Senator, absolutely.

Senator Sullivan. We want to work with all of you on this. Because again, the original idea NEPA and EIS was to make sure there was public input with the EISs. Well, the irony is now, the EISs now are in the thousands of pages. They cost millions of dollars. They stop development. And nobody reads them,

because they are too big. So the idea of public input has been turned on its head. Usually an EIS comes out, it is several thousand pages and nobody has any idea what is in it and nobody reads it. I think we can do better as a Country.

Mr. Sukut. That and it costs money.

Senator Sullivan. It costs a lot of money and it stalls projects and jobs.

Let me just ask one kind of final question. I think there is this really, really exciting area in the world of energy and technology, that relates to some of our traditional resources that we have and the marriage of technology.

Let me just give you an example, natural gas. So our Country is now the largest producer of natural gas in the world. I happen to think that is a really good thing. We actually are the largest producer of oil in the world. I actually think that is a really good thing. We are actually the largest producer of renewables in the world. That is also a good thing. All of the above, energy.

But in terms of gas, because it is low carbon, and when you burn it really high, you can actually almost zero out any emissions, the marriage of technology and a hundred to two hundred years of supply of natural gas in America creates enormous opportunities. Some of you might be familiar, I was out in the Silicon Valley area not too long ago. Bloom Energy

is doing all kinds of really exciting work with natural gas and fuel cell opportunities.

What do you see as some of the opportunities that relates to integrating some of our current, abundant resources, in particular I want to ask about natural gas, and technology, or renewables, for example. There is a lot of experiments going on with wind power and solar power. It is intermittent, and when you don't have the wind, you find up natural gas turbines that can create power generation. I think it is a very exciting area and I would love any of your views on that.

Mr. Oldham. Just a quick comment. Our direct capture plants use natural gas. They can be powered by natural gas or renewable electricity or both. And the reasons are exactly what you say, it is a prevalent resource, it is effective.

Senator Sullivan. Low carbon when you burn it high.

Mr. Oldham. We also capture all of the CO2 emissions from using natural gas and it becomes part of our product at the end of the day. So yes, I agree, natural gas is a tremendous resource.

Senator Sullivan. So becoming the world's largest producer of natural gas in terms of jobs, energy security, national security, but also in terms of the environment in the future is pretty exciting, wouldn't you say?

Mr. Oldham. Certainly when you combine it with a

technology like ours, absolutely, yes.

Mr. Waltzer. I would say that there is enormous potential to use low-cost gas to actually drive forward low carbon technologies. There is also a caution that we have to do that by managing things like upstream methane emissions and insuring the coal life cycle chain of the gas is truly low carbon.

But a couple of areas on the technology side that are most interesting to us, anyway, we have talked before about the Net Power technology that is potentially a breakthrough technology to supply zero carbon power, fueled by natural gas, at very low cost. The other area that we think is particularly interesting is generation of hydrogen or ammonia from zero carbon gas. You can even repurpose conventional gas turbines to burn hydrogen or ammonia. They are looking at that in the Netherlands right now. But that can also apply to the industrial sector and the transportation sector.

It does have enormous potential, but it also is going to require some diligence on all the elements that are necessary to insure it is truly low carbon.

Senator Sullivan. Thank you. Thank you, Mr. Chairman.

Senator Barrasso. Thank you very much. Senator Van Hollen?

Senator Van Hollen. Thank you, Mr. Chairman, and thank all of you for being here today.

I like this legislation, because it seems to be a bipartisan acknowledgment that we have to make public investments in order to reduce carbon pollution emissions, in order to address the risks of climate change. Do all of you gentlemen agree with that statement? Is that a yes? I see all of you nodding.

Mr. Sukut. Yes.

Mr. Oldham. Absolutely.

Mr. Waltzer. Yes.

Senator Van Hollen. All right. Now, as you have all testified, there are a number of ways to do that. We have tax credits in the area of solar, we have had tax credits in the area of wind. A number of us have bills that would put a price on carbon.

I would like all of you, if you could, to respond to an article that was written in Forbes just a few years ago. It was by Jeffrey Rissman and Robbie Orvis. One of them is the Energy Innovations head of modeling and energy policy. The other is the Energy Innovations policy design projects manager. Here is what they said. "While many technologies can reduce power sector emissions, carbon capture and storage has gained support in Congress. But it is the most expensive option available."

They go on to say, "Our analysis shows coal plants equipped with CCS are nearly three times more expensive than on-shore

wind power and more than twice as expensive as solar photovoltaics. Although these costs will decline with research and development, the potential for cost improvement is limited. Coal with CCS will always need significant subsidies to compete economically with wind and solar."

Now, the reason I support this legislation is I think that we are at a dangerous point and that we need to put all hands on deck. We need to turn off the faucets, as you said, Mr. Oldham, and pull out the plug. So I support this.

But could you just discuss briefly the cost comparisons with respect to public subsidy, with respect to technologies, both today and what you see going forward?

Mr. Oldham. Yes, I think that is a really challenging question, because it is a multi-faceted one.

I think the way to look at it is to baseline what we think the cost of a ton of carbon is. And the cost of a ton of carbon has an impact in a variety of different ways. A large amount of carbon has a very significant cost.

So for us, the way that we look at our business is to drive our cost per ton of carbon down as low as we can. We do so by using technology that exists today, measurable performance. And we have driven it down to around about \$100 per ton.

So the question then becomes, is that a reasonable cost per ton of carbon. Now, the carbon that I am talking about is

atmospheric carbon. It is not emitted carbon. So emitted carbon is easier to capture, because it is more prevalent in the source. CO2 in the atmosphere, 400 parts per million. So my carbon is more expensive to capture, but it is also essential per the bathtub analogy we discussed earlier on.

So for us, about \$100 per ton of CO2. A few years ago, the National Academy of Scientists published a report that said the cost of a ton of carbon from the atmosphere would be about \$600. We are now at \$100. So your point about innovation driving down the cost point, it is already happening and it will continue.

Mr. Waltzer. So in a limited way I agree with that statement. Reducing current generation technology through incremental improvements on the kind of technologies we are applying to coal plants today, I don't think they are going to get radically lower. But there are next generation technologies and carbon capture and storage that can take us to that golden zone of trying to be cost competitive with carbon-intensive alternatives.

And so I think it is important to move forward to try and obtain that goal. The risk is if we don't do that, then we are relying on fewer technologies. We support significant deployment, additional significant deployment of renewables, but they are variable source technologies, and there is a point at which you have to over-build the system in order to pay for it,

even if on an incremental basis they are cost effective.

Senator Van Hollen. I am sorry to interrupt. Do you envision that you are going to require a significant public subsidy for the foreseeable future to address, to provide for carbon capture technology?

Mr. Waltzer. I would say the kind of support that is needed to move the technology forward isn't that different than the kind of support that was needed to move wind and solar technologies down the cost curve. I don't think we really want any technology to be on a perpetual subsidy. We want them all to become as affordable as possible as soon as possible.

Senator Van Hollen. Absolutely.

But if I could, Mr. Sukut, you mentioned, I think in response to Senator Whitehouse, that the cost of doing this relative to a carbon fee, you saw this technology being a lower cost, if I understood your answer.

Mr. Sukut. And I do, Senator. In fact, I would offer this up, I actually, again, I go back to our integrated test facility in Wyoming. One or two of those test guys are actually offering up that it would be less than \$40 a ton, because I think it is, and I absolutely agree with it, it is cheaper to extract from the existing flue than it is from the air, it really is.

So less than \$40, in terms of our Dry Fork Station, I don't mean to be overly practical here, but that is such a new plant

that it runs way cheaper and more efficiently also. So we have a lot more cost groom there in order to be able to still compete in the market. And the technology will improve a little bit. So I think they will come together some.

But I think we have room to run those facilities, and if we can capture it in a way that is more economic, I think we have a good, good chance here to do this.

Senator Van Hollen. I appreciate that. I see my time is out. It is that last part, if it is economical, right. That is the focus.

Senator Barrasso. Senator Whitehouse.

Senator Whitehouse. Mr. Chairman, if I could just interject one point on it. The way I see this is that, let's say hypothetically there were a \$50 per ton carbon price. That puts a huge economic incentive into the hands of every entity that is paying that \$50 per ton carbon price to instead pay \$49 per ton to have the carbon removed, or \$48 or \$10, depending on whatever the price is.

And the fact that we have this artificial failure to price carbon emissions in our marketplace I think is discouraging to this industry. If we went to a proper market system in which the externalities are in the price of the product, then anything cheaper than that becomes something that becomes quickly marketable. I don't consider that a subsidy. I consider the

subsidy as not having that in the market system.

So I just wanted to add that point, and I appreciate Senator Van Hollen's concern.

Senator Barrasso. Senator Van Hollen.

Senator Van Hollen. If I could just, I agree with Senator Whitehouse. Look, a price on carbon in my view is the most economic way to do this. Subsidies, or the flip side of it, right. Because on one hand, a price on carbon, you are letting the market set the price by requiring people to be more efficient. The other side is you provide subsidies for different kinds of technologies.

I would prefer the market approach, because I think that allows all players to compete on a more even playing field. There are some different pieces of legislation to do that.

But in the meantime, I support efforts like this. Thank you.

Senator Barrasso. Well, thank you, Senator Van Hollen. Just to interject, Senators Whitehouse, Carper and Duckworth are all cosponsoring the legislation. If you would like to, that would make it four Republicans and four Democrats from this committee.

Senator Van Hollen. I would be happy to do that.

Senator Barrasso. Thank you so much. Senator Merkley.

Senator Merkley. Thank you very much. I appreciate this

conversation. I have felt that so much coal and gas is being burned around the world, that if we can find a way to extract carbon dioxide efficiently, economically, that it can make a big difference. We have to move quickly.

I am struck by the fact that in the industrialized era, we have increased the amount of carbon dioxide in the atmosphere by 50 percent. And most of that has happened in my lifetime. And we are on an upward accelerating, an upward curve. So I think we have to explore every possible option.

Meanwhile, though, I remain somewhat skeptical. Worth investing and exploring, but somewhat skeptical. And here is why I am skeptical. I think about Xcel Energy doing their request for proposals where they came back with proposals at two cents per kilowatt hour for wind, three cents for solar, both of which were below the cost of burning coal at an already depreciated coal plant.

Now, the cost, whatever the cost, there is at least some cost, whether it is \$100 or it can be driven down to \$50 or \$40. And a number of the technologies require a significant amount of extra energy inputs and extra water. I used to have, somewhere in my office, I think I could find it, a hockey puck made out of carbon dioxide that was captured by some technology some ten years.

Give me a sense of why I should be a little more

optimistic, at least in power generation, that burning fossil fuels with carbon capture can compete when it is at cost to an industry that is already falling above the line, if you will, of where solar and wind are now, and they will continue to drop over the next ten years as a still-evolving technology. Just a brief comment.

Mr. Waltzer. Sure. Again, solar and wind are important technologies and we need them to be deployed globally. The reason why we need carbon capture and storage and a broader assortment of low-carbon technologies options is first. There is at some point a level where because of the variability and because we don't have seasonal storage, the levelized costs of electricity of those technologies really don't reflect the full system costs. They can get substantially larger if we are approaching 80 to 100 percent. So we need load-following technologies, in addition to those technologies.

In addition, there are technologies that are in pilot development that are really rethinking the way of doing carbon capture. Net Power is one that is often cited, but it is part of a broader class of technologies that use CO₂ as a fluid within the turbine. It is thermodynamically very different. They are targeting \$10 a ton as the objective of that cost.

Mr. Merkley. So I am going to have you stop there, simply because my time is so short. But this is exactly the way I look

at it. It is worth exploring these future technologies. I again remain skeptical. The cost of battery storage is coming down. Demand response systems can help address the supply and demand.

But there is another issue that I am concerned about. That is, we have extensive leakage in our gas pipeline system. A number of the stretches of the system have a 4 percent or more factor, at which point you have methane, which unburned, is far more potent as a heat trapping gas than is carbon dioxide. Over a period of 20 years, 80 times more heat trapped per pound.

So I wrestle with whether it makes, even if you can get the carbon dioxide out of the smokestack where you are burning gas, are you sustaining a system in which leaky methane is doing a lot of damage? And that is a much harder problem, well, I won't say it is a hard problem, it is an additional big part of the picture. So should I not be worried about sustaining a system of pipelines that are leaking methane into the air?

Mr. Waltzer. You should be worried about the fugitive methane emissions that are a significant source of greenhouse gas emissions. And those are controllable. We were strong supporters of the earlier Administration's rule to reduce methane emissions from both new sources, and we think it should have gone further to look at existing sources. We are working with, we worked with the government of Mexico and are working

with Argentina and Colombia on developing exactly those kinds of rules and regulations to reduce methane emissions.

But that is something we need to do irrespective of whether or not we use gas and the way that we are talking about for a low carbon source. That is just something that has to happen. If we do expand its use into those areas, we need to double ensure that those upstream methane emissions are managed. But it is not really an either-or, it is an and, in our view.

Senator Merkley. My time is expiring. Thank you. Those are a couple of my concerns. I am also concerned that we need to look at every strategy to remove carbon. If, for example, the best dollar effect is in supporting modified agricultural practices that maybe produce improved crop yields and store carbon in the soil, let's look at that. If we are looking at forest practices that reduce the amount of forest fires and allow trees to grow and store more carbon, let's look at that. Let's look at this from every angle.

Thank you all.

Senator Barrasso. Senator Carper.

Senator Carper. Thanks, Mr. Chairman. Before we close, I just want to mention one other thing. First of all, just thanks a lot for coming. Jim and I love music, and every now and then I like to work some lyrics into our hearings. One of those sets of lyrics is "Hope in a Hopeless World." Great song, if you

have never heard it. It is a great song.

It actually kind of reminds me of this hearing, the hope. A lot of people don't see much hope for our world, but there is some hope. And you have given us some reasons to be hopeful.

I hope we have given you some reasons to be hopeful, given the kind of bipartisan cooperation we have, led by our chairman, Sheldon and others on the committee.

The other lyric I was reminded of today was, you have heard of doing a one hit wonder, there was this guy named Thomas Dolby who was a one hit wonder. But he had a great hit, the song was "Blinded by Science." Maybe we can have a remake of the song, at least for our purposes, it could be "Guided by Science," not blinded, but guided by science.

What you are giving us is some areas where we can agree and provide some hope, and also be guided by science in a way that can do good things for our planet and create economic opportunity. That is the goal, the holy grail, that is the holy grail for me and I think it is for our Chairman and others.

So we thank you. I would like to ask unanimous consent, Mr. Chairman, if I could, to submit for the record letters and documents related to the USEIT Act and the technologies we discussed today.

Senator Barrasso. They will be accepted in alphabetical order, without objection.

[The referenced information follows:]

Senator Carper. Thank you so much. Thank you all.

Senator Barrasso. No further questions. Thanks so much for being here. Some of the other members of the committee may actually put some written questions to you, so I hope that you will submit answers quickly. The committee hearing will be open for two weeks.

I just really want to thank you for your testimony. It was very helpful. Senator Van Hollen, thank you for cosponsoring this wonderful, bipartisan piece of legislation. The hearing is adjourned.

[Whereupon, at 1:48 p.m., the committee was adjourned.]